

Dinesh Goyal · Amit Kumar Gupta ·
Vincenzo Piuri · Maria Ganzha ·
Marcin Paprzycki *Editors*

Proceedings
of the Second
International
Conference
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Preface

AICTE-Sponsored International Conference on “Information Management and Machine Intelligence” (ICIMMI 2020) is being held at Poornima Institute of Engineering and Technology, Jaipur, Rajasthan, India, on July 24–25, 2020, with reputed publication partner Springer Nature, Bentham Science, InderScience and IGI Global.

ICIMMI 2020 has been showing the trends to deploy developing intelligence in all the domains of information management. The current scenario of IT which cover the complete technology market in all disciplines engineering, whether it infrastructure (civil engineering), machines and automobile (mechanical engineering), power and energy (electrical engineering), communication and devices (electronics and communication) or IT-based applications and services (computer engineering and IT), especially with the emergence of AI, machine learning and deep learning. This conference has achieved academic and research contributions of all the experts working in the domain of providing intelligence to their machines and systems.

The objective of this conference was to provide opportunities for the researchers, academicians, industry persons and students to express and communicate data, skill and proficiency in the recent development and strategies in respect of the information management and machine learning is discussed.

The conference was focused for a great figure of submissions and encourages the progressive explore consultation among various scholastic revolutionary researchers, scientists, industrial engineers and students from all around the world and provides a forum to researchers for.

- a. Propose new technologies, share their experiences and discuss trends for recent development and strategies in respect of the information management and machine learning.
- b. Provide common platform for academic pioneering researchers, scientists, engineers and students to share their views and achievements.
- c. Augment technocrats and academicians by presenting their original and productive information.

- d. Highlighting pioneer issues at international level by bringing together the experts from different countries and institution on one platform.

The conference that is AICTE Sponsored **International Conference on Information Management and Machine Intelligence (ICIMMI 2020)** is a big success and really proved to be very beneficial and informational for everyone. In this conference, we received a total of 272 papers in which 20 are international and 252 are national papers. We selected a total of 213 papers on behalf of reviewer score generated by the OCS submission portal and the plagiarism report. A total of 200 papers have registered and presented in this conference, out of which 83 quality and premier papers have been selected for publication with Springer Nature.

Ten technical sessions and two keynote speakers (international) were conducted in ICIMMI 2020.

Jaipur, India

Jaipur, India

Milan, Italy

Warsaw, Poland

Warsaw, Poland

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Smart Wireless Network Algorithm in the Era of Big Data



Krishna Kumar Singh and Vibha Kushwaha

Abstract Challenges due to 7 Vs of big data analytics are growing by leaps and bound. The exponential growth of wireless technologies and handling pace of data transfer from wireless media is always a challenge for data scientists. Dealing with time complexity with same set of computing infrastructure is the real cause of concern. It requires defining new model of wireless-based big data movement for segregation while in the network. This paper deals with the problems in wireless network during big data processing and suggests new methodologies for the better processing of the data. It also suggests new methodology of data segregation and processing at data centers. At last, it will compute time complexity and green aspects of big data segregation and processing, while data is in wireless network. This method will help in mapping of data during network movement and helps in preprocessing of data.

Keywords Big data analytics · Wireless network · Wireless data network · Algorithm · Green computing · Time complexity

1 Introduction

Big data and related technologies have been affecting all other science and technologies in a very positive manner. Integration of various technologies will result better than single one. As we are rapidly moving toward portability of all possible technologies, wireless-based technologies are most emerging and prefer network technologies for the new generation. Wireless big data defined as big data in the wireless system

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and analytics is the well-defined processing while data in the network. Emerging technology based upon big data analytics has benefitted all stakeholders who are dealing in 5G or above wireless-based technological products. If deployed and managed effectively, wireless-based big data technologies will be most effective in the areas of system security, monitoring and traffic control. Graph of various nodes and vertices representing wireless network covers broader area. Big data generated by these wireless sources is large and unstructured used to handle many of these devices [2]. Management of big data requires suitable infrastructure. Wireless sensor networks (WSNs) are one of the main sources of big data through network [5]. Wireless-based electronic devices are growing by leaps and bounds. Rich sources of big data like social media sites, black box and others are contributing a lot. According to IBM's recent report, each day, 2.5 quintillion bytes of data are created through wireless sensor networks. It is predicted by various agencies that the amount of data generated in 2022 will be 49 trillion gigabytes, 48 times greater than that in 2009. With such a data explosion, we are evolving to the era of big data [6]. Wireless-based cloud network and technologies will be very effective while dealing with these types of data explosion. Segregation of big data is the major concern and consuming large amount of time. To reduce its segregation time, authors are trying to address these challenges to reduce overall time. This paper deals with these challenges of time complexity of the big data set segregation and provides solution for these issues. Model is divided into two parts; first part discussed the issue of identification and filtration of data sets. In this part of the paper, model of data segregation while in network has been designed. Second part of the paper throws light on preprocessing and data storage. Authors have developed an algorithm and discuss time complexity of the entire process of wireless big data handling.

2 Literature Review

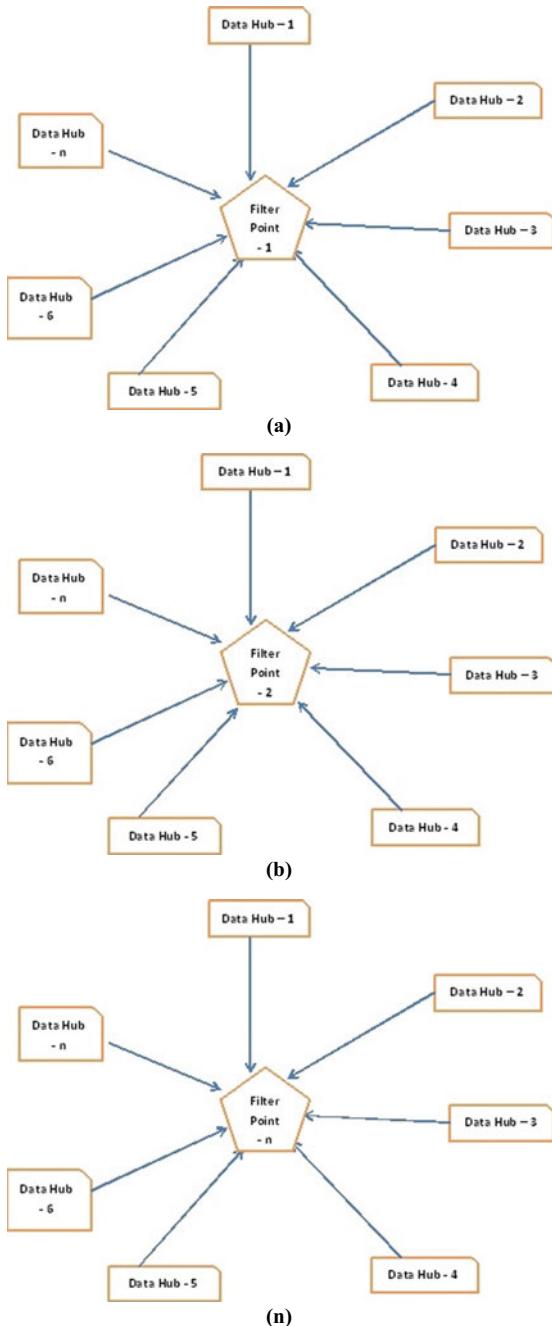
These days, we are confronting an unstable development in wireless systems. These facts can be incredibly dimensional, heterogeneous, thoughts boggling, unstructured and unusual. Then again, the plan and the interest of a wireless device can be great source of data collected from broadly conveyed sensors, prepare gadgets, patron practices and one-of-a-kind sources [3]. Authors considered SH and Wyner both schemes featured no network planning, so inter-cellular interference dominates. Closed-form expressions have been evolved for both the classical Wyner version and the SH version [1]. The rapid growth of heterogeneous data in mobile communication networks needs customize models. Authors have attempted to highlight some of the customization both from a design and implementation perspective and in its basic research which paradigm shift seems to be less appreciated [4]. The world of big data analytics is based on distributed as it is distributed in its nature. There is a great demand of this area to extract better insight of the system for decision-making process [9]. In a work, author has studied the design of strategies for the development of wireless network of cloud radio access networks. Different from the conventional

approaches, author has proposed to exploit multivariate compression of the signals of different networks [8]. Socioeconomic-technical points of view need intra-site cooperation to make our model more realistic. However, inter-site cooperation will be needed in order to exhaust the full interference reduction potential of base station cooperation. The mix of joint handling of big data analytics at one site with joint planning between the locales is of extraordinary models will furnish promising increases with constrained network backhauling [7].

3 Smart Wireless Network Model Base upon Big Data

Data is coming into multiple sources, and each source pumps data into multiple formats as well as multiple forms. First and foremost challenge is to assign appropriate processing environment for the processing of the data. As per the definition and understanding of big data, author has treated data sources as data hubs. Segregation of big data on the basis of its behavior or identity will be one of best methods to save cost, time and energy of big data processing. We will inch toward green computing in the big data analytics. It can be done by adding a counter at head of the data for its identification. Author has designed an algorithm to data identification and data segregation. After generation of data set, it spends justifiable time in the network itself, and this time is sufficient to segregate it according to the counter attached. Figure 1a shows filter point—01, in which different format of the data is defined as data hub—01, 02, 03, ..., On. Data hubs (1 to n) will send data to the destination through wireless network. In this wireless network, author has placed a filter point—01 for filtering the data variation while passing through the network itself. Once data set has been filtered as per the parameters set in the filtering point algorithm, it will pass through the network with a prefix which will differentiate the various data sets. Then, filtered data set will be passed to the processing unit as per its format and other parameters. Figure 1b shows filter point—02, in which different format of the data is defined as data hub—01, 02, 03, ..., On. Data hubs (1 to n) will send data to the destination through wireless network. In this wireless network, author has placed a filter point—01 for filtering the data variation while passing through the network itself. Once data set has been filtered as per the parameters set in the filtering point algorithm, it will pass through the network with a prefix which will differentiate the various data sets. Then, filtered data set will be passed to the processing unit as per its format and other parameters. Figure 1n shows filter point—On, in which different format of the data is defined as data hub—01, 02, 03, ..., On. Data hubs (1 to n) will send data to the destination through wireless network. In this wireless network, author has placed a filter point—01 for filtering the data variation while passing through the network itself. Once data set has been filtered as per the parameters set in the filtering point algorithm, it will pass through the network with a prefix which will differentiate the various data sets. Then, filtered data set will be passed to the processing unit as per its format and other parameters.

Fig. 1 **a** Data segregation and filtrations hub. **b** Data segregation and filtrations hub. **n** Data segregation and filtrations hub



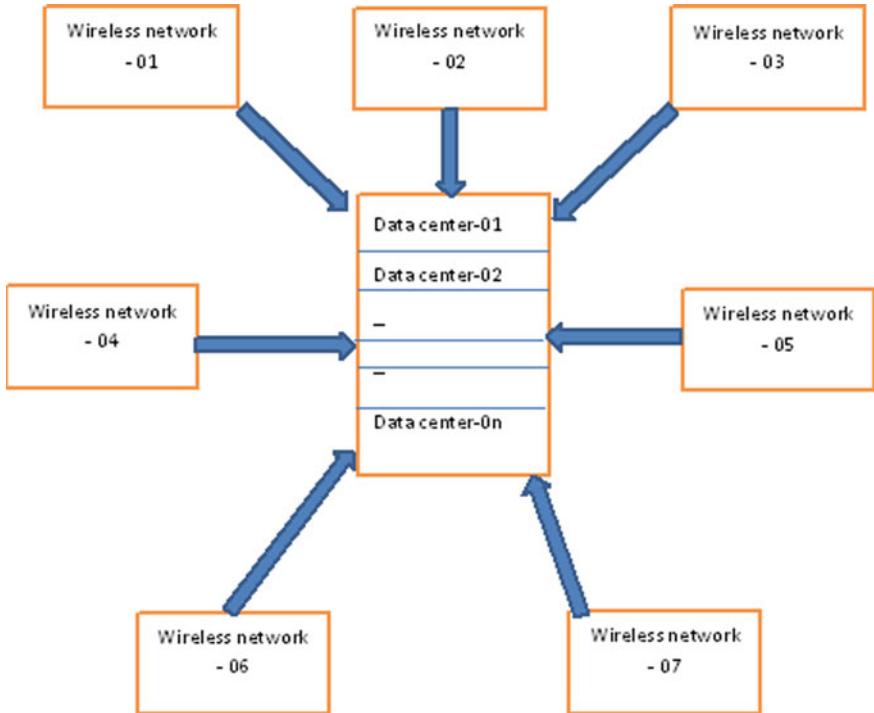


Fig. 2 Big data processing at data centers

Figure 2 shows a multiple data center having multiple racks and nodes as one integrated unit. Data received from different wireless network is been continuously and dynamically updated and processed as per the processing unit which consists of relative algorithms and appropriate tools.

4 Smart Wireless Network Algorithm

Smart wireless network algorithm is the well-defined procedures of the above-discussed model. After start, author has initialized all network filtrations system (NFS) and network collection system (NDCS). F_1, F_2, \dots, F_n is the data filtrations system in each individual network system and set K_1, K_2, \dots, K_n as key for data type or nature of the data set placed at different data hubs. After initialization of a, searching and equalization of data process will end when counter will reach to the last filtrations point ($F_a = K_a$). Next step is to set keywords d_1, d_2, \dots, d_n for the data. After keywords have been set and attached with the data, our next step is to

apply and attach prefix in all data as pre01, pre02, pre03, ..., pre0n for each one of them. Starting from $a = 0$ to $a = f_n$ with an incremental counter, da = PRE(a)da. Now, save the data into data center dd₁, dd₂, ..., dd_n into final data center and apply data processing tools as per the desire format of the data. It is discussed as below:

1. Start;
 2. Initialize all network data filtration system (NFS);
 3. Initialize network data collection system (NDCS);
 4. Apply F_1, F_2, \dots, F_n as data filtration system in each individual network system;
- # Set keywords K_1, K_2, \dots, K_n as per data types or nature of the data;
5. For ($a = 0; a = f_n; a++$)

$$\{Fa = Ka\}$$

6. Set keywords d_1, d_2, \dots, d_n for the data.
7. Segregate data as per desired keywords with the help of NFS;

#Apply prefix in all data as pre01, pre02, pre03, ..., pre0n;

8. For ($a = 0; a = f_n; a++$)

$$\{da = PRE(a)da\}$$

9. Save data into data center dd₁, dd₂, ..., dd_n into final data center;
10. Process the data by applying processing tools;
11. Exit.

5 Time Complexity Analysis and Green Aspects of Proposed Model

Algorithmic Steps	Amortized time	
Start:	C ₁	NIL
Initialize all network data filtration system (NFS);	C ₂	NIL
Initialize network data collection system (NDCS);	C ₃	NIL
Apply F1, F2,, Fn as data filtration system in each individual network system;	C ₄	N
# Set keywords K1, K2,, Kn as per data types or nature of the data;	C ₅	NIL
For (a=0; a=fn; a++)	C ₆	N+1
{Fa = Ka}	C ₇	N+1
Set keywords d1, d2,, dn for the data.	C ₈	N
Segregate data as per desired keywords with the help of NFS;	C ₉	NIL
#Apply prefix in all data as pre01, pre02, pre03,, pre0n;	C ₁₀	NIL
For (a=0; a=fn ; a++)	C ₁₁	N+1
{da = PRE(a)da}	C ₁₂	N
Save data into data center dd1, dd2,, ddn into final data center;	C ₁₃	N
Process the data by applying processing tools;	C ₁₄	N
Exit:	C ₁₅	NIL

$$\begin{aligned}
 T_n &= C_1 * 0 + C_2 * 0 + C_3 * 0 + C_4 * n + C_5 * 0 \\
 &\quad + C_6 * (n + 1) + C_7 * (n + 1) + C_8 * n + C_9 * 0 \\
 &\quad + C_{10} * 0 + C_{11} * (n + 1) + C_{12} * n + C_{13} * n \\
 &\quad + C_{14} * n + C_{15} * 0 \\
 T_n &= C_4 * n + C_6 * (n + 1) + C_7 * (n + 1) + C_8 * n \\
 &\quad + C_{11} * (n + 1) + C_{12} * n + C_{13} * n + C_{14} * n
 \end{aligned}$$

Thus, running time of this algorithm is in linear function of $n + 1$.

$$T_n = O(n + 1)$$

6 Results and Conclusions

This article addresses challenges and opportunities of wireless network in the era of big data. The proposed model is efficient enough to filter out big data according to its nature while moving through network and segregate as per requirement. After segregation of the data, placed counter will send data to the appropriate processing unit placed in the data centers. This process of segregation and filtering will save time and cost of big data and make it more efficient. A large part of time and cost of computing is being used in the process of filtration and segregation of data in the existing distributed computing system. Multiple machines are t and processing capabilities. Pre-filtration process will speed up l will open a new school of thought while dealing with the five V's of big data analytics. Time taken by proposed algorithm is linear ($O(n)$).

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Detecting Aggressive Driving Behavior Using Spectral Kurtosis and MEMS Accelerometers



Tarun Dadhich and Sakar Gupta

Abstract World Health Organization has shown that nearly 1.25 million people die in road traffic accidents each year. In fact, the American Automobile Association conducted a research showing that unsafe driving accounted for more than 56% of road accident fatalities. Due to the explosion of sharing economy, we can easily hail a ride at anywhere and anytime in most urban cities. Such ride-hailing platforms, e.g., Uber, benefit our everyday travel and ensure efficient use of vehicles. However, the riding experience differs a lot among drivers, and sometimes they may even adopt aggressive driving behaviors to arrive earlier. In order to make driving safer, monitoring the traffic system by investing in loop detectors, road-side speed indicators, or constant vigilance through CCTVs throughout a city can become pretty expensive. This becomes a vital issue when states lag behind in driver safety improvement programmes and proper road maintenance due to financial crunches along with disregard of drivers toward traffic safety rules. So, a cost-effective and real-time solution for road safety monitoring was very much in need since smart transportation system is one of the most essential components for realizing a smart city.

Keywords MEMS · Accelerometer · Spectral kurtosis · Aggressive driving behavior · Gyroscope · Magnetometer

1 Introduction

World Health Organization reports on the enhancement of mortality rate due to traffic accidents. It claims in the report that more than 1.3 million victim's loss their life in a year globally. In the list of reason behind the death causes, traffic accidents place ninth around the world. The major factors responsible for such high rate of deaths regarding road accidents are:

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- Lacking of awareness and education by people under the influence of psychoactive substances during driving such as the effect of alcohol
- Habits to drive aggressively on the name of skillful driving
- Health issues.

Such points characterize the drivers as aggressive, distracted, teenage, drowsy, and impaired. Indian roads provides a stressful experience to the drivers exclusively on highways due to ever-rising risk of road rage day by day. In India, Transport Research Wing (TRW) of Ministry of Road Transport and Highways, New Delhi, collected the data of road accidents in the year of 2014. It stated that State Highways witnessed the 25.2% of accidents while National Highways had 28.2% of the accidents out of the total recorded cases of 489,400 [1]. This report delivered that the driver has the extreme safety threat. Intelligent Transportation System (ITS) has the raid technological development in order to lessen this threat connected with the transportation system. Nowadays, vehicular environment has the IEEE 802.11 p as the wireless access technologies resulting the progress of several road safety applications that leads to lessen the fatalities number due to road accidents.

Driving is always a complex decision-making process. It is because of the complex relationships between the major entities (driver, environment, and vehicle) and the dynamic nature of such entities [2]. Cognitive science and psychology has several recent advances showing that the emotions (like fatigue, stress, distraction, anger, and fear) of an individual play the significant role in the behavior of person during aggressive driving. Such behavior of driver (rash driving) has attracted the researchers for carrying out their research in order to estimate the crucial aspects causing the road accidents or the factors that significantly affect the individual's ability to drive safely [3]. Driver, vehicle, and environment are the major parameters that affect the complex system of driving behavior. Some other factors are discomfort due to long driving hours, vehicle safety features, traffic, attention workload, training/experience, capabilities, memory, expectancies, distraction, goals, errors, drowsiness, fatigue, and automaticity. Numerous researchers from psychology field are considering that rash driving due to aggressiveness of driver in order to reach early at the destination is the prime cause of road accidents. The other leading factors are drunk or high-speed driving, fatigue, and drowsiness. Therefore, it becomes necessary to detect the driver behavior and driving states for real-time monitoring system with the actions that leads to aggressive driving [4].

2 Literature Review

Driving monitoring system techniques: it is a complex issue to consider the driver behavior characterization due to it is subjected to numerous individualities of traffic state as well as driver and is a multidimensional issue. Group of constraints such as driver behavior, vehicle kinematic, and road conditions derive the complete traffic state. A set of vague driving rules explain all such constraints developing through

experience for diverse conditions and drivers. Consequently, tactics and maneuvers as the recognition of driver behavior recognition must be attained. Recognition and evaluation of driving style consider different constraints such as physiological/biological status, identifications and classification of events and vehicle, road state, and environmental factors. It is difficult to create a complete and accurate model depending on all such constraints and impossible to achieve practically. Analysis of driver behavior proposed several research systems and different commercial techniques mostly in the last ten years. It gives the methods to assist drivers and examine the performance of driver. Driving monitoring system shares a common infrastructure for all these systems. Such systems are generally characterized into real-time monitoring systems or in-vehicle data recording systems and smartphone-based sensing in vehicles.

(a) In-Vehicle Data Recording Systems

It becomes important to record and monitor the driving performance through the utilization of external devices and in-vehicle sensory with data acquisition or classical monitoring systems. The available systems are depending on achieving data of driving from using OBD interface or direct CAN-BUS [5]. Sometimes, CAN-BUS system fails to deliver the obtainable or accessible parameters. Therefore, extraction of the information carried out by the utilization of sensory systems in other methods. Sensor fusion technique improves the reliability and accuracy of both systems by the integration of both external sensory as well as in-vehicle systems called hybrid systems. Research suggested another system depending on installation of Camera inside the car where the driver is suffering from fatigue or distracted. This technique easily detect the status and can send alert to the driver directly. Another work illustrates the installation of two cameras at the end and in front of the car helping in to make lane-changing decisions by driver. Advanced systems include the installation of in-vehicle data recording feature for the identification of various maneuvers of driving under environment condition as analysis factor. Another report suggested a system for visual features to observe swinging heads to detect behavior and drowsiness detection of the driver. RFID technology also utilizes for developing the method to estimate the violations of the traffic through detection system.

(b) Smartphone-based Sensing in Vehicles

Last decades witness the advancement of smart phones enabling to the owners by carrying the processing power and a significant computational at all times. In addition, nowadays, smart phones have carried the advance features with the equipment of a wide range of sensing devices like magnetometer, gyroscope, accelerometer, and several other sensors. Smartphone offers a link to the Global Positioning System (GPS) in addition to built-in sensors via satellite network that permits the tracking and navigation to the systems. Depending on smart phones, several driving behavior systems are available to evade the numerous issues linked with the utilization of different hardware devices. Furthermore, these get connected with the advancement of smartphone technology like cheap cost and different sensors availability (magnetometer, gyroscope, accelerometer, etc.).

It has also other merits boosting the smartphone as an efficient and good for the monitoring and detection of driver behavior. Another feature attached as the motion sensors in smartphone for driving classification as aggressive and normal behavior. Furthermore, another system has the driver maneuvers detection depending on only the accelerometer sensor. A report suggested a system for driver behavior recognition. Advancement of this work carries the smartphone motion sensors for the detection of the behavior as to observe the driver's distraction with mobile. Some other work suggested the mobile applications for the detection of inefficient and dangerous driving [6]. They involve the driving maneuvers detection in systems depending on smartphone. A system provides the unsafe driving detection through the smartphone connected with the orientation sensor and accelerometer.

3 Tool and Techniques

3.1 *MEMS Accelerometer*

In general, such components used in industrial applications for the conversion of mechanical action with respect to its electrical output signal are capacitive, piezoresistive, and piezoelectric in nature. Capacitive accelerometers can operate in frequencies up to 1 kilohertz and are chosen for the applications such as the material in silicon-micro machined sensor [7]. Piezoresistive devices are utilized in extreme and sudden applications of vibration. Piezoelectric devices are more considered for high frequency range up to 100 KHz or in cases where it is easily mounting and to be used in very high temperatures. All such devices deliver optimum linearity and very high stability.

In modern world, a unique of accelerometer known as micro electro-mechanical system (MEMS) accelerometer. It is being utilized as extremely cost effective, reliable, and simple. It is including a seismic mass associated with a cantilever beam that deviates because of acceleration applied. Such deviation is calculated using digital/analog methods and will be a measure at applied acceleration. Piezoelectric accelerometer is the most commonly device in MEMS. It utilizes the concept of piezoelectric effect as the name suggests. The device is containing a quartz crystal as piezoelectric material that applies the accelerative force for the measurement of its value [8]. The crystal generates a voltage proportional to the accelerative force because of the property of special self-production. Such device is known as vibrating sensor as the device explores its application as an extremely precise vibration-measuring device. Measurement of vibration can be performed by vibration in bearings of pressure lines and heavy equipment. The characterization of piezoelectric accelerometer can be done into two was such as low impedance accelerometer and high impedance output accelerometer.

3.2 Spectral Kurtosis

Spectral kurtosis (SK) indicates the variation of signal according to frequency with the level of impulsiveness including the statistical parameter. Meanwhile as the rolling elements strike faults on the races resulting the faults in rolling element, bearings produce a short impulse response series [9–11]. Usually, SK consisting the resonance frequencies coming from fault excitement that becomes significant in estimating the frequency bands dominated by the bearing fault signals. Such activity will be helpful in conducting “envelope analysis” that is based on the above data it leads to select the optimum frequency band for demodulation performing on the bearing signals. Resonance frequencies excitement dominated the whole procedure as the bearing fault signal in raw spectrum form carry out small diagnostic information, while amplitude modulation achieves the envelope signal including the needed data of repetition frequency with their influences and fault passages causing any modulation through the load zone.

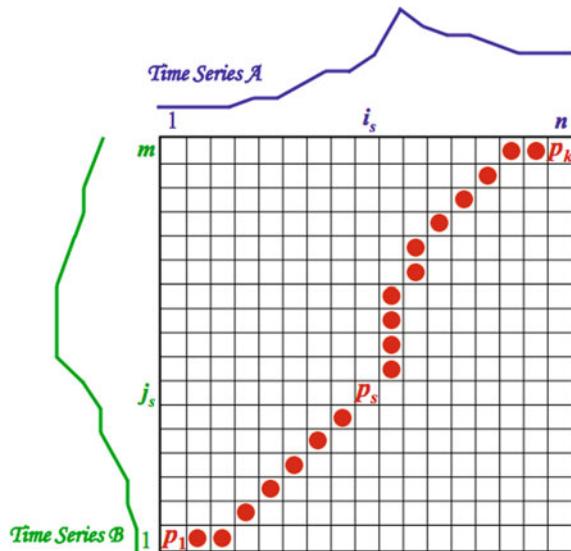
In the existing literature, a long debate has been recorded on the selection of best method for frequency band and envelope analysis in demodulation process. Few researchers suggested the response analysis on the bearings for hammering taps. However, comparing the spectra is the most logical method after and before the manifestation of a variation thought because of the fault in bearing. As compared with the rate of excitation, it leads to the occurrence at very high frequencies. In the later, small random fluctuations are developing the response spectrum to smear any harmonics that could otherwise specify the repetition frequencies. However, a bearing fault causes the variation, the difference in dB (i.e., $20 \log 10 (As/An)$, where As is the amplitude of the spectrum value with fault, and An is the original spectrum value, or masking noise) would illustrate that where the bearing signal’s signal/noise ratio to background is optimum. In addition, it also provides a better guidance to the demodulation band with their optimum center frequency. Several works show that band demodulated width directly estimates the maximum frequency in the achieved envelope spectrum. Any fault diagnosis can be achieved through this that is at least four times of the inner race fault frequency.

3.3 Dynamic Time Warping

The aim of time-series comparison procedure is to generate a distance metric between two input time series. Conversion of the data into vectors measures the dissimilarity and similarity of two time series and measuring the distance as Euclidean between those points in vector space.

Dynamic time warping algorithm computes the proximity between two vectors with respect to the speed or time variation. DTW calculation keeps the track on the most ideal way at that example in spite of the above-mentioned algorithm that never

Fig. 1 Dynamic time warping technique



determines all the possible manners that complete the tasks ate definite condition. This is the dynamic time warping intensity calculation.

It functions as pursues in systematic order as:

1. Divide the two arrangements into equivalent focuses.
2. Compute the Euclidean separation between the primary point in the main arrangement and each point in the subsequent arrangement. Store the base separation determined (This is the ‘time twist’ arrange).
3. Move to the subsequent point and go to step 2. Move well-ordered along focuses and repeat 2 till all focuses are depleted.
4. Repeat 2 and 3, however, with the second arrangement as a source of perspective point.
5. Add up all the base separations that were put away, and this is a genuine proportion of similitude between the two arrangements.

Dynamic time warpping algorithm is subjected to certain constraints or optimisations as per the features of path through the grids which are acceptable—condition of Slope constraint, condition of warping window, boundary condition, continuity condition, condition of monotonic (Fig. 1).

4 System Model

The circuit diagram is shown in Fig. 2. For constructing the data acquisition device, VCC +5V pin of Arduino UNO is connected to VCC pin of MPU6050. Ground

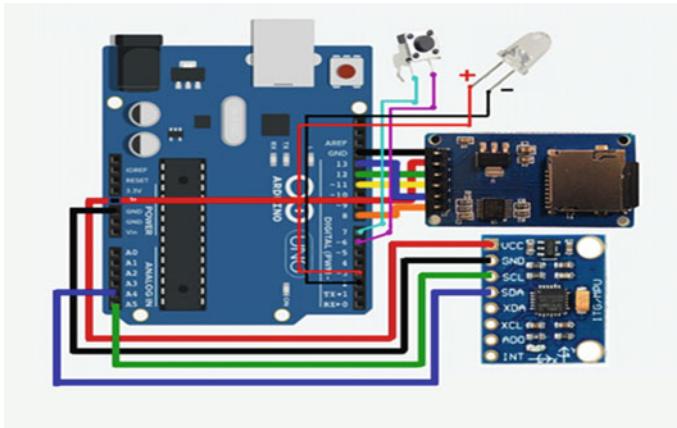


Fig. 2 Proposed circuit diagram for aggressive driving detection

pin of Adriano is connected to ground pin of MPU6050. SCL pin of MPU6050 is connected to analog pin A5 of Arduino. SDA pin of MPU6050 is connected to A4.

Positive and negative terminals of read write indicator LED are connected to Digital pin 3 and 2 of Arduino UNO. Terminals of button are connected to Digital pins 6 and 7 of Arduino UNO. VCC pin of micro SD card reader is connected to 5V VCC of Arduino UNO. Multi input single output (MISO) pin of micro SD card reader is connected to Digital pin 12 of Arduino UNO. MOSI (Multi Output Single Input) pin of micro SD card reader is connected to Digital pin 11 of Arduino UNO. Serial clock (SCK) pin of micro SD card reader is connected to Digital pin 13 of Arduino UNO. Chip select (CS) pin of micro SD card reader is connected to Digital pin 8 of Arduino UNO.

The fabricated data acquisition device is shown in Fig. 3. The data for training was acquired from a four-wheeler (EON) as shown in Fig. 3. The training data was gathered for smooth driving, normal driving, rash driving, sharp left and right turns, wrong pick up, and hit and run driving behavior. The data was gathered during 8 km travel from MNIT, Jaipur to Jagatpura Flyover.

Fig. 3 Fabricated data acquisition device



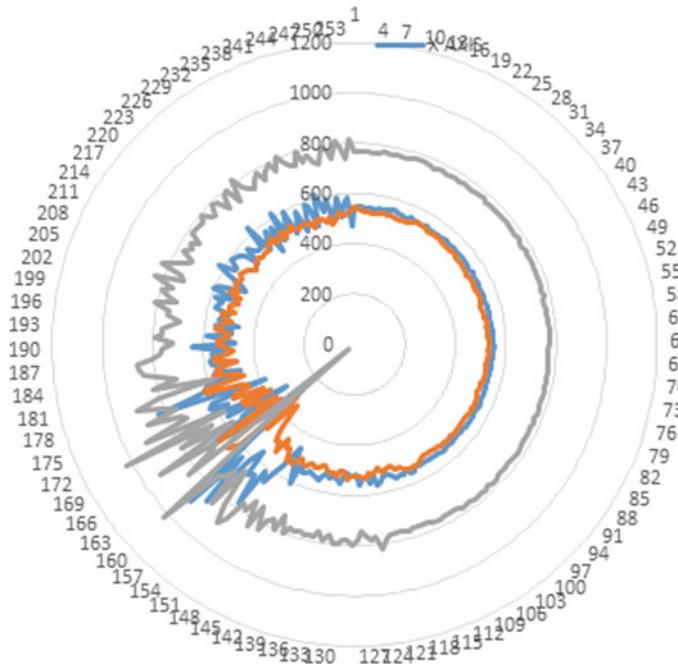


Fig. 4 Acceleration signature during sharp left turn

5 Result and Discussion

The gathered data is split into training and testing database in ratio of 6:4. The acceleration signatures generated during various driving behaviors are shown in Figs. 4, 5, 6, and 7. The developed application for data analysis unit is shown in Fig. 8, firstly test case is selected from the list box. After clicking the start button firstly, raw acceleration data and acceleration signatures acquired after spectral kurtosis are displayed. Then classification takes place by dynamic time warping algorithm and identified case is displayed. Figure 8 shows the final result obtained in MATLAB.

The efficiency of the proposed approach is 97% which is higher than the previous approaches as shown in Fig. 9.

6 Conclusion

In this research, an algorithm for detecting aggressive driving behavior by MEMS accelerometer is demonstrated. The driving behaviors used in the proposed approach are smooth driving, normal driving, rash driving, sharp left and right turns, wrong pick up, and hit and run driving behaviour. Spectral kurtosis is applied for preprocessing

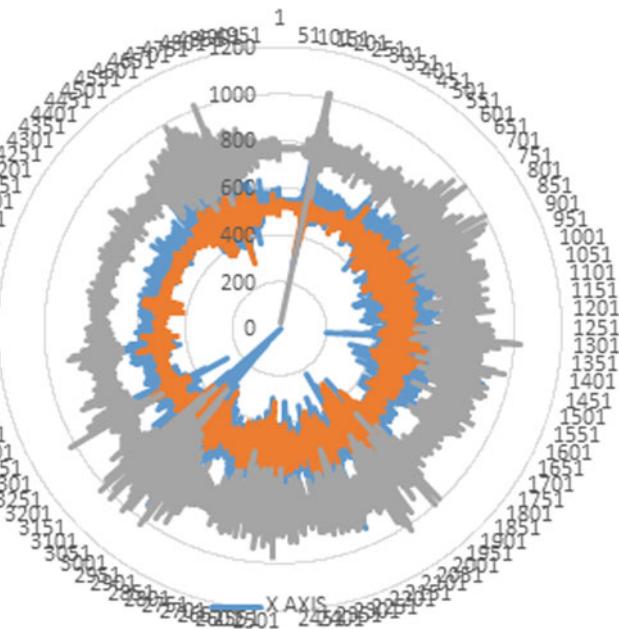


Fig. 5 Acceleration signature during smooth driving

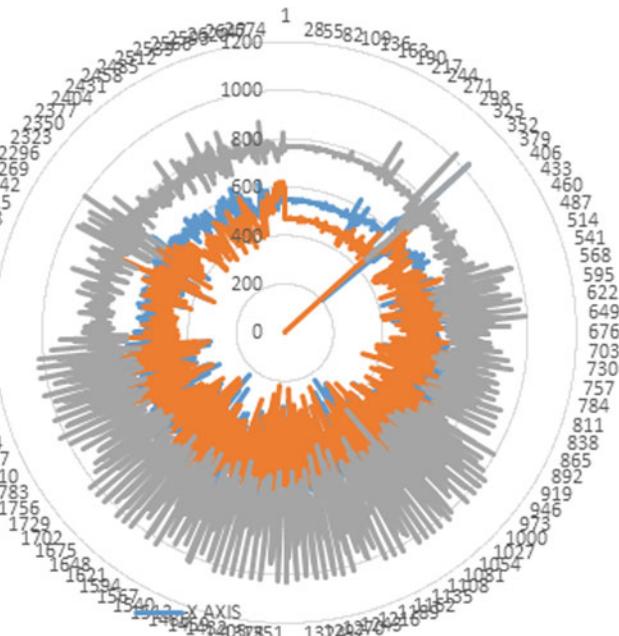


Fig. 6 Acceleration signature during normal driving

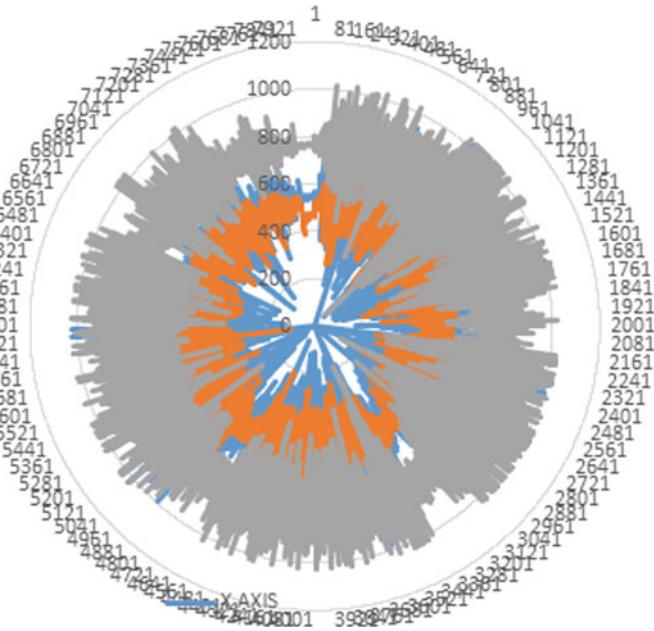


Fig. 7 Acceleration signature during rash driving

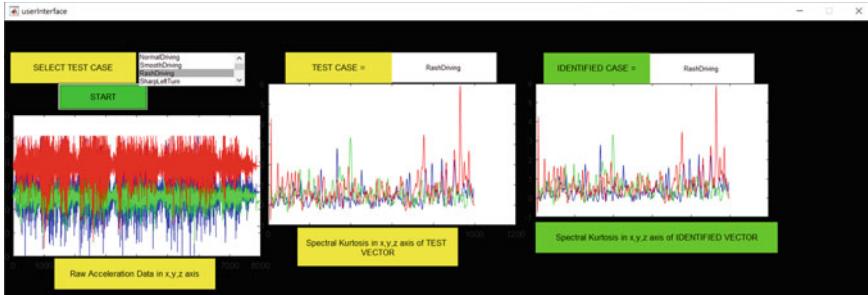


Fig. 8 Identified rash driving behavior

for removing noise, and dynamic time warping algorithm is used for classification prosecute data which is gathered from real-road conditions. The aggressive driving behavio accuracy of the proposed approach is 97%. The algorithm can be used for detecting aggressive driving behavior. The proposed approach has immense future scope. The algorithm can be linked to engine control unit and behavioral biometrics for automated countermeasures in case of aggressive driving. In future, the research can be further extended by incorporating other aggressive driving behaviors such as over speeding. The proposed approach can be linked with Global Positioning System to forecast drivers and vehicle information to nearby Police Stations in case

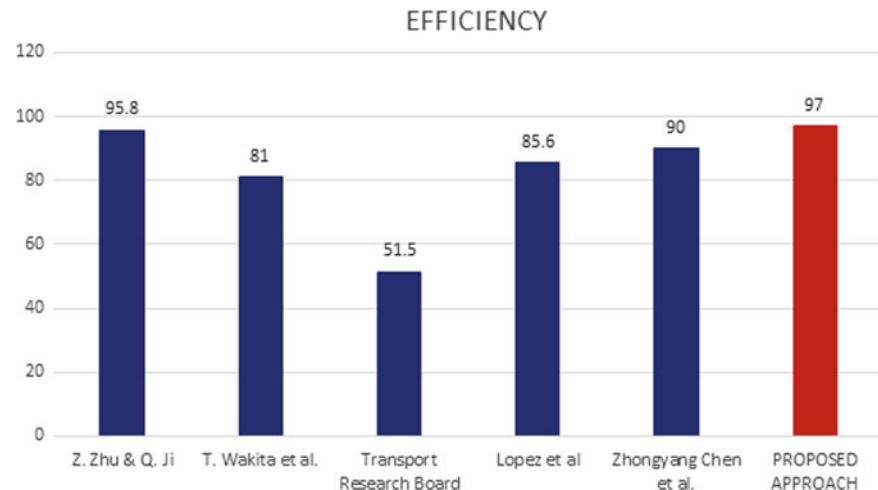


Fig. 9 Performance analysis of proposed technique

of aggressive driving. The system can be linked with cloud computing for faster processing and tracking.

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Processing Large Text Corpus Using N-Gram Language Modeling and Smoothing



Sandhya Avasthi, Ritu Chauhan, and Debi Prasanna Acharjya

Abstract The prediction of next word, letter or phrase for the user, while she is typing, is a really valuable tool for improving user experience. The users are communicating, writing reviews and expressing their opinion on such platforms frequently and many times while moving. It has become necessary to provide the user with an application that can reduce typing effort and spelling errors when they have limited time. The text data is getting larger in size due to the extensive use of all kinds of social media platforms and so implementation of text prediction application is difficult considering the size of text data to be processed for language modeling. This research paper's primary objective is processing large text corpus and implementing a probabilistic model like N-grams to predict the next word when the user provides input. In this exploratory research, n-gram models are discussed and evaluated using Good Turing Estimation, perplexity measure and type-to-token ratio.

Keywords Natural language processing · N-gram model · Text mining

1 Introduction

Mobile devices have evolved enormously in the last decade and so is an application being used on mobile devices. The use of mobile devices has increased and impacted how we handle data. As users starting to use mobile devices, fast and reliable methods of input are very much required. The user is interested in buying only those applications which save their time and effort. The companies build up sophisticated applications to provide the user with good user experience with minimum effort. The popular applications are Facebook, Twitter, online banking, shopping, Instagram, Google, Snapchat, and digital libraries. The next word prediction aspect

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helps user in text entry with minimum effort. Such applications utilizes language model, which is a probability distribution of words over text collections and states how often a word appears in the collection. The most used application of language model is auto-completion or next word predictions in search engines helping user in completing search keyword [1–4].

A feature known as word prediction is incorporated in applications to reduce the typing effort of the mobile users. The language model predict most probable next word or phrase after processing few words or letters user have entered. At present, since use of portable and mobile devices is on the rise, activities on various social media account are increasing too. The social media network mainly consists of Twitter, Facebook, blogs, whatsapp, Instagram and LinkedIn. With so many options on hand, users are spending their valuable time commenting, texting, blogging and reviewing. The aim of text prediction tools is to save typing time of the user while using application on mobile devices. The application apply language model and provide word completion, auto-correction and next-word prediction features. The search engines like Google helps users by auto-completion when they provide search keywords. Auto-completion saves keystrokes by predicting the search keyword, this is possible through returning top-most searched N-grams and auto-completion reduces the chances of spelling errors.

N-grams are valuable in identifying words in noisy, ambiguous and varied user input [5, 6]. The N-grams are very much indispensable in tasks like information retrieval, Natural language processing (NLP) and information extraction. Any NLP based system [5] can easily deduce that the sequence “I am sick” is more likely to occur than “I am seek” or “I am sink”. In understanding audio or speech, for example, the input speech sounds are confusing most of the time and many words in the speech seem similar. Initially language identification methods developed to process the natural languages were simple and one must have the knowledge of language to recognize it. This process was not efficient so various techniques were developed to help a reader to identify a language without even knowing it. It takes considerable amount of time before one can actually find one of the hidden patterns or any underlying uniqueness in the text collections. The processing task becomes difficult due to presence of foreign words or misspelled words or use of specific vocabulary. Therefore, such techniques perform poorly in terms of processing speed and accuracy. The NLP methods along with statistical methods have become widely used by data scientists to analyze text-based [7] data for prediction purpose. Prediction of text like next word, letters, phrase or sentence while user is trying to input is known as text prediction application.

The process in prediction application is collection of text data, preprocessing, generating various N-grams [8], applying prediction model and returning best predicted word. The language model searches most probable word from N-grams that matches the preceding word or phrase. The process is described in Fig. 1, the main steps are data collection, data preprocessing, language modeling and prediction. The objective of the exploratory research is to use text corpus from different sources, cleaning and analyzing such a text corpus. After doing initial steps, new found patterns and structures are used in predictive modeling in predicting next

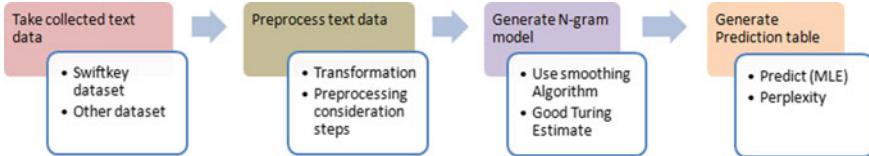


Fig. 1 Flow of prediction process using N-gram model

word using previous two words or three words provided by a user. The accuracy of any prediction model [9] depends directly on the text corpus size and diversity if the model is used for prediction. A prediction model need a large data collection for training purpose, the collection should give the best representation of user provided text. In the paper, we trained the N-gram language model with Good Turing smoothing technique for better prediction of the next word. Perplexity measure and Type-to-Token Ratio evaluates the goodness of predicted word. The background summaries are given in Sect. 2, data preprocessing methods is given in Sect. 3 and Statistical modeling explained in Sect. 4. The results, conclusion and future work are summarized in Sect. 5 and Sect. 6.

2 Related Work

The study of similar work provided many sources of text mining, natural language processing, sentiment analysis, text classification. We found many tools and R programming packages that directly helps in information extraction to build a model [9–11]. The NLP working and research work done in this area is explained in detail in paper [5]. In the paper, a very useful approach N-Gram is explained for building prediction models. This technique is based on counting the frequency of words from the text corpus to find probabilities of next words. The N-grams and its count produced only on the basis of probabilities of occurrence of word is called unsmoothed N-grams. Jurafsky and Martin [5] described prediction model for large text corpora and put light on various points related to it, given in following strategies. The Markov assumption clearly says that probability of a word only depends on previous word [12]. The models based on such Markov assumption predict probability of some word without even looking for words in the past. As text corpus grows the number of unseen words grows and known as out of vocabulary words [13]. The out of vocabulary (OOV) rate is ratio of unseen words and total words in test set. The vocabulary diversity measurement has been used in linguistic research, language impairment, forensic linguistic, stylistics and many other areas. The diversity is equal to the ratio of distinct words and total number of words known. This measure is known as Type-Token Ratio (TTR) [14]. The text or documents having large number of tokens always gives lower TTR values and vice versa [15]. The larger corpora one look at, the more word type you will be able to see. It is clearly explained in that vocabulary

size (different unique type or number of type) increases proportional to square root of the number of tokens. If number of token is n , then vocabulary size is proportional to \sqrt{n} . In general spelling checkers identifies misspelled words but fail to point out incorrect use of word in sentence. In the paper, Latent semantic analysis is used to identify incorrect use of words, or contextual spelling errors. Latent semantic analysis [16] was used to solve problem of misspelled word, letter n-grams was used to build semantic space and words was directly used.

The N-grams are evaluated using perplexity [5–7] measure known as intrinsic evaluation measure. The perplexity is the probability of test set normalized by number of words. For a set $W(w_1 w_2 \dots w_n)$ perplexity is $\sqrt[n]{1/P(w_1 w_2 \dots w_n)}$. In case of sparse data, Maximum Likelihood Estimate (MLE) creates problem for N-grams model so smoothing methods [17] are used to improve probabilities. To make distribution little bit balanced between higher level N-gram and lower level N-gram, probability mass from higher level N-gram is shifted to lower level N-grams. The Laplace smoothing [17, 18] simply adds one to count of each N-gram. The Good Turing discounting re-estimate the probability mass of N-grams which have zero counts by utilizing N-grams having count one. The Laplace and Good Turing smoothing [17, 18] solves the problem of zero-frequency N-grams. If one want to find $P(w_2|w_1)$ of Bigram but there is no such bigrams in corpus, this creates problem. To solve this problem interpolation method like Katz Backoff N-gram model is used [19]. This model works by finding N-grams having zero count and that is approximated by backing off to $(N-1)$ -gram. The Absolute discounting method like Kneser-Ney smoothing [19, 20] provides better method of revised count. The different features available in R packages like *openNLP* [21], *tm* [22] and *ggplots* described preprocessing methods and reading text corpus. The text mining functions to transform the text corpus is explained along with preprocessing functions. The stop words removal, punctuation symbol removal, conversion to lower case, numbers removal and stemming are important preprocessing steps [1, 2, 23]. The issues like sparsity in text and a fundamental of count based analysis is described.

3 N-Grams Model and Smoothing

The basic understanding of the text data and identifying what can be done with the data is really important. The preprocessing of the text corpora is also helpful in providing better results. In this section extraction of text corpus, preprocessing and exploration is explained in detail.

3.1 Data Set and Preprocessing

The Swiftkey Company produces software to help mobile users in entering text fast and with higher accuracy. The collaboration with Johns Hopkins University

Table 1 Preprocessing steps assumptions

Step	Assumptions
Case of letters	All letters are converted into lowercase letters
Stop words	All words from text corpora are considered in preprocessing including stop words
Word forms	Stemming is not be used as N-grams considers existing word forms in text corpus
Punctuation	All punctuation to be removed from text corpus
POS	POS tagging is not a consideration here
Numbers	The numbers were removed in preprocessing step
Sparse words	All words from text corpus are considered for exploratory task
Whitespace	For prediction model these are not important and so whitespace are removed
URL/https	Remove all https, markup and metadata words/symbols
Profanity words	All profanity words to be removed

in direction of producing prediction model on text data they provided a dataset known as Swiftkey dataset [23]. The dataset proved to be useful for exploratory research and various other text mining projects. The Swiftkey dataset is a compressed file which consists of document collections of blogs, twitter and news data. The dataset is available in four languages English, Finnish, Russian and German. For the purpose of downloading and processing this dataset various R programming language tools were used. The text mining activities were performed using package called *tm* [22]. The Swiftkey dataset has 71 million words and so dataset went through many preprocessing steps. The main transformations applied on texts are lowercase conversion, number removal, whitespace removal and lemmatization. But transformations exclude removal of apostrophes to maintain contractions. The blog post size is 108 MB after going through different preprocessing steps. The original size of blogs post data was more than 200 MB. The Table 1 describes various assumptions taken in the process.

3.2 Exploratory Analysis Over Datasets

In the exploratory analysis the relationships between the words and sentences is explored. After going through various steps in the analysis one can have better understanding of relationship between objects in the text corpus and language elements. One can have an idea about uniqueness in words, distribution of various N-grams which is used to re-evaluate the initially given idea. Our experiment on Swiftkey dataset statistics is presented in Table 2. The table put together a number of document collections in each category “Blogs”, “News”, and “Twitter” and other statistics. The words distribution is visualized through word cloud.

Table 2 Describing corpora by total word count, average words per line

dataSources	total.Lines	total.word.count	avg.words.per.line	max.char.per.line
Blogs	899,288	38,222,279	42.503	40,833
News	77,259	2,748,071	35.570	5,760
Twitter	2,360,148	30,433,285	12.895	140

Table 3 Characterizing word corpora by vocabulary, word type and ratio

Source	Vocabulary (V)	Word type(T)	TTR(T/V)	Diversity(D)
Blogs	38,222,279	1,103,548	0.0288	127.71
News	2,748,071	197,858	0.0719	86.04
Twitter	30,433,285	1,290,170	0.0423	165.53
Corpus	70,351,643	2,123,809	0.0301	179.04

The summary Table 3 lists total vocabulary (V), Word Types (T) and Type/Token Ratio (TTR) counts. The total vocabulary is equal to total number of words present in each category. As seen in summary table, more than 50% of the total corpus belongs to blog posts. Here the Word Types are representing the number of distinct words present in the total vocabulary. A very good measure to compare languages is the Type/Toke Ratio (TTR) which is ratio of total Word Type and total vocabulary. The TTR directly measure the complexity of the text corpus, bigger the number higher the complexity of the collections. From this you can infer that the repetition of word usage is less in the corpus. The ideal TTR is 1 (one) in case where all the words are different. For example take a sample of 30 words and all are different then the TTR is 1 (30/30). If you improve the corpus by increasing the number of token, TTR will decrease because it is negatively associated with number of token.

As one can see in Table 3, The TTR decreases with increase in corpus vocabulary. The “Diversity” measure tells about words diversity. The Diversity factor tells how diverse words are in text corpus. The Diversity is equal to ratio of distinct words and square root of twice the number of total words. The diversity values flatten at about 60% of the total documents. Therefore the technique for separation of data takes 60% as training set, 20% as validation set and 20% as test set.

3.3 Generating N-Grams

A very important feature of full corpus is the frequencies of frequency in N-grams because these values assist in predicting other words. When one compares unigrams to trigrams these frequencies reduce rapidly and previous research indicates that frequency tables can be used in smoothing out the information. The N-gram gives the number of words in a string or paragraph. The 3-gram model is taken for prediction of next word problem. To implement this unigrams, bigrams and trigrams from the text corpus is build first. All frequently occurring single words in the text corpus

make unigrams [24]. Figure 2 gives top 20 words of size one in the taken corpus and Fig. 3 top 20 words of size three (Fig. 4).

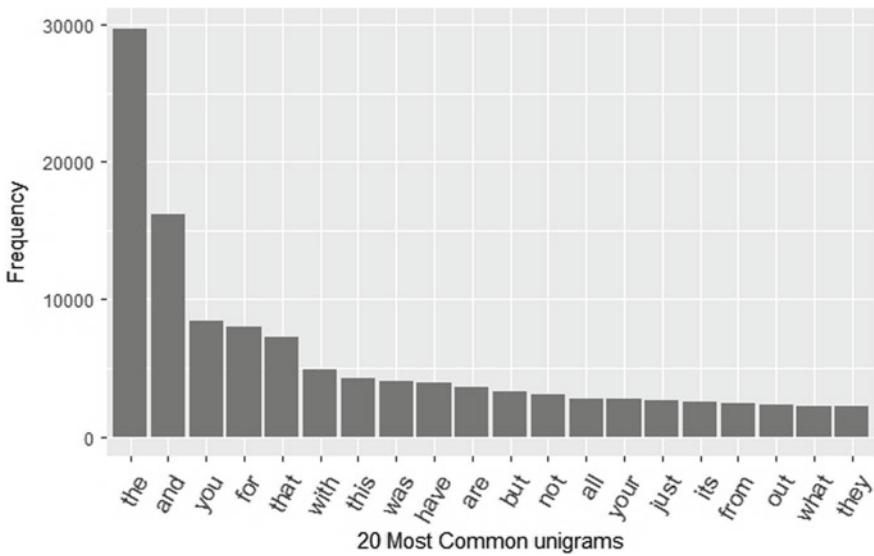


Fig. 2 Top 20 common unigrams

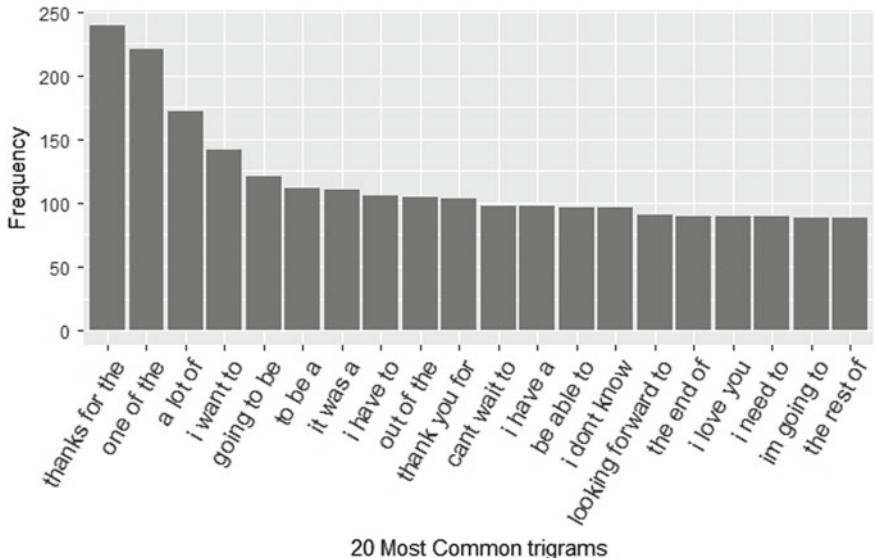


Fig. 3 Top 20 common trigrams

word	freq
the	29742
and	16173
you	8445
for	7967
that	7215

word	freq
of the	2680
in the	2500
for the	1400
to the	1349
on the	1267

word	freq
thanks for the	239
one of the	220
a lot of	172
i want to	142
going to be	121

Fig. 4 Top 5 words in each unigram, bigram and trigram table and frequency

3.4 Good Turing Smoothing

The probability of an unseen token or words can be estimated easily by utilizing the Good Turing smoothing method. A Good-Turing smoothing matrix is generated by having N-grams models in the frame [2, 3]. The N-gram having frequency count less than five ($n < 5$) is suitable to adjust the count using Good-Turing method. Smoothing is not required for the N-gram appearing six or more times because they are realistic. Good-Turing method provides way to calculate the probability of the unseen N-grams. A discount steps is used to make up the probabilities of N-grams to add up to one and this is further used to calculate unseen word probabilities. The discounted count (C^*) for token seen before is given by Eq. (1),

$$C^* = \frac{(C + 1)N_{n+1}}{N_c} \quad (1)$$

Here, N_c is total count of all N grams that have the same count ‘c’ (frequency) in text corpus. For example, N_6 is sum of all n-grams that appear 6 times in the corpus.

For unseen n-grams probabilities can be estimated by Eq. (2), where P_{GT} is Good Turing estimate for unseen n-grams and N_1 is total count of token having frequency one.

$$P_{GT} = \frac{N_1}{N} \quad (2)$$

3.5 Reducing Memory Use

In the corpus low frequency elements are very unlikely to come up as predictions to the user so pruning such terms can do huge memory savings. After building look up table, eliminate those N-grams with a count less than four except for unigrams.

Hence discard all lower-order (N-1)-grams which start with same words and are not in their respective top five.

4 Statistical Modeling

The statistical model for a text corpus is based on the process of taking the corpus and dividing into training, a testing and a validation set. When this is processed, a training set generates a model whose accuracy can be checked by applying the model on testing set. The dataset for such predictive modeling experiments should be large scale corpus. We considered two models for the experiment. In the first model stop words were considered but in second model they were removed. The model used and algorithms were improved in terms of accuracy, speed and precision. The initial model and algorithms used were enhanced in terms of accuracy, speed or both.

4.1 Prediction Model

The N-gram model is used in integration with Good Turing smoothing methods as predictive model. The N-gram models exploited Markovian properties and proved to be useful. According to the Markovian assumption one can easily predict a word if the trigrams, bigrams and unigrams are known for corpus no matter what is the length of a particular phrase is.

4.2 Prediction Algorithm Based on Good Turing Smoothing

The steps in prediction algorithm are given below:

- i. The user enters two words to prediction function.
- ii. The search for bi-gram takes place in trigram model look-up table.
- iii. If bi-gram is found in table, a subset of tri-gram beginning with bi-gram is produced.
- iv. If bi-gram is not found, a message appears stating “word does not exist” in the table.
- v. The Smoothing model updates the count taking element where count is less than five
- vi. Calculate the probability of options by dividing the count of the tri-gram by count of bi-gram
- vii. The highest probability words are the predicted words(output)

The package *tau* is used for cleaning and tokenizing process of text collection in R programming environment. The process is efficient in terms of usage because it

represents text collections into small number of columns and considers large number of observations.

5 Results and Discussion

The number of unique N-grams present in corpus is given in Table 4; the table also shows number of bi-gram and tri-gram. The N-gram with frequency less than three is adjusted using Good Turing smoothing method. All the frequency of various N-grams is plotted against logarithm of frequency e.g. a unigram having frequency 1 will have value 0 ($\log 10(1) = 0$). The dataset is divided into training, testing and validation subset in 0.6, 0.2 and 0.2 ratio. The density plot as shown in Fig. 5 clearly describes distribution of words. The 21% of unigrams accounts for only 10 words and top 10,000 words accounted for 93% of all occurrences. Only top 10 words fractions are 2.4 and 0.3% in case of bigrams and trigrams. It is visible from the density plot that the frequency distributions are heavily skewed for few top n-grams.

The contribution of top n-patterns was similar to dataset with stop words, but peaks on the density were shorter. The generation of validation and test trigrams followed

Table 4 Various N grams counts for both models

n-grams	Count (Model 1)	Count (Model 2)	Accuracy (Model 1)	Accuracy (Model 2)
1-gram	100,849	100,831	0.09	0.042
2-gram	1,353,570	1,576,543	0.09	0.042
3-gram	3,056,349	2,240,224	0.09	0.042

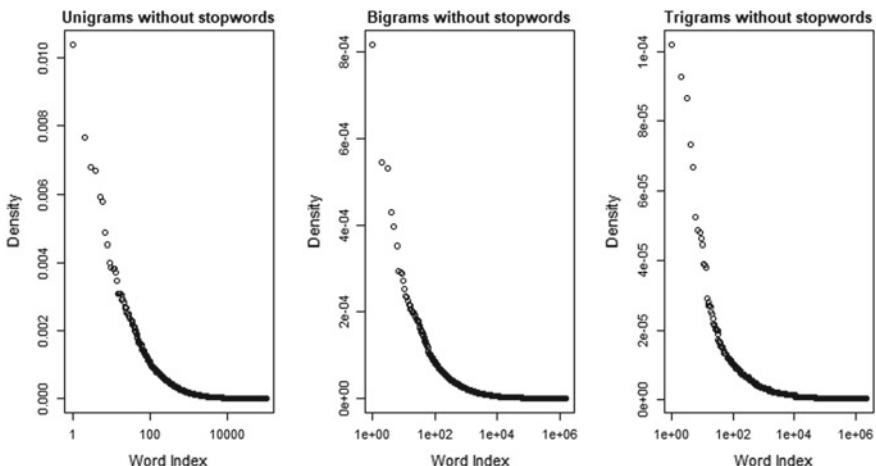


Fig. 5 Frequency distribution on unigrams, bigrams, trigrams without stop words

Table 5 GT estimate in predictive model

Count	Unigram	Bigram	Trigram
0	1.28	4.74E-05	7.81E-10
1	0.30	0.24	0.17
2	1.32	1.15	0.22
3	2.39	2.13	3.44
4	3.36	3.13	3.21
5	4.30	4.15	4.29

the same procedure used for the training trigrams. As far as prediction accuracy is concerned Model 1(n-grams with stop words) performed well as compared to Model 2(n-grams without stop words). The accuracy for model 1 is 9% as compared to Model 2 accuracy of 4%. The N-grams which appeared more than six times do not need smoothing and considered realistic. The predictive model is tested against the text corpus under consideration and smoothing method is applied. The Good Turing Smoothing estimate for unigram, bigram and trigram is given in Table 5.

6 Conclusions

The vocabulary, word types and diversity of experimental dataset is calculated and relationship between these measures is observed. The TTR and its analysis explain clearly that its association with number of words in the corpus is inversely proportional. The improvement in algorithm balanced the depth of information with speed of processing. The text corpus used in experiment gave a balanced result between competing parameters. This exploratory analysis explains that prediction model is most useful for predicting common words stems and perplexity value has reduced. The model based on training data including stop words performed well as compared to model without stop words. This proves that stop words should always be included in predictive models. Future work includes improvement of the online applications to allow better understanding of sense of user input, utilizing contextual information in return increasing prediction accuracy.

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A Dynamic Gesture Recognition System for Mute Person



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Abstract For a person with inability to speak, communication is the primary challenge. It is really difficult to express to a normal person understand what they are trying to communicate. The sign language is a common method used by a person with inability to speak and a normal person face difficulty in understanding signs. The gesture recognition system acts as a translator between a normal person and a mute person. The field of pattern recognition is a developing field of research and provides many techniques for image processing and learning. This paper is centered on the different approaches to gesture recognition and the impact of each technique used. In this paper kNN classification, hue saturation value model and rule-based classifier methods are discussed, and comparison is presented.

Keywords Gesture recognition · Pattern recognition · Hue saturation model · Rule-based classifier

1 Introduction

In this world, a person without speech rarely stand a chance as the world is habitual of listening from ears not from eyes, so this program will make a dumb person to get rid off of his inability as it will convert the gesture of the person into speech and will make the conversation more interactive. The system understanding sign language is a really important application for people with inability to speak or hear. Having a normal conversation with such person is really a big problem. Mute person faces difficulty in communicating with normal person because not every person is trained in sign language. The recognition of sign language is a challenging process due to the involvement of several technological aspects. The automation system for interpretation of signs made by disabled person is really a necessity these days as there are millions of deaf and mute person all over the world.

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In this paper, we have discussed about how to develop a system that can behave as an interface in order to speak with a dumb person. The hand gesture is taken as input which is mapped with the sample gestures from the database and then converted into speech. Each gesture will be matched from database, and the one which has the accurate meaning will be processed. The technique used in this project is image processing as the data sets will be huge in size and to continuously map it with the input set in real time is quite a job which can be handled using image processing and to make the output more precise classification algorithm like kNN, hue value saturation and rule-based are used. The gesture recognition system has many stages of processing like image segmentation, feature extraction, gesture classification, and gesture recognition (Fig. 1).



Fig. 1 Common hand gestures used by deaf and dumb people [1, 2]

2 Background Study

Gesture recognition is divided into two types; first is static gesture recognition system, and second is the dynamic gesture recognition system [1, 2]. In static gesture recognition system, the recognition of the hand's shape and expression is performed. While in the dynamic hand gesture recognition system [3, 4], the recognition of the hand motion as a trajectory in the space is performed, and then, the various corresponding operations based on all the trajectory parameters are done. In vision-based gesture recognition system [4], it used a camera to capture the hand gesture and movements to the system, and after performing image processing (i.e., detecting the image, identifying, and omitting the background from it, and then, analyzing it to perform segmentation to it) in order to extract features of all the extracted images as a sequence to understand the behavior and significance of every image. The major advantage of the vision-based gesture detection system is that it required simple inputs which were independent on the equipment and were quite interactive in nature to the system. Some previous work exists on sensor-based gesture recognition system like gloves, wires, and helmets. Such methods create problems due to requirement of wearing it continuously [5].

In [6], the authors used Gabor filter with PCA to extract the features and then fuzzy-c-means to perform the recognition of the 26 gestures of the ASL alphabets. Although the system achieved a fairly good recognition accuracy (93.32%), it was criticized for being computationally costly which may limit its deployment in real-world applications. Another hand gesture recognition system was proposed in Swapna [5] to recognize the numbers from 0 to 100 where each number is represented by a specific hand gestures. It received a recognition rate of 89. In this approach, several feature extraction techniques have been used which includes orientation histogram, wavelet transform, Zernic moment, edge codes, Hu moment, geometric feature, and finger earth movers distance (FEMD), but most of these techniques have some limitations.

The other type of popular technique of gesture recognition system is image-based approach for hand gesture. The various techniques for gesture recognition are hidden Markov model (HMM), artificial neural network (ANN), rule-based method, and hue saturation value (HSV) [4, 7, 8]. The classification of hand gesture can be done two ways; static hand gesture or dynamic hand gesture classification. The whole process of gesture recognition can be broadly divided into two categories which includes the static gesture recognition and the dynamic gesture recognition [4]. Static gesture recognition is mostly used to recognize finger-spelled signs. The classification is performed by through template matching by calculating Euclidean distance between feature vectors of input gestures and template [9, 10]. In dynamic gesture recognition, two different signs cannot be compared using Euclidean space because of time difference. Dynamic time warping (DTW) and HMM are widely used because they can align frames of signs and compute the probability of similarity [11–13]. A simple heuristic method for classification is rule-based where explicit If-Then rules are used to refer to the target features. This is used as a primary step for the dynamic hand gesture classification algorithms.

3 Methodology

The static gesture recognition system only includes the recognition of the hand movement, i.e., its shape and expression to be conveyed by the person. On the other hand, the dynamic gesture recognition a much more complex process is achieved by recognizing the hand's motion as a trajectory in space and also searching for the corresponding operations based on this analysis of trajectory motion of hand. The flow of recognizing the gesture is shown in Fig. 2, and system architecture is presented in Fig. 3a. The process starts with collecting image and preprocessing it to extract best feature from it.

The vision-based recognition system records all the gestures by camera and use image processing to extract all the possible information. The Arduino device is used to collect dynamic parameters for image like flex sensor, accelerometer, and tactile sensor. The image of hand gesture is taken through Web camera and is converted to a binary image as shown in Fig. 3b. The binary image is basically monochromatic and can be processed and segmented according to need. Once gesture is recognized through algorithm, it is converted to text and then to speech using Text-To-speech API [14].

3.1 KNN for Classification

KNN algorithm is known as the simplest classification algorithms, and this algorithm is used for various purposes. It does not involve an estimation of the parameters of



Fig. 2 Flowchart for pattern matching

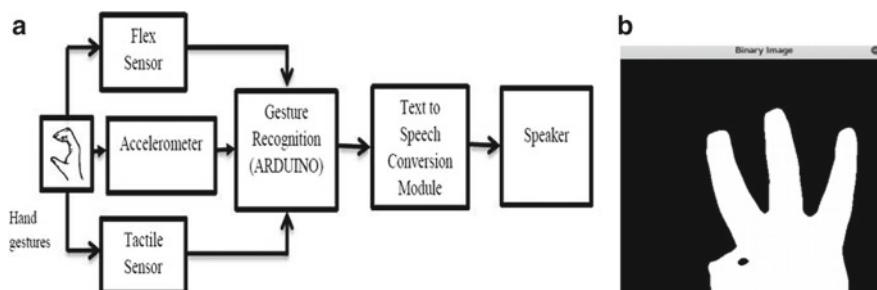


Fig. 3 **a** Block diagram for gesture recognition system, **b** binary image of letter 'W'

a statistic. It uses a database in which the data points are kept separated into various classes to predict the classification of a new sample point [4, 15].

The steps of procedure of how to calculate the nearest neighbors by this algorithm

1. Find parameter k , i.e., number of closest neighbors
2. Calculate the distance between the query-instance and all the training samples
3. Sort the distance
4. Find closest neighbors depending on the k -th minimum distance
5. Collect the class of the closest neighbors
6. Predicted class for the object is majority class of nearest neighbors.

3.2 Hue Saturation Value Model Function

HSV can be called as the procedure of how humans perceive color. It consists of three components: hue, saturation, and value. This space of color describes colors (hue) based on their shade (saturation) and their brightness value. Some pickers of colors, like Adobe Photoshop, use HSB, which uses the term “brightness” for “value,” but HSV and HSB is referred as the same color model. The gesture system depends on the correct division of the hand gesture area and deals with the coloring agent of the human skin [9]. The HSV model takes into consideration that different ethnic group have diverse skin color and that can be easily represented by pigment concentration affecting saturation of the skin [9]. The HSV segmentation method is applied to split the hand area from captured image using threshold value. The input gesture which is RGB color space gets converted into HSV color space. The value which has ranges for each of H, S, and V is decided so that it can accept the coloration of human skin [16].

3.3 Rule-Based Classifier

This is known as the process of getting relevant if-then rules from the data which can be extracted directly by the use of sequential covering algorithms or also from the other mining of data methods like building of decision tree or association rule mining. It is a simple heuristic approach to classification which is a set of explicit if-then rules that refers to the target’s features and generally points to a specific gesture. The rule-based method provides technique for dynamic gesture classification.

If $A < \text{Threshold}$, then the gesture is recognized

If $A \geq \text{Threshold}$, then object is the hand

Table 1 Outcome (accuracy rate) for various gestures

Gesture	States	Training	Trials	Correct	Wrong	Rate
1	8	65	20	20	0	100
2	4	56	20	20	0	100
3	8	59	20	20	0	100
4	4	59	20	20	0	100
5	3	60	20	20	0	100
6	4	56	19	19	1	95
7	8	57	19	19	1	95
8	3	57	19	20	0	100

4 Results

We capture the images using a webcam in real time and stored those images on local drive of the computer and treated it as a database. These stored images are then processed for detection of the hand, and training will be performed on it so as to omit the background and noise from it; then, morphing technique is used in the image to make a skeleton of the gesture. In the phase of recognition, the gesture is mapped with all the images in the database and that image is taken into consideration whose features matches the most and corresponding output will be seen by the system. To achieve natural human–computer interaction (HCI), a hand of human is taken as an input. Initially, eight gestures are used, and 20 trials were performed. The system is evaluated by calculating recognition rate as follows:

$$\% \text{Accuracy} = \frac{\text{Correctly classified gestures}}{\text{Incorrect classification of test data}} * 100 \quad (1)$$

$$\% \text{ Average accuracy} = \sum_{i=1}^n \frac{\text{Accuracy}}{n} \quad (2)$$

The real-world conditions are different from experimental setup conditions. They can be different in frame content, lighting, backgrounds, and user dependency. Table 1 shows results obtained during various trials for eight gestures in consideration. The recognition algorithm goes in two stages, first HSV is used, and then rule-based classification is done for better recognition.

5 Conclusions

The gesture of hand which is taken as the input of computer command has done extensive research with the existence of virtual reality. In this system, the captured

video image gets preprocessed which is done by feature extraction and classification. Feature extraction is one of the major problems for gesture recognition, and so it became an important part of recognition algorithm. Hardware is developed in such a way that it recognizes the hand gestures and converts that into voice. This study describes the way that gestures can be changed into the various groups of computer explainable symbols which can further be preceded. In this study, it is made possible to convert the gestures into voice, but in the same process, a wide range of variety of distinct devices can be supervised as well. We have accomplished 98% recognition rate using different gestures at various conditions.

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Evaluating and Exploring Industry 4.0 Framework



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Abstract The concept of this paper is to illustrate the moving of Industry 4.0 advancement and the forthcoming ideas of the smart factories in the future. The utilization of new instauration captivated, digital-physical frameworks with the Web, prompts massive enhancements, for instance, the increment of mechanisation and curtail period between the advancement of another item and its market dispatch.

Keywords Industry 4.0 · Factory of the future · Smart factory · Internet of thing · Augmented reality

1 Introduction

Our general surroundings have been changing every day alongside the improvement of human progress. Accordingly, specialised and mechanical improvements underway are changing too. Industry 4.0 is a model that shows how the modern generation pursues the most recent developments and changes after some time. Accordingly, the man, machine, and the generation itself establish the power in one intelligent and free system. The expression “Industry 4.0” signifies the shrewd manufacturing plant in which keen computerised gadget are organised, and they speak with crude materials, semi-completed items, items, machines, devices, robots, and men [1]. This industry is portrayed by adaptability, effective utilisation of assets, and

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joining of clients and colleagues in the business procedure. In an arranged production line, robots and men are turning out to be equivalent accomplices, having a higher level of human-made reasoning in connection to the past age of robots. The sense transmitters that react to the scarce sign are inserted into the robots, which empowers the collaboration among robots and labourers [2].

Industry 4.0 incorporates:

1. Factory 4.0:
Robots
 - Autonomous vehicle (independent vehicles),
 - 3D printing/additive assembling,
 - Advanced assembling system
 - Sensors (sensors—information assortments)
 - Industrial cell phones (stage)
 - Nanotechnology/propelled materials.
2. Digital security (information security)
3. Software for information handling—big data
4. Logistics 4.0
5. Mass personalisation (an infinite number of custom)
6. Internet of things
7. A top-notch group of workers and skilled group of partners.

Industry 4.0 consists of organised frameworks which give availability to nearby decentralised data handling, and dynamic scaling down considers little and minimal effort and elite sensors and actuators, auto-ID for altered item fabricating. It makes one of a kind identification and connections to the virtual world, canny field gadgets utilising programming that takes into account the unique worldwide circulation of functionality is a vital piece of the framework coordination and also cell phone management (MDM). Man-machine interfaces for the natural activity of complex frameworks without unique preparing [3, 4].

2 The Action Plan for the Fourth European Industrial Revolution

The world's driving makers and the market do not stop; they are dynamic and adjusting to modern patterns each day. During the conference of key industry pioneers (providers of advanced innovation, assembling, compound, and flying machine industry), hung on 11 January 2016, the commissioner and CEO of transformation “Industry 4.0”, Mr Gunther Oettinger, declared the reception of an action plan for the fourth European mechanical insurgency dependent on four “offensives”. Figure 1 represents the overview of digital manufacturing initiatives across Europe.

APPENDIX B: OVERVIEW OF DIGITAL MANUFACTURING INITIATIVES

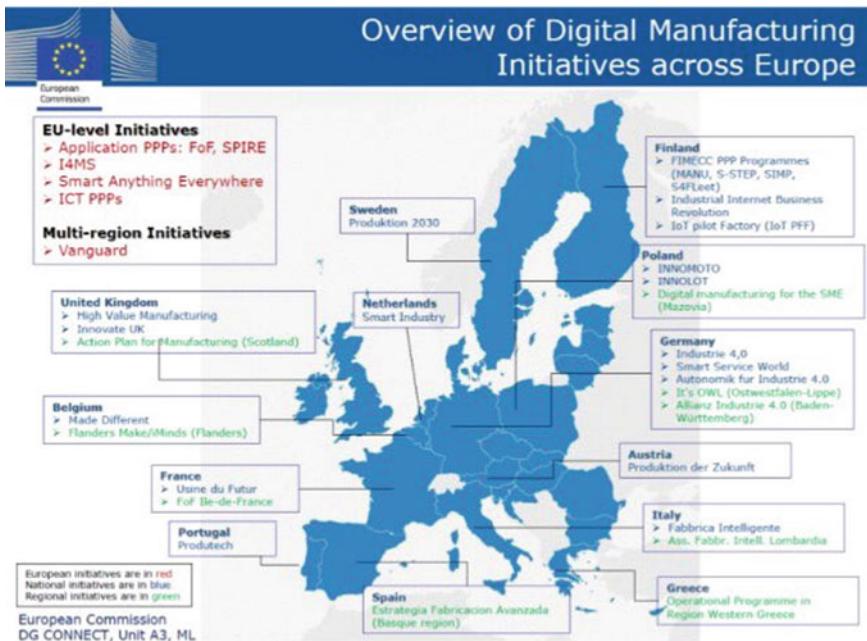


Fig. 1 overview of digital manufacturing initiatives

1. The principal hostile tells about the need for every single mechanical organisation (particularly little and medium-sized), from the immoderate area and some piece of the E.U., to empower simple entryway to the computerised foundation and to shape innovations.
2. The subsequent hostile works that the vehicle business, the aeronautics business, and energetic must take the European head in the computerised mechanical railroad track.
3. The third hostile is devoted to the work power, for example to the advancement of computerised aptitudes crosswise over Europe and its districts, at all degrees of instruction and preparing, to get ready labourers for the advanced transformation and to have the benefit of it. As indicated by the European Commission for “Industry 4.0” estimation, one fifty thousand new I.T. experts are vital annually.
4. The fourth hostile states that nation ought to embrace standard brilliant administrative answers for the astute business—how to direct risk and security of the self-sufficient frameworks, possession, and utilisation of up-to-date information. Digitisation of industry naturally entails cross-border proceedings, and none of the signatory states can discover solutions to global problems.

3 Technological Trends and Practical

A fundamental necessity of assembling organisations is the high accessibility of generation forms to cause the ideal utilisation of creation offices to guarantee intensity thus. Disturbances or even disappointments of such offices are generally connected with high pursue on costs. Industry 4.0 makes the reason for advancements and arrangements that empower fabricating organisations to recognise weaknesses and fast approaching disturbances in their creation forms at a beginning period, giving them adequate time to make a move before a disappointment happens. The ideas “condition observing” and “diagnostics” join different advances to empower the status of procedures and create frameworks to be checked continuously, changes to be recognised and offer guidance on the best way to streamline them. Data straightforwardness is at present viewed as unsuitable. This implies the effect of the working conditions on the administration life of the gadgets which is regularly not known. While blunders can be identified, it is regularly without exact data on the influenced gear or its area. On the off chance that breakdowns do exist, they can frequently just be analysed by means of neighbourhood flagging or even gathering cautions. Deciding causes and remedial measures usually are exorbitant and tedious. Lastly, support, for example, control or alignment, is as of now performed at fixed time interims, paying little mind to real utilisation [5]. The execution of data straightforwardness represents a few difficulties. It is regularly the situation that not all the accessible data is moved to more significant levels, only the control-important information. Significant status data for framework diagnostics regularly stay covered up at the field level. Moreover, even though data is heightened by means of correspondence chains, getting to the control factors includes additional work. Figure 2 depicts information transparency in Industry 4.0. It is likewise oftentimes essential to change over conventions and alter information. At last, there is an absence of producer free guidelines [6].

Data straightforwardness with Industry 4.0, then again, has the accompanying components: improved cloud-based data preparing, actualised start to finish information security, change of crude information to valuable data, and correspondence empowered procedures and frameworks. The centre elements of Industry 4.0 are along these lines digitisation, organising, examination in superordinate I.T. frameworks, inference of improvement measures, and criticism from forms [9, 10]. Present-day creation frameworks are in this manner related to progressively complex structures and incredibly expound robotisation plans as an accomplice in industrial connectivity Weidmüller is driving forward the savvy systems administration of generation. This can be outlined by various genuine models.

1. Example: Energy-efficient process optimisation

The “vitality effective procedure enhancement through condition observing and conclusion” showing machine is a regular infusion forming machine that is joined into an industrial Ethernet creation organise utilising correspondence empowered parts. The implicit power screen measures and records all the significant electrical parameters of the machine and makes them accessible to the vitality of the board framework. Correspondence empowered ACT20C signal

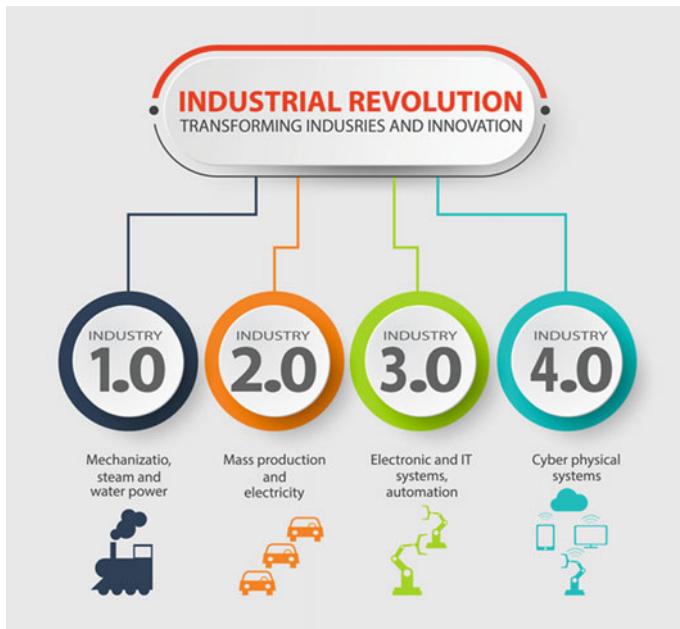


Fig. 2 Comparing Industry revolutions from 1.0 to 4.0 [7]



Fig. 3 Weidmüller demonstration machine—the next step on the road to Industry 4.0 [8]

converters to convert simple machine information into computerised information, which is in this manner prepared and broke down in the cloud. ACT20C modules can be incorporated into Industrial Ethernet structures because of their correspondence interface. What is impressive about the sign converters is that they remember exhaustive analytic capacities for expansion to current capacities, [11] for example, signal obtaining, readiness, institutionalisation, and yield. The consequent exchange of information to the cloud empowers generation and assembling information to be adjusted together with other data, for example, current vitality costs, and in this manner gives total straightforwardness of all creation information. Another bit of leeway of ACT20C signal converters is that

- they can be incorporated by means of Ethernet interface legitimately into existing industrial ethernet structures. Figure 3 depict the similar Industry 4.0 machine.
2. Example: Achieve data consistency for remote maintenance via the cloud Weidmüller framework arrangements comprises of system parts, u-remote I/O framework, including the coordinated Web server, extra correspondence empowered computerisation segments, and, not least, the u-connect online remote help arrangement u-interface encourages the handcraft of remote support arrangements and is synonymous with elevated level machine accessibility, rearranged administration and expanded plant efficiency [7, 12]. The more exhaustive the plan of remote upkeep answers for machines and frameworks, the more mind-boggling and tedious their administration will in general be. The two significant difficulties are the formation of committed, secure utilitarian associations with the current I.T. frameworks and the rise of progressively all-inclusive arranged frameworks. For some clients, every one of these posture significant obstacles. u-interface was structured as an electronic remote support arrangement and gave incredible basic, quick and secure access to machines and frameworks [13]. The natural interface of u-connection can be arranged to coordinate the framework and immediately redid to meet specific structure necessities. Notwithstanding an inventive cloud administration running on secure, high-accessibility servers in Germany, u-connect likewise furnishes an online stage with secure “compartments”, for example, information is shielded from being gotten to by “outsiders”. Indeed, even exhaustive remote upkeep arrangements can be set up modestly and safely with u-connect. The necessary administration of various assembling offices and clients is encouraged by an unmistakable, straightforward structure, and framework explicit individual rights the board. The open-finished u-interface remote support arrangement can enlist any number of switches and clients on the entrance, including more as and when required. Along these lines, u-connection can be ideally adjusted to address the issues of a regularly changing and developing organisation [14, 15].
 3. Web server for section-based commissioning and accelerated maintenance Web advancements are a vital segment of Industry 4.0. The present Web servers offer broad alternatives and can be keenly incorporated into items direct from the manufacturing plant [16]. A web server incorporated in the Weidmüller Fieldbus coupler with its naturally planned U.I. can be utilised to do tests locally or remotely, regardless of whether it is remote diagnostics, the recreation of data sources or the compelling of yields locally [17]. U-high-accessibilityremote, Weidmüller's remote I/O framework, does not require any extraordinary programming for this, only a standard program. Procedures and systems can be re-enacted without an associated controller; this even applies to the recovery of status data, diagnostics and procedure information [18, 19]. Notwithstanding a rearranged staged dispatching, this likewise accelerates adjusting in case of any impromptu framework vacation [20, 21]. The Web server configuration dazzles with its high level of ease of use and straightforward setup,

particularly with regards to sequential machines. Requiring no extra equipment or program establishments, clients can design and parameterise the I/O station both effectively and helpfully.

4 Conclusion

Industry 4.0 is the bionic upheaval of the twenty-first century that encourages firms to create “more astute” objects and administrations by decreasing costs and widening proficiency, where the workplace efficiency is essential for the application and the work depends on the latest report the region. The brilliant factory makes an answer which, because of the framework’s digital platforms, unproblematic vernation including essential, need-based establishment, and, eventually, a high level of adaptability, can help firms in the assembling part further enhance their procedures and fundamentally support their inward proficiency [22]. Five million work environments could be lost due to digitalisation in leading industrialised countries by 2020 [23]. Likewise, it is going to abruptly halt the market interest group for the objects made with archaic inventions because of lack of value and such generation would need to be barred because of high costs and wastefulness [24]. Since 2011, both generation and robotisation have been busy with Industry 4.0. The idea alludes to the utilisation of data and correspondence advances for machines and frameworks, considering a beneficial interaction of data innovation and designing and adjusted to the ecological conditions and prerequisites of the client. The term business 4.0 likewise includes a change in perspective that rethinks the worth creation and plans of action of assembling organisations. This has since a long time ago stopped to be a vacant vision is borne out by the models given. They pinpoint key zones, for example, condition observing and diagnostics, the online remote support answer for expanded machine and plant accessibility, data straightforwardness and correspondence ability just as the foundation of future frameworks [25]. The arrangements introduced are a significant advance towards this path and help to make Industry 4.0 progressively conceivable. Individuals who are utilised in organisations must be the fundamental driver of changes and developments identified with the presentation and usage of Industry 4.0. Figure 4 shows a similar review of the fundamental aptitudes that workers presently have and the abilities they will get by 2020 to make the Industry 4.0 conceivable [26].

Top 10 skills

in 2020

1. Complex Problem Solving
2. Critical Thinking
3. Creativity
4. People Management
5. Coordinating with Others
6. Emotional Intelligence
7. Judgment and Decision Making
8. Service Orientation
9. Negotiation
10. Cognitive Flexibility



in 2015

1. Complex Problem Solving
2. Coordinating with Others
3. People Management
4. Critical Thinking
5. Negotiation
6. Quality Control
7. Service Orientation
8. Judgment and Decision Making
9. Active Listening
10. Creativity



Source: Future of Jobs Report, World Economic Forum

Fig. 4 Comparison of top 10 skills in 2015 and 2020 [17]

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Predictability, Power and Procedures of Citation Analysis



Sandeep Mathur  and Loveleen Gaur

Abstract There is a significant range of writing that shows the after effects of citation examination contemplates. Most of the scientists do not give enough detail in their way of thinking toward emulating in the examination and offer premise to methodological decisions. Library and data specialists search for examples of production which may respond to the inquiries identified with bibliometrics which provides as a lot of instruments. The underlying investigation of utilizing the assortment of creations and databases discovered that the field is so far developing with no reasonable limits or began the best diaries, foundations for research or other clear examples. The summary of dominant authors has been summarized over citation analysis with the research gaps in the ongoing research work by the researcher.

Keywords Data analytics · Citation analysis · Computer science · Data science

1 Introduction

Citation examination is a part of bibliometrics that analyzes the citations found in productions, for example, diary articles and books to search for patterns of utilization. This sort of concentrate consistently incorporates recording the conflict of the reference game plans of different preparations to make sense of what equipment are advised plus after that dismembering those materials by sort, repeat, times, neighborhood assets or various segments. It is an inconspicuous methodology that can regularly complete with promptly accessible information. By leading a citation investigation, a specialist can see academic correspondence slants inside an order, survey the utilization or precision of citation files, make book indices, examine citation patterns

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of explicit client gatherings or decide the degree to which a library's accumulation addresses scientists issues [1]. Reference examination is the appraisal of the repeat, models and graphs of references in records. It uses the case of references, gets beginning together with one file then onto the following report, to reveal properties of the documents. A common point is recognizing the most critical records in a collection. An excellent model is that of the references between educational articles and books. For another model, judges of law support their choices by smart back to decisions made in before cases. An additional model is given by licenses which contain prior craftsmanship, reference of earlier licenses critical to the present case. Chronicles can relate to various features despite references, for instance, makers, distributors, journals like their real works. The general assessment of a collection of chronicles recognizes as bibliometric, and reference examination is a solution bit of that field. For example, bibliographic coupling and co-reference are connection gauges subject to reference. The references in a collection of records can similarly be addressed in structures, for instance, a reference outline. An early example of robotized text requesting was Cite Seer, which uses for references between educational papers. At the same time, Web of Science is an instance of a propelled system which joins an option that is other than insightful books and articles reflecting a gradually broad extent of information sources. Today, motorized reference requesting has changed the possibility of reference examination investigate, empowering several references to analyses for huge scale models and learning discovery. Reference examination gadgets used to process several impact measures for analysts subject to data from reference records. These have various applications, from the distinctive evidence of ace authorities to review papers and grant suggestion, to giving direct data in favor of academic authenticity study, residency and headway decisions. This test for limited resources may incite ethically broken directly to accumulate references [2]. A great deal of examination has been made of the display of guiles sly using reference examinations to consider the impact of different quick articles without considering various components which may impact reference designs. Among these responses, a discontinuous one spotlights on "field-subordinate parts", which suggests the mode that reference practices move beginning with one area of science then onto the following, and even between fields of research inside a request.

2 Objectives

The research has the following objectives: (a) The paper aims to ascertain the rudimentary concepts of citation analysis. (b) To find out the purpose, explain citation structure and the significance of citation analysis.

3 Literature Review

The reason and targets of the citation investigation think about regularly gave a comprehensive depiction of the degree. However, scientists additionally gave insight regarding the gathering of clients and type and date scope of distributions. The reference examination studies verified an extent of ports of learning and almost fell into the classes of science, remedy or prosperity, humanism or building. Everything aside from one of the examinations coordinated in an insightful library setting, and they verified the extent of customer bundles that would be typical in educational libraries: staff, Ph.D. understudies, pro are understudies and school understudies [3]. A couple of examinations looked than one part of the information, more than one class of customer social affair or more than one kind of creation. The vast mass of the assessments driven in the United States and the others were driven in countries spreading more than five landmasses: Australia, Belgium, Canada, China, Finland, Iran, Nigeria, Spain and Turkey. Nearly every researcher used the worksheets or database programming to analyse the reference data, collected programs referenced. The most frequently conceivable were Microsoft Access, Microsoft Excel, and the Statistical Package for the Social Sciences (SPSS). A couple of benefits uses to check or standardize references, including WorldCat, Ulrich's Serials Directory, CASSI, ISI's Journal Citation Reports, PubMed, neighborhood stock records, distributor Web goals and diverse article databases. Most researchers did not comment on who orchestrate and dissect the references, anyway some referenced assistance from understudies or associates. The hugest segment of analyzing documents identifies with the factors that every analyst broke down [4, 5]. All factors that were examined by more than one scientist exhibit in Appendix A. The focus is on the four most now and again talked about factors: sorts of asset referred to, time of referred to assets, recurrence of citation to diary titles and library possessions. We give explicit models identified with these four factors underneath and allude pursuers to the rundown of studies and related factors in Appendix A for all instances of how scientists examined these factors.

4 Purpose of Citation Analysis

Following are the purposes of citation investigation:

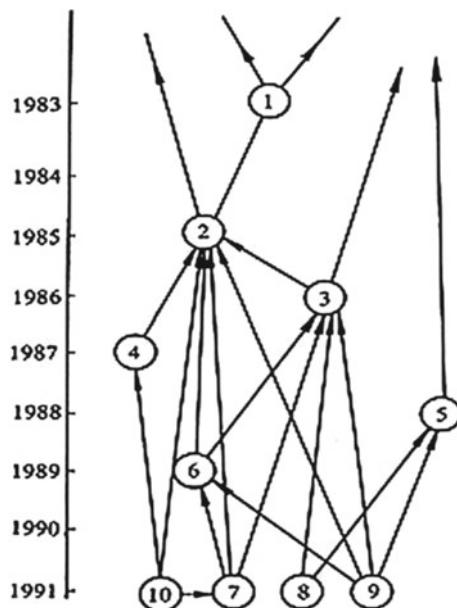
- To set up the effect that specific work has had by recognizing which different creators put together their work concerning it or referred to it inside their very own papers.
- Get the familiarity with the field/subject and establishing a differentiation.

The legitimate composition is not isolated, anyway is interrelated with one another. The relationship among sensible composing chooses usually alluded to documents. An all-out consistent paper contains two areas: the body part and the reference region.

The references reflect the conditions that makers ingest or abuse as considerations, systems and strategies. The shock that alludes to the concentrations in the pillars recorded as a printed copy and marks a reference point can undoubtedly prove that the exchange of logical composition combines with the level and vertical heritage. The exchange situation is the standard structure of the reference relationship called the reference classification.

The scholars use an analysis or an endnote that summarizes the references or references in conveyed coherent documents or essential books. Such records structured the association among the reference and alluded to cohesive composition. The reference composing is one of the vital natures of rightful writing. As indicated in Fig. 1, the reference relationship of legitimate writing is the critical reason for reference examination [5]. Reference examination uses various techniques, including numerical, truthful, connection, acknowledgement, thinking, suggestion and cognizant methodologies. These strategies are utilized to examine an assortment of logical diaries, papers, objects of citation and referred to wonders to decide the attributes of an amount strategy and the inborn law of a bibliometric investigation technique. Reference examination introduced during the nineteen-twenties. In nineteen-twenty-seven, Gross et al. have driven the essential reference examination all through the whole presence of composing. They examined the references of articles in a few substances designing periodicals and center periodicals in chemistry training. Buckland discussed outdated working quality and composing dispersing, which relied upon reference bits of knowledge. Multiple database records and legal papers, each

Fig. 1 Citation network [22]



having their own set of rules and syntax for citation have been in use. It makes trouble and confusion among the researchers in referencing the paper.

5 Citation Behavior and Motives

The citation referred to the logical writing and are signs of consistent development of the law which exemplifies the constant information and knowledge of collected and persistent legacy. They additionally illustrate the rule of the solidarity of science and cross-infiltration among different orders. Subsequently, the records of logical learning and logical research straightforwardly gather that logical writing cannot be detached yet is interrelated [6]. A writer of consistent writing unavoidably refers to the writing of different writers recorded as hard copy logical papers to gain from their experiences and results. In this way, the referring to conduct of logical specialists is an across the board wonder and is a vital piece of logical correspondence. The citation investigation strategy has been applied broadly and has pulled in across the board consideration and top to bottom research. Researchers have talked about this strategy in numerous viewpoints for an assortment of referred to inspirations. The creator of logical writing, for the most part, does not refer to writing that is inconsequential to his/her theme [7]. Different reasons are accessible for commonly referred to writing. M. Weinstock called attention to the accompanying fifteen purposes behind writing citation after precise acceptance. Besides, the association and qualification among logical papers, researchers and logical diaries, science and logical orders can likewise be gathered. In this way, the citation examination strategy has broad applications. This strategy can be adequately applied to numerous regions by training, and it assumes an inexorably significant job. The citation and referred to logical writing are appearances of the consistent development of law, which exemplifies the logical information and knowledge substance of gathered and constant legacy. They likewise epitomize the standard of the solidarity of knowledge and cross-entrance among various controls. Like this, the proceedings of logical learning and logical research legitimately induce that logical writing cannot be disconnected, however, is interrelated [8]. A writer of logical writing unavoidably refers to the writing of different writers recorded as hard copy logical papers to gain from their experiences and results. Subsequently, referring to conduct of logical specialists is an across the board marvel and is a crucial piece of logical correspondence.

- To regard the overcoats
- To show moving mindset regarding the associated mechanism
- To estimate past workers
- To search for full quarrel for their conflicts
- To give on hand works
- Provide a manual not to disclose, rarely indicated or ever referred to the composition
- Sign data and physical constants

- Check if an idea or thought inspected in the raw material
- Check the explanation behind the characters in the raw materials or various works of thought or thing
- Deny the work or point of view of another
- To the thing for the need of others
- Age of referred to benefit
- Frequency of reference to diary title
- Library property
- Other variables analyzed [9].

These fifteen reference reasons are typical for the constant improvement of writing. The reference directly accumulates some sensitive data structures. This is done directly by reference and refers to the composition of all edges and levels to reflect the intelligent advancement of the current condition and the law. In this sense, the progress of science and innovation is continuous. Meanwhile, existing controls are achieved, converging and made shared thanks to scientific solidarity.

6 Fundamental Variety and Stages of Citation Investigation

For citation information, an examination is performed dependent on different pointers or different viewpoints as indicated by the reason for the investigation. Purposes incorporate the hypothetical testing of citations, the focus and discrete pattern investigation of citation amount, the citation amount law with the time of development and the significant citation list investigation, for example, self-citation amount, citation language, literature type, time and nation [10]. The guideline of citation butt-centric wises performs a relating examination. Other general standards are applied to pass judgment and anticipate the investigation. Citation insights are critical parts of the essential strides of citation investigation. An inquiry must direct on citation measurements, paying little heed to the sort of embraced citation examination [11]. Along these lines, citation measurements are preconditions for citation investigation. In gathering citation information for citation measurements, we should pick the standard factual articles first, and the citation data wellspring of writing can be given. Numerous kinds of writing sources are accessible for citation insights, for example, audit diaries and other fundamental productions [12]. Figure 2 specifies the basic citation method structure. It is essential to mention the sources used in your search for several reasons:

- To show your reader that you have done
- Be a responsible scholar giving credit to other researchers and recognizing their ideas.
- To avoid plagiarism by citing words and ideas used by other authors
- To allow your reader to keep track of the sources, you used when you accurately cited them in your document using footnotes, a bibliography or a list of references.
- A proper investigation by listing the sources you used to get your information.

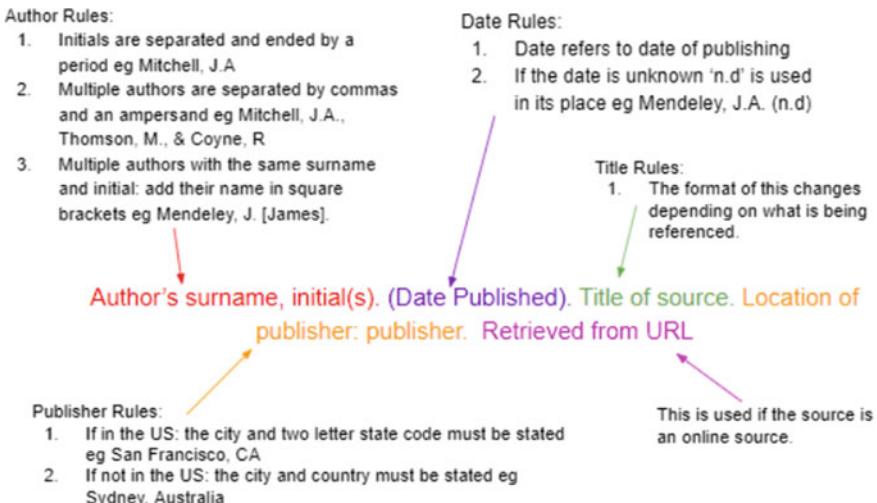


Fig. 2 Citation analysis [23]

7 Limitations of Citation Analysis

Even though the citation investigation strategy has a full application and significance, it shows a few confinements. Creator citation is a human-controlled reasoning and judgment process. As an indication of citation, it is only a large scale and surface measure. Hence, investigation on citation law requires improvement. Many constraining elements influence citation examination.

7.1 Citations are not so Much Equivalent Significance

For instance, a few papers may have wrong thoughts or ends, and scientists may scrutinize them for further discourse. Along these lines, these papers' citation might be high. Citation is restricted by numerous components, for example, production time, language and discipline [13]. Minor contrasts in citations cannot portray the upsides and downsides of value. It includes a lot of haphazardness. Just when the thing that matters is enormous, can the issue be clarified?

7.2 Influence of False Association on the Citation Connection

Research papers are referred to early writing for various reasons or from other points of view. For instance, an article may refer to its techniques, and another may refer

to its outcomes. In this manner, the connection in the substance of these two papers might be false. Citations may show up in the prelude, title, content, end and talk. In these cases, the substance and degree of the first writing that the writer referred to are not the equivalents. The relationship and significance of the citation for the first writing are different, yet in the present citation examination, they are dealt with similarly and without qualification [14].

8 Future Work

The intents and purposes for every researcher to saw the sorts of alluded through a remarkable some kind of inside. The number of classes are used from three to twenty-six association types. Specialists investigated different types of assets as suitable to the subject of the examination; for instance, licenses were a sort utilized in some studies of designing client gatherings [15, 16]. The citation is often based on text base analysis, e.g., the name Sandeep Mathur the citation for this will be as S. mathur, Mathur S. or Sandeep Mathur, and for all the three cases, the citation will be analyzed as three different entities. In future, we will develop the tool/algorithm to deal with this issue.

9 Conclusion

In looking into the approaches of citation examination, we found that the measure of detail given by specialists shifted generally. In any case, standard topics among the philosophies can provide direction to specialists who are wanting to lead citation examination contemplates, in regions that range from characterizing the extent of the investigation to recovering and examining citations [17]. In every one of these zones, there are numerous components to consider, and specialists should ponder the decisions that will best meet the goals of their study. If there are distributed investigations that will be utilized for examination, analysts ought to consider using a methodology that is steady with those investigations. On the off chance that the citation examination results are proposed to be utilized primarily to upgrade nearby understanding, specialists ought to pick a methodology that fits with neighborhood rehearses. In the entire belongings, analysts should exist intentional regarding procedural decisions, live about what is broke down and introduced to portray their choices and basis. These practices will help guarantee lucidity and similarity. In this manner, expanding the estimation of every individual citation examination study [18, 19]. All investigations we checked at the citation conduct of a particular client gathering is to do in any event one of the accompanyings, evaluate the amleness of the present library accumulation and advise accumulations rehearses. For example, acquisitions and scratch-offs or educate accumulations arrangements, and for, subsidising appropriation, maintenance approaches and electronic access [20, 21].

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A Systematic Literature Review of Deep Learning for Detecting Dementia



Deepika Bansal, Kavita Khanna, Rita Chhikara, Rakesh Kumar Dua, and Rajeev Malhotra

Abstract Dementia is a brain disorder which causes loss of memory leading to disruption in the normal course of life of an individual. It is emerging as a global health problem in adults of age 65 years or above. The early diagnosis of dementia has gone forth as a key research zone having an aim of early identification for hindering the advancement. Artificial Intelligence, Machine Learning and Deep Learning have acquired a great importance in the medical field. Deep Learning provides path breaking application in medical imaging. This study gives a detailed summary of different implementation of deep learning for detecting the disease Dementia.

Keywords Dementia · Machine learning · Deep learning · Convolutional neural · Networks · Magnetic resonance imaging

1 Introduction

Dementia is a neuropsychological disorder which causes loss of memory leading to disability and dependency of the adults. Dementia is commonly found in adults above the age of 60 years. Alzheimer's disease (AD) is a type of dementia, being most prominent in almost 75% of the cases. The different sorts of dementia incorporate Frontotemporal Dementia, Parkinson's disease, Dementia with Lewy Bodies, Vascular Dementia, etc. As indicated by the World Health Organization (WHO), almost 50 million people are experiencing Dementia across the world and about 10 million new cases are expected to emerge every year [1]. The treatment of dementia at an early stage is very important for the social and economic impact of the disease.

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Several publicly available datasets can be obtained from Open Access Series of Imaging Studies (OASIS) [2] and Alzheimer's Disease Neuroimaging Initiative (ADNI) [3] which includes both longitudinal [4] and cross-sectional studies [5]. ADNI [6] established in 2004 provides us with various types of data being used for the treatment of dementia for example, clinical data, genetic data, biospecimen data and few neuroimaging data. The neuroimaging data includes magnetic resonance images (MRI), positron emission tomography (PET) and single photon emission computed tomography (SPECT) which are being utilized.

A systematic literature review of various datasets available for dementia along with different techniques of machine learning used for detection of the disease is presented by authors in [7]. In addition, irrelevant and redundant features are removed through efficient feature selection techniques to achieve improved classification accuracy [8, 9]. The brief survey of microsimulation and machine learning implementation for the diagnosis of dementia are extensively presented by Dallora et al. [10]. The different segmentation, modalities and machine learning techniques are reviewed by various researchers [11, 12]. The detailed literature survey is given in subsequent section.

2 Literature Survey

Deep Learning [13] is contributing a lot in the early detection and restriction of the progression of Dementia. A great number of architectures [14] stand out in vogue, among different methodological renditions of deep learning. The Convolutional Neural Network (CNN) [15] is one of the most accepted algorithms utilized for deep learning in medical imaging. The idea of CNN roused from the neurobiological model of visual cortex [16]. Other credible architectures for Deep Learning incorporate Deep Belief Networks (DBNs) [17], Restricted Boltzmann Machines (RBMs) [18], Deep Boltzmann Machines [19], Deep Autoencoders [20] and Recurrent Neural Networks (RNNs) [21].

A concise summary of varying deep learning approaches for the identification of dementia is presented and summarized in Table 1. Rueda et al. [22] presented a bag of features (BOF) image representation scheme using Support Vector Machine (SVM) for the classification of AD MR Images. They considered the 222 subjects from OASIS database and performed skull stripping and registered the images with 1988 atlas space of Talairach and Tournoux. Brosch et al. [23] uses MRI images of ADNI dataset and proposed a learning of manifold of brain MRI using deep learning obtaining a high classification accuracy correlation. Suk et al. [24] presented a multi-modal data fusion deep learning feature representation using stacked autoencoder with MRI, PET and CSF image modalities. High classification accuracy of 95.8% (for AD), 85.0% (for MCI) and 75.8% (for MCI-converter) is obtained. Liu et al. [25] presented an early diagnosis of AD using Deep Learning feature selection with Elastic Net. The architecture contains stacked autoencoder and softmax output layer and the results are compared with single-kernel SVM and multi-kernel SVM.

Table 1 Survey of deep learning techniques used for the detection of dementia

Ref.	Year	Image modality	Dataset	No. of subjects	Preprocessing	Technique	Accuracy
[22]	2012	MRI	OASIS	222 subjects	Skull-stripping, registration to 1988 atlas space	BOF image representation scheme with SVM	Improves 10% error classification rate
[23]	2013	MRI	ADNI	300 subjects	Skull-stripped, Bias field corrected, registration	Deep belief networks or Conv RBMs	p-value = 8.24 × 10-9
[24]	2013	MRI, PET, CSF	ADNI	51 AD, 99 MCI 52 healthy	AC-PC, skull-stripping, segmentation into GM, WM and CSF	Stacked Auto encoder	95.9, 85.0, and 75.8% accuracy for AD, MCI, and MCI-converter
[25]	2014	MRI	ADNI	311 subjects	Registration to ICBM_152 Grey matter extraction	Deep learning using Elastic Net	83.75%
[26]	2015	MRI	ADNI	755 patients	Normalize to ICBM template	CNN Auto encoders	89.47%
[27]	2015	MRI	ADNI	100 subjects	Registered to MNI152 and AAL template	Feature extraction and classification	81.79%
[28]	2015	MRI	ADNI	51 AD, 99 MCI, and 52 normal subjects	AC-PC correction, skull stripping	Sparse multi-task learning	90.36%
[29]	2016	sMRI	ADNI	210 subjects	Extracted Brain features using conventional 3D autoencoder	Deep 3D-CNN	94.8%
[30]	2016	fMRI	ADNI	28 AD 15 NC	Motion correction (MCFLRIT)	CNN and LeNet-5	96.85%
[31]	2016	MRI	ADNI	68 NC, 70 AD, 111 MCI and 26 Late MCI	Spatial normalization with PET and VBM-T1 templates	Deep Belief Network as feature extractors	90%

(continued)

Table 1 (continued)

Ref.	Year	Image modality	Dataset	No. of subjects	Preprocessing	Technique	Accuracy
[32]	2016	fMRI	ADNI	300 subjects	Motion correction, skull stripping, and spatial smoothing registered to the MNI152	CNN with LeNet	96.85%
[33]	2016	MRI	ADNI	509 subjects	Preprocessing procedures were performed using the VBM8	Ensemble of feature selectors	Proposed fusion gives good performance
[34]	2016	MRI, fMRI	ADNI	144 fMRI 302 MRI	ICBM 152 template registration	Adopted LeNet and GoogleNet	98.84%
[37]	2017	MRI	ADNI	33 AD, 22 LMCI, 49 MCI, 45 healthy	Skull stripping, gray matter segmentation, bias correction, modulation using SPM-8 tool	4-way classification using DCNN with 3 frameworks	98.88% GoogleNet
[38]	2018	MRI	OASIS, ADNI	160 subjects	Removal of film artifacts and high frequency components	DWT + FNN, DCT + ANN, SVM	95.5
[39]	2019	MRI	OASIS	416 subjects	Resizing using interpolation	DCNN and transfer learning	Accuracy > 80%
[40]	2019	MRI	NRCD	326 subjects	Cortical and subcortical features	PCA + SVM, k-NN, NB	F1-score 99.06
[41]	2019	fMRI	ADNI	138 subjects	Brain extraction, motion correction, intensity normalization, image registration	2D CNN, ResNet-18, Transfer learning	97.88%

Payan et al. [26] predicted AD with CNN using auto-encoder and preprocessing of MR images is done using SPM obtaining high classification accuracy. Automated feature extraction and classification [27] for AD patients is performed using Deep Learning with no. of epochs up to 300, learning rate 0.05 and 2 convolution and 2 pooling layers, an accuracy of 81.79% is obtained. A novel deep architecture [28] using preprocessed images performs sparse task learning. Hosseini et al. [29] predicts AD using deep 3D CNN learning generic features capturing AD biomarkers obtaining an accuracy of 94.8%. Sarraf et al. [30] successfully classified fMRI data of AD from normal controls reaching an accuracy of 96.85%. CNN and LeNet-5 are used with no. of epochs 30, batch size 64, learning rate 0.01 which drops initially after each 10th epoch. Ortiz et al. [31] explored the deep learning-based classification method applicable for brain regions which are defined by Automated Anatomical Labelling (AAL) using Deep Belief Networks (DBN) as feature extractors obtaining the best classification outcomes. The author [32] used CNN for classifying AD from normal brain using Le-Net 5 on fMRI data acquiring an accuracy of 96.85%. Nanni et al. [33] proposed a fusion for diagnosing AD using ensemble of feature selectors. Preprocessing steps includes image re-orientation, skull-stripping, cropping, image normalization to MNI and segmentation into gray matter tissue.

Saman Saraf et al. [34] considered MRI and fMRI images from ADNI dataset for distinguishing the Alzheimer's brain and normal subjects using Deep CNN adopting LeNet and GoogleNet. The preprocessing of the datasets is done with the help of Brain Extraction Tool FSL-BET [35] and FSL-VBM [36] library. Both the models are initialized with 30 epochs with Stochastic Gradient Descent base learning rate 0.01, gamma = 0.1, weight decay 0.0005, momentum = 0.9. GoogleNet showed slightly better accuracies than LeNet, 99.9% for fMRI data and 98.84% for MRI data. A 4-way classification using DCNN with 3 frameworks of CNN [37] is proposed adopting 100 epochs Xavier initialization of weights. The accuracies obtained with GoogleNet-98.88%, ResNet-18 98.01% and ResNet-152 98.14%.

The classification of AD with fuzzy neural network using feature extraction from DWT is proposed [38] obtaining 95.5% accuracy compared with Discrete cosine transform using ANN and SVM. The detection of dementia and classification of MRI with deep neural networks and transfer learning [39] is performed while achieving accuracy greater than 80%. The cortical thickness and subcortical volumes of MRI images are extracted using FreeSurfer [40] and the classified using PCA + SVM, k-NN and Naïve Bayes. The classifier softmax is concluded the best for the AD versus HC classification for obtaining a F1 score of 99.06%. The 2D CNN with ResNet-18 are used [41] for diagnosis and classification of different AD stages acquiring an accuracy of 97.88% with fMRI data from ADNI.

3 Conclusion and Analysis

Dementia is a brain disorder, emerged as one of the primary causes of death and the early detection of the disease is a challenging task. For the same purpose, deep

learning has captivated a great consideration in recent years. This paper is started with the definition of Dementia, its types and prevalence, followed by the available datasets for the disease and related biomarkers for example MRI, fMRI, PET. It is highly recommended that the combination of these neuroimaging modalities along with neuropsychological tests can help us to convey a more promising diagnosis. Considerably more research is required with the combination of modalities for finding the multi-modal biomarkers.

Further, an introduction of Deep Learning is discussed with a detailed literature survey of various deep learning techniques used for the detection of dementia. A comparison of the existing techniques over various image modalities, data sets and preprocessing techniques used has been presented. Large datasets can definitely improve the accuracy of detection of the disease. In terms of preprocessing, skull stripping, normalization and image registration to a template is recommended. It is very clear from the above survey that the best accuracies have been obtained using transfer learning with various architectures of CNN namely, LeNet, Resnet and GoogleNet.

Our future work will include the exploration of various datasets available for dementia including the real-world dataset for contribution towards the study of detecting dementia using the deep learning model.

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Software-Defined Networking Based on Load Balancing Using Mininet



Himanshi Babbar and Shalli Rani

Abstract In traditional networking devices, there is a tight coupling of data plane and control plane. It handles a huge volume of traffic on the Internet which is not possible in traditional networking devices. The strategy emerged of disassociating the control plane from the data plane is defined as software-defined networking (SDN). The rapid increase in the number of Internet users is becoming a difficult task for conventional load balancers to handle network traffic. SDN provides power over the network from the centralized controller to distinguish between the control plane and the data plane. SDN is a prominent technology in today's Internet. Nowadays, our networks handle the extensive amount of traffic that serves the hundreds and thousands of clients where it is very difficult for the single server to handle such a huge load. To overcome this problem, the load balancing technique came into existence. The main purpose of this work is to show how SDN applications can be created without using any controller and analyze the efficiency/effectiveness of load balancing algorithms based on SDN.

Keywords SDN · Load balancing · Round-robin algorithm · Weighted round-robin algorithm · Mininet

1 Introduction

Computers communicate over a network through packets. In the center, several tools route the data from its source machine to its destination computer. As the computers grow exponentially, so is the backbone of networking to handle the enormous amounts of data that they generate. Traditional networking is inflexible and

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prone to errors [1]. A new architecture called SDN has gained ground in the academic and business world, brought a new set of ideas, solved many of the challenges that conventional networks have to face. SDN distinguishes the network logic control plane and the forwarding function data plane (e.g., firewall, switch). Therefore, the details about network management and the network logic are centralized over the SDN controller (also known as control) [2].

In SDN, load balancing plays a prominent role in today's network, millions and millions of people use the Internet today and this leads to the storing of huge amounts of data with various servers known as server farms and the rise in web traffic. To equally distribute the load across all servers, we need load balancers [3]. Load balancing is a network feature of computer networks that are used to spread the load equally across various servers and connections.

Load balancing can be executed in either the software or the hardware equipment. The main sole responsibility of a load balancer is to divide the workload requests into multiple servers of a similar type to reduce the burden on the single server. Load balancer consists of OpenFlow virtual switches (OVS) with a controller and various servers that are intermingled to the ports of the OVS as explained in Fig. 1.

The rest of the paper is organized as follows: Sect. 1 describes the introduction and need of load balancing in SDN, Sect. 2 frames the literature review of load balancing in SDN, Sect. 3 explains the load balancing algorithms based on SDN, Sect. 4 tells about the emulator used in the paper followed by the conclusion in Sect. 5.

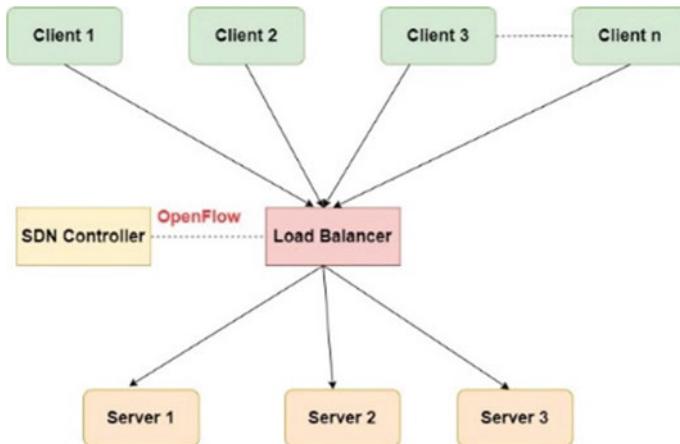


Fig. 1 SDN-based load balancing

2 Literature Review

In this section, we have described the literature survey of the proposed solutions by the various authors in SDN based on load balancing from the year 2009-2019. The main idea behind choosing load balancing is to keep the network balance the load in SDN [4]. The proposed action must be taken into consideration which should be adaptive to the traffic of the network. The primary aim of this proposed action is to optimize the path load and choose the least loaded path for the upcoming flow of data [5]. Kaur et al. [3, 5] implemented the Mininet emulator and compared this emulator with the testbeds which include GENI, VINI, and Emulab. It is accessible to run the real and candid code that is EstiNet, ns 3. In 2016, authors displayed a statistical flow-based method for our load balancer, which runs on the top layer of the POX controller and is written in Python. Contrast this innovative approach with the round-robin load balancer. We worked on the custom hardware consisting of using the Mininet emulator. We have made a system definition into the OpenFlow-based turn. Kaur et al. (2017) framed the load balancing algorithm based on the least time-based weighted round-robin load balancer and fortunately applied using the POX controller. Testing is being done on the tool known as the Mininet emulation tool. Therefore, authors have compared and made a contrast of least time-weighted round robin with previously implemented round-robin algorithm. Joshi et al. [2] facilitated and explored the performance of the network load balancer of SDN and made a comparison of various algorithms of load balancing to evaluate the highest performance over the controller of SDN. For performing this task, the POX controller is taken into consideration.

3 Load Balancing Algorithms Based on SDN

The networks have to handle huge volumes of traffic in today's Internet world, i.e., the request coming from the client. A single server cannot handle the enormous volume of traffic. When a request is submitted depending on the load strategy, the request will be forwarded to a server that is least loaded [7]. Load balancing aims to achieve maximum network efficiency by increasing both the performance and the output of each node. To achieve this, few algorithms have been designed which are programmable and do not require any hardware [5–7].

3.1 Round-Robin (RR) Algorithm

It is one of the simplest load balancing algorithms in SDN. To forward the request of the client, we use the circular register and the pointer that points to the last server selected [4]. Let us say if J_i is to be the last server selected, then the new request that is arriving is J_{i+1} . This algorithm forwards the request among the nodes in the order as requests are received.

Algorithm 1

- a. Round-robin server load balancer maintains server index and state of the server if available or busy. Initially, all servers are allocated to zero.
- b. The client request is received by the controller.
- c. Now the controller reserves the arrival and burst time of the request of the user.
- d. The requests arriving are dedicated to the servers are based on the state of the server that is known from the queue.
- e. The quantum of time set for the request of the user's execution are to be dedicated by the balancer.
- f. The turnaround time of each process is calculated by the load balancer.
- g. The average waiting and response time will be calculated for the user's request.
- h. After the execution of the user's request, the servers are required to be deallocated by the load balancer.
- i. Lastly, the controller will check for the pending new requests there in the queue.
- j. Continue from step b.

3.2 Weighted Round-Robin (WRR) Algorithm

It is another algorithm for load balancing. WRR makes the use of advantages of RR to remove the starvation. It focuses on an effective criterion to distribute the workload among the various servers in the round-robin fashion but based on the weights assigned [10]. The weights that are assigned to the server are authorized by the network model. The “weight” here defines the number of requests sent to that particular server.

Algorithm 2

- a. The controller firstly checks for the greater processing capability means which can handle the highest load.
- b. Depending on the processing capability, weights will be assigned to every server.
- c. The higher processing capability will be assigned with more weights.
- d. According to the request received, the request from the client will be forwarded.

4 Mininet Emulator

Mininet is an emulator of the network orchestration system. It can run a wide collection of hosts, switches, routers, and links. It utilizes the virtualization of lightweight to create a unique system that should behave like a complete network running the same kernel, system, and user code. Mininet is written in **Python** [3]. It facilitates the basic **Python API's** to create and test the large networks.

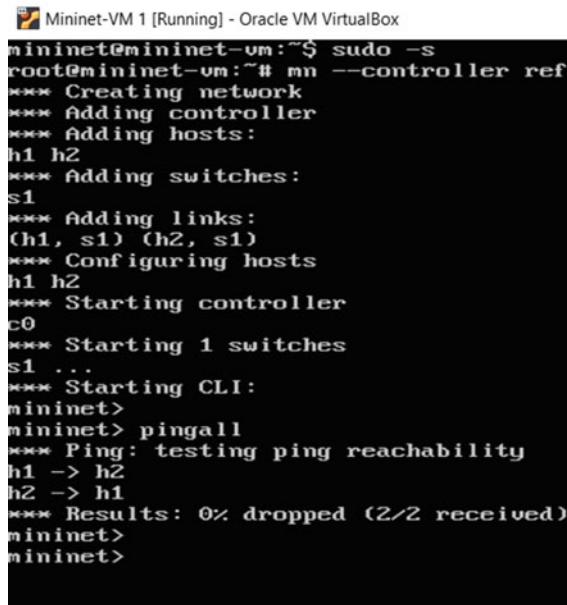
Emulator Scenario

Emulator version	2.2
Operating system	Linux 18.04 64-bit OS with 16 GB RAM
Controller	Ryu
Language	Python
VirtualBox oracle	Version 6.0.18

4.1 Creating SDN Applications Without Using a Controller

OpenFlow switches comprise of two types: physical and virtual switches. By default, Mininet creates the virtual switch in OpenFlow mode. We need an OpenFlow controller to manage and control the OpenFlow switch. Mininet supports various controllers including OpenFlow reference controller and OVS controller. Figure 2 can choose the OpenFlow controller simply by using the mn command. By default, Fig. 3 Mininet runs Open vSwitch in OpenFlow mode, which needs an OpenFlow controller. Mininet comes with built-in controller() classes to support various other controllers which includes the OpenFlow reference controller. Pingall() command tells from the virtual namespace of h1 the virtual protocol stack researcher is going to execute the ping command to host h2 [7].

Commands	Description
Default controller	Figure 4 creates the Mininet network from the command line. It can create the parameterized topologies, invokes the Mininet CLI, and run the tests
Ovs-vsctl show	Figure 5 command is used to start the controller and attach it with the current OVS switch. Setting the controller in bridge mode, i.e., s1 using the OpenFlow version 1.3
mn-controller remote	Command creates a topology that have the controller which is there in the remote machine and that controller is connected to the switches
mn-controller none	Creating the topology without specifying any controller, hosts will not be able to ping with each other

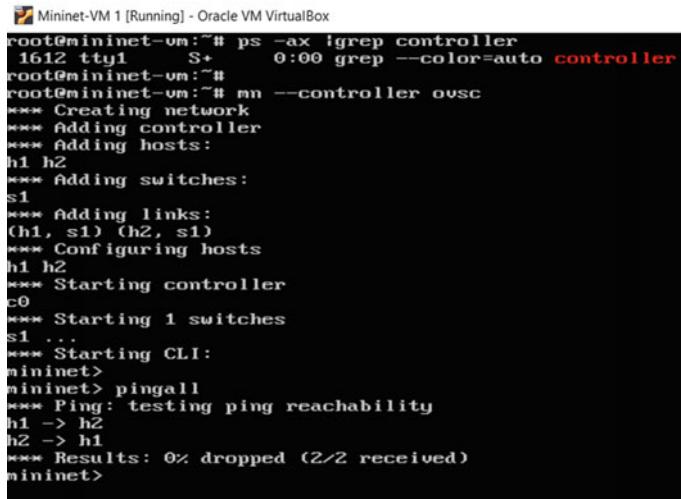


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Mininet-VM 1 [Running] - Oracle VM VirtualBox
mininet@mininet-vm:~$ sudo -s
root@mininet-vm:~# mn --controller ref
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1)
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 1 switches
s1 ...
*** Starting CLI:
mininet>
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2
h2 -> h1
*** Results: 0% dropped (2/2 received)
mininet>
mininet>

```

Fig. 2 OpenFlow reference controller



```

Mininet-VM 1 [Running] - Oracle VM VirtualBox
root@mininet-vm:~# ps -ax |grep controller
1612 ttys1    S+        0:00 grep --color=auto controller
root@mininet-vm:~# 
root@mininet-vm:~# mn --controller ovsc
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1)
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 1 switches
s1 ...
*** Starting CLI:
mininet>
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2
h2 -> h1
*** Results: 0% dropped (2/2 received)
mininet>

```

Fig. 3 Built-in controller

Fig. 4 Default controller

```
root@mininet-vm:~# mn
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1)
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 1 switches
s1 ...
*** Starting CLI:
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2
h2 -> h1
*** Results: 0% dropped (2/2 received)
mininet> _
```

Fig. 5 Open virtual switch

```
mininet> sh ovs-vsctl show
918037ec-b307-45d7-a75a-f1ac4337d135
    Bridge "s1"
        Controller "tcp:127.0.0.1:6653"
            is_connected: true
        Controller "ptcp:6654"
            fail_mode: secure
        Port "s1-eth2"
            Interface "s1-eth2"
        Port "s1"
            Interface "s1"
                type: internal
            Port "s1-eth1"
                Interface "s1-eth1"
        ovs_version: "2.0.2"
mininet> _
```

5 Conclusion

Software-defined networking is termed as an evolving and important technology for networking. It was adopted in many networks of the data centers. SDN can provide versatility in managing components of the infrastructure and smart usage of network resources (e.g., load balance). In this paper, we have created the SDN application without using any controller in Mininet. In future work, a weighted round-robin algorithm will be implemented in MATLAB to validate it against already existing algorithms in Mininet.

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Performance Analysis of Caching Strategies in Information-Centric Networking



Divya Gupta, Shalli Rani, and Syed Hassan Ahmed

Abstract Information-centric networking (ICN) is a paradigm shift to host-centric communication. It provides a promising solution for efficient content delivery between the subscribers and the publishers. In-network caching is of great importance as efficiency of ICN primarily depends on performance of caching strategy. Therefore, in recent years researchers proposed many caching strategies with the aim to improve ICN performance. However, due to lack of common evaluation scenario for comparison among these strategies, it is not clear which one has better performance than other. This paper compares Cache Everything Everywhere (CEE), Leave Copy Down (LCD), Random Copy One (RCO), ProbCache, Centrality-Based Caching (CBC), Greedy Caching (GrC) and Optimal Caching (OptC) in common evaluation scenario with same simulation environment. The paper also analyzes the performance of these strategies in terms of content retrieval delay (CRD) and cache hit ratio (CHR) to determine the one which best fits in every scenario.

Keywords In-network caching · Information-centric networking · Cache hit ratio · Content retrieval delay

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1 Introduction

The information-centric networking (ICN) has proven efficient content delivery due to its name-based communication model [1]. The center thought of ICN is to isolate contents from hosts and thus incorporates various features, for example, multicasting, content-level security, in-network caching, routing and forwarding by name and encryption support. Among all, caching in NDN is of great importance due to storage of requested contents by in-network routers [2]. Any node having content may serve future requests of clients, and requests need not travel all the way to original server. Caching helps in better utilization of network bandwidth and resources, reducing the load on servers and reducing content retrieval delay as well as less traffic in the network. However, redundant copies are stored by in-network routers which besides several merits brings some demerits in the form of cache overflow, cached content redundancy and security issue among others. Therefore, in-network caching has received a lot of attention from research community and several solutions have been proposed in past toward efficient content caching for improved network performance such as Cache Everything Everywhere (CEE), i.e., default caching strategy for NDN [3], Leave Copy Down (LCD) [3], Random Copy One (RCO) [4], ProbCache [5], Centrality-Based Caching (CBC) [6], Greedy Caching (GrC) [7], Optimal Caching (OptC) [8] and many more.

These caching strategies, however, are typically tested using various simulation settings with a variety of parameters such as different topologies, content popularities, cache sizes and workloads. Moreover, these suggested caching techniques have never been compared with one another, making it nearly impossible to conclude anything from these works. Therefore, it is really difficult to answer general question based on caching strategies in ICN such as “which one is better than other with same framework” or “which is really contributing to enhance overall network performance.”

To answer these questions, this paper compares the foremost relevant caching strategies in common analysis scenario. These strategies have been implemented in same simulation environment, and their performance has been analyzed for common metrics.

The rest of the paper is presented as follows. In-network caching is described in Sect. 2 with emphasize on various challenges and strategies for its implementation in ICN. In Sect. 3, various evaluation parameters used in this paper are discussed. Section 4 presents the simulation environment and common evaluation scenario for comparison of caching strategies. The result analysis of the performance with respect to common metrics is given in Sect. 5 followed by concluded observations and future work in Sect. 6.

2 Caching in ICN

Caching the content within the network at intermediate nodes is the most popular and a leading feature of ICN [9]. This feature allows all network nodes to cache data contents in route through original servers (refer Fig. 1). Any node having content may serve future requests of clients, and requests need not travel all the way back to original respondent. There are numerous benefits associated with caching the content within the network such as better utilization of bandwidth of network by providing requested content near the consumer, simple and efficient content retrieval process, reduced content retrieval latency and bandwidth cost, and path reduction. However, the problems such as content redundancy, high retrieval latency, long path stretch, low content diversity, complex network topology and so on further encompass several challenges to ICN caching and, therefore, affect the whole network performance. Various challenges faced by ICN in-network caching are listed in this section. This section also describes the only caching strategies proposed in the literature to better handle listed challenges which are compared in this paper.

2.1 Challenges in ICN Caching

- (i) Content caching in ICN is a big challenge, i.e., to decide whether content is to be cached on all routers or not. The ICN demands availability of cache on all

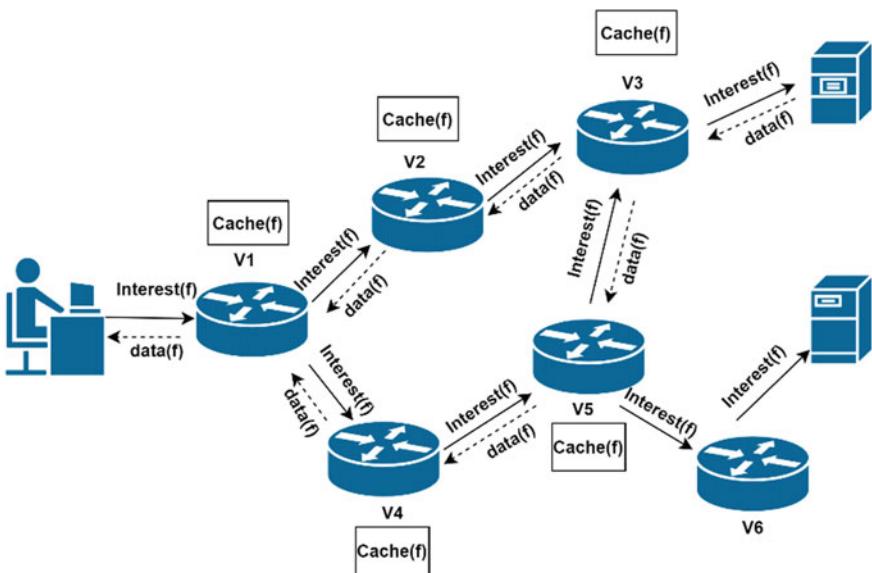


Fig. 1 Caching in ICN

- routers, but some researchers argue cache to be enabled only on edge routers [10].
- (ii) To improve performance of the network, the issue is to decide what, where and how much to cache. “What to cache” refers to decision of caching something from huge stream of data, “Where to cache” refers to placement of content at specific network nodes, and finally “How much to cache” refers to cache size of the node.
 - (iii) Different traffic types in content store compete for same caching space due to limited CS capacity and thus become critical for network to manage space [10].
 - (iv) To cache incoming request in case of content store has reached its limit is another challenge in ICN. The main challenge lies in deciding which and when content to be replaced.

2.2 *Caching Strategies*

For efficient content caching in network, cache decision policies are used to determine whether content will be cached at intermediate nodes or edge nodes or somewhere else. The implementation of different caching strategies is followed by several caching algorithms. The caching algorithms must be intelligent enough to answer the following two questions: Where to cache the content, and which content will be replaced first in case of cache full. Researchers in the past have developed various strategies in order to improve performance of network based on different parameters. We describe the ICN caching strategies proposed in the literature which we will compare under common simulation environment.

CEE The Cache All also refers to CEE [3] is in-built cache insertion policies in design of ICN. In CEE, each intermediate router caches the content and thus satisfies any request coming in its way locally without forwarding it to upstream routers. Although caching the content at each node improves bandwidth utilization and cache hit ratio, yet it results in high content redundancy in whole network.

LCD This caching scheme [3] improves redundancy by storing the content merely at node which is just one level below the node where cache hit occurs. To cache content at edge node, unlike CEE, LCD requires multiple requests where each request will cache the content at one node near the consumer. Caching only at single node in the path increases cache hit ratio as well as manages cache space.

RCO It randomly selects a single node along the content delivery path to cache the content. RCO supports delivery of content with reduced hop counts and server hits [4]. The LRU policy is used to evict contents during cache full. However, due to random selection of any node for content caching, it lacks from better cache space utilization and hence affects overall performance of network.

ProbCache In probabilistic caching, each node individually takes caching decision as whether to store content or not based on some probability. For ProbCache [5],

Time Inception Field (TSI) and Time since Birth (TSB) field are required for interest packet and data packet, respectively [5]. At each router, these values are used to calculate probability of content caching.

CBC In this caching strategy [6], contents are cached only at single node with the highest betweenness centrality along the delivery path. For more than one node with highest centrality value, content is cached at node which is in close proximity to the consumer. However, due to use of LRU, most popular contents got evicted and requests are forwarded to servers. This in turn leads to maximize network bandwidth usage with reduced cache hit ratio.

GrC To increase cache hit ratio by efficient caching among all nodes, greedy caching [7] determines the set of contents to be cached at each network node. It stores the most frequent content at the network edge, recalculates the relative frequency of each bit of content dependent on the request miss stream from downstream caches and afterward decides the content to be cached in core of the network.

OptC The optimal caching strategy [8] caches most optimized contents as close as to edge routers based on content popularity and content distance from original server to reduce content retrieval latency. The probability of each incoming packet is calculated using cache gain probability (CGP) formula and compared with CGP of existing cached contents to make caching decisions.

3 Evaluation Parameters

In the existing literature, there is a wide variety of parameters that are significant to evaluate the performance of different caching strategies for ICN. This paper compares the performance of caching strategies based on following parameters:

Cache Hit Ratio (CHR) While analyzing an individual cache for a specific content request, if corresponding data is available in router's own cache then it is reported as "hit" otherwise "miss" [8]. For cache miss, the content gets retrieved from server itself. CHR refers to the segment of requests satisfied by caches deployed inside the network. It basically estimates the efficiency of routers and can be calculated using formula given in Eq. 1.

$$\text{Cache Hit Ratio (CHR)} = \frac{\text{Cache}_{\text{hits}}}{\text{Cache}_{\text{hits}} + \text{cache}_{\text{misses}}} \quad (1)$$

Content Retrieval Delay (CRD) It measures the delay incorporated to satisfy a content request and is computed in milliseconds [7]. More specifically, it refers to the units of time a user waits to get response after sending a content request. It might get affected due to individual factors such as high network congestion and low content diversity. By assuming both congestion and diversity roughly to be same,

CRD could be used as a stand-alone metric to estimate the performance of caching strategy and is computed using formula given in Eq. 2.

$$\begin{aligned} \text{Content Retrieval Delay (CRD)} &= \text{interest travel delay} \\ &\quad + \text{data travel delay} \end{aligned} \quad (2)$$

4 Simulation Environment

In order to evaluate performance comparison of various ICN caching strategies under the roof of same simulation environment as well as common evaluation parameters, this paper implements existing state-of-the-art caching strategies such as CEE, LCD, RAC, ProbCache, CBC, GrC and OptC. For routing of content request from subscriber to publisher, Dijkstra's shortest weight path routing algorithm is assumed, where link delay on the network corresponds to path weights. To compare the effectiveness of various caching strategies in same environment, simulations are performed on Icarus [11], a discrete event-driven simulator written in Python. In network, every individual request is considered as an event. Therefore, a corresponding time stamp is stored, whenever an event occurs. The result collection block is responsible for collecting the results obtained during simulations. To demonstrate effectiveness in common evaluation scenario, the extensive experiments were performed on real-world network topology GEANT. This topology is an academic network spread around the world consisting of 40 nodes and 60 edges. The results of experiments were recorded after performing 4 runs of simulations, and graphs are plotted with 95% confidence interval.

Before evaluation in simulation scenario, initially all caches are warmed up with 100,000 content requests and subsequent 100,000 requests were used for evaluating the caching performance (refer Table 1). The content popularity follows Zipfian distribution with skewness parameter α . Before simulations, contents are uniformly distributed across all servers and randomly distributed across all clients. Node with degree 1 is treated as client. The results of experiments are generated with content universe $F = 10000$, variation in cache size from 10 to 1000 and α with value of 0.8.

Table 1 Simulation setup

Number of cache warm-up requests	100,000
Number of measured requests	100,000
Popularity model α	0.8
Network topology	GEANT
Cache size	10,100,1000
Request rate	1 req/s

For evaluation, ICN's default LRU strategy is assumed. The parameters presented in Sect. 3 are used to evaluate the effectiveness of caching strategies.

5 Results and Discussion

This section compares the performance of caching strategies described in Sect. 2 under common evaluation scenario for predefined parameters such as cache hit ratio and content retrieval delay. These strategies were preferred for comparison based on their relevance and consistent performance.

5.1 Discussion on Cache Hit Ratio (CHR)

CHR is an important parameter to evaluate performance of caching in ICN. It is used as a measure for cache utilization and traffic offloading. The CHR of any caching strategy is calculated using formula given in Eq. 1. Figure 2 presents the CHR of different caching strategies under said common evaluation scenario. In this experiment, CHR of different caching strategies is compared against cache size of 10, 100 and 1000 elements. In terms of CHR, LCD and Opt-Cache show better results for small cache size as compared to other. However, Greedy overcame LCD with small increase in cache size. The reason behind consistent high performance of Opt-Cache is due to routers caching decision; i.e., router will cache content only if an optimal solution is found for transfer between source and consumer.

Both CEE and ProbCache represent almost the same level of performance with moderate cache size. However, ProbCache shows improved results than CEE due to caching decisions dependent on probability of content and is chosen as a better candidate.

Fig. 2 Hit ratio of various strategies for different cache sizes

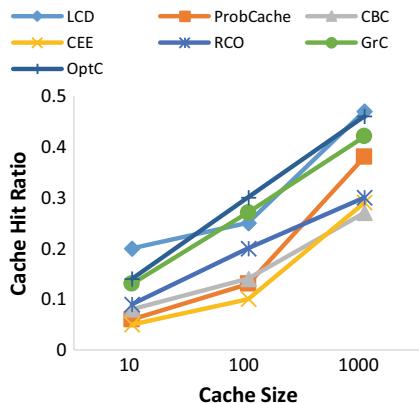
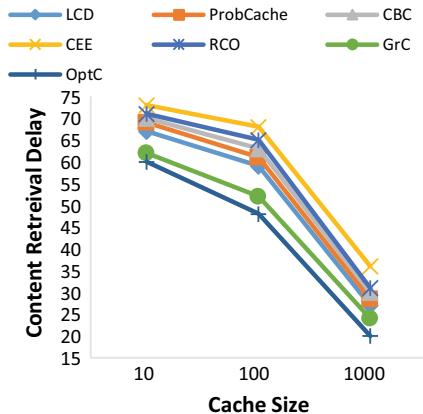


Fig. 3 Delay of various strategies for different cache sizes



5.2 Discussion on Content Retrieval Delay (CRD)

In addition to CHR, CRD is also used as a measure to compute caching efficiency. The CRD of any caching strategy is calculated using formula given in Eq. 2. Figure 3 shows the results for CRD for different caching strategies under common evaluation scenarios. The results revealed best performance of Opt-Cache followed by GrC. The main reason behind improved performance of Opt-Cache in comparison with other strategies is better cache utilization in core of the network.

6 Conclusion and Future Work

In this paper, various caching strategies based on their relevance and performance in ICN environment are compared. Importance of caching in ICN with various implementation challenges is presented. Subsequently, a common analysis scenario is shown to analyze different caching strategies under identical simulation environment. Further, this paper has implemented CEE, LCD, RAC, ProbCache, CBC, GrC and OptC for various performance parameters. At last, results are discussed and represented on case-by-case basis with respect to performance of these strategies to estimate which performs better. For instance, OptC outperforms other caching strategies due to its efficient cache utilization but is expensive to be implemented in real network due to its high computational overhead. However, OptC could be used as a boundary strategy for future implementations as well as for comparisons in the same domain. Even though GrC and LCD are fine aspirants as caching strategies, choosing the ideal strategy depends on the network's objectives. As the implementation of efficient caching strategy is an important research perspective, the further work will contribute to the future deployment of ICN caching.

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IoT Architectures and Its Security: A Review



Latika Kakkar, Deepali Gupta, Sapna Saxena, and Sarvesh Tanwar

Abstract The Internet of Things (IoT) is a technological advancement that interconnects things anywhere that can communicate among themselves for developing different valuable applications. IoT typically has a three layered architecture that comprises of perception layer, network layer, and application layer. However, this complex architecture makes the IoT environment vulnerable to potential security threats. Also due to lack of battery power, storage, and computation capacity, IoT nodes become vulnerable to security attacks. Hence, each layer requires security protocols to accomplish a secured IoT environment. This paper presents an overview of IoT, its various architectures, security conventions, technological, and security challenges in IoT architectures. It also reviews, discusses, and analyzes the current scenarios and concerns of IoT security.

Keywords IOT · IOT architectures · Security · Privacy challenges · SOA · Attacks

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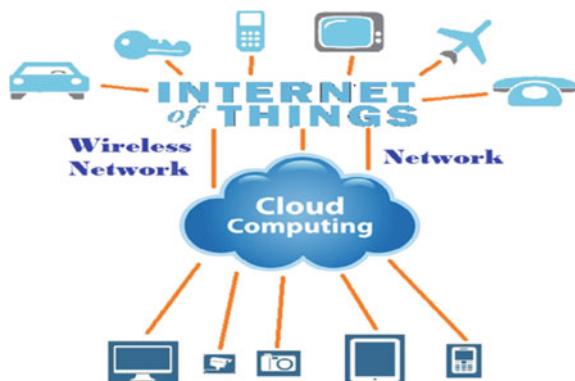
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1 Introduction

IoT is a promising network model that offers interactions among omnipresent things like humans, computers, gadgets, vehicles through heterogeneous networks. IoT is an interconnection of various objects or things for instance vehicles, buildings, devices, and many more things which are entrenched with electronics, software, sensors, and network connectivity. These characteristic features provide the facility to collect the data from these devices (things) and interchange the data [1]. Various fields in which IoT plays a leading role in the future are domotics, healthcare, facilitating living environment, transportation, and intensified learning [2]. Usually, the functionality of IoT system includes sensing the things and also to perform measurements and calculations, so that some specific actions can be taken in that particular areas for its improvement. For example, in healthcare-related systems, the health of the patients in form of heartbeats, temperature, blood pressure, etc., can be monitored with some healthcare devices. This helps in treating the patient in case of any emergency as doctors can understand patient's conditions immediately and can give immediate treatments [3]. The other advantages of IoT are for the business users which are accountable in some fields such as ingenious portability of goods and people, logistics, automation manufacturing, Industrial manufacturing, and business management [4]. To connect various things in the IoT infrastructure, a layered architecture is the required that should be ductile in nature. Depending upon the types of architecture being utilized, numerous diverse IoT models have been evolved. The most basic model comprises of three-layer architecture having three layers: perception, network, and application layer [5–7]. IoT works on different types of architectures which have been proposed by different researchers that are discussed in detail in the later sections. All the layers of IoT architecture have concerns related to privacy and security and is prone to various security attacks [8, 9]. To cater to this issue, a secure system should be implemented in IoT environment.

Fig. 1 Internet of Things [4]



2 Related Works

The authors in [1] discussed diverse perceptions of this IoT paradigm, technologies used to implement Internet of Things. Feasibility of IoT on the factors of scalability and efficiency were analyzed. The authors in [2] proposed a framework for IoT that minimized the overall surveillance video distortion. In [3, 5], IoT was discussed and the work that has been done to enhance the security of IoT data. The authors in [4, 6] worked on security challenges involved in the amalgamation of IoT and cloud. Vision, features, and architecture challenges of IoT were discussed in detail [7–10]. The author [11] reviewed and analyzed that the travel-time can be anticipated through a number of another equivalent method using different input data that helped to reduce transport operation cost and diminish the impacts. [12–14]. IoT contributes in agriculture by tracing the food using radio frequency identification technique, to monitor the plants, soil supervision, and managing the temperature [15, 16]. Authors in [17] defined analysis on security of IoT and the architecture utilized in IoT. IoT, its features and different types of architectures proposed by various researchers were defined [18, 19]. IoT architecture and key challenges being faced in IoT were elaborated in [20]. Significance and detailed analysis of middle-ware architecture in contrast to its techniques, approaches, and challenges to meet the requirement of IoT was elaborated [21, 22]. SOA is service-oriented architecture which is designed to join various services, known as functional units of an application through interfaces ad protocols [23–26]. Key issues in security and privacy in IoT applications and security in relation with IoT architecture were defined. As all layers of IoT architecture are defenseless to security threats, thus this leads to the development of a mechanism that has privacy-preserving technique to ensure that there is no exposure to the private data to the adversary in the IoT environment. Due to lack battery power, storage, and computation capacity, IoT nodes are vulnerable to different kinds of security threats and attacks [27, 28]. Malicious code injection attack, denial-of-service attack [29], replay attack [31–33], and malicious virus [34] can temper the security of IoT as attacker gets access into IoT system. An effective code authentication scheme should be integrated into IoT to survive from this type of attack [29, 30].

3 Internet of Things

A peculiar technology that has grown its wings in last few years is Internet of Things. IoT is a technology which uses some communication protocols to connect various things or objects in the form of world-wide network [1]. The key feature of IoT is to collect the useful data from the environment and interpret it to use the information for improving the quality of life [7]. The reason why this technology came into existence is the requirement for innovation and that the things are made enough capable that they have the ability to measure, interpret, distinguish, and mutate the environment.

IoT has various applications in fields such as smart home, smart healthcare, smart city, smart video surveillance [9], agriculture, and environment. Smart home is the solution which can help in saving the household expenses on the daily basis and adapt to our needs thus making life more comfortable [1, 7]. Many areas like transportation, public safety, tourism and urban consumption are improved as a result of smart cities [6]. IoT contributes in agriculture by tracing the food using radio frequency identification technique, to monitor the plants, soil supervision, and managing the temperature [15, 16]. A generalized scenario of IoT environment as well as its applications has been depicted in Fig. 1.

4 Architecture of IoT

4.1 Three-layer Architecture

The commonly used architecture is three-layer architecture which comprises of perception layer, network layer, and application layer. **Perception Layer** It is the physical layer which senses and gathers the information from the environment by utilizing sensors. The smart object and physical parameters are sensed by this layer for further processing [17, 18]. The perception layer comprises of RFID tags, cameras, two-dimensional bar code labels, global positioning system, and sensor network. The focus of this layer is to fetch the sensing objects properties including temperature, noise, leakage, location, etc., by using the sensors. This layer is also known as sensor layer [17]. This gathered information is further converted to digital signals for transmission into the network layer [19].

Network Layer A network layer is the brain of IoT which act a center for Internet network, smart processing, and network management center. The information sensed from the objects in perception layer is transmitted and processed in this layer. It connects various smart objects, servers, and other devices in the network [18, 19].

Application Layer This is top layer of IoT architecture, also known as business layer [4]. This layer is amalgamation of social division of IoT and requirement of industry for comprehension of widespread intellectualization. This is responsibility of application layer to provide application specific services to the people. The authentication, confidentiality, and data integrity are confirmed in this layer [17].

4.2 Middleware Architecture

IoT consists of various computing heterogeneous devices that have varied standards because of wide-ranging requirements of different applications. This heterogeneity

of devices leads compatibility among devices. To cater with this issue, a middleware platform should be incorporated between things or objects and the applications. Middleware will hide the details of the intelligent objects and provides only necessary information to the applications developers [21]. It saves the time the developers utilizes on interacting with the hardware and provides only the necessary requirements. Middleware act as an application programming interface (API) for computation, communication, interactions, integrity, and security of data [18, 22]. Middleware addresses challenges related to scalability, security, privacy device detection, and big data.

4.3 SOA-Based Architecture

SOA is an architecture which is designed to join various services, known as functional units of an application through interfaces ad protocols [8]. An advanced layer known as service layer (SL) or interface layer that will consist of data services from existing network layer, and application layer can be effortlessly integrated into the existing three-tier architecture [9, 10].

Sensing Layer The hardware objects used in IoT have been provided with sensors to sense the environment. In this layer, the sensors have embedded smart systems which can automatically sense and analyze the environment and can also transmit this data among devices or to servers. Sensors should have high energy efficiency so that it is all time active to gather real data [11]. The SL comprises of four sub-services: Service Discovery, Service Composition, Service Management and Service Interfaces [25].

Network Layer The network layer in IoT is an infrastructure that makes the things connected to each other using either wireless or wired connections. By utilizing the network layer, data can be shared among various connected things that plays vital role in managing and processing IoT data. The network layer transmits the processed data to decision-making divisions for analysing various multifarious services [11].

Service Layer The middleware technology that enables IoT services and its applications is the base for service layer. Using middleware technology a cost-effective platform is provided. Service layer performs the functionality of storing of information, data management, communication, exchange of information.

Interfaces Layer Different devices are utilized in an IoT application which is provided by different vendors. As these devices have different vendors, so these may not have same standards and thus compatibility issues arise when these devices interact with each other. The interface layer is capable of solving the compatibility issue like exchange of data, communication, and processing of data. Various interaction methods are defined under interface layer [11].

4.4 Five-Layer Architecture

In this architecture, IoT is divided into five layers [18, 19]: The perception layer uses sensors to gain and fetch the object's physical properties like speed, location, humidity, temperature, etc. Sensors can be RFID, global positioning system, infrared sensors, and 2D barcode sensors. The transport Layer receives the data from the sensors in the perception layer and transmits it to the processing center. It is also called network layer as it uses WLAN, enterprise LAN, Bluetooth, 3G to transmitting of data. The processing layer is also named as middleware layer that is used for storing, analyzing and processing the enormous data transferred from transport layer. Application layer: The processed data in the processing layer is used in application layer for developing various applications of IoT. These applications can be related to safety, intelligent home, intelligent city, intelligent logistics, etc. Business layer act as a manager of IoT that manages the whole IoT system. The management at business level includes business models, applications, user's authentication and data security, etc.

5 Security and Privacy Issues in IoT

Perception layer: This layer assembles the data from the sensors, so that the security threats here focus on falsify accumulating data and annihilate the IoT devices. The security of this layer can be disturbed in three ways: (i) by disturbing the waves and transmitting path of wireless technology used between sensor nodes. (ii) Hardware and various components of sensor nodes active in external environment can be tampered by the attacker physically. (iii) Due to lack of battery power, storage, and computation capacity, IoT nodes are vulnerable to different kinds of security threats and attacks [27]. Perception layer is prone to various types of attacks like malicious code injection attacks [28, 29] replay attacks [30], and Eaves dropping attack [18]. Secure encryption algorithms are required to resist this attack [25]. Network Layer: This layer has the risks on the availability of network resources. Network layer is prone to various types of security attacks including Denial-of-service (DoS) attack, spoofing attack [31, 32]. Application Layer: The essential services necessary for the users are supplied by application layer. There are various possible challenges in this layer including phishing attack, malicious virus, malicious scripts, etc. [32]. These viruses can be avoided utilizing defensive measures like trustworthy firewall, worm detector software to fight against malevolent virus/worm attacks in IoT [33].

6 Conclusion

This paper was focused on IoT, its applications, and various architectures with various challenges that addressed by these architectures. The IoT framework is prone to various attacks at each layer; as a result, there are numerous security disputes and related necessities that need to be focused upon. As all layers of IoT architecture are defenseless to security threats, thus this leads to the development of a mechanism that has privacy-preserving technique to ensure that there is no exposure to the private data to the adversary in the IoT environment. The future work in IoT framework comprises of ensuring that the security issues allied with it are deeply focused and resolved.

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Finger Tracking in Real-Time Human–Computer Interaction



Anila Dhingra Shefali

Abstract Finger tracking is a technique which uses the bare hand to operate and to make interaction between human and computer much easier and faster. Finger tips were used extraction of information hand positioning and featuring. In this technique, we use the direction and position of fingers so that we get the desired segmented region of interest. Finger pointing system purpose is to replace pointing and clicking device like the mouse, screen with bare hand. This system has ability to track the movement of finger without 3D model building of the hand. In a live video fed, coordinates and movement of finger can be taken so that it may become mouse pointer's coordinates and movement for interaction purpose of human–computer. Observation of performance of tracking is being done in promising condition, which includes firm gesture and obstruction from various alike objects. The purposed procedure has an effective computationally building, and it is appropriate for real-time application on the system with least complex computers.

Keywords Real-time tracing · Human–computer interaction · Hand/finger tracking

1 Introduction

Gesture-based user interfaces, important part, are represented by hand and finger tracking technique. Due to progress of computers in nearly all the region or areas of the modern life style conducts for the need of more natural interfaces than traditional interfaces which depends upon the input devices like mouse, keyboard, touchpad or touch screen [1]. As human being uses gesture to create communication among themselves similar to this for creating communication between human and computer, we required a natural method which is represented by gesture-based interfaces.

In the pitch of computer visualization, a considerable amount of work in signal acknowledgment is established.

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Three main components which compose a vision-based signal acknowledgment system are image preprocessing, tracing the important body elements and gesture acknowledgment. In the vision-based research, the problems are still challenging, although lots of researches have done in the field of finger and hand tracking [2]. For the application of finger and hand tracking algorithms for gesture acknowledgement and HCL, there is a need for tracing robustness and real-time uninterrupted which is very vital.

To acquire the desired results, there are various available algorithms which depend upon special and expensive devices. Poured multilayer structure with computationally efficient building is being used to design the proposed tracking algorithm. In the respective paper, we represent the limb tracing algorithms which are working in real time, and it is appropriate for the use in different image-based human-computer borders extending from pointing type boundaries using fingers as mouse. The system can easily track the coordination of index finger without using any special markers or gloves and without building the 3D model of hand in real time.

2 Proposed System

The proposed system was developed to track the index of finger to provide the obtained movement for different gesture recognition, or mouse-like pointing boundaries. Algorithm of tracking depends upon the multiple characteristics and features of finger-like foreground object, color, shape and proportionality [3, 4]. The prescribed following calculation was tried on eight video game plans taken in various conditions. The test plans were created both under common and fake lighting, including straightforward and complex foundation, hand development at different rates, development speed variety, halfway hindrance with different items hand present changes, superposing with other yield object, incorporating hands with broadened manage finger (Fig. 1).

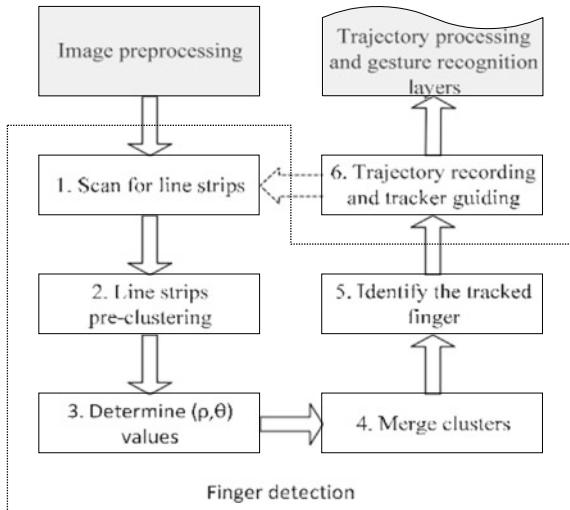
Multilayer approach is being used by proposed finger tracking algorithm. The lower layer is being used for finger detection, meanwhile topmost layer records the movement and guides the tracking process. At the topmost coating, obtained data is being passed to movement handling and signal acknowledgment layers, and it is used for managing trailer.

Spilled planning allows an well-organized application, where each layer reduces amount of statistics that transfer for the next layer for further process. Through a combination of filters, correct target identification is achieved which is practical in both gathering prejudiced ordinary, and mean filter and semantic domains [5].

The low-level features are being extracted by the image preprocessing through the background subtraction and skin color segmentation.

- **Background subtraction** is the principal period of following framework which include isolating potential hand pixels from non-hand pixels. Since overhead a non-moving workstation cameras are mounted, a simple background subtraction

Fig. 1 Layers of tracing procedure



arrangement is used so that to segment any potential foreground hand information from non-changing background hand.

- For **Skin Segmentation** threshold-based method is used. It is useful in mutually RGB and HSV color spaces.

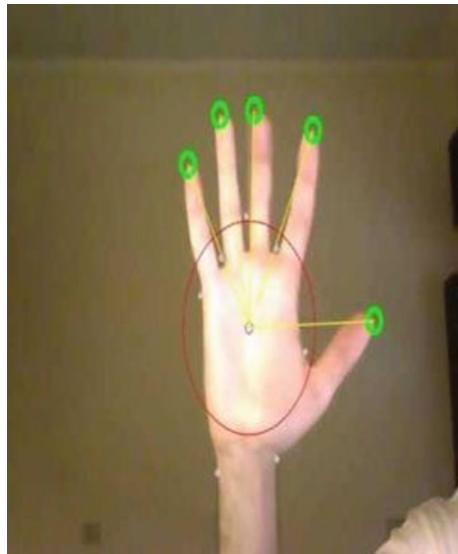
2.1 Hand recognition

Further preparing the preprocessing steps—enduring information is additionally separated by five handling films for acknowledgment of finger [6, 7]. At the bottom coating, exploration area is being got designated using data from trailer controlling layer which gets scanned further horizontally and vertically for strips line. For the strip line, only length and average coordinates need to be maintained so that very compact representation of data is done. Representation of data is done (Figs. 2 and 3).

2.2 Path Soundtrack and Trailer Guiding

The top film of tracing procedure is usage the documents which is providing the lower layer so that we can perform 2 different tasks

- I. Finger line recording in order to provide the necessary data to gesture recognition layer.
- II. Tracker movement in order to guide the movement of the hand and maintained finger-gesture.

Fig. 2 Hand/finger tracking**Fig. 3** Finger line strip

3 Practical Implementation

HCL is a technique in which we basically study the designing and uses of computer system. This technology is basically based on the interfaces between human bare and computer. In the field of HCL, it been observed that how human interact with computer and create invention in a way that how human interact with computer in innovative ways. Human being can interact with computer in many ways; the interaction between humans and computers is essential to assist this interaction [8].

The recommended tracing procedure was verified on eight video arrangements taken in various situations. The test arrangements were created both under ordinary and manufactured lighting, including humble and composite foundation hand development at different velocities, development speed distinction, fragmentary impediment with different articles hand present varieties, superposing with other yield object, containing needles with broadened manage hand. The result of tracking was very good for all the eight test orders. Although result of tracking was accurate in the absence of disturbing factors, both for the fingertip location and finger bounds through no objective loss and no noticeable localization errors (Table 1).

Fingers peak is detected in the revealing mode appropriately. When rotation of hand is not around 45° above y-axis, then the vertical axis for image formed, and even it does not rotate around 45° x-axis, then horizontal degree image formed [9, 10]. When the rate of frame is 20 fps and high in tracking mode, then the result we get is very accurate. For recognition and tracing to get accurate result and to robust the condition of lighting must be set so light is forward in way that it will spread evenly on the working area, as side or above lighting may cause deceitful hand region revealing and tracking process will get effected (Figs. 4 and 5).

Table 1 Tracking results comparison

Test consequence	Proposed calculation	Cam shift	Algorithm [8]
Firm gesture	Yes	Provisionally	No
Alike objects around	Yes	No	Yes
Total occlusion recuperation (comparable)	Yes	Disarray conceivable	Disarray conceivable
Total occlusion recovery (different)	Restrictively	Provisionally	Restrictively
Across face	Restrictively	No	No

Fig. 4 Tracing at firm gesture speed

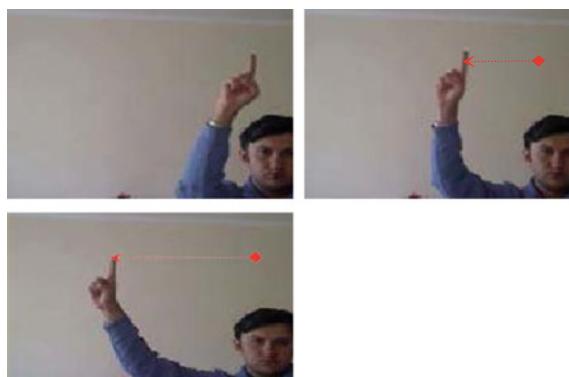
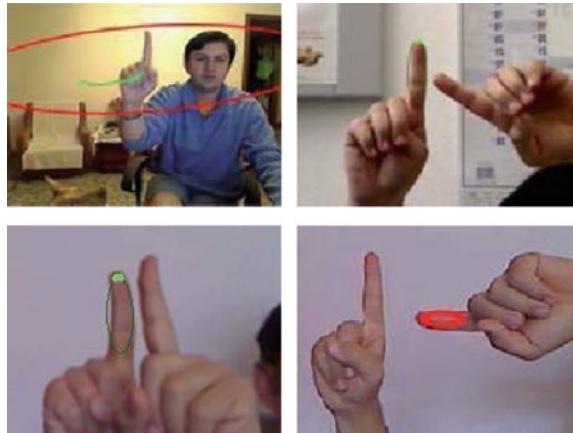


Fig. 5 Tracing finger in region of skin colored object



Following the finger or hand with another hand with an overextended finger\hand is in region of the objective is an exceptionally animating condition. The alarming object has same color and is a lead object, as is case with the face, but also has geometrical features.

4 Result and Discussion

Exact following outcomes were additionally cultivated when the point moved quick through the scene uncountable way. The same outcomes were acquired for firm vertical and the askew movement: double the appendage length inside less than 0.25. It was tested by various people, and result was very efficient. The respective conclusion is based on the experiments.

5 Conclusion

The proposed finger and hand revealing and tracing procedure is efficient and robust. It provides effective and desired result in all the challenging situations. In lower layer, following durability is accomplished by joining the numerous low-level element so as to produce a meager portrayal by utilizing line strips which is trailed by social event and stressing for making new component. The authorization of hand presence at the top layers with tracing guiding mechanism in order to improve the performance of tracking. Use of strip certifies computational effectiveness by dipping the amount of data.

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IOT-Based Electronic Ticket Device for Environmental Conservation Using GSM Module



Harsha Chauhan, Deepali Gupta, Sheifali Gupta, and Devashish Kumar

Abstract Public transportation services are the largest flourishing business as it is the cheapest and hence always been popular in the world. Everyday number of people travel in buses; they get their ticket on a piece of paper which is a printed slip that makes the use of carbon printing and leads to environmental issues, such as an increase in the greenhouse effect and deforestation. Therefore, these issues must be addressed immediately. For this, green technology should be used to reduce the effect of carbon footprinting which will consequently make the public transportation system more sustainable. In this paper, we are proposing an electronic ticket device using the GSM module to make public transportation services more efficient and eco-friendly. The proposed system is an embedded-based device that helps to diminish the use of paper and carbon footprint by sending the tickets to passengers on their mobile phones with the use of a GSM module. Although nowadays almost every individual is having mobile phones either smart or traditional keypad phones, thus it will help to save paper, as a result of which will usher to the conservation of the environment.

Keywords Ticket system · Environmental conservation · Transportation · Smart city · Internet of things · Cloud

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1 Introduction

Transportation services are the core of a city as it plays an essential role in every day's life, while most of the people prefer public transportation to reach their destinations [1]. In the past few years, there is a huge transformation in technologies and being utilized in the field of transportation services to make the public transportation system more efficient [2]. The advancement was done in various ways such as e-ticketing, m-ticketing, various smart cards system, despite all these existing systems, they are having their drawbacks due to which still the research is going on to make the transportation services more flexible and efficient [3]. However, to promote the usage of sustainable and green technology, that must not only meet public requirements but the public must also value the benefits of adopting sustainable and green technology in their daily routines [4]. To promote the green technology, A.S. Balaji et al. [5] proposed a smart bus ticket system using QR code in mobile application for Android end users. After the registration process, the passenger has to submit their bank details. They are using the QR code of Aadhaar card for the generation of bus tickets. Passenger has to fill the source and destination, and after the payment of ticket, the conductor will get the increment in the passenger count.

According to a survey, in a country like India, 14% of the population who are not using any mobile phone, 34% of the population who are using traditional keypad cell phones and 52% of the population who are using smartphones that are having different operating systems such as Android, iOS, blackberry [6], therefore the implementation of this system is not appropriate as it is only restricted to the Android end users. To overcome this issue and promoting sustainable development, we have proposed an electronic ticketing device for environmental conservation using the GSM module to make the transportation system tenable, eco-friendly, and hence, the proposed solution is focused on the conservation of the environment.

The proposed solution is easy to use as the conductor has to first initialize the machine by setting up the route of the bus and the time of dispatcher. After initialization, the device is ready for the ticket generation. The device will able to work for the passengers who are having any type of mobile phone and as well as for the passengers who are not having a mobile phone. The conductor has to fill the particulates such as source, destination, contact number and the number of passengers, after submitting all the required details, the conductor will select the ticket generation mode, and if the passenger does not have the mobile phone, then the conductor will select the paper mode else he will choose the SMS mode. After the ticket generation, the ticket will get provided to the passenger after the payment of the ticket. The generated ticket data will be stored on cloud with the use of cloud service that will provide a quality of service to the passenger as well as to the conductor also; all the booked ticket details will store in the cloud database, and as if any passenger denies that he/she did not get the ticket, SMS, then the conductor can verify it by checking the database entries.

The projected device is based on an embedded system consists of various modules such as liquid crystal display (LCD) module, microcontroller ESP32, GPS module,

keypad, battery, power supply. The LCD module is used to display all the required options for the generation of e-ticket. Microcontroller ESP32 module has Xtensa® dual-core 32-bit with LX6 microprocessors, due to which the processing of this microcontroller is fast. The speed range of microcontroller ESP32 is from 160 MHz up to 240 MHz, and thus, it provides a very good speed to the connected modules for computing. The keypad is an input peripheral device, which is used to provide input to the device. The device is having a chargeable battery of 5 V voltage and 3000 MAh current rate.

The focal point of the projected solution is towards the current environmental issues in the bus ticketing system. To overcome this, we are working towards embedded systems and cloud services. We have identified the existing research gaps and open research areas. The proposed solution is eco-friendly as it is minimizing the use of paper, and hence, it will help to conserve our environment.

2 Literature Review

The literature reviewed for this study was majorly focusing on eco-friendly ticket generation approaches for sustainable development in the field of transportation services to reduce the paper as well as carbon printing usage to conserve the environment.

Traditionally, the paper slips were given by the conductor in the form of ticket to reduce the manpower. M. Bhuvaneswari et al. proposed an embedded system-based automatic ticket vending machine for modern transport system based on radio frequency identification (RFID), the proposed ticketing machine consists of an LCD which shows the availability of buses, and the passenger will choose the bus and generate the ticket slip by scanning the smart card [7]. This solution only promotes the reduction of manpower to promote the green technology. Nwakanma Ifeanyi Cosmas et al. developed a Web-based online ticket reservation system that works under a centralized network, this platform provides a passenger to book or cancel the ticket using online transection, and there are two payment modes cash or online payment option. The passenger will get the ticket through mail [8].

Consumers are more dependent on their mobile applications for their commercial, social dealings and interaction [9]. The result derived from conducted survey which shows that airline, buses and travel agents are being the good service provider, and by expanding the mobile ticketing system to promote the mobile ticketing, Reddy, C. U et al. developed an Android-based mobile applications using QR code [3]. In this platform, the user will register themself, after registration, they will scan the QR code and fill the route details such as destination, bus route number and number of passengers, after submitting all these details, user will get a summary ticket, and after making the payment, the passenger will get a PDF ticket on E-mail.

Traditional ticketing systems are getting replaced with the emerging ticketing systems because of a lot of advantages and that satisfies the needs of the passengers. E-ticketing system begins in trend with the development of the Internet, and before

Table 1 Types of tickets

Type of ticket	Advantages	Disadvantages
1. Paper ticket	<ul style="list-style-type: none"> • Easy to generate • Cheaper in price 	<ul style="list-style-type: none"> • Not multifunctional • Risk of falsification • Not secure
2. Bus pass	<ul style="list-style-type: none"> • Simple and cheaper 	<ul style="list-style-type: none"> • Risk of falsification
3. Smart cards	<ul style="list-style-type: none"> • Multifunctional • More convenient • Give detail of the passengers • Easy to operate 	<ul style="list-style-type: none"> • High implementation cost • Less secure • Fake card can be generated
4. Mobile ticketing	<ul style="list-style-type: none"> • User-friendly platform • Easy to operate • Convenient in use 	<ul style="list-style-type: none"> • Limited to only smart phones

this technique, there was several ticket system which uses paper and smart cards. All these systems are having their advantage and disadvantage and classified in the following Table 1 [10].

3 Proposed Solution

In this proposed system, the conductor will fill the required particulates such as source, destination and the contact number of the passenger, after filling all the required fields, the system will generate an e-ticket, which will be sent to the passenger on their registered mobile number through SMS service, and the passenger has to pay the ticket fees to the conductor. The use of cloud service provides quality of service to the passenger as well as to the conductor also; all the booked ticket details will store in the cloud database, and as if any passenger denies that he/she did not get the ticket, SMS, then the conductor can verify it by checking the database entries.

4 Methodology

4.1 System Architecture of Proposed Solution

The proposed device is based on an embedded system consisting of various modules that are liquid crystal display (LCD) module, microcontroller ESP32, GPS module, cloud computing, keypad, battery, power supply as shown in Fig. 1. The LCD module is used to display all the required options for the generation of e-ticket. Microcontroller ESP32 module has Xtensa® dual-core 32-bit with LX6 microprocessors, due to which the processing of this microcontroller is fast. The speed range of microcontroller ESP32 is from 160 MHz up to 240 MHz, and thus, it provides a very good speed to the connected modules for computing. The keypad is an input peripheral device, which is used to provide input to the device. The device is having a chargeable battery of 5 V voltage and 3000 MAh current rate. The use of cloud service is to store the data of tickets that will provide quality of service to the passenger as well as to the conductor.

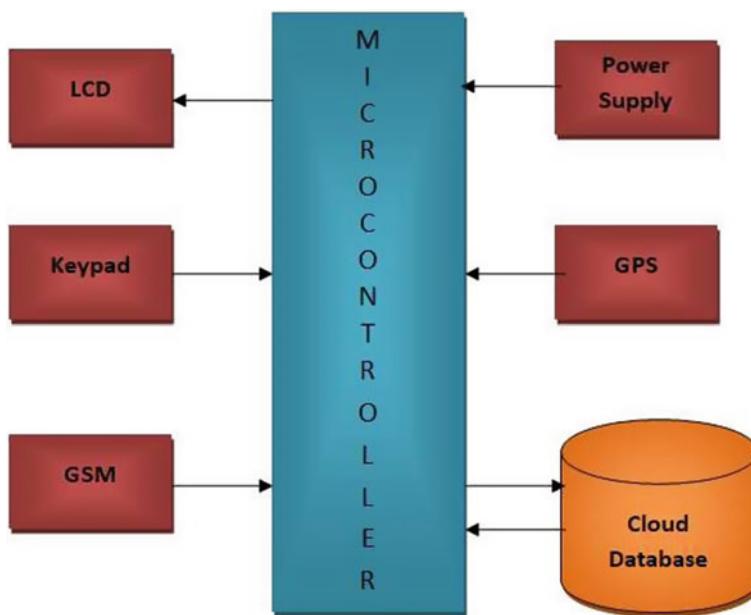
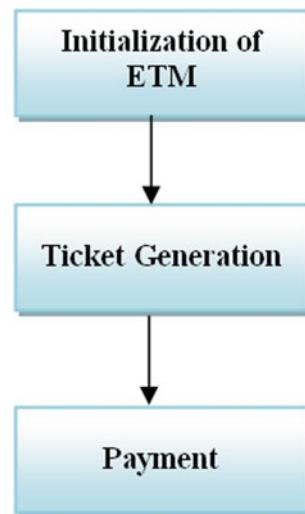


Fig. 1 Architecture of proposed solution

Fig. 2 Phases of ETM

4.2 Working of ETM

The aim of this proposed solution is to promote green technology and conserve the environment. In order to make the electronic ticketing more convenient and efficient, there are three working phases as shown in Fig. 2.

Initialization of ETM

Initialization of electronic ticketing machine is done by the conductor for one time only before starting the trip. First, the conductor has to switch on the device, and after that, the route selection will be done with the use of up and down keys. After the selection of route, the conductor will select the trip by selecting the source and destination of the trip as shown in Fig. 3.

Ticket Generation

After the initialization, the system is now ready for the ticket generation process, the conductor first has to select the source stoppage, and after that, he will enter the details of the passenger such as destination, contact number and the number of passengers as shown in Fig. 3.

The ETM machine worked on two modes that are as follows:

1. SMS Ticket
2. Paper Slip Ticket.

If the passenger is having any mobile phone, then the conductor will select SMS ticket mode and the passenger receives the ticket through SMS, else a paper slip will

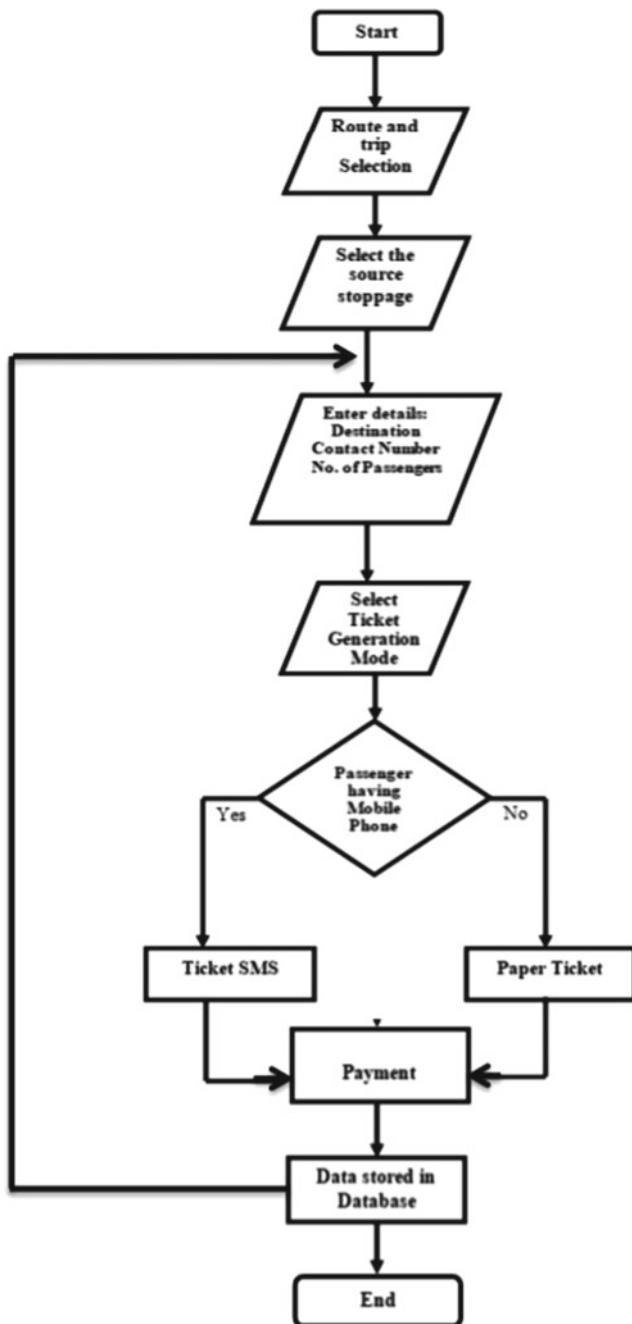


Fig. 3 Working flow chart of ETM device

be given as in the form of ticket. Payment can be done by cash to the conductor directly.

Database

After the ticket generation, the details of the passenger will get uploaded on cloud database as shown in Fig. 3. The active time of data is only for 24 h. If any passenger claims to the conductor after getting the ticket or not taking the ticket, he can directly check the transactions of database.

5 Conclusion

The entire proposed work concentrated on environmental conservation using green and sustainable technology. Due to the increase in the public transportation service, environmental issues are increasing day by day, such as an increase in the greenhouse effect and deforestation. Therefore, it is required to propose an automated device that could make the transportation system more efficient. Our proposed system is to make the transportation system more efficient and sustainable with the use of some green technology. The device is having two working modes, first one is for the passengers who are having any mobile phone will get their tickets through SMS, and the second mode is for them who are not having a mobile phone and the passenger will get a paper slip as a ticket. With the use of this machine, the wastage of paper and the carbon footprinting should be minimized, and thus, it will help to conserve our environment.

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Trust Model for Cloud Computing System



Ajay Mohan and Deepali Gupta

Abstract Cloud computing is a distributed architecture for providing pay per use, on demand computing services through the Internet exclusive of actually attaining them. In this way, it holds supervision cost and time for associations. Many associations are going toward the cloud because of the uncomplicated accessibility of administrations gave by the cloud suppliers. In cloud computing, customer information is set up and protected in the data center of a cloud supplier. The limited power over the information may incite diverse safety issues and dangers, including sharing of resources, denial of service, etc. There are diverse investigation difficulties for obtaining cloud computing, such that, well-managed Service Level Agreement (SLA), protection, reliability, and interoperability. This paper spreads out cloud introduction, different cloud models, primary safety dangers, and issues that are correct currently present inside the cloud computing.

Keywords Cloud computing · SLA · Trust model · Cloud model

1 Introduction

Cloud computing is a disseminated design that coordinates server resources on a versatile stage to give on request processing resources and services. Cloud computing is a pay per use on demand resource utilization of resources without genuinely attaining them. Cloud Service Providers (CSP's) propose cloud stages for its clients to underwrite and build up its Web activities as Internet Service Providers (ISPs) present consumers fast broadband to get to the Web. Cloud computing is a representation which encourages easy to understand, on request arrange access to a mutual pool of

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configurable registering resources. As a rule, cloud suppliers recommend different kinds of services, for example, Platform as a Service (PaaS), Software as a Service.

(SaaS) and Infrastructure as a Service (IaaS). Different explanations behind associations to step toward Information Technology (IT) arrangements that incorporate cloud processing, as they are simply need to pay for the resources on utilization premise. Furthermore, associations oblige the requirements of hastily varying markets to guarantee that they are consistently on the main boundary for its purchasers [1, 2]. Cloud computing emerged like a trade need being lively by the possibility of simply utilizing the infrastructure exclusive of managing it. While originally this proposal was available just in the scholarly field, newly it was moved into enterprises by organizations. This secures it for new companies to get in the market effectively, service provisioning the expense of the infrastructure is generously diminished. This benefits designers to focus on the business esteem rather on the forthright spending plan. The customers of business clouds contract figuring force or extra room progressively, as per the prerequisites of their business. By utilizing this innovation, clients can get to enormous applications by means of handheld compact gadgets, for example, cell phones, Personal Computers (PCs), and Personal Digital Assistants (PDAs). Despite the fact that there are numerous favorable circumstances of utilizing cloud computing, there are additionally some critical boundaries to selection. Two of the most serious obstacles to selection are security and privacy [3].

2 Related Work

The author [1] proposes the security concerns with the Cloud. Sharing of resources and multi-tenancy is one of the major security challenges in Cloud computing. Cloud suppliers are required to educate their consumers about the security which is provided on the Cloud. The author admits that in view of the obscurity of the Cloud, it will be trying to realize start to finish safety. New safety approaches are required to be created and more established safety efforts should be completely pulled out to have the option to work with the Clouds design.

The author [4] describes a possibility and discussed issues and restrictions to grasp cloud processing from cloud purchaser's perspective. Because of these issues, probable consumers are not persuaded whether they can believe the cloud suppliers in contribution subordinate types of assistance. Trust-helped united evaluation conspires by utilizing trust, and notoriety frameworks can be utilized to review loyalty of cloud suppliers.

The author [5] presented that the trust is one of the most significant channel to upgrade safety of existing diverse free cloud stages. The researchers previously inspected different trust models utilized in enormous and conveyed conditions and afterward exhibited a particular cloud trust representation to fix safety worries in cloud situation where cloud consumer can incline toward various supplier administrations, and resources in diverse areas can work together. This replica is domain based. It separates two distinct jobs cloud client and cloud server and constructed

separate procedures for them. This replica achieves both personality validation and conduct confirmation.

The author [6] proposes a trust assessment model dependent on D-S proof proposition and sliding windows for cloud computing. Trust appraisal model is of much enthusiasm to back system safety. In sliding window mechanism, collaborations are secluded into significant communications and invalid cooperation. Just substantial cooperation can impact the trust level of elements. The immediate trust of elements is determined dependent on the communication proof by D-S proof proposition. The conflict of the proposal trust as the recycled proof is killed with a support of an upgraded combination way beyond what many would consider possible.

The author [7] proposed a model “Extensible Trust Evaluation Model (ETEC)” that includes a time difference exhaustive estimation procedure for passing on direct trust and a space variation estimation approach for computing trust. A computation dependent on the ETEC model is utilized to assess the trust in cloud systems. Model structure and review shows that this replica can assess the trust degree enough and reasonably in cloud systems.

The author [8] illustrates that cloud has affirmed to be a worthy pronouncement for furnishing processing and competence resources only for associations as of late. The worry of least trust on cloud registering is an obstruction, one of the huge preventions to its far reaching organization. For clients to recognize cloud suppliers to the extent that trust exhibited here have to be some approach to evaluate trust benefits by autonomous outsiders.

The author [9] investigates the issue of building trust in hybrid cloud situations. Like the scope of federated cloud processing develops to pervasive computing, it is a necessity to hold and decides the honesty of cloud computing elements. The researcher gives an entirely isolated structure that encourages trust-based cloud client and cloud specialist co-op connections. The system helps an assistance purchaser in dispensing an appropriate load to the condemnation of different raters with respect to potential specialist co-op.

The author [10] proposed a trust the executive model dependent on fuzzy set hypothesis, where direct trust is separated into two kinds because of the variety of their own trust evaluation traits whose degree was totally passed on as the abstract trust valuation set. This replica will be set up and tried on cloud processing foundation of the Oracle Sun and Mars Information Open Source Center of Excellence.

3 System Model

Think about the instance of another cloud client; say an organization proprietor or director is thinking about adopting cloud facility for the organization. Main preference and obligatory condition are to ensure organization information security and protection. The administrator can see loads of cloud specialist organization in the market however not adequate directions to embrace the best made sure about cloud specialist co-op for an association. New cloud client needs the security and trust

declaration or report of these suppliers for settling on a choice to pick the correct cloud specialist organization as far as dependability, security, and reliability. So plainly security issues are the most huge concern which hampers the development of portable cloud computing. In any case, few ranked systems are accessible in service provisioning or execution concern yet not adequate. We have proposed a trust model for evaluating the trust for a customer so that the customer can use the trustworthy cloud services. Our model is based on trusted third party, which evaluates trust for a customer. The trusted third party establishes trust between the customer and cloud service provider by sending security messages. After establishing the trust between the customer and cloud provider, the customer and cloud service provider then evaluates trust directly without the intervention of trusted third party through security messages. After establishing the trust, the customer communicates with cloud provider directly. Now, the data flow occurs between the two parties (Fig. 1).

The user communicates through user interface to communicate with the system manager to get authorization and authentication. The system manager authenticates the customer by checking its details and privileges the user with the described services. The user also interacts with the catalog services for Quality of Services (QoS). The catalog service also communicates with the system manager to provide the information to it about the quality of services provided to the customer. The system manager in-turn communicates with different modules like trust manager, SLA manager, provisioning services, and service governance module.

The SLA manager evaluates the agreement between the customer and cloud provider. It establishes the agreement by providing the customer with the intended services. It really sets up client desires concerning the specialist co-op's exhibition and quality in various manners. SLAs may determine the following measurements:

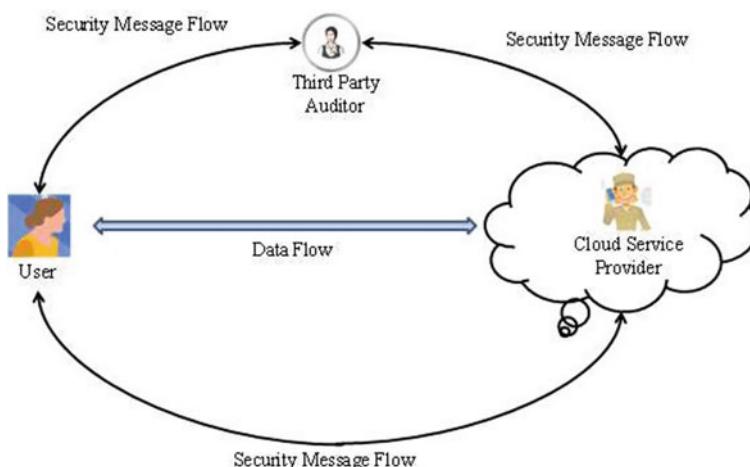


Fig. 1 Flow diagram

- Uptime and availability—the level of the time services will be accessible to the clients.
- Specific execution guidelines to which genuine execution will be considered about after specific interims of time.
- Time in which the application will reaction to the solicitation.
- The time table for notice ahead of time of changes in arrange topology that may influence clients.
- Usage registration that will be given time to time.

A SLA may show the execution, accessibility, and different parameters for different sorts of the client infrastructure—servers, inward systems, and framework segments, for example, uninterruptable force supplies.

The trust manager is responsible for evaluating trust for different cloud service providers and provides the customer with the appropriate cloud service provider. The trust manager evaluates trust using SLA, other parameters and also communicates with system manager for trust. The trust evaluated is stored into the trust repository. Whenever a customer requires a cloud provider, the trust manager returns the cloud provider according to the customer requirements and SLA from trust repository. The trust repository is storage for storing the trust values evaluated by the trust manager.

The system manager also communicates with the service governance for various purposes like billing, monitoring, and metering. The service governance module monitors various parameters while user uses the cloud services. The service-provisioning module provides various services required by the customer. The services required by the user are described in the service level agreement. All these modules communicate with each other to provide the user with the required services according to the needs and on the basis of trust. In this way, this model provides the customer with trustworthy cloud service provider.

4 Conclusion

After studying all this, we have drawn a conclusion that while using a cloud by the user, the security is of utmost importance to both user and cloud provider. The user usually stores the important and sensitive data in the cloud. The user data must be stored securely, and it must not be tempered by any means either by cloud service provider or by any other user. Hence, the security is very much important in cloud. Among the security, the first thing that a user needs is the trust. Because it is the trust on behalf of which a user chooses a particular cloud service provider. For this, we must have a model to evaluate the trust for different cloud providers and provide to the customer while choosing the cloud provider. There are different trust evaluation models but each one has some limitations. We have developed a trust evaluation system model, considering different parameters to evaluate the trust for different cloud providers (Fig. 2).

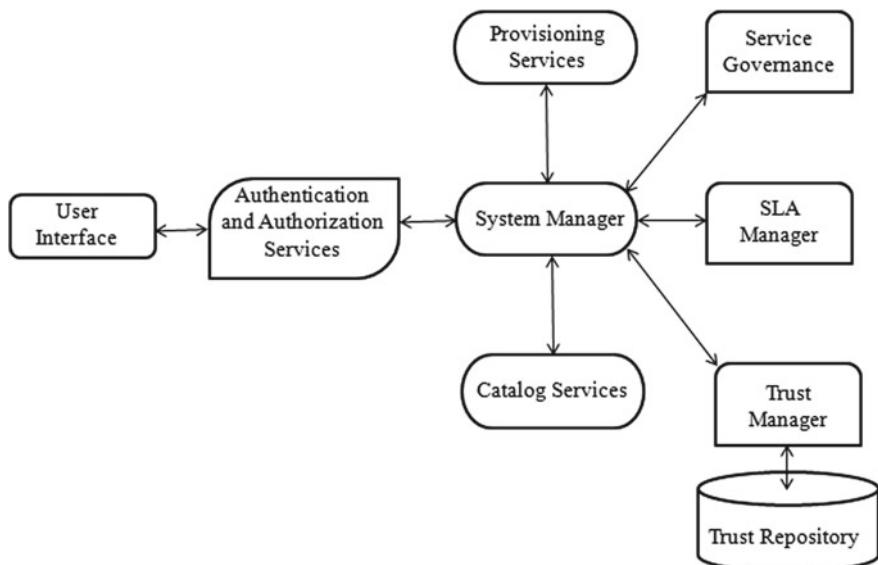


Fig. 2 Trust evaluation system model

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IoT-Based Portable Vital Sign Monitoring System for Rural Area



Vishal Verma, Deepali Gupta, and Sheifali Gupta

Abstract There is a heavy deficiency of medical equipment in rural areas. That is why there are needs of an electronic medical system for the rural area that is used to measure the vital sign parameter of a human. In this paper, the author proposes an electronic system that is capable to tell us about cardiovascular disease. The electrocardiograph (ECG), heart rate, and blood pressure (B.P) are the three important vital sign parameter of the human body. Cardiovascular diseases are related to human blood vessels. The human heart has four important parts like left atria, right atria, left ventricle, and right ventricle. The heart job is to pump blood into the human body. When our heart pumps blood in our blood vessels, the electrical signals are generated. This electrical signal tells us about the heart activity of the human body. Currently, the available ECG apparatus is bulky in size and it consumes a big amount of electricity. In rural areas, if a patient wants to check his heart activity, firstly, he goes to the pathology laboratory and performs ECG tests on the heart. After the test, he consults to the medical expert. So, the patient wastes his time and money both. So, we need an electronic system that itself is capable to tell us patient suffers from what type of heart disease.

Keywords IoT · AD8232 · Pulse sensor · Ubidot · Raspberry Pi · Sunroom blood pressure sensor

1 Introduction

Internet of things (IoT) means when we connect the physical world with the Internet then it became the Internet of things. The physical world tends for sensors, electronic gadgets, programming innovations, and system availability [1]. To make our health monitoring system long term and continuously monitoring, IoT plays an important

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role. Today some of the existing solutions use radio frequency identification (RFID) tag sensor to measure the vital sign of the patient. These RFID tags take power from small batteries and RF power source [2]. In an existing medical solution, a fixed bulky ECG system is used so that if any patient wants to diagnose heart disease firstly he came to the hospital [3]. The low power consumption health monitoring system is also existing and it contains a relay transmitter module that receives the ECG sensor, eye detection sensor, and accelerometer signals and then transfers to nearby module [4].

The proposed electronic system takes ECG, heart pulse, and blood pressure of the patient. Then, it converts ECG signal and heart rate into the graph. Now, artificial intelligence work starts the electronic healthcare system and compares ECG graph and heart pulse graph with existing dataset of different types of patients. The electronic system itself is capable to tell us about the approximate every type of heart disease.

2 Related Work

Xiao et al. [10], in this paper, the author describes a non-contactable radio frequency-based heartbeat monitoring system. This system is working on a 5 GHz frequency band spectrum. The patient distance must be under 2.5 m then approximate 80–90% accurate heartbeat results are observed with very low transmitted power app 20 MW.

Mansor et al. [11] develop a heartbeat monitoring electronic system that is called the smart home clinic. This electronic system is developed to order to connect remote access between the patient and doctor.

Park and Chou et al. [12] currently used wet ECG patches as they required a gel or chemical to establish electrical connectivity with the human body. This author presents a non-contactable ECG measure device. Capacitive ECG patches are used to measure the electrical activity of the human body. This ECG data are transferred wirelessly to the cloud. The doctor can retrieve their ECG data from anywhere in the world.

Koshti et al. [13] developed the electronic system that is used for telemedicine and this electronic system can measure the vital sign of the patient. 3-lead ECG module is used in this electronic system. This ECG data of the patient are sent to the cloud so that doctor can see the vital parameters of the patient. The doctor provides telemedicine to the patient.

Surya Deekshith Gupta et al. [14] make an inexpensive healthcare system for rural areas. This electronic system contains a Raspberry Pi microcontroller and an ECG module. This paper tells us how the Raspberry Pi is used for the healthcare system. After measuring the vital sign of the patient, it transfers to the Web cloud at which doctor can see their vital sign.

Hsu et al. [15] developed a healthcare system that records ECG, pulse rate, and blood pressure of the patient. After recording these parameters, they perform FFT power analysis on these parameters. Analysis of the spectrum of the patient heart

activity analyzes low-frequency spectrum and high-frequency spectrum increases or decreases again and again.

3 Proposed Solution

In this paper, we proposed a healthcare kit for rural areas. This electronic system contains a pulse sensor, an ECG sensor (AD8232), and a blood pressure sensor module as shown in Fig. 1. All these sensors are interfaced with a Raspberry Pi microcontroller. Raspberry Pi microcontroller has an in-built Wi-Fi module, so that all vital sign parameters are easily transferred to the Internet cloud. The doctor can access all this parameter anywhere in the world. After analysis of the vital sign, the parameter doctor gives telemedicine to the patient so that patient easily recovers from the disease.

There are different types of the cloud platform available but we used Ubidots as an Internet cloud. All the patient data pulse rate, blood pressure, and ECG are transferred to it. Anyone can see their parameter from anywhere in the world.

As we know Raspberry Pi microcontroller has no in-built analog-to-digital (ADC) module. So Raspberry Pi microcontroller cannot read analog inputs, firstly we convert analog inputs into digital outputs. So we want to connect an external ADC so that

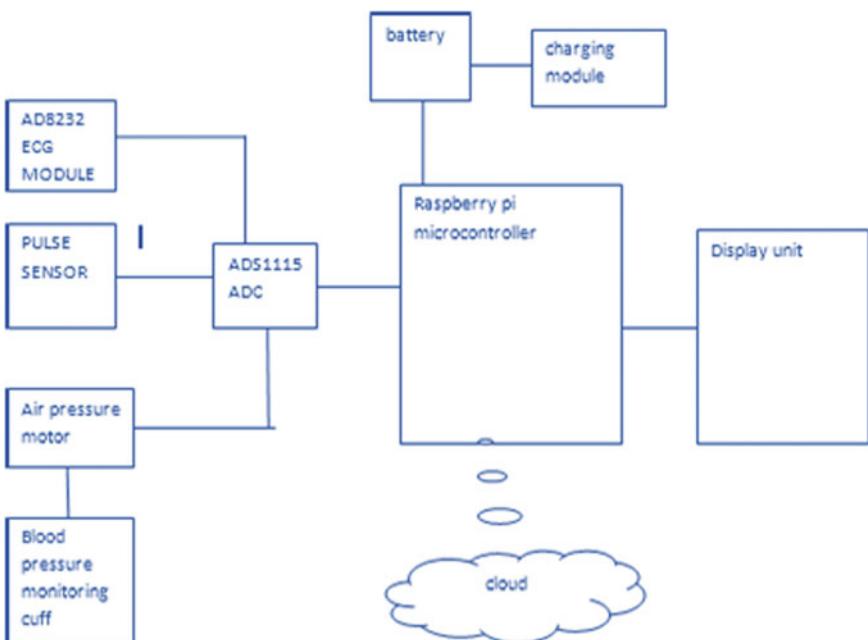


Fig. 1 Block diagram of proposed system

Raspberry Pi wants to read analog sensor outputs. AD1115 is 16-bit 4-channel ADC that makes analog sensor output compatible to the Raspberry Pi microcontrollers. The block diagram shows how we interface all the sensors to a single microcontroller. ECG (AD8232) is a sensor that measures the electrical activity of the heart. This sensor has five pins but out of five, we use only three pins (Vcc (3.3v), GND, output). Vcc and GND pins are used to provide power supply to the sensor module. The output pin is used to take the output from the ECG sensor. We use sunroom blood pressure and pulse sensor that is used to capture the pulse and ECG graph of the patient. These pulse rate and blood pressure data are serially transferred to the microcontroller and we can easily access these data.

4 Hardware Description

Raspberry Pi: Raspberry Pi microcontroller is a central processing unit (CPU) of our electronic system. The microcontroller has four USB ports, one Ethernet, one HDMI, and one audio jack as shown in Fig. 2. Raspberry Pi has 256 MB inbuilt RAM. It has approximately 40 GPIO pins that are used to connect external peripheral with it [5]. The advantage of using a Raspberry Pi microcontroller is we can apply artificial intelligence on an ECG signal with it.

Analog-to-Digital Converter (ADX1115): The microcontroller has two types of inputs and outputs. One is digital and the other is the analog as shown in Fig. 3. On the basis of this, some microcontroller has an inbuilt analog-to-digital converter. ADX1115 is 4-channel 16-bit analog-to-digital converter. It is working on the I2C communication protocol. The only limitation of the Raspberry Pi microcontroller is it cannot have an inbuilt analog-to-digital converter (ADC). So Raspberry Pi

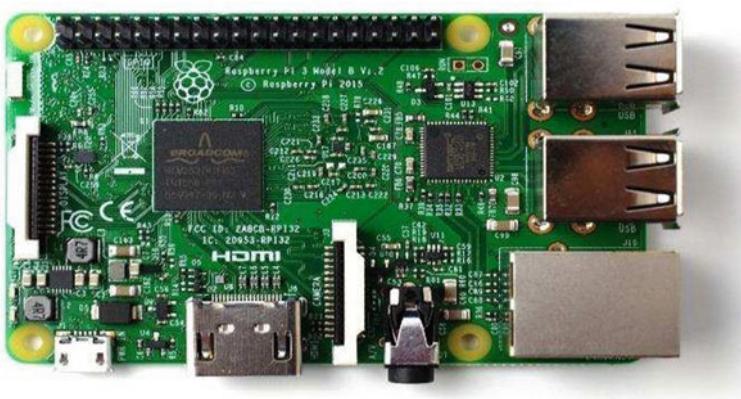
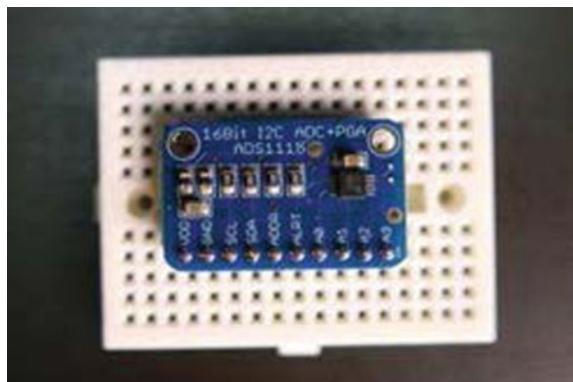


Fig. 2 Raspberry Pi microcontroller

Fig. 3 ADX1115
analog-to-digital converter



microcontroller is read-only digital signal. Overcoming limitation of Raspberry Pi microcontroller, we use ADX1115 analog-to-digital converter with it [6].

Pulse sensor: PLSNSR1 is an optical pulse sensor that is used to measure the heart activity of the heart. When human heart contracts and expands, it pumps the blood in our body as shown in Fig. 4. The blood pressure changes according to heart expansion and contraction is occurring. The optical strength is changed when blood pressure changes and on that basis heartbeat is recorded by the optical pulse sensor. The electrical signal captured by the ECG electrode pass through this amplifier for better amplification [7].

AD8232 ECG sensor: Electrocardiograph (ECG) is a very important vital sign parameter for the detection of heart disease as shown in Fig. 5. The AD8232 is the three-lead single-channel ECG sensor which is used for heart disease detection. Our solution shows the live data graph of the ECG signals.

Fig. 4 Pulse sensor
(PLSNSR1)



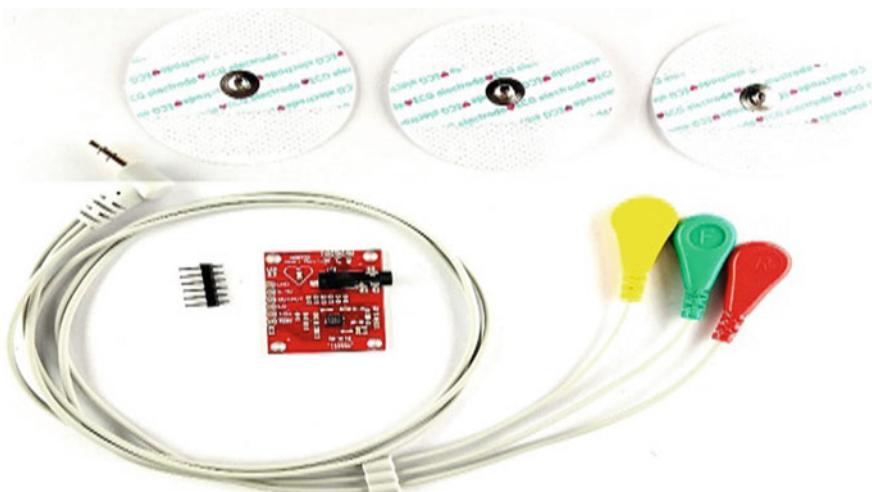


Fig. 5 AD8232 ECG sensor

Blood pressure sensor and pulse sensor: We used sunroom blood pressure and pulse sensor as shown in Fig. 6. That sensor is used to measure blood pressure and pulse rate of the patient. Sunroom sensor is given output in the form of serial data. We can easily interface serial communication with the sensor. We can easily interface the sunroom sensor with the Raspberry Pi and take sensor output on screen [8]. This sensor is firstly calculating the higher pulse this is systolic value and after it reading becomes constant. After reading the first higher pulse, it starts to measure the second higher pulse and the second-high pulse is the diastolic pulse of the patient.

Fig. 6 Sunroom blood pressure and pulse rate sensor

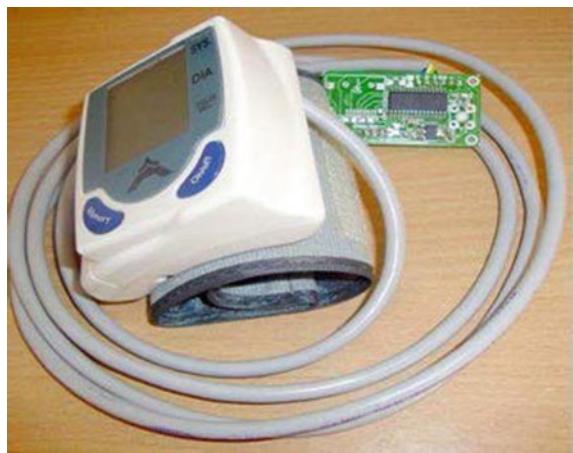




Fig. 7 Cloud for displaying data

5 Software Description

Ubidots Internet cloud: Ubidots as shown in Fig. 7 is Internet cloud platforms for professionals and beginners. It is established in 2012 and provides end-to-end Internet of things services to the users. Ubidots establish this IoT platform with a partnership with NETUX Pvt. Lmt. Ubidots IoT cloud platform is efficiently used for automation, surveillance, and healthcare applications. Approximately all microcontrollers with Wi-Fi modules are easily interfaced with Ubidots and we can easily transfer any sensor data or control any device with this IoT cloud platform [9].

Python: There are several programming languages like C, C++, Java, .Net, Python, etc. But the Python has many advantages over all other languages due to easiness and learning point of view. Python supports multiple paradigms object-oriented and functional programming.

Matplotlib: Doctors can process the ECG data if it is in the pictorial representation or in graphical representation. So matplotlib is the data visualization Python library that converts the AD8232 raw data into the graphical representation. Matplotlib is the Python library used for 2D graphical representation.

6 Working of Proposed Solution:

The proposed solution is used to get the all vital sign parameter of the patient. The architecture of the proposed solution is shown in Fig. 8. The pulse sensor (PLSNSR1) is used to get the heart rate of the patient. The ECG sensor is used to check the electrocardiograph of the people. In this proposed solution, three-lead single-channel ECG patches are used. The sunroom blood pressure sensor is used to check the blood pressure of the patient.

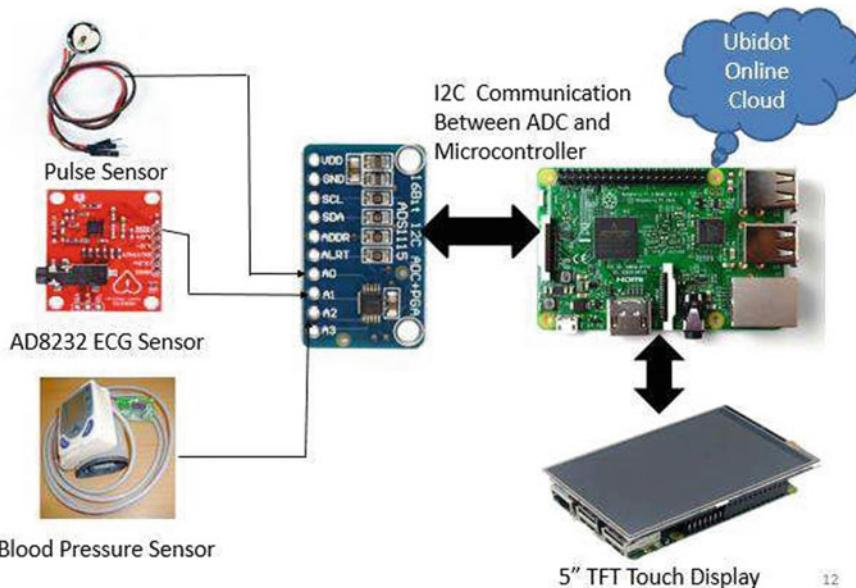


Fig. 8 Proposed solution architecture

All these sensors are the analog sensor that is interfaced with the Raspberry Pi microcontroller. The Raspberry Pi microcontroller does not have an inbuilt analog-to-digital converter. The ADS115 16-bit is used to convert the analog output into digital output. The ADS115 is the four-channel ADC so the four analog sensors are attached with this analog-to-digital converter.

Adafruit ADS115 library is used to get all the vital sign data from the sensors. In the coding part, firstly all sensor data are stored in the excel sheet. From the excel sheet, matplotlib Python package is used to get the live graph of the ECG sensor on the display. The doctors can see the live graph of the patient's vital sign on the display and take the appropriate action against it.

In the emergency, the doctor can see the patient vital sign parameter from anywhere in the world. Ubidot is an online cloud that plays a very important role. Then, the doctor can see the patient vital sign parameters as well as in the online Web cloud. The Ubidot is used for online cloud storage. Figure 8 shows the architecture diagram of the proposed solution (Fig. 9).

7 Conclusion

In this paper, we developed a healthcare kit for rural areas. This health monitoring system is capable of measuring almost all the vital sign parameters of the patient like blood pressure, heartbeat, and ECG. All the vital sign parameter is stored on

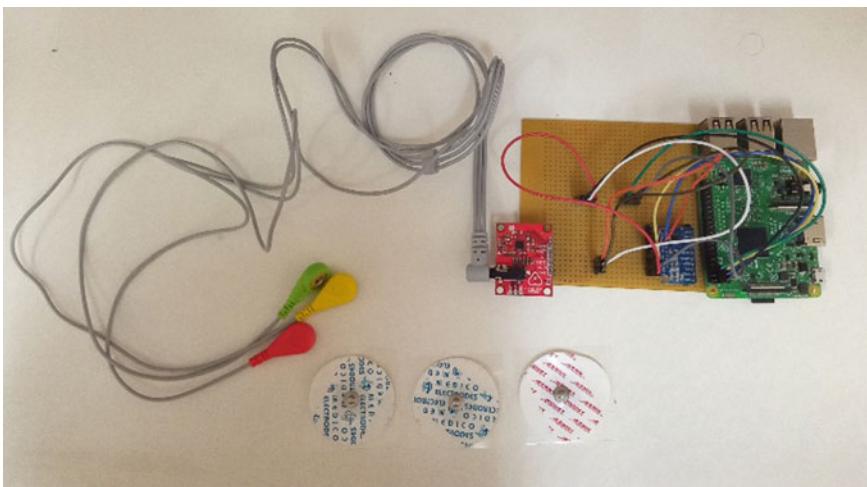


Fig. 9 ECG sensor interfacing with Raspberry Pi

the Web cloud. These vital signs are seen by the doctor for anywhere in the world. Furthermore, in the future, we apply an artificial intelligence o this system so that system itself capable to tell us about the heart disease of the patient.

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Automated Grading System to Evaluate Ripeness of Tomatoes Using Deep Learning Methods



Sahil Malhotra and Rita Chhikara

Abstract Proper quality and supervision of fruits during harvesting would be beneficial for the buyer and also result in yielding better income for the supplier. Agricultural products are graded on the basis of their dimension and quality. Traditionally, grading was human dependent; however, grading of fruits by human is not efficient, work-intensive and prone to errors. We propose an automated grading system for sorting tomatoes based on their maturity level. Not only does this speed up the processing time, but it also minimizes the error. A great demand for this is observed both in foreign and local markets. Our research utilizes openly available datasets for fruit grading, uses neural network-based advanced computer vision and transfer learning techniques and achieves a state-of-the-art accuracy in classifying maturity for all of the tomato images from the test set correctly. The framework suggested in this study could aid in precisely grading tomatoes based on ripeness and help agricultural industries in various processes like automatic segmentation of tomatoes on conveyor belts, or robotic harvesting, thereby projecting to impact hundreds of millions of tonnes of food that get wasted each year due to maturity factors at harvest time.

Keywords Computer vision · Deep learning · Transfer learning · Fruit grading

1 Introduction

One of the several hurdles faced by the food industry lies in systematic determination of food maturity in various growth phases. A proper monitoring is required in order to determine the condition of fruit in both harvest and post-harvest conditions. The

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importance of monitoring lies in the fact that variability in ripeness is considered as a lack of quality by the buyers. The conventional method used to assess the quality of fruit is essentially destructive, work-intensive and thus cannot be applied efficiently. In addition, due to the increased competition in fruit markets, an efficient technique needs to be applied in order to decrease the potential losses to both producers and suppliers and to minimize the chances of spoilage of food for the consumers. This paper provides one such non-destructive ripeness detection technique for tomatoes.

The proposed effective and automated grading system for tomatoes is based on machine learning, machine vision and transfer learning methods. The software is developed by implementing machine vision-based ripeness classification algorithm to output a model that accurately predicts the fruit maturity levels.

We obtained the data from openly available datasets on GitHub. A repository named Fruit-360 was used to gather images of tomato in different maturity stages [1].

For the modeling process, we used PyTorch, an open-source framework to implement deep learning models [2]. We also used TensorBoard for visualizing neural network models. There is also a scope to capture hyper-spectral images to determine the internal features like sugar and water content in it.

2 Related Work

For ripeness identification in fruits, various research works have been proposed in the past. Several computer-based vision systems were used in various applications requiring visual evaluation of fruits like dates [3], apple [4], bananas, mangoes, tomatoes, gooseberries, mandarins, oranges [5], etc.

For ripeness detection in bananas, a framework was developed in Paulraj et al. for color recognition to classify the maturity stage of bananas based on deep learning neural networks. The system was able to achieve an accuracy of 96% [6].

Clement et al. implemented a tomato classifier based on color, size and weight with an accuracy of 84% [7].

W. Castro et al. conducted a study to evaluate maturity classification for gooseberries. Twelve maturity classification models were developed consisting of four different algorithms, namely support vector machines, artificial neural network, decision trees and k-nearest-neighbors with three color spaces and were able to achieve an accuracy of 93.02% with $L^*a^*b^*$ color space [8].

C. S. Nandi et al. implemented a computer vision-based ripeness classifier for mangoes. They conducted their study with various classification methods and achieved an accuracy of nearly 87% using fuzzy incremental algorithm [9].

For avocados maturity detection, in Guerrero and Benavides, authors proposed a ripeness identification system which is based on (F-LDA) Fishers linear discriminant analysis along with K-means models. The system achieved an accuracy of around 87.85% [10].

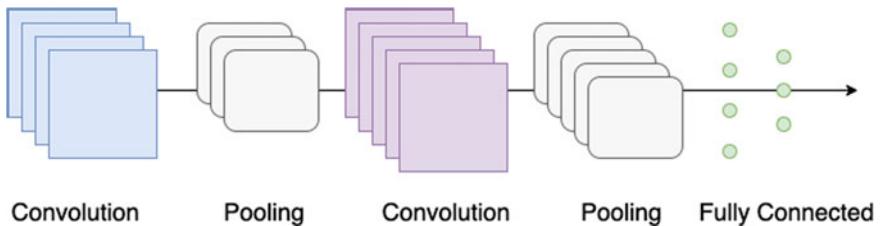


Fig. 1 Layers in a convolutional neural network

From the literature review above, it was observed that, the present fruit maturity classification systems do not provide state-of-the-art accuracy, mostly due to a smaller number of labeled data available here to train a much more advanced convolutional neural network from scratch. Instead, we propose a methodology using transfer learning to train a pre-trained ConvNet model like a RESNET18, trained on a dataset called “IMAGENET,” which contains above a million images with around a thousand categories, and then try to use the already trained network either as an initialization-then-fine-tuning or a fixed feature extractor to train another related classification task [11].

With such an approach, we can train a state-of-the-art tomato ripeness classifier, with relatively lesser amount of data (Fig. 1).

3 Proposed Methodology

3.1 Work Environment

For training our model, we used Python, as our core programming language, and PyTorch, Seaborn and TensorBoard for data visualizations and modeling purposes. All our research work and code are documented in Jupyter Notebook. The model training is done on a Jupyter Notebook platform deployed on cloud with 30 GB RAM and an 8 GB Nvidia Quadro M4000 GPU.

3.2 Data Preparation

For training the model, we used a subset of Fruits-360 dataset. According to the dataset publication, “It has 82,213 fruit images for 120 fruit classes. Fruits and vegetables were planted in the shaft of a low-speed motor (3 rpm), and a short movie of 20 s was recorded.” A dedicated algorithm was created by the Fruits-360 author which extracts the fruit from the background.

The dataset images taken were:

Table 1 Distribution of classes

	Ripe	Under-ripe	Over-ripe
Training set	~479	~414	~353
Validation set	~155	~141	~120
Test set	~42	~34	~24

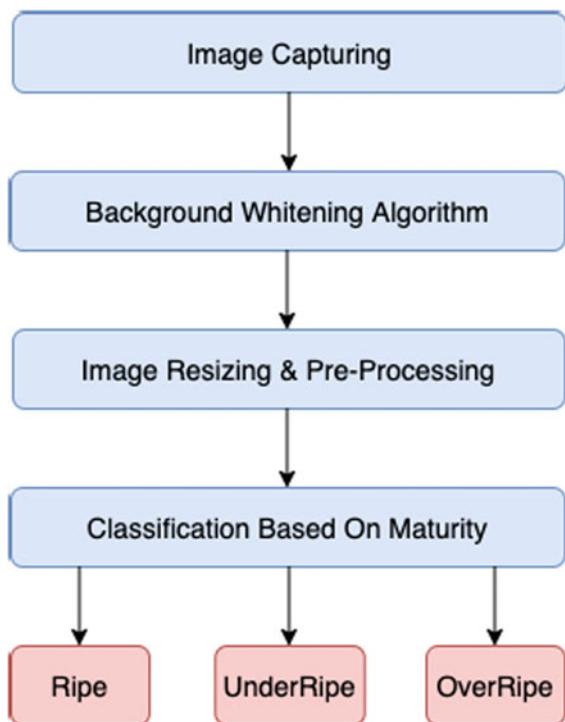
1. Cherry red tomatoes, labeled as ripe.
2. Yellow tomatoes, labeled as under-ripe.
3. Maroon tomatoes, labeled as over-ripe.

The dataset was divided in three proportional parts: train, validation and test set. The approximate distribution of classes sampled (K-fold sampling for training and validation sets) from the image dataset (1762 images) is as shown in Table 1. We separate out 100 images for the test set.

Data augmentation techniques like randomly resizing and cropping the images to $224 \times 224 \times 3$ pixels and data normalization were also applied [12]. And, images are converted into tensors for parallelism and training purposes. Also, the authors from the same Fruit-360 Dataset Paper implemented a flood-fill-type algorithm to extract the fruit from the background.

We define the system pipeline as shown in Fig. 2.

Fig. 2 System pipeline



4 Model Training

Our data is ready to be trained on an image classifier. As from Table 1, we can see we do not have an enough amount of data required to train a CNN from scratch. As collecting more data could turn out to be an expensive task, we would retrain an already trained image/object classification model, using transfer learning.

4.1 Transfer Learning Methods

We can use the pre-trained model in one of the two ways:

Fine-tuning a CNN. Rather than randomly initializing the neural network, we initialize the network with pre-trained weights such as the ones trained on a dataset like “IMAGENET,” which was used to build a RESNET model. The remainder of the training would be done normally.

CNN as fixed feature extractor. In such an approach, we fix or freeze all the weights and biases for whole of the network except the ultimate fully connected layer. This layer is then replaced with another layer according to the classes from the problem of interest, initialized with random weights and is trained further [13].

4.2 Optimization Functions and Hyper-parameters

Before, training the model, we move all the variables and dataset to the GPU for parallelism and faster training. **Loss Function**—We take cross-entropy loss as our loss criteria.

Optimization Function—Weights and biases are optimized using stochastic gradient descent (SGD) [14].

Hyper-parameters Space. We split our dataset using K -folds cross validation method (where $K = 4$, in our case) and do a grid search over learning rate from 0.01 to 1 and momentum from 0.2 to 0.9.

4.3 Training Process

The data is loaded in batches and training takes place using gradient descent over 10 epochs. After every epoch, training and validations losses are calculated.

First, we download our pre-trained RESNET18 model and modify its layers based on the approach we want to apply. For fine-tuning the pre-trained model, we just change the number of classes in the final layer to the desired number of classes, i.e.,

Table 2 Hyper-parameter space: fine-tuning Resnet-18

Learning rate	Momentum	Running-train accuracy (%)	Train accuracy (static wts.) (%)	Validation accuracy (%)	Average epoch number
1	0.2	92.70	99.93	100.0	5.50
1	0.5	93.07	99.55	99.69	7.00
1	0.9	44.64	44.02	43.19	5.75
0.1	0.2	96.08	99.91	100.0	6.50
0.1	0.5	96.20	99.81	100.0	7.00
0.1	0.9	97.67	99.27	99.15	8.25
0.01	0.2	91.15	100.0	100.0	1.50
0.01	0.5	96.85	100.0	100.0	4.50
0.01	0.9	90.75	99.85	100.0	5.50

3. For fixed feature extraction, in addition to the modifications applied during fine-tuning, we also turn off gradient calculations for all but the ultimate fully connected layer.

After the completion of training, the model is scored on the test set which contains the data it has never encountered while training or validation.

5 Result Analysis

5.1 Parameters for Result Analysis

We interpret our results using accuracy on train set, validation set, accuracy on train set while model is training (termed as Running Train Acc. in below tables), and average epoch number where our model attains this validation accuracy across K-folds.

Best hyper-parameters from Tables 2 and 3 are chosen, and we test our results on test set.

5.2 Interpreting the Results

After training the model using the abovementioned two transfer learning approaches, we observe the following results:

Method 1: Fine-Tuning Pre-Trained RESNET Model

- The model achieved the highest training and validation accuracy of 100.0%.

Table 3 Hyper-parameter space: fixed feature extractor

Learning rate	Momentum	Running-train accuracy (%)	Train accuracy (static wts.) (%)	Validation accuracy (%)	Average epoch number
1	0.2	91.11	99.95	100.0	5.50
1	0.5	97.89	99.53	99.63	7.75
1	0.9	37.36	45.50	46.69	3.75
0.1	0.2	82.40	98.51	98.79	4.75
0.1	0.5	96.40	99.73	99.93	6.25
0.1	0.9	91.99	99.89	99.75	6.50
0.01	0.2	91.17	100.0	100.0	1.25
0.01	0.5	92.82	100.0	100.0	2.50
0.01	0.9	94.00	99.89	99.87	6.00

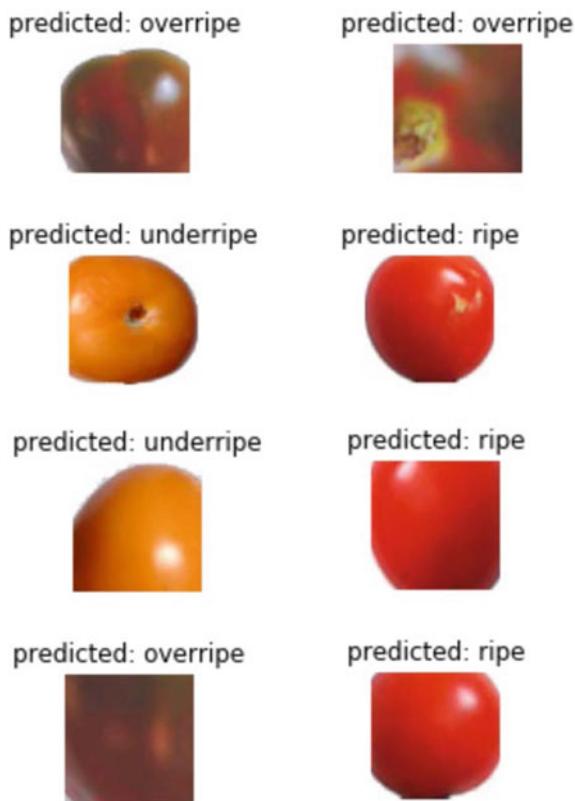
- We achieved this result in an average of 1.5 epochs (averaged across K -folds) when learning rate is set to 0.01 and momentum to 0.2.
- We were also able to successfully predict all samples correctly in test set, thereby achieving a state-of-the-art accuracy.

Method 2: CNN as a Fixed Feature Extractor

- The model achieved the highest training and validation accuracy of 100.0%, again.
- We achieved this result in an average of 1.25 epochs when learning rate is set to 0.01 and momentum to 0.2.
- We again were also able to successfully predict all samples correctly in test set (Fig. 3).

Other Interpretations

- At learning rate of 1 and momentum of 0.9, we see a significant drop in performance with validation accuracy near 44%. Also, on analyzing the results across K -folds for these hyper-parameters, we found that the accuracy and losses were unstable. This could be due to a higher learning rate which resulted in learning a sub-optimal set of model parameters, and a higher momentum, which led to underfitting of our data.
- In some cases, we find the validation accuracy is a bit higher than train accuracy, and much higher as compared to running-train accuracy (where accuracy and losses were calculated while training on batches).
 - For the running-train accuracy, it is much clear that the losses were calculated after every training step, whereas the validation accuracy and losses were calculated after completing an epoch, so on average the training loss is measured half an epoch earlier, which resulted in a higher accuracy for validation set.

Fig. 3 Prediction on test set

- The train accuracy, calculated after completion of an epoch, could be sometimes slightly lesser than validation accuracy as the number of examples in training set is relatively much more than validation set. Or, the validation set could have some easier examples to classify. The latter case could lead to a significant difference in train and validation accuracy, but as we have calculated the losses and accuracy across K -folds, we have kind of minimized this effect.

6 Conclusion

We were able to train a state-of-the-art tomato ripeness classification model, which accurately predicted all the available samples in the validation and test set. The framework would aid in the successful grading of tomatoes for the local consumer and agricultural industries. Combining this model with Fruit-360's background whitening algorithm can prove out to be a great use-case in industries, where on a conveyor

belt, fruits or vegetables are needed to be segmented based on their maturity level or can be useful in implementing smart food harvesting robots.

The adoption of this system can help ensure the well-being of the human being as well as helping the supplier to supply good quality of fruits, thereby yielding better incomes.

There is also a challenge to inculcate hyper-spectral images into the data to detect internal features of fruit but as capturing such images require costly and bulky equipment, building one of our own can help tackle this one too [15].

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Comparative Analysis of Seam Carving in Images



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Abstract Owing to the incessant advancements in technology, there are a number of electronic gadgets of different shapes and sizes available with everyone today. As such, the content available through the Internet in the form of online websites, videos, etc., may be viewed through these varied digital devices. Most of the content is multi-modal with images forming a large chunk of this digital content. Hence, the digital images may be viewed using a number of diverse display devices having a multiplicity of resolutions. This makes viewing images challenging as they need to be retargeted for the different resolutions and resized as per space. Simple image resizing methods include interpolation and cropping. However, interpolation blurs the image and cropping alters the image composition and is not always desirable. In this work, we present a dynamic programming-based image resizing technique named seam carving. Furthermore, we present a detailed performance analysis for seam carving. We carry out our experiments on a dataset of 100 images having diverse content, size, number of seams and carry out seam removal using different filters. As per our results, the factors image size, number of seams removed and image content affect the performance of the seam carving algorithm.

Keywords Images · Resizing · Retargeting · Seams · Seam carving

1 Introduction

The ever increasing digital display screens in the form of laptops, mobile phones, televisions, etc., all of different sizes have necessitated the rescaling and resizing of digital media content according to screen sizes in order to be displayed appropriately.

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Most of the digital media content nowadays is multi-modal with images constituting an enormous amount of it. This in turn poses the challenge of adjusting images for the different resolutions and resizing them in accordance with screen sizes. Simple image resizing methods include interpolation and cropping. However, interpolation blurs the image and cropping alters the image composition and is not always desirable. The proposed image resizing technique is one step ahead of the simple resizing techniques as it will take into account image content and not just focus on geometric constraints for resizing.

Dynamic programming is a mathematical optimization technique for solving intricate problems by sub-dividing into smaller sub-problems recursively [1]. Seam carving is a dynamic programming-based image resizing technique that alters image size by removing the pixels that are unimportant or inserting new seams [2]. The process exploits the energy function of an image by locating the seams or threads having the lowest energy and changing the image size by targeting these seams. Seams may be vertical or horizontal. A route consisting of eight linked pixels in the direction top to bottom comprising of a single pixel in every row constitutes a vertical seam in an image. Similarly, a horizontal seam is in the direction left to right. The energy function determines pixel importance by computing contrast with surrounding pixels.

One of the most common applications of seam carving is to reduce the image size. Seam carving does this by locating in the image the routes having a width of one pixel from the top to the bottom and removing such routes. This is based on the premise that the pixels present in the one pixel wide routes will be analogous to the adjoining pixels, and hence, their exclusion may be carried out. Seam carving may also be used for retargeting an image into an image of larger size, altering image dimensions and object exclusion.

2 Related Work

There exist several approaches for image retargeting. Cropping is the most widely used image adaptation method which eliminates content from image boundaries. Authors in [3, 4] carry out image cropping for retargeting. Authors in [5] proposed an approach for image retargeting for displaying on smaller screen sizes like those of cell phones by identifying the most significant region in the image and displaying the significant region on the cell phone screens. In [6], the authors proposed another approach for image retargeting for cell phones by identifying multiple small size significant regions in the image and displaying the significant regions in quick succession. Re-adapting images to different sizes has been studied at length in the domain of texture synthesis to produce a big texture image from a small one.

However, the commonly used image resizing approaches like interpolation and cropping lead to loss of information and perceptible alterations in image content. Seam carving is a content-aware image retargeting technique introduced in [7] which can be used for image size reduction as well as enlargement. This method eliminates

the insignificant pixels while retaining the essential features in the image. Authors in [8] present an approach for improving the efficiency of seam carving. Authors in [9] propose a fractal-based approach for seam carving in images combining the fields of geometry and dimension theory.

In [10], the authors present a supervised seam carving technique that learns the unique periphery of the Region of Interest (ROI) based on a set of training images. Then, it identifies the peripheries of the test image and using this information carries out seam carving in a way that has reduced amount of seams interfering with the ROI. In [11], the authors propose an approach for three-dimensional image retargeting using classification guided fusion network (CFN) for fusion of the left and right eye images which are designed differently.

However, most of the work on seam carving like in [12] considers 2–3 or at most 10 images. In this work, we compile a dataset of 100 images of size 500 * 500 pixels and also three images each of sizes 768 * 1024 and 1080 * 1920 pixels and work on this dataset. Furthermore, we also carry out a comparative analysis of the different filters used to acquire the energy map for seam carving.

3 Proposed Work

As explained in Sects. 1 and 2, image size reduction using seam carving is based on the foundation of eliminating pixels prudently. Consequently, the major task in the proposed scheme is detecting the pixels to be eliminated. Instinctively, we would try to eliminate the pixels that are imperceptible. The basic steps in seam carving are outlined as under:

- Identify the image to be retargeted.
- Compute the energy of each pixel of the identified image.
- Compute the cumulative energy of each pixel of the identified image.
- Create a list of the seams based on the cumulative energy of the pixels in the last row.
- Take out seams from the image to reduce the image size.

Formally, let I be an image of size $p \times q$. We represent a vertical seam in I as given in Eq. 1:

$$v^x = \{v_i^x\}_{i=1}^p = \{(x(i), i)\}_{i=1}^p, \text{ where } \forall i, |x(i) - x(i-1)| \leq 1 \quad (1)$$

where x is a mapping $x: [1, \dots, p] \rightarrow [1, \dots, q]$. This establishes that a vertical seam is an eight connected path of pixels running from top to bottom of the image, comprising of exactly one pixel in every row of the image.

Likewise, we represent a horizontal seam in I as given in Eq. 2:

$$v^y = \left\{ v_j^y \right\}_{j=1}^q = \{j, (y(j))\}_{j=1}^q, \text{ where } \forall j, |y(j) - y(j-1)| \leq 1 \quad (2)$$

where y is a mapping $y: [1, \dots, p] \rightarrow [1, \dots, q]$.

Then, we can establish the pixels of the path of the vertical seam v_i to be:

$$I_v = \{I(v_i)\}_{i=1}^p = \{I(x(i), i)\}_{i=1}^p \quad (3)$$

The consequence of eliminating the pixels forming a seam from a picture is that all the remaining pixels will be moved left or up to recompense for the eliminated sm. This effect is evident only along the eliminated path, the remaining picture will be as it is.

We describe seam value as:

$$E(v) = E(I_v) = \sum_{i=1}^p e(I(v_i)) \quad (4)$$

where e is the energy function used for computing the energy of pixels.

We will search for seam, having the least seam value. We use dynamic programming for this. This is represented in Eq. 5.

$$v* = \min E(v) = \min \sum_{i=1}^p e(I(v_i)) \quad (5)$$

Different energy functions can be utilized for calculating the energy of pixels as represented in Eq. 4 and assessing the proposed technique. In this work, we use the well-known Sobel, Laplacian and Canny filters to acquire the energy map [13, 14].

4 Experiments and Results

In this work, we present a comparative analysis of the efficiency of different filters for estimating the energy in width reduction using seam carving. Seam removal is applied to the images.

We perform our analysis on a number of images of different shapes and sizes as well as same size images.

First, we take 100 images of size 500 * 500 and apply Sobel, Laplacian and Canny filters to all these images and report the results obtained in Table 1. We compiled this dataset from [15] taking 100 images of size 500 * 500 only from the available 8000 images in all. We observe that the Laplacian filter takes more time compared to the Canny and Sobel filters which take almost comparable time. We also reproduce three

Table1 Average execution time (in seconds) for image size 500 * 500

Number of seams removed	Canny	Sobel	Laplacian
10	17.0229	18.2993	67.2981
50	74.7262	80.5657	296.2322
100	139.7851	150.3002	554.2838
249	287.6640	309.5355	1149.9067

of these images and the results obtained after removal of 100 seams from Canny, Laplacian and Sobel filters, respectively, in Fig. 1.

On observing the results obtained, we can infer that the performance of different filters is dependent on the image content.

We also represent a graphically the average execution time versus removed seam numbers for all the three filters in Fig. 2.

To facilitate comparison, we also take three images each of sizes 768 * 1024 and 1080 * 1920 and apply Sobel, Laplacian and Canny filters to all the images of each of these sizes and plot the average execution time versus number of seams removed graphs for these images sizes as well. We represent the results obtained in Fig. 3.

According to comparative results, in addition to the number of seams to be removed and image content, image size also affects the performance of the algorithm.

5 Conclusions and Future Work

In this work, we presented a dynamic programming-based image resizing technique named seam carving and detailed performance analysis of seam carving by trying different filters for the energy map calculations. We used the Sobel, Laplacian and Canny filters in this work. We performed seam removal using these different filters on a dataset of 100 images having size 500 * 500, diverse content and number of seams. Additionally, we performed seam removal on three images each of sizes 68 * 1024 and 1080 * 1920 and applied the different filters to all the images of each of these sizes and reported the results obtained to facilitate comparison between different image sizes. We observed that the factors image size, number of seams removed and image content affect the performance of the seam carving algorithm. In future, we aim to incorporate more filters like LOG. We would also want to extend this approach for resizing of videos in the future.

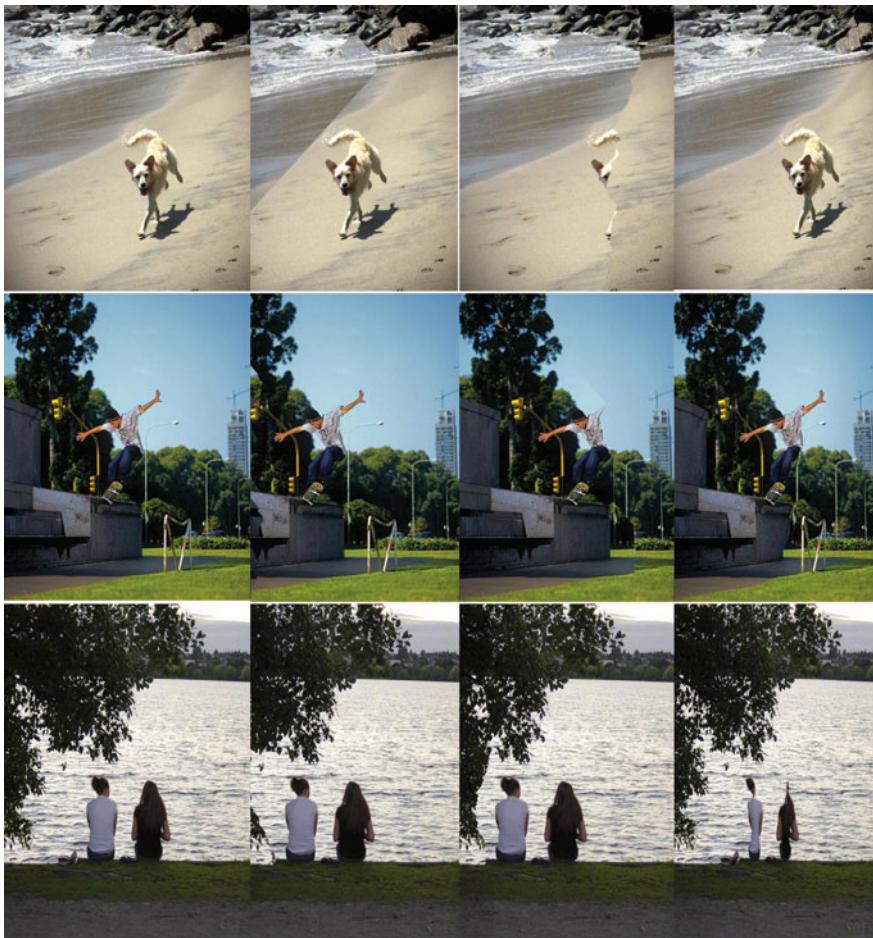


Fig. 1 Original image(s) and results obtained after removal of 100 seams from three different images using Canny, Laplacian and Sobel filters, respectively

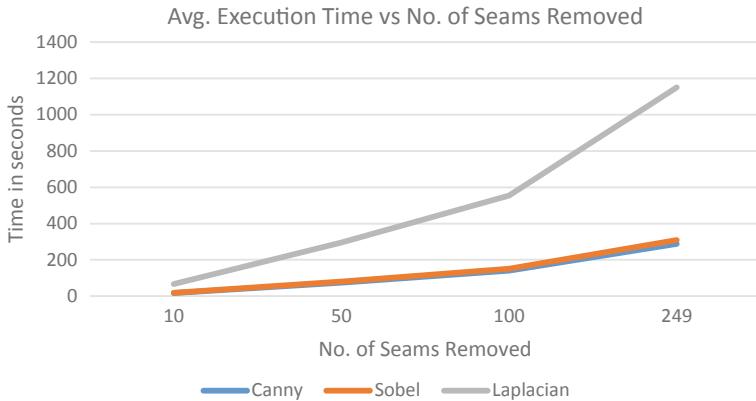


Fig. 2 Average execution time versus no. of seams removed for image size 500 * 500

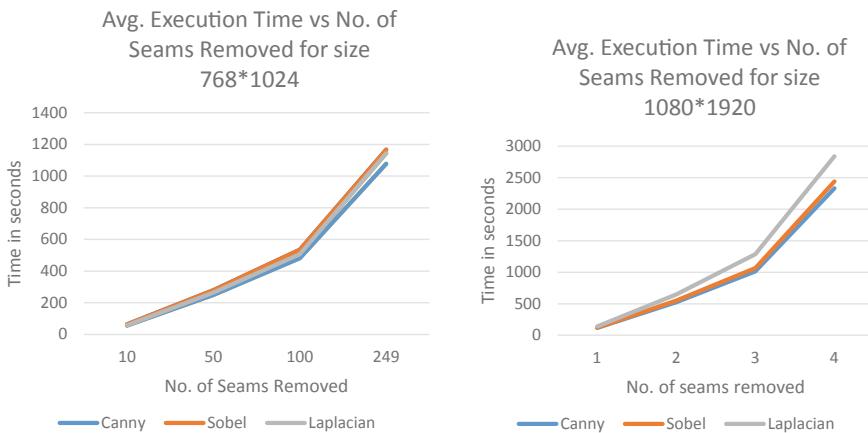


Fig. 3 Average execution time versus no. of seams removed for image sizes 768 * 1024 and 1080 * 1920 pixels, respectively

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Artificial Intelligence in Agriculture Sector: Case Study of Blue River Technology



Suraj Panpatte and C. Ganeshkumar

Abstract UN food and agriculture organization estimated that population will increase by two billion by 2050. Only 4% additional land will come under cultivation by them. The main income source in India is an agriculture sectors because more than 50% population depend on farming and related works, and hence, agriculture in India is a backbone for Indian Economy. So, improve traditional farming into precision or smart farming is needed; industrial development reaches to fourth level which is initiated to use this revolution in agricultural sectors on large scales so that it can be effectively utilized to improve the farming yield effectively. Nowadays, agriculture adopting advanced innovative technology for agriculture-based activities. In this research work, we have discussed how artificial intelligence changed the whole agriculture sectors in the context of business model, SWOT, and PESTEL analysis of blue river technology company. The study results found that main role of artificial intelligence in agriculture like precision farming, machine learning, demand forecasting will play key role in sustainable Indian Agriculture.

Keywords Agriculture · Artificial intelligence · Blue river technology

1 Introduction

The main income source in India is an agriculture sectors because more than 50% population depend on farming and related works, and hence, agriculture in India is a backbone for Indian Economy. So, improve traditional farming into precision or smart farming; industrial development reaches to fourth level is initiated to use this revolution in agricultural sectors on large scales so that it can be effectively utilized to improve the farming yield effectively. The fourth industrial revolution: Industry 4.0

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or IR 4.0 is defined as the cross cutting impact of information and communication technologies, especially the Internet of Things (IoT) in various industrial sectors translates itself into a phenomenon “Agriculture” is the backbone of national Gross Domestic Product (GDP). It is not giving only direct economic benefits but also facilitate better farmer lives. Technologies disrupt all sectors like IT, automobiles, pharma, food, and now agriculture [1]. This gap will fill by agri-tech startup. There is no biggest industry on our planet than food and agriculture, with a consistent, loyal customer base of 7 billion. The World Bank estimates that food and agriculture consist of around 10% of the global GDP which means food and agriculture would be valued at around \$8 trillion globally based on the projected global GDP of \$88 trillion for 2019 [2]. There are multiple issues in agri-food industry, and it is overcome by using technology like artificial intelligence, machine learning, computer vision and robots, and so on. Here, we have addressed the various problems in agri-food industry. Problems like farmer not getting better price, lack on market information, lack of crop disease relevant information, lack of assistance, less availability of raw material, customer satisfaction, defects in food product, traceability, etc. The biggest problem faced by unorganized agriculture is inadequate knowledge and information on the part of the farmers about what they should produce when agri-tech solutions like blue river technology offer a range of comprehensive solutions that touch every stage of cultivation [3]. The following research questions were addressed in this research paper: What is the canvas business model of blue river technology, what are the external and internal (strength, weakness, opportunity, and threats) dimensions of the company, what is current status of Political, Economic, Social, Technological, Legal, Environmental (PESTLE) analysis of the company, and what is the use of AI technology in agriculture industry [4].

2 Literature Review

For this study research, we have observed different types of review of the literature all are related to artificial intelligence in agriculture [5]. Majorly the literature review collected from secondary sources like journals, research paper, etc., it has been covered use, challenges, and operation of AI in agriculture industry. Based on this review, we have further discussed study work. Most of the literature review depends on use of artificial intelligence but for this study purpose, we have found their major finding. Jha et al. [6] nowadays every businesses or sectors need to adopt automation because of changing market, consumer demand, product portfolio, and number of competitor. In today's world, automation is everything for business. For example, in product manufacturing industry, they want to produce more goods but they cannot make because lack of trained worker and high labor cost. Zambon et al. [7] in this paper they have discussed how industry 4.0 revolution affects the SMEs. We know that agriculture sector are facing many challenges like climate change, pollution, etc.; in this paper, researchers presented the whole structure of industry 4.0 means there benefits and advantages in agriculture sector. At that time, in other hand, industry

has one step ahead than farming because already they are using automation and innovative technology [8]. Agriculture is foundation base of the country. Based on the data obtained, the agriculture industry added in US GDP around only 1% US this value up to 350 US billion dollars. We know that the agriculture industry are facing many threats and problem regarding the farm activity like lack of rain fall, untrained labor, minimum produce, etc., now this industry need to adopt technology for on farm activities. Roldán et al. [9] using of robotic tools in farming and its allied activities has been increased day by day. It has some of threats but we can overcome it in future [10]. This study suggested to the major strength and threat of robots in agriculture industry. These technological tools has already used in automobile, information technological companies, and pharma. In this study, we found that no one existing research work done on business model, SWOT, and PESTLE of agri-tech industry. This is main research gap of study. For this research, we have observed that existing review of the literature it only related to use of AI in agriculture industry [11].

3 Research Methodology

Research is the systematic design, collection, analysis, and reporting of data and findings related to a specific situation or problem. The objective of this part is to present the research procedure and methods that have been adopted for the achievement of the project objectives [12]. The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Research design of the study used an exploratory research design that means not having past data or only few studies for references. Sometimes this study is an unstructured. It serves as a tool for initial research that provides a theoretical idea of the research problem. Nature and source of data of study are qualitative means that in this study, data is not numerical in nature and data collected through methods of observation. Source of data in this study are primary and secondary. Primary means data collected from telephonic conversation by industry person, through observation method and unstructured method and secondary data gathered from company website, journals, newspaper, blogs, books, and research papers [13].

4 Results and Discussion

In this section, the results of the study are presented and discussed with reference to the aim of the study. We presents about business model of blue river technology followed by Strengths, Weaknesses, Opportunities, and Threats (SWOT) and Political, Economic, Social, Technological, Legal, Environmental (PESTLE) factors of the blue river technology. In this section, will see how business model helps to the

company and also discussed the products and services of the blue river technology. Blue river technology: It is US-based company work on agri-tech. Blue river technologies produce innovative technology for betterment of agriculture field and their activities. This company is solving the farmer problems and gives result-driven solution through their services, and the company was established in 2011 by Jorge Heraud and Lee Redde [14] (Table 1).

SWOT Analysis: The main elements of SWOT analysis are like strength, weakness, opportunity, and threats.

Strength: Co-founder of the blue river technology has been used company strength for developing niche types of market positioning. With the help of these strength, they have been completely minimized their weakness. It has been provided

Table 1 Business model of blue river technology

Key partners	Key activities	Value propositions	Customer relationships
<ul style="list-style-type: none"> • Hardware providers • Cloud computing providers • Pontifax AgTech • Texas University • BASF Company • The Stanford Linear Accelerator Center (SLAC) • Digital globe • DuPont • Adobe • Evolution robotics 	<ul style="list-style-type: none"> • Data collection • Plant identification using deep learning • Development of software • System of software • Data analysis • Machine design • Technology improvement • Industrial design • Development of automatic vehicles 	<ul style="list-style-type: none"> • It facilitates customer feedback • Taking decision based on crop problems • Development of automated machineries for precision farming • ML and computer vision applied in agriculture for solving the on-field problems • It helps for teaching machines how to farm helping farmer 	<ul style="list-style-type: none"> • Provide result-oriented solution • Environment-based Farming • Automation • Customization • Personalized help • Provide end to end help • Strong relation develops between team and farmer <p><i>Customer segments</i></p> <ul style="list-style-type: none"> • Farmer • Businesses (whose looking automation) • Agriculture based
	<i>Key resources</i>		<i>Key channels</i>
	<ul style="list-style-type: none"> • Robotic based see and spray machine • Software • Cameras 		<ul style="list-style-type: none"> • Newspaper • Letters • Digital tools • Team for direct customer support
<i>Cost structure</i>		<i>Revenue streams</i>	
<ul style="list-style-type: none"> • Costs of management • Software and hardware development 		<ul style="list-style-type: none"> • Sale of hardware system • Software data-based platform • Additional services • Machineries 	

to the company structure, rules, and regulation, lastly facilitate to created strategies to overcome threats.

Weakness: Weaknesses of the company are coming from lack of financial, human resources, successful experiences, and lack of physical resources such as land and building of the company, dissatisfaction of customers through some products, replicated of company business model, path records on environment taking care is not that much encouraging; some work wars are there within the several types of departments [15].

Opportunity: Expanding new market, increase standardization of the products means company can reduce number of un-demanded products and services from the market and only focused on most demanded products, expanding market size through customer preference, reduce the market entry costs, and Adopting advanced technology (AI) [16].

Threats: Political decision, changes of government policies on agriculture, technology, and environment, shifting of consumer preference, Local and national competitors, entry of new agriculture technology-based startup, market price fluctuation, international market pressure, governmental rules and regulations, day by day increasing bargaining power of customers and suppliers, economic growth instability in the home nation, and failure in supply chain [17].

PESTLE Analysis: PESTLE analysis of the business shows the present situation and scenario of the organization.

Blue river technology is working under the guidelines and policies of government as considering environment benefits. By using PESTLE analysis for blue river company to estimate external environment with assurances of product quality and safety.

Political Factors: Government regulation and policies — Regarding products and services of the blue river technology, role of non-government organization, local government bodies, continuous changes in government policies, taxation: will effect of total cost of business, support of government (monetary and regulation helps), and government stability impact on business activities [18].

Economic Factors: Gross domestic product of the country, rate of employments of the domestic country. Foreign Exchange (Fx), inflation rate of the nation. Interest rates effect on buying power of the consumer, Un-employment ratio of the country, and economic instability [19].

Social Factors: Consumer behavior toward products, social pattern, social trends, social awareness. Blue river technology is use consumer centric solution; company has been more customers oriented than product centric solution and Educational factors—hire talented peoples in the organization.

Technological Factors: Advanced technology and innovation, use of social media for promotional activity, blue river technology always improving their value chain structure, R and D, use of machine learning and AI implementation of technology into society and rate of technology acceptance in the nation [20].

Environmental Factors: Environmental factors affected on consumer preferences and government policies, influence of local environmental agencies, carbon emission rate also matter, standards and regulations on environment (national

and international licensed), waste management system (policies), CSR activities, more focused on renewable energy, and climate changes are the major factor of environment [21].

Legal Factors: Blue river technology has maintained all legal laws, consumer protection act, organizational authorities and laws, consumer health and safety laws of the company, data protection act—this law is every important for blue river company because this company gathering consumer data and further processed [22].

5 Conclusion and Implications

The business model is a blue river company's plan for making a profit, and it identifies the products or services the business which is selling, target market and the expenses it anticipates. Business model helps to identify key partners, all activity of the business, value proposition of the business, key resources, and main cost structure of the business based on that we can easy to find out external and internal strength of the organization. Blue river technology has been used company strength to developing niche types of market positioning. With the help of these strength, they have been completely minimized their weakness. Also found the PESTLE analysis of company and their impact on organizational growth. Academicians those who are interested in the research work, they can take this topic and more insight in the artificial intelligence in agriculture; based on this research work, policy maker can review their future policy decision making.

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Mapping of Agritech Companies in Indian Agricultural Value Chain



C. Ganeshkumar and Abrar Khan

Abstract This research aims to present the mapping of agritech companies operating in the Indian agricultural value chain. The research work is the first attempt to list out all the agritech companies. One hundred and sixty-three agritech companies have listed according to their area of operation in the agricultural value chain. Literature review on agricultural value chain actors has been done, and the research gap was identified from the literature. Agritech companies are operating or serving the ‘storage and trading’ and ‘distribution and retail’ in the agricultural value chain were found very less compared to other actors of the value chain. Hence, more number of agritech start-ups is essential for sustainable Indian agriculture.

Keywords Agritech · Agriculture · Value chain

1 Introduction

Census report 2011 says almost 70% of the Indian population comes from rural areas, and agriculture remains the primary occupation for more than 50% of the Indian community for their livelihood. With more than half a billion people engaged in the agriculture sector, it is still suffering from numerous problems such as (1) the use of outdated equipment, (2) lack of infrastructure facilities, (3) farmers lacking access to the full range of markets [1]. From the past few years, agritech start-ups in India are addressing agricultural value chain issues enhancing the market and infrastructure of the agriculture sector. Indian agritech start-ups are providing innovative solutions across the agricultural value chain, starting from weather prediction to sowing advisories to farm output through web portals. Farming as a service, big

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data analytics, market linkage models, and Internet of Things are the principal target segments of the majority of agritech start-ups. Agritech start-ups have been responsible for bringing innovation in the agriculture sector. This paper focuses on listing the agritech companies based on their nature of work or the areas they serve in the Indian agriculture sector [2].

Value chain mapping provides a framework to understand the factors and conditions under which agritech companies are operating and build a pipeline for various actors working in an agricultural value chain. Also, to recognize inefficiencies in the agricultural value chain that can be addressed with holistic digital solutions [3].

2 Literature Review

The agricultural value chain has majorly divided into six actors such as;

Farm Inputs → Land and Farming → Storage and Trading → Agriculture Processing → Distribution and Retail → Consumers.

Reported definitions from the literature review: Agritech is defined as ‘a segment of companies using technology in the field of agriculture, leading to an increase in productivity, efficiency, and output. Agritech can be applied across the agricultural value chain and can be in the form of a product, a service, or an application’ [4]. ‘A value chain is an economic system that consists of all distribution and supply itineraries used by all producers who aim to sell a similar family of goods competing on the same consumer market’ [5]. Agriculture value chain refers to a full range of activities and flow of products, information, and money that aim to add value to a raw agricultural product and link farmers to end consumers [3]. Various researchers have projected different models for various agricultural produce. All the previous literature addressed only some specific regions like agri-food supply chain management [6], agriculture supply chain [7], agriculture, and food value chain [8]. However, none of the authors compiled all the agritech companies of the agriculture value chain in their studies to date. Hence, it is essential to study and understand how agritech companies are operating under different value chain actors. Also, the purpose of the literature review is to collect and analyze a significant amount of information on various aspects [9].

3 Methodology

The best economical and productive way to conduct any research is by use of the internet and other scholarly databases. There is also vast information available on the internet, which is not authentic, non-effective, and non-reliable. Therefore, Google scholar is used to searching for research papers. Initially, ‘Agritech in India’ was used to search for quality papers. After that, some other keywords, like ‘agriculture value chain,’ ‘Agritech companies in India,’ ‘Agtech,’ and ‘Value chain mapping,’

have used to search for research papers. The purpose of this study is to list out agritech companies that are operating in the Indian agricultural value chain. Hence, the proposed research design is descriptive. The secondary data has derived from critical informants through consultations with national stakeholders of value chain actors, news articles, ministry reports, and other online databases. The list of agritech companies operating in India was prepared by referring to various secondary sources such as the National Association of Software and Service Companies (NASSCOM) reports, agritech India reports, companies' websites, and other online databases [10].

3.1 Value Chain Mapping Analysis

'Value chain map graphically illustrates all the actors, and the relationship between them, of the selected value chain. It is a visual tool to understand how a particular industry or sector works. The value chain map also demonstrates how a product in the industry moves from raw material through production, processing, distribution, and other steps until it ends up with the final consumer. The level of details in the value chain map can vary from basic to highly comprehensive components' [11]. One hundred and sixty-three agritech companies were listed according to their area of operation in the agricultural value chain. Figure 1 represents the number of agritech companies operating under different actors of the agriculture value chain in India. 'Combination' column represents the agritech companies that are serving more than one value chain actor in the agriculture sector [12] (Fig. 2).

Farm Inputs [13]: Evaluated the present structure of agricultural inputs marketing in India and also to study the challenges and difficulties faced by farmers and input suppliers in India. Data collected for this study is from secondary sources like research

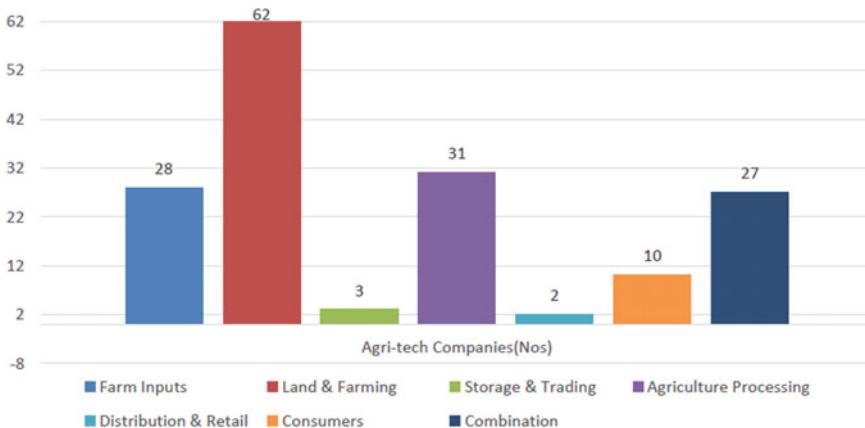


Fig. 1 Shows the number of agritech companies operating in the agricultural value chain



Fig. 2 Agritech companies segregated according to their area of operation

papers, books, documents, etc. Findings represent that the government should introduce policies and programs to address the problems of marketing liberalization and to overcome the limitations faced by various organizations involved in agricultural marketing [14]. Studied the economic impact of the agriculture industry on the farming economy and to set up the formation of most suitable agrarian policies. (Farm Business survey) Data from a sample of 52 farms were collected to examine the territorial distribution of inputs and outputs. Results show a significant linkage between the farms and their locality, especially for the small farms.

Land and Farming [15]: Explored to determine why Indian farmers are not assessing information and also where the information gap exists. This paper reviews some of the critical agricultural extension programs by considering their ability to facilitate information sharing and use in the farming community. The result of this analysis concludes that there is a need to work in collaboration and to share knowledge and skills to meet the information needs of Indian smallholder and marginal farmers [16]. Explored to study the farmers' conservation behavior using a structured social-psychology model. Responses from 100 farmers of Bedfordshire were collected and analyzed to identify the fundamental determinants of behavior and to understand farmers' attitudes. Results depict that conservation-related issues more influence farmers accompanying greater environmental awareness and farming and wildlife advisory group members [17].

Storage and Trading [18]: Researched on grain storage facilities management in India. Grains production in India has firmly increased due to technological advancements. However, the loss at the post-harvest stage is still constant at 10%, and losses at storage and accounts level are 6% due to the non-availability of appropriate

storage facilities. The government has taken initiatives to build depositories for long-standing and secure storage facilities for grains. However, the literature available on the behavior of grains at the post-harvest.

Level in India was very less. This creates a need for more research to develop proper guidelines for safe storage [19]. Examined the impact of the free trade agreement (FTA) of agricultural products like fisheries, coffee, and tea. Previous literary work is reviewed after that trade values, historical trends of production, prices, and tariffs were identified. It has also investigated the position of these items in ASEAN's tariff liberalization program (TLP) to evaluate if producers of India will get an equal opportunity for preferred market access or not. Case studies on fisheries, coffee, and tea about FTA were analyzed, and findings summarize the opportunities and threats for Indian producers [20].

Agriculture Processing [21]: studied the emerging trends of agriculture processing in India. The challenge of how to improve the capacity of agro-industries to efficiently convert a part of the output to a value-added product that is acceptable domestically and internationally. It is also an employment generation process for different types of skills, such as packaging, food processing, sorting, grading, transporting, and distribution [22]. Researched to study the challenges and opportunities of the food processing industry in India. The agricultural base of India is very strong, but the processing of food products is deficient, and the wastage is very high. The processing of food to comestible standards in India has reached only 10%. The conclusion presents the strengths, weaknesses, opportunities, and threats of the agro-processing industry in India. It also says that the challenges should be addressed to achieve the possible growth of the industry.

Distribution and Retail [23]: explored the challenges of food production and distribution in India. The pressure of exponentially growing population, changes in climatic conditions, land for cultivation, the government policies on public distribution, marketing of food grains, etc., are the factors responsible for restricting the availability of food. The situation has to be fixed, and people should get the assurance of food security. This review summarizes different strategies for production, distribution, and accentuates the need for a second green revolution [24]. Explored to understand the nature of the link between the emerging food retail sector and small-holder farmers in India. Both qualitative and quantitative research methods were applied. The quantitative focused on data collection from 263 producer companies through a structured questionnaire. Qualitative research was carried by interviewing 60 experts of producer companies, modern retail companies, etc. Results conclude that there is a scope for producer companies of India to become a part of modern retailers' supply chains [25].

Consumers [26]: Examined consumers' willingness to pay (WTP) for organically cultivated fruits and vegetables and the factors involved for consumers' WTP. For the estimation of consumers' WTP, a contingent valuation method was used. A survey conducted in Bangalore and empirical data were collected from 250 consumers. Also, a binomial logistic regression model has applied to get the values of consumers WTP and to determine the various factors influencing it. Results indicate that 90% of consumers are willing to pay high-price range between 5% to above 100% to acquire

organic fruits and vegetables. Various factors that significantly influence consumers' WTP are the gender, size of the family, family income, and other variables such as chemical contents in conventional foods, taste, trust in retailers, and environmental concerns [27]. Conducted a study to investigate factors determining consumers' actual buying behavior towards organic foods [28]. Data was collected from 611 Indian consumers with the help of a structured questionnaire by survey method. Independent t-test, factor analysis, analysis of variance (ANOVA) hierarchical multiple regression, and multiple linear regression methods were used to analyze the data. Results confirm that subjective norms, knowledge, health consciousness, and price are the four factors that influence the consumers' attitude towards the procurement of organic food products [29].

4 Conclusion and Future Implications

The review focuses on the research contribution of various authors, and the findings from the current study are as follows. Agritech companies are operating or serving the 'storage and trading,' and 'distribution and retail' in the agriculture value chain were found very less compared to other actors of the value chain. Hence, more number of agritech start-ups is required, especially in these two areas, to make the agriculture sector more efficient, inclusive, and resilient. The government should initiate more number of policies and schemes, especially for the above two agricultural value chain actors. Researchers can come up with innovative ideas for the storage and distribution of farm products (for example: how to increase the shelf life of perishable products, etc.). For new entrepreneurs, there is considerable scope and value to work in this area and to fill the gap that exists among the various actors of the agricultural value chain. There is a need for more number of agritech start-ups in all the sectors of the agriculture value chain to meet the increasing demand of drastically increasing population and decreasing resources for food and agriculture sector.

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An Advanced Approach for Link-Based Spam Detection Using Machine Learning



Sourabh Bhaskar , Bhupendra Ramani, and Warish D. Patel

Abstract A great deal of research has been done to discover highlights, which could classify spam. Many have tried to include content-based features to get accuracy. Although the results were positive, the overhead of extracting the content-based features was high and complicated too. This work focuses on finding structural elements of a web graph containing URLs of a domain, to replace the content-based features. The purpose of this work is to discover less complicated features that could expand the precision and decrease the weight on the search engine's computation. The obtained results demonstrate that even though the issue cannot be disposed of yet, a ton may as of now be done to improve the search engine's response to user-submitted queries. The result produced from our approach has an F-Score of 0.9829 and an accuracy of almost 99%. This shows that the link properties of a web graph could tell us a lot about the nature of the web itself. Combining this approach with content analysis could give rather great results.

Keywords Spam detection · Link farming · Machine learning · Logistic regression · Web graph · PageRank

1 Introduction

Web spam has long created a problem for the search engine industry. This problem has occurred only because of the nature of clients who only are interested in links displayed on the top of the result generated by the engine. It is not rocket science to

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know that the more traffic one's website gets, the more revenue a website could get in terms of sales profit, ads, etc. Therefore, to get such economic benefits, one would want their website to be topped by search engines. Due to this particular reason, many website operators try to manipulate their ranking by using non-ethical ways of search engine optimizations [1]. Adding extrinsic pages that link to the destination page is one such technique. Using link filling, one can raise the target page's ranking in search engines. The content of the page can also be changed in a way to increase the rank of a website. Keywords that are trending, or which customers use most during the search, can also lead to an increase in website rank. The only reason for implementing such gray-hat techniques is to boost their rank to increase traffic. A system is required to filter out spam links effectively, so the clients get the desired search result. Web spam is classified into two categories, which are content-based spamming and link-based spamming.

Content-based spam is implemented by increasing the frequency of the essential terms on the website. Spammers try to understand the vulnerability of the search engine's model and shape the content of the target page [2]. Typically, title spam, body spam, meta-tag spam, anchor text spam, and URL spam are five subtypes of content spamming depending on the structure of the web page.

In general, outgoing and ingoing are two types of link-based spamming techniques. Outgoing link spam, spammers links the outgoing links from the target page to high-ranking websites, which makes the engine think that the target page will also belong to a group of top-ranked websites. Whereas in ingoing link spam, we link incoming links to the target page of a dense web of interconnected links (link farm). By doing this, the outcome of the target page will grow.

2 Literature Survey

The web has become an essential tool in our daily life. It is the place where one can find information, products and services, and many more things. In order to find something in a vast space like the web, the search engine plays an important role. Search engines are the “dragons” that hold a precious treasure: information [3]. Most of the traffic a website gets is through the search engine. It is seen that a user prefers to click a link from the first five links only. So, there is a competition to be in the prime list of the search engines. The authors for [3] have shown approaches like supporter estimation to detect spam. They say the node with higher support nearer to it could be spam as it could use link farming to gain PageRank [4]. Beccetti et al. [5] have stated an approach for detecting link farms using an improvised PageRank technique called truncated PageRank. It removes the support of links nearer to the node by ignoring them in the calculation of the PageRank, thus eliminating the help of the link farm if any. The authors of [6] categorize link-based spamming into these five groups of label propagation, link pruning and reloading, graph regularization, feature-based and label refinement. Finally, they compile the pronouncements and underlying principles applied for web spam exposure. Web spam exposure research has gone through a

few pages: rising from simple content-based approaches to complex link mining and user behavior mining methods. In addition, existing anti-spam algorithms have shown an aggressive performance in detecting about 90%, showing the promising results of many researchers. Another improvised page ranking technique suggested was TrustRank [7], which worked on the theory that “Good pages will support Good pages,” that is, no right page will have a link to the wrong page. So, this algorithm tends to isolate the right pages from the crazy pages.

3 Materials and Methods

3.1 Web Graph

It is the graph representation of any portion of the web, where each node represents a page, and the hyperlinks between pages are the edges. Formally, we have a graph $G = (V, E)$ consisting of a set V of N pages and a set E of directed links (edges) that combines pages.

3.2 PageRank

Search engines, before the idealization of PageRank by Larry Page and Sergey Brin (Google Founders) [4], used to calculate the importance of a page by looking at how many words match those entered by a user search query. The idea was the same as in classic IR system: counting the number of the link that pointed to a page should suggest its importance. As in [4], the intuitive description for PageRank is: “a page has high rank if the some of the ranks of its backlinks are high. This covers both the case when a page has many backlinks (in-links) and when a page has a few highly ranked backlinks.”

Let φ be a damping factor between 0 and 1 (typically 0.85), as suggested in the original PR’s proposal, used for normalization, and the following equation can express the above description

$$r(p) = \varphi \sum_{q:(q,p) \in E} \frac{r(q)}{o(q)} + (1 - \varphi) \frac{1}{N} \quad (1)$$

The equation is recursive so that standard reinforcement occurs between pages, where the value of a particular page is affected and the importance of some other pages. It can be iterated by starting with any set of calculations and computation until it changes. It usually happens that the ranks are initialized equally ($1/N$), and the number of iterations is set instead of waiting until it converges.

3.3 Truncated PageRank

The truncated PageRank [5] is a somewhat modified variant of the PageRank algorithm to avoid the impact of a special kind of link-based structure commonly used by spammers to lure link-based ranking algorithms such as PR: link farms—densely connected sets of pages. For a better understanding of what a link farm is, a comparison between a standard link structure and a link farm is made in Figs. 1 and 2.

“Link farms can receive links by buying advertising, or by buying expired domains used previously by legitimate websites.”

Studies presented in the original paper have shown that, usually, extremely ranked pages have a huge number of followers from a farther distance in the web graph, while under-ranked pages do not. Spam pages participating in link farms will not follow this rule.

Formally:

Fig. 1 Normal link structure of a group of web pages

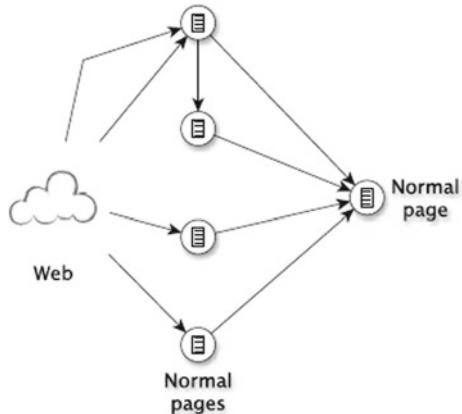
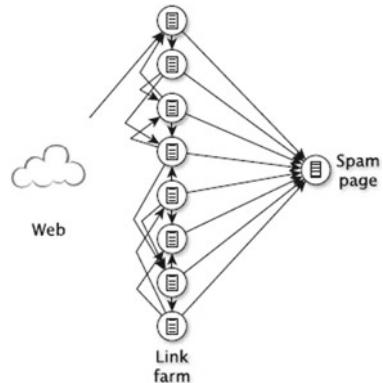


Fig. 2 Link farm



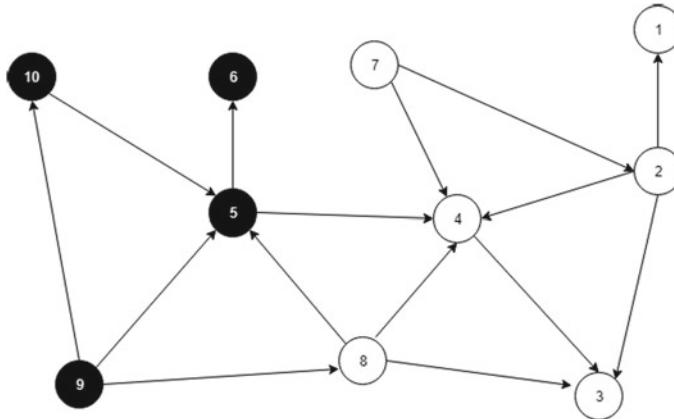


Fig. 3 Web graph example—proper pages in white, bad pages in black

$$R^{(0)} = \frac{C}{N}$$

$$R^{(t)} = \varphi R^{(t-1)} U$$

And the truncated PageRank is calculated using:

$$W = \sum_{t=T+1}^{\infty} R^{(t)} \quad (2)$$

3.4 TrustRank

Let us call the non-spam pages “*good*” and the spam pages “*bad*.” Given the set of pages of the web graph from Fig. 3, where the proper pages are in white and the bad pages in black, let us suppose we do not know the quality of all of those pages, just from a small portion of them. A sample of pages, called “*seed*,” which was previously labeled by humans as “*spam*” or “*non-spam*.”

3.5 Assortativity

The coefficient of the level of a page divided by the medium degree of both its in-neighbors and out-neighbors. The degree, in this case, is undirected. The first step is to calculate the degree of every page by adding out-degree and in-degree each of them. Then, the average degree of the neighbors of every page is then computed. Finally,

the rate among the degree of every page and the medium degree of its neighbors is then calculated. If the average degree of the neighbors of a page p is equal to 0, it also means that $\text{degree}(p) = 0$. In this case, an assortativity of 1 is given.

3.6 Average In-Links in Out-Neighbors

For a page p ,

$$\text{ave}_{\text{in}_{\text{out}(p)}} = \sum_{q \in (p,q)} \frac{i(q)}{o(p)} \quad (3)$$

The average in-links in out-neighbors computation is doing by simply passing over the graph and adding up the ration between the in-degree of the out-neighbors of a p and the out-degree of p .

3.7 Average Out-Links in In-Neighbors

For a page p ,

$$\text{ave}_{\text{out}_{\text{in}(q)}} = \sum_{p \in (p,q)} \frac{o(p)}{i(q)} \quad (4)$$

The average out-links in in-neighbors computation is doing by only passing over a graph and adding up ration between the out-degree of the in-neighbors of a p and the in-degree of p .

3.8 In-Degree and Out-Degree

The out-degree of every page may be found with a simple call to a method from the WebGraph. The in-degree is found by passing through all the out-neighbors of a page and adding 1 to its in-degree variable.

3.9 Reciprocity

The part of the out-links is also in-links of a page. For instance, if a page p has five out-links, and three of those out-neighbors links back to p , reciprocity $(p) = \frac{3}{5}$. If p has no out-links, reciprocity $(p) = 0$.

To calculate the reciprocity of every page in a graph, it is necessary to follow the links in the chart and check if there is a “*backlinks*” for each of them. So, for each link from page p to page q , if there is also a link from page q to page p , $\frac{1}{o(p)}$, it is added to the reciprocity of p .

3.10 Average Distance

Average distance is distance where the count of neighbors is the maximum. It can be calculated using the following formula:

$$d = \frac{1}{\text{total reach}} \sum_{h=1}^{h=1} h * \text{dist}(h) \quad (5)$$

4 Dataset

The dataset used in this work is the **WEB SPAM—UK2006** [8] collection detailed in [8]. It is a snapshot of the .uk domain pages that was made in May 2006. The pages were crawled using UbiCrawler in Breadth-First-Search, searching over 190,100 URLs in 150,000 hosts of .uk domains listed in the Open Directory Project [8]. With such procedure, the collection includes 77.9 million pages from 11,402 hosts, and over 300 billion edges.

The available files are:

“uk-2006.05.hostgraph.txt.gz” (1.9 MB): A text format graph was each line is formatted as regards: “src \Rightarrow dest₁: nlinks₁, dest₂: nlinks₂... dest_k: nlinks_k” in which src is the reservoir host, dest is the target host and nlinks the number of the page to page links within the two hosts.

“uk-2006-05.hostname.txt.gz” (97 KB): contains one URL per line, sorted lexicographically: which is also same node accesses order when using graph, the first URL is recognized with the number 0.

From the uk-2006-05.hostgraph.txt.gz, we create a graph with node as a key and its out-neighbors as list of values to that key. The distribution of the human labeled classes to the host pages are as follows (Table 1).

Here, we can see that the dataset contains some nodes with class as undecided. To keep the dataset with just the spam or normal classes we have removed the pages

Table 1 Class distribution

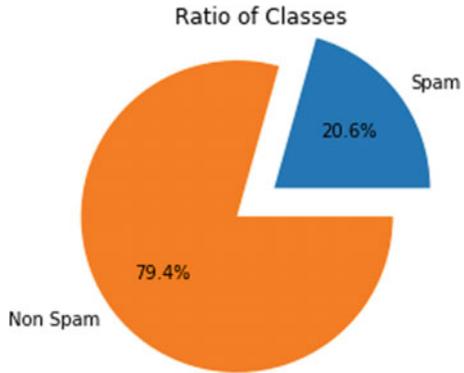
Class	Count
Normal	8123
Spam	2113
Undecided	426

with the status undecided. So now we have only two classes in our dataset that is normal (79.4%) and spam (20.6%). The attributes are computed using the algorithms mentioned in the research methodology section. Some extra attributes were also added such as ratio between two columns, logarithmic values of the columns so as to make easy for the classification model to converge properly.

After the dataset was ready, we needed to divide the dataset into two parts, training set and testing set. For the splitting, we choose the ratio of 7:3 for training and test set, respectively.

5 Results and Discussion

The class distribution is shown as pie chart in Fig. 4. After applying the classification model, the metrics found are shown below. The confusion matrix which shows the true-positive (correctly classified as spam), true-negative (correctly classified as normal), false-positive (incorrectly classified as spam) and False-Negative (incorrectly classified as non-spam), is shown in Table 2.

Fig. 4 Ratio of classes**Table 2** Confusion matrix

		Prediction	
		Spam	Non-spam
True label	Spam	635	5
	Non-Spam	2414	17

The above-mentioned values in the table is of the test set which is 30% of the dataset used. Evaluation measures based on the confusion matrix are as follows:

- Accuracy: 0.9928
- Precision: 0.9921
- Recall: 0.9739
- *F1* score: 0.9829

From the above reading, we can say that our model can correctly predict the class of the node up to 99.28%. And the *F1* score of 0.9829 proves both the precision and recall are very accurate.

6 Conclusion

In this work, we propose a link-based way to identify spam web pages. We have combined the link-based techniques of personalized PageRank such as truncated PageRank, TrustRank, and graphical properties of Web Graph such as assortativity, reciprocity. To classify web pages as spam or non-spam, the dataset chosen for this purpose is of Web SPAM 2006 of 11,402 pages. The result produced from our approach has an F-score of 0.9829 and an accuracy of almost 99%. This shows that the link properties of a Web Graph could tell us a lot about the nature of the web itself. Combining this approach with content analysis could give rather great results. Further work could be done in computing the dataset with parallel computing to reduce the computation time.

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A Comprehensive Survey on Emotion Based Health Prediction Using Internet of Things and Machine Learning



Aartidevi S. Rathor, Kirit Modi, and Makhduma Saiyad

Abstract The Internet of Things (IoT) marks clever objects the last word structure blocks interior the time of computer-generated right persistent contexts. The IoT carries a type of utility fields, alongside health care. The IoT revolutions is restructuring stylish fitness care with talented scientific, financial, and then common views. This article studies progresses in IoT mostly generated health care technologies and analyses the progressive community planning/platforms, applications, and engineering trends in IoT-based fitness care solution. There are some Objectives-to check the user's health details and update to Server via an advanced Internet of Things [IOT] and the Care takers or other persons can immediately check the patient's condition without any hidden activities, reduced duplication of diagnostic testing. Emotion is a strong instinctive and intuitive feeling in people who arise from one's situations, circumstances, mood and dating with others. So, emotions are a mental state of person which cannot be stopped. Thus, Emotion Recognition is an important challenge when speaking about human-system interplay and to doing the evaluation and controlling of feelings. Emotion can be detected using many strategies like facial expressions, speech, body gesture and mental signals. We have used facial expression based on total health emotion identity approach.

Keywords Smart health care · Internet of things · Health network management · Good care contexts · Remote observance

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1 Introduction

With the Internet-of-Things (IoT), the gadgets can sense, and use IPs to talk among themselves and share knowledge about their environment any time from any area. Wireless sensors network (WSN) is considered alongside of key technologies of IoT and is widely applied in varied regions like useful resource structures, surroundings all observance structures, structural fitness observance (SHM) structures, etc. As a novel set up, IoT has quickly emerge as a stunning subject for researchers and industries. Its integration into observance structures like SHM are getting high-quality to Industries, businesses, consumers, environment, people, and society. The concept behind SHM is to assemble data from multiple sensors placed on structures and so on techniques and to extract useful knowledge about the current state of the structure for maintenance and protection purpose (Fig. 1).

Apart from the capability of IoT on such systems, the quantity facts know-how of statistics sampling which can be accumulated from structures that are huge and complicated which is tedious to apply in the best statistics management systems. To discuss and technique such statistics, therefore emergence of huge technologies, which can be used to store and method huge observance data.

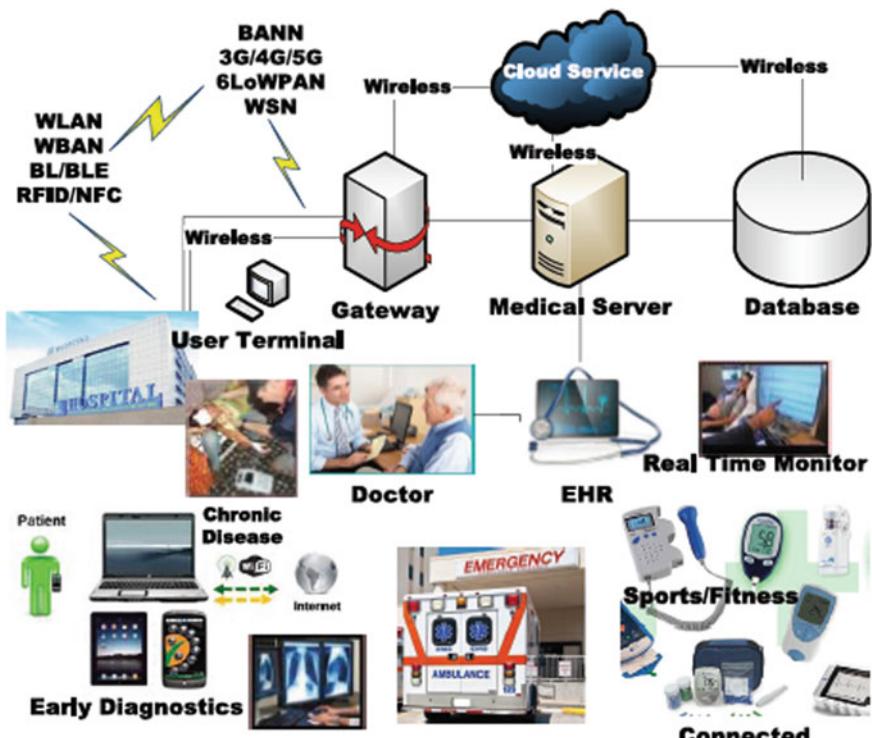


Fig. 1 Healthcare trends [1]

2 Existing Methods

In the medical IoT, there are units associated with huge type of sensors accustomed to observe patients, location of hospitals, and conjointly the environments of medical policies. The amount and form of these devices vicinity unit is extensively big. Medical IoT strategies have the traits of small energy intake to create positive energy used for accomplice diploma prolonged interval as a consequences of sensor they cannot replace the battery or price often times [1] (Fig. 2).

Here are some benefits of exploitation NB-IoT in smart hospitals. (1) The advanced skill: NB-IoT can offer billions of connections Associate in Nursing join tens of hundreds of customers in an extremely only region, which can meet the affiliation necessities of package in clever clinics. (2) The broader coverage: study with the cutting-edge cellular system, NB-IoT can increase a 20 db+ connection price range that substantially improves its perception capability then permits to very desirable for the instrumentality affiliation of clinics' structures and cellars. (3) The subordinate electricity ingesting by a battery-operated lifestyles above 10 years, that is improbably perfect for the plans like wearable gadgets that consume very little dimensions. (4) The worse rate: the worth of every unit might be a smaller amount than five bucks, that can much decrease again the really worth of disposable instrumentality.

IOT packages devour info about physical and simulated gadget things. This data, from different bases like devices, social media, or uniform automatically succumbed with customers is rare and yelling desires technique by way of packages to be cleaned then purified into practical info (Fig. 3).

Also, from the computer file, applications should excerpt perspective: high-stage inattentive facts. Now, environment tends to human-centric groupings (e.g., Position, action) that vicinity unit necessary to various entirely diverse sets [4].

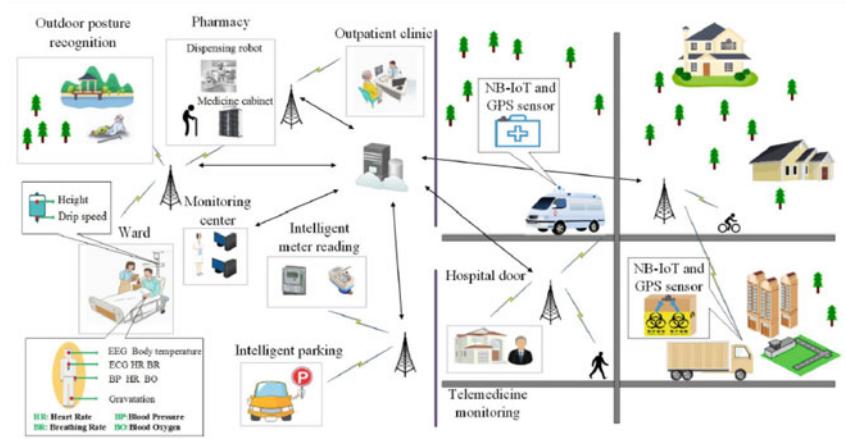


Fig. 2 Smart hospitals exploitation NB-IoT [2]

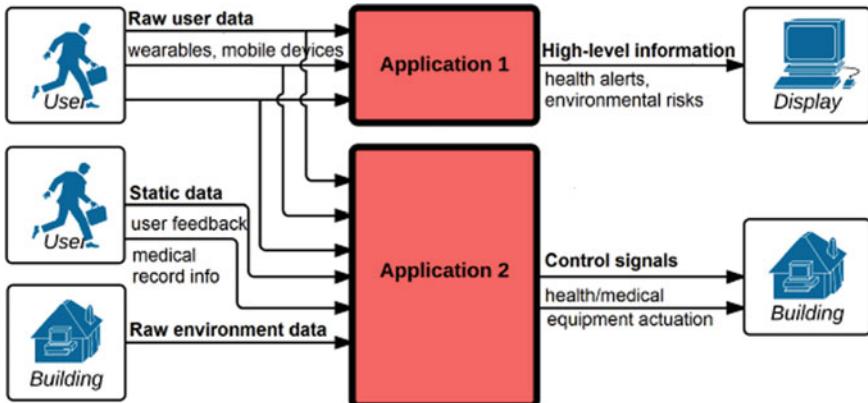


Fig. 3 Monolithic MIMO implementation [3]

Black-container executions of packages from information to output cover every kinds of method output (pre-processing and normal middle environment) from different packages that results are idle in working out. Our suggestion is an order of purposeful devices in place of huge applications trades off density for state. A hierarchy technique breakdowns one utility into a couple of purposeful units, increasing structure great. While specializing the method able to growth potential if a very compact rule became distended, it can also show midway output for use through different uses, hence decreasing cypher severance most of the organism. We have inclination to before attempted that such associate approach decreases average cipher nice as well as recovers organism fine for procedure that beats 2nd-order complex (please see past work for heaps of details [5]). For example we have a tendency to suggest in our case studies later at some stage in this article, even the sole applications top quadratic best device learning maintenances. We have inclination to boot offers a shut investigation of shielding the truth exploitation in our previous study [5]. To boot, cacophony single-step programs into very little fixed devices (every with less inputs, easier logic) helps a general data alteration over gadget gaining knowledge.

In 2016, Ahmad et al. [2] projected a framework for interest remarked as Health Fog at some stage in that fog layer applied as partner negotiates layer between cloud and conjointly the give up users. Authors in particular centered on improving and flexibly dominant the information privacy troubles in concern systems. To boost the device protection, cloud assess security broker (CSAB) included with Health Fog. Moreover, scientific field primitives have been also revealed to increase the software of the Health Fog. In 2016, Nandyala and Kim [6] conferred partner issue test of IoT primarily-based healthcare commentary gadget. This style in particular nervous on blessings of Fog computing that interacts lots of serving closer to the sting at smart Homes and sensible Hospitals. In 2015, Gia et al. [7] projected associate exaggerated cloud-primarily-based Fog ADPS all through that bio-signals region unit analyzed at the fog server aspect for real-time applications. In 2017, Negash et al. [8]

centered a sensible e-health entree application to use among the fog computing layer. They loaded particularly on connecting a network to such gateways, each home and health facility use. Moreover, choices of the entree in fog implementation region unit mentioned and evaluated. In 2017, Rahmani et al. [9] used the idea of Fog computing in interest IoT systems. Associate negotiate level of intellect printed between tool nodes and cloud. An epitome of a wise e-fitness entree conferred for implementation. They also implemented partner IoT-based first caution notch (EWS) health statement to abundant appearance of the device via addressing a medical case study (Fig. 4).

The electrocardiogram detecting network is the basis of the system, it really accountable for assortment physical info from the body surface and transmission. These facts to the IoT cloud thru a Wi-Fi network. Wearable ECG sensors rectangular degree generally accepted during this method which have little or no effect at the user's day by day normal life. It means, ECG info recorded over lengthy hours or perhaps days. Then, the ECG signals rectangular degree handled via a chain of processes, like reduction, filtering, etc., to enhance the signal great and to fulfill the desires of wireless broadcast (Fig. 5).

The ECG data collected from sensors square measure convey to the IoT cloud via a selected Wi-Fi protocol, e.g., Wi-Fi, Bluetooth, Zigbee, etc. All the 3 protocols can give enough information costs for transmission ECG signals with adequate power consumption. Although, the restricted communications stages of Bluetooth

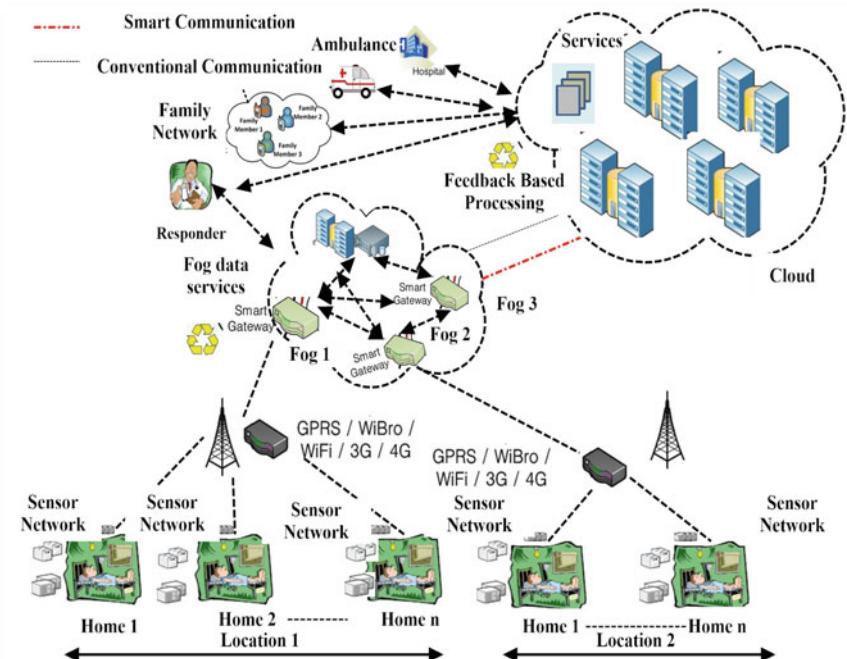


Fig. 4 Fog computing primarily-based patient observation in sensible homes

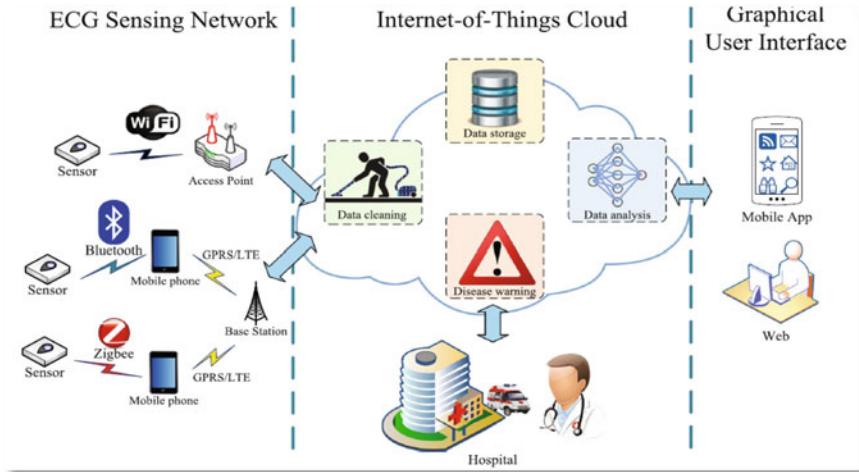


Fig. 5 IoT-based ECG observation systems [7]

and Zigbee, a smart fatal (together with a cellular phone) is normally had to get hold the ECG data then ship the facts to the IoT cloud via the wireless protocols of the last Packet Radio Service (GPRS) or longer term Evolution (LTE). Comparisons amongst varied sorts of ECG.

3 Literature Survey

In [4] authors had planned accomplice degree encephalogram (EEG) to apprehend the fame of sufferers that would love a different carefulness offers a vital comments for close helped Alive. They deliver partner diploma EEG-based feeling recognition method to find the spirit of patients. Their planned method had combined riffle energy, adapted energy, riffle entropy and applied math options to categorize four feeling states. Completely extraordinary classifiers had been recycled (quadratic discriminate study, K-Nearest neighbor, and guide vector technologies) toward capture a sensation of users strongly. The novel method remained examined supported the electroencephalogram information “DEAP” victimization four electrodes. It demonstrations excessive show as related to present systems.

In 2017 Oh, Kyo-Joong had deliberate chatbot for psychological attention. The chatbot supports psych iatrical course in negotiations. The facility connects with a user over negotiations and behaviors psych iatrical route. To know the negotiations and acknowledge user’s feeling, the provide put on severe feeling intellect methods: a multi-modal emotion reputation from voice communiqué gratified, inflection, and face look, companion degree smart equal like psychiatrically case-based intellectual and long observation, and morals decision, etc. The strategies alter non-stop

remark of person's emotion ups and downs delicately. In addition, the helpfulness of direction receives higher, at that moment the fulfillment to customers United Nations organization would love intellectual kingdom care can improve.

Hossain, 2017 had deliberate associate diploma feeling-aware related attention device using a powerful emotion detection module. Completely different IoT gadgets are wont to capture speech and image indicators of a patient in a completely sensible home state of affairs. These indicators had been used because the repose to feeling detection module. Speech and photograph signals are process one with the aid of one, and classification rankings victimization these signals have coalesced to give a very last score to need a call about the sensation. If the feeling detected as pain, caregivers will go to the patient. Many experiments performed to confirm the planned gadget, and smart inaccuracies, as much as 99.87%, have executed for feeling detection. The deliberate framework would substantially give customized and seamless emotion-aware fitness care services toward 5G.

In 2019, authors had planned a way as a layer-primarily-based layout for method sensing detail information (e.g., the guts rate companion degree facemask structures) to discover and categorize the user's spirit in a Health smart houses atmosphere. The outcomes show a layer primarily established layout used for process lets in a stronger carrier load supply seen of the completeness of every formulation and the handling energy of every layer of the design. The outcomes display the formula for the guts price continues a continuing and small reaction period, although the formulation for the feeling identity through the face is more vulnerable to linear boom betting on the level of requests in every layer of the design. Therefore, with relation to the technique control, it is far mounted that layer of design will be great desirable for closing the method since it's going to deliver a response in a very timely way for any moderately intervention.

Authors of [6] reviewed fifty 3 papers on deep learning techniques implemented to health-care applications supported physical signs. The study turned into meted out in 2 distinct steps. The primary stage became biometric key-word evaluation supported the co-occurrence chart. This exploration phase well-known shows the affiliation on the issues coated happening the studied articles. They show 4 different groups, one for each physical sign. That result helped us. To assembly another exploration phase that efforts on the article contented. For example, the article content turned into hooked up via removing the unique use space, the bottomless getting to formula, device act, and the styles of dataset wont to improve the system.

(Alhussein, Musaed 2016) had deliberate associate diploma feeling recognition gadget from expression victimization used for a Healthcare machine. Within planned gadget, a fixed face appearance is split into several chunks. A multiple scale WLD stays carried out to every of the chunks to get a WLD bar chart for the picture. The many boxes of bar chart remain originate by victimization Fisher judgment quantitative relation. Such box standards set up caption of face. The expression caption remains before enter to an aid route device founded classifier to reputation the feeling. 2 publically provided database used in the experimentations. New effects show that the deliberate WLD-based system realizes a certainly great popularity ratio,

wherever the first-rate reputation correctness grasps up to 90 nine.28 p.C simply for Cohn–Kanade information.

For next aged health-care systems [8] authors had planned a wearable two fitness-care device to enhance QoE and QoS of succeeding technology attention system. Within the planned system, drip-dry practical wear, devices, conductors, and cables, stays that the vital detail to bring together customers' functional information and get hold the study consequences of customers' health and emotional standing supplied by cloud-based device intelligence. Within the planned device, the user's physiological records changed into unconsciously calm, and personalized fitness-care services are big information analytics on clouds. Moreover, this article had given system design, beneficial parts, and the fashion details of sensible put on supported a wearable two attention system. Finally, a tested with severe compelling conditions are given to confirm the practicability of the deliberate design.

In [9] planned will software of understanding technology in fitness care supported the analysis of several thoughts and expressive study approaches. The risk of feeling and expressive estimate in mental picture of medical facts and patient's anamnesis is given at some point of this article. So, companion diploma combined read of understanding mining, information analytics and statistics mental picture in fitness care has remained given.

In [10] they planned a completely different attention system supported a 5G psychological feature System (5G-Csys). The 5G-Csys includes a source psychological function train and a statistics mental engine. Reserve psychological function intellect, supported the training of net environments, goals at ultra-low invisibility and ultra-high dependable ness for psychological feature uses. Information psychological function intellect, supported evaluation of attention big records, employed to discuss a person's healthiness position physiologically and psychosomatically. During in article, the design of 5G-Csys is first given, also the main tools as well as present situations are mention. To confirm their suggestion, they improve a version stage of 5G-Csys, joining dialogue feeling gratitude. They supply their new effects to prove the efficiency of the planned device.

Authors of [11] had deliberate the usage of patient pictures partner degree emotional detection to support sufferers and senior folks at durations an in-home attention context. They additionally talk the prevailing literature and show that majority of the studies at some point of this space do not build use of photos for the aim of observation patients. Additionally, there had been little research take below attention the patient's spirit that is important for them to able to pass via a wellness. Finally, they revealed their model that runs on more than one computing systems and display results that show the practicability of their approach.

In order to apprehend the target, a collected works review turn out to run research the various methods and techniques that care existing for social emotion reputation: several scholars are running in growth of healthiness carefulness structures the usage of Internet of Things. Considered some of the studies article "Patient in Medical statistics Systems and way ahead for Inter-net of Healthiness" current the effects of Learning Healthcare development, delivered via the usage of Dell EMC Exterior Investigation and Educational Associations. Huge Records assessment of Medicinal

info gadget information have become applied the use of collection evaluation in Python [12].

In article [13] the clever spaces method implemented for improvement of cell healthcare (mobile-Health) offerings install in IoT environments. The novelists deliberate a mention structure version of the facility environment with specify in sensible usage for multiple source statistics created as the IoT surroundings. Supported a design the writers' present allusion situations: help in provided that the emergency care and verbal exchange through the hospice truths organism [13].

Mechanized countenance Acknowledgement Method—at this phase novelist considered feelings the usage of facial languages and categorized feelings into 6 natures, i.e., pleasure, unhappiness, shock, panic, revulsion, and irritation. He advanced multiplied them into extra types like release, fulfillment, humiliation, etc. [5]. That Women are often an actual interval structure for feeling reputation over assessment of countenance and dialogue structures. The organization cracking the video movement addicted to series of snap shots, formerly notices expression of a character from his/her feeling [14]. Facial languages, a non-verbal message shows an important place in emotion popularity and categorizes the human feeling obsessed by six main facial languages: pleasure, unhappiness, shock, panic, revulsion and irritation as investigated finished [15].

4 Conclusion

Researchers across the world have started to explore many technological solutions to strengthen aid provision in companion degree extremely way that complements existing services through capacity of the IoT. This paper represents many components of IoT-primary-based useful resource technology and several aid network architectures and structures that guide get entry to the IoT spine and help medical information transmission and reception. Substantial R&D effort created in IoT-driven useful resource services and applications. In addition, this paper presents detailed evaluation of activities referring to medical technology which is address the usage of IoT.

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Challenges with Their Solutions for IoT Applications



Himanshi Bhatia, Dollie Juneja, and Manvi Breja

Abstract With advancement in technology, IoT has given a new phase to the devices. This paper provides an overview of IoT technology, briefs how it has emerged as one of the most demanding technologies, ways in which this technology has attracted users towards it and the numerous obstacles this platform faces in diverse fields. It compares various existing research works to get insights about the various problems associated with this technology, provided solutions and the applicability of the solutions in similar areas. Major challenges faced by IoT are addressed in detail with a solution to resolve these issues.

Keywords Internet of things · Smart city · Connectivity · Confidentiality · Security

1 Introduction

The Internet of things abbreviated as IoT is visualized as a network of interconnected machines and devices to share resources among themselves. It is an effective integration of the physical world and the digital world. Apart from just connecting the devices together, it allows data transmission, sharing and control of those devices. An IoT device can collect different variety of data using sensors and actuators which are further processed for various applications like mobile technology, advanced robotics, big data, etc.

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IoT is considered to be one of the most critical fields of emerging technology that attracts interest from a large variety of industries particularly in health sectors, personal and homes, automated offices, industries, connected wearables, computing platforms, etc. A survey was conducted by KRC Research [1] in UK, USA, Japan and Germany which are recognized as the early adopters of IoT revealed the devices likely to be used by customers in coming years.

The paper is divided into four sections. Section 2 briefs the need and motivation behind surveying IoT challenges. Section 3 discusses the comparison of the prevailing works in fields of IoT and smart city concept. Section 4 provides a glimpse of challenges faced while working with the technology. Further, the last section concludes with different findings and future prospects.

2 Motivation

As the IoT expands, new challenges and concerns arise with it. There are various technologies with which IoT is enabled such as cloud and edge computing, 3D printing, mobile Internet, artificial intelligence, big data analytics, embedded systems, security and communication protocols. For the IoT industry to thrive at its best, there are various concerns and challenges that need a solution in hand like security, connectivity, compatibility, longevity and technology. Various growing issues need to be resolved at its earliest and demand for a prominent and stable solution. To address this challenge, the paper has focused on finding solutions for complex event processing, real-time data analysis, driving timely decision all demands for accurate data and legacy systems that are well suited to work efficiently. With an aspiration to grow, opportunities need to be realized, and strategies are to be developed with the aim to interact the individual choices across a broad compass, while still bringing up advancement in new technologies and preparing for the upcoming challenges that are encountered.

3 Related Work

This section briefs the comparison of various existing works. Table 1 explains the short summary of the paper, numerous problems that are faced by IoT technology in various fields for its applications in smart city projects. It describes different solutions to the challenges faced and its applicability in real-life scenarios.

Internet of things is not just limited to this but extends over various areas like energy management, fleet management, facility management solution, street lighting solution where IoT has been proved efficient as it provides predictive/preventive analysis, real-time monitoring and detailed reporting for auditing purposes track and trace records, speedy fault detection and reduction in human intervention.

4 Challenges Faced in Different Areas of IoT

With great innovations and rapid improvements in technology and techniques, IoT has emerged as a technology to reduce the gap between the physical and digital world. Irrespective of the various applications and opportunities it provides, there are various challenges ahead for the IoT industry to succeed. The first major challenge is **security** which has questioned the confidence of IoT apps and even leads to data breach. Another problem arises when it becomes difficult for service providers to **monitor the devices**. The users not having much knowledge are unaware of the threats associated with the technology and have no idea if their devices can be or are controlled by any other person without consent which can lead to data leak. To overcome this challenge, public key cryptography is used for safe transfer of information over the Internet and ensures confidentiality, integrity, authenticity and non-repudiation in data transmission and data storage [6]. Another big challenge is **integration of IoT devices** with IoT platforms. Improper integration could lead to anomalies in functionality of the product or system. Some other challenges associated are described in Fig. 1.

Table 1 Comparison of existing works

S. No.	Paper title	Description	Problem	Solution	Our viewpoints
1	Centenaro et al. [2]	Introduce low-power WANs (LPWAN) technology and the advantages that it provides with another type of connectivity in the unlicensed spectrum. It describes the experiments of the IoT network based on some of the LPWAN solutions that are already available focusing mainly on the LoRa network	The latest cellular networks like universal mobile telecommunications service (UMTS) and long-term evolution (LTE) did not connect to a large number of devices at the same time	Low-power wide area networks (LPWANs) provide connection allowing different devices to be connected to IoT that can further be used according to our needs	The paper provides a solution to transfer large amounts of data with low power consumption, reduced cost, proper connectivity between large numbers of devices and enhancing tolerance level by integrating LPWAN and IoT. Thus, the technique can be utilized in various fields like real-time tracking, satellite communications, security and many smart city projects

(continued)

Table 1 (continued)

S. No.	Paper title	Description	Problem	Solution	Our viewpoints
2	Memos et al. [3]	Outline the architecture and security challenges of IoT networks and surveys approaches for security and privacy in wireless sensor networks (WSNs). The media-based surveillance system (EAMSuS) is proposed to ensure high security levels and offers better quality and privacy to the citizens in the smart city framework	Many factors should be taken into consideration while working with the technologies like media security and users privacy of the networks	Integration of algorithm for user's privacy, sensor node memory requirements and media security with IoT network for smart city concept	This paper puts light on resolving the privacy concern of users using the combined methodology of IoT with sensor networks with the help of remote monitoring and video compression. It helps in reducing data redundancy resulting in faster recognition and prevention of attacks. This technology will be helpful in prior tracking of terrorist activities, home security systems and smart parking systems increasing the overall performance and scalability of the existing surveillance systems

(continued)

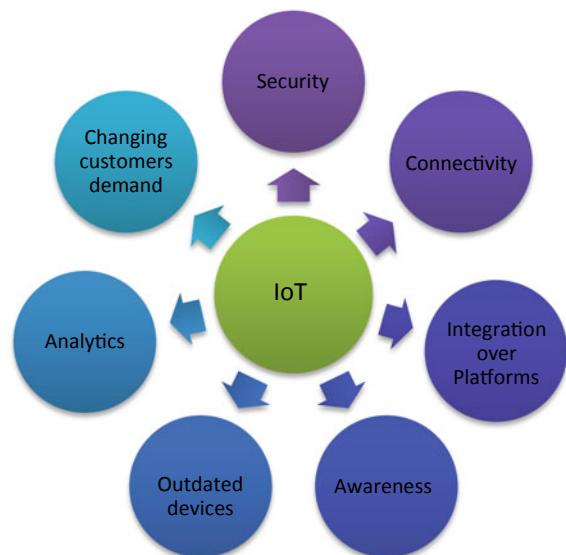
Table 1 (continued)

S. No.	Paper title	Description	Problem	Solution	Our viewpoints
3	Immino et al. [4]	Explain the role of development of long-term evolution advanced standard using small cells and analyzing its benefits in providing services to people and companies, discusses business models architecture for effective service planning in ecosystems and role of small cells and LTE-A	<p>There are a lot of open challenges that were focused:</p> <ul style="list-style-type: none"> • Ecological sustainability for future broadband wireless access • M2M communications—low data rate flows • Security 	<ul style="list-style-type: none"> • Direct small cells communications involving multi-cell scenarios and are local IP access • The LTE-A development and D2D paradigm • The LTE-A security framework 	The paper focuses on providing a solution for better connectivity, low cost and efficient transmission of data using small cell technology for better network coverage. The technique reduces the electromagnetic emission and contributes to the environment by saving energy, wide reachability and providing a more reliable system in terms of security. Its use in various other industries apart from mobile services will improve the user experience and can contribute towards smart city projects in an efficient way

(continued)

Table 1 (continued)

S. No.	Paper title	Description	Problem	Solution	Our viewpoints
4	Perera et al. [5]	Discuss different types of sensing as a service model and connecting them with IoT, explores open challenges and its related issues taking three different perspectives into consideration, i.e. social, technological and economical	<ul style="list-style-type: none"> • Standardization, accuracy, security and privacy • Architectural designs, sensor configuration, storage, infrastructure and energy consumption 	<ul style="list-style-type: none"> • Automated sensor configurations • Optimized sensing strategies to ensure sustainability • Sensing the data and extracting valuable and accurate information in order to take important strategic decisions based on them 	With increased usage of sensors in IoT, the paper provides us various techniques to be utilized for smart city projects and its variants. The paper also highlights how the sensor technology in collaboration with cloud services makes sensor data more easily accessible and helps to facilitate the decision-making processes, real-time monitoring and devices used in our everyday routine

Fig. 1 Challenges of IoT

5 Conclusion and Future Scope

The paper has presented a survey on the plethora of challenges and threats in the advanced world of IoT. By presenting current challenges and open issues in the research field, the paper acknowledged the urge & importance of adapting and extending tools & measures for extracting & preserving the information. It also highlighted the need for strategic relevance of different solutions to challenges and opportunities that will continue us to grow exponentially. The survey gives an answer to maintenance, operational woes of heavy industries, manufacturing, enterprise and service industry. It focuses on the compleptive aspects that any IoT strategy must focus on for business development. The outstanding existing IoT automated solutions have helped bring in ideas that resolve issues like security breach, manual intervention and inaccuracy. With the development of a platform that is customizable, scalable and built with highly interactive APIs, the objective is to pioneer on futuristic lamp posts that could measure and display time, temperature, humidity and other necessary parameters.

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Review of Amblyopia and Artificial Intelligence Techniques Used for Its Detection



Renu Vadhera and Meghna Sharma

Abstract Artificial Intelligence-based models are widely used in health care for prediction, detection and treatment of diseases. The aim of this paper is to study artificial intelligence (AI) techniques used in ophthalmology. Many AI-based models are used to solve ophthalmological issues and show good results for detection of eye diseases like glaucoma and diabetic retinopathy, age-related macular degeneration, amblyopia, etc. Amblyopia is an eye disorder in which brain catches the signals from one eye only and starts ignoring the signals from the other eye, which is called as a lazy eye. Lazy eye should be detected on time for its timely treatment, otherwise its treatment is not possible in adulthood. Earlier amblyopia was detected with traditional method, but now early detection is possible with different machine and deep learning techniques. In this paper, we did exhaustive study of artificial intelligence techniques such as decision tree, random forest and artificial neural network, k-nearest neighbor, Naive Bayes used by many researchers for the detection of amblyopia. Pros and cons of each method are also discussed. From this survey, it is concluded that there has not been much work done for the detection of amblyopia (lazy eye), and it needs further research to get more accuracy in the detection models.

Keywords Artificial intelligence · Amblyopia · Machine learning · Convolution neural network · Image processing · Ophthalmology

1 Introduction to Artificial Intelligence in Ophthalmology

AI is used in various fields, like autonomous vehicles, robotics, natural language processing, health care, image processing, etc. Models developed with artificial intelligence give us better results in many tasks than human being. Looking into

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healthcare sector, eye diseases are very common and growing very fast. Reasons for this can be genetic, aging and excessive use of screens such as phones, laptops, TV, etc. Around the world, people are suffering from many eye diseases, but some eye diseases like amblyopia, strabismus appear in childhood and its early detection and appropriate treatment is very important to prevent vision loss. Deep integration of ophthalmology and artificial intelligence has the potential to reform current disease diagnose pattern and generate a significant clinical impact [1]. Artificial intelligence especially deep learning is accepted in ophthalmology to diagnose eye disorders like amblyopia, diabetic retinopathy, glaucoma [2], AMD (age-related macular degeneration) [2] and ROP (retinopathy of prematurity) [3] and shows very good results [3]. With the use of new diagnostic tools and techniques, very large amount of data is generated specially in the forms of images that may lead to the delay in the interpretation of outcomes, but with the help of machine learning techniques, we can solve these problems and help doctors not only in diagnosis of disease but also in monitoring. Artificial neural network is used for diagnosis of congenital stationary night blindness, and support vector machine is used to analyze eye tracking for the detection of dyslexia. With the use of image dataset, excessive ciliary muscles activity can be detected using k-nearest neighbor and support vector machine. As we studied, it is found that machine learning is mostly used for the detection of eye diseases in adults, but for pediatric treatment many new models are required that work with pediatric dataset and give better results [4]. If we can have an open access to pediatric datasets, then machine learning models can be made for the detection of eye disorders that found in children like amblyopia, NLDO (nasolacrimal duct obstruction) and strabismus.

1.1 Amblyopia

There are many vision disorders like glaucoma, diabetic retinopathy, retinopathy of prematurity, amblyopia, etc., where amblyopia is a form of poor vision that occurs in one eye only and affects 2–5% of children [5]. In amblyopia, the brain catches the signals from one eye and starts ignoring the signals from the other eye, which is called as a lazy eye. In this, one eye becomes stronger and another becomes weak or lazy [6]. It is a visual inability that shows the dreadful working of eye and mind through the optic nerve [7]. It puts the bad effects on the particular visual function and general welfare of youths [8] (Fig. 1).

Fig. 1 Amblyopia



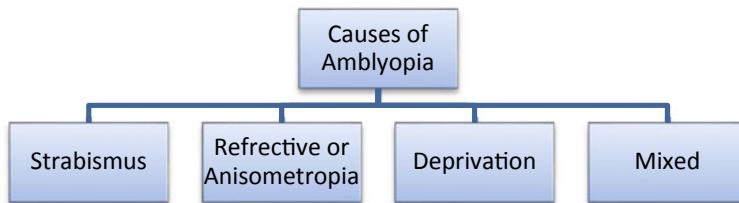


Fig. 2 Causes of amblyopia

There are four reasons for amblyopia as shown in Fig. 2. But anisometropia (50%) and strabismus (19%) are main causes for amblyopia. Anisometropia is the state in which the refractive error in both the eyes is different from each other. If anisometropia is not diagnosed at time, then it can be a cause of strabismus. Strabismus is found when central point is misaligned in the eyes or there is no coordination between the two eyes, which means the patient could not bring both eyes into concentration on the same point and avoiding suitable binocular vision [9]. Strabismus can be defined as an irregular binocular collaboration between the eyes, in which identical point does not reach the fovea of eyes at the equal time [10]. Another type of cause is mixed (27%) when both strabismus and anisometropia exist at same time. One another cause is there, and that is called as deprivation (4%) which occurs due to some obstruction to vision. Reasons for deprivation are anatomic discrepancies of the retina and uneven movement disorders of the eye [8].

To find the main causes for amblyopia such as strabismus, cataract and high refractive error, conventional screening was used. But now remote autorefraction and photo screening are new techniques which are used for the identification of refractive error and optical alignment in preschool-aged children [11]. For detection of functional and structural deficits in humans with amblyopia, fMRI (functional magnetic resonance imaging) [8] and aMRI (anatomic magnetic resonance imaging) are also very helpful [12]. Identification of amblyopia or lazy eye in early age is very necessary for its timely treatment. Because its treatment is possible only when the brain is in development stage [13]. Otherwise, it will continue into adulthood which cannot be managed and cured and leads to temporary or permanent vision loss [7].

It is analyzed that children between the age of 7–13 years are responding less to the treatment of amblyopia than the age below 7 [14]. If it is detected at early stage, then it can be treated with the non-controversial methods of glasses and patching therapy [13]. Another cost-effective system for treating lazy eye is using binocular amblyopia therapy that is based on virtual reality (VR) technology. In this system, patient is trained on eye-to-eye, brain-to-eye and hand-to-eye coordination using games and visual environments designed for it. With this, lazy eye increases visual perception and progresses stereovision of the amblyopic (lazy) eye [15].

2 Related Work

Balyen et al. explain various AI, ML and DL techniques used in diagnosis diabetic retinopathy, age-related macular degeneration and glaucoma. These techniques can be used in ophthalmic setting to validate the diagnosis of diseases, read images, perform corneal topographic mapping and intraocular lens calculations. Two image-processing techniques are used as diagnostic systems; one is fundus digital photography, and other is optical coherence tomography (OCT). Out of both, OCT is mostly used because of high accuracy in diagnosing multiple retina disorders with promising results in automated image analysis [2].

Xue-Li Du et al. explain how AI [13] and ANN help in ophthalmology in diagnostic and treatment of many eye-related diseases with high frequency, such as diabetic retinopathy, age-related macular degeneration, amblyopia, glaucoma, ROP (retinopathy of prematurity), age-related cataract and others with retinal vein obstruction [3] and can be achieved accuracy between 75 and 100%. Image dataset is used in this and is explained in three steps as shown in Fig. 3. First, gather a large number of images and then relative specialists label the distinctive lesions. After that features are extracted of a disease with the help of a program that based on marked input images. At last with the help of statistical feature of target lesions, input image can be distinguished from other types of disease. But deep learning used in this has some limitations like high computational cost and training experience; without our involvement, it cannot completely identify disease separately because it identifies a feature mechanically, it is difficult because features of a disease and parameters used for an algorithm are different with different tasks so human intervention is necessary. It is also suggested that excessive database may be outfit or less efficient, so choose the database very carefully and images from an extensive demographic for higher exterior validity can be used [3, 16].

Reid et al. review various machine learning techniques such as deep learning and support vector machine, convolution neural network, Naive Bayes, random forest those are used for the detection ROP (retinopathy of prematurity), strabismus, etc.[4].

To identify the children with the risk for having amblyopic conditions, random Forest, decision tree and artificial neural network are used, and a tenfold stratified cross-validation technique is used to check their efficiency in medical domain. The results of decision tree, random forest and artificial neural network are compared based on pixel value, PCA pixel value, one-color slope value, four-color slope value. Clark et al. found that random forest is best because it overcomes the over-fitted issue. For future work, other frame selection techniques can be used on more patient data and

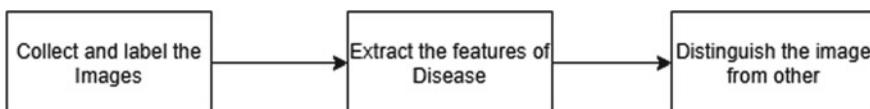


Fig. 3 Eye disease classification using images

hybrid system can be used for good results [9]. A multi-classifier machine learning architecture consisting of a heterogeneous mixture of classification techniques is used to accurately identifying the amblyopic condition by using three existing data and feature sets (AVVDA dataset, initial color slope dataset, pupil color slope dataset). At last conclusions drawn about the efficacy of the feature sets, applied to a variety of classifiers, as well as a multi-classifier decision fusion methodology in the vision diagnosis domain [13]. As one of the main reasons of amblyopia is strabismus. Deep learning neural network is applied on strabismus dataset, collected and labeled by the ophthalmologists for the detection of strabismus. Firstly, R-FCN (region-based fully convolutional network) is applied for eye region segmentation; then, deep convolutional neural network is built and trained to classify the segmented eye regions as strabismus or normal. This shows good results for telemedicine application. The big challenge for this to collect the dataset and strabismus detection with different image sizes and resolutions [17]. The Pediatric Vision Scanner (PVS) is to classify the children with strabismus and shows good results. Disadvantage of this method is that it does not calculate refractive error [18].

Although artificial intelligence is widely used nowadays, it has some ethical challenges like transparency, bias, human values, data protection and intellectual property, social dislocation, cyber security, decision making, liability, legal and regulatory issue [2]. While detecting many eye disorders, training datasets of homogeneous populations are used in various deep learning techniques. With the variations in dataset, better results can be achieved. It is not clearly defined in any paper how we can calculate power and performance of independent datasets. The present artificial intelligence screening systems are developed for adult patients and validated using images. This system is lack of stereoscopic potentials. For improving medical acceptance of deep learning techniques or systems, we should untie the deep learning's black box nature with current and future methodologies [19]. Chang et al. did pilot study which shows that an idea or concept should be understand on individual basis and also the meaning of a concept should be by predictable understanding. A big challenge in AI is to understand the exact sense of a word or concept that may be different with different situations. Main motive of this research work is to study artificial intelligence in a new way because agent's understanding and knowledge are more important for any result. Cognitive science can be used for better results of the detection of eye diseases [20] (Tables 1 and 2).

Table 1 Eye disease and its detection methods

Disease	Method
Amblyopia	Random forest, artificial neural network, k-nearest neighbor, Naive Bayes, decision tree, convolution neural network
Strabismus	Convolution neural network, deep learning, support vector machine, neural network

3 Conclusion

This paper reviews that amblyopia is vision disorder in which brain starts ignoring the signals from lazy eye. After amblyopia, brain is not able to generate the neural pathways which cause temporary and permanent vision loss. So, its early detection is mandatory for timely treatment that can save vision loss; otherwise, it will continue till adulthood and cannot be treated after the brain is fully developed. We studied many papers and analyzed that there are four main causes of amblyopia such as strabismus, anisometropia, deprivation and mixed. With the help of large amount of data especially in the form of images that are collected with the new techniques and technologies used in ophthalmology along with machine learning models are used to detect amblyopia. Machine and deep learning techniques such as k-nearest neighbor, artificial neural network, Naive Bayes, decision tree and random forest are used for early detection of Amblyopia. Other artificial intelligence techniques and models are also studied those have been used to detect eye disorder in adults like glaucoma, age macular degeneration, etc., and it is observed that these models do not work well when used with pediatric data. So, new models are required that can be used for pediatric data and provide good results.

4 Future Scope

Artificial intelligence algorithms are used for detection of many eye diseases. But amblyopia is detected with very few techniques as current applications to pediatric ophthalmology have some limitations those are divergence on reference standards, lack of time-based information, poor reproducibility and comparability which can be improved in future work. Artificial intelligence techniques those are used for the detection of AMD (age macular degeneration), glaucoma, ROP (retinopathy of prematurity) and other retinal vein obstruction can be used for prediction of amblyopia. But till now limited work is done for the detection of amblyopia. If amblyopia is not detected at early stage, it may lead to vision loss and its treatment is not possible in adulthood. So, with the use of artificial intelligence hybrid techniques if dataset eye and MRI images of amblyopia patients are used, it may lead to better results.

Table 2 Literature review of some papers

Paper No.	Author name	Year	Publication	Tools and techniques used	Description
[5]	Umesh, L., Mrunalini, M., and Shinde, S	2016	International Research Journal of Engineering and Technology	Image processing	Shows a proposed model that is used in image processing and data mining techniques to detect eye related diseases
[21]	Granat ikov Boris	2017	Bio Medical Engineering On Line	Classical feed forward, 2-layer neural network architecture and pattern recognition	Artificial neural network is used for classification and detection of central fixation that is based on retinal bioreflection scanning In this neural network firstly trained, then validated and at the end tested on the on-eye data and able to identifies eyes with misalignment eye
[7]	M. Bala Anand and et al	2018	International Journal of Pure and Applied Mathematics	k-Nearest neighbor	First the training dataset is trained by the k-nearest neighbor algorithm which recognizes the pattern of the disorder, then the separated tested dataset is tested on the model After that predictive analytics can priorly detect the children who can be affected by amblyopia
[22]	Wai-Lun Lo et al	2018	Journal of Healthcare Engineering	Convolution neural network	In this strabismus is detected automatically using convolution neural network strabismic gaze data(Gaze Deviation images of eyes)

(continued)

Table 2 (continued)

Paper No.	Author name	Year	Publication	Tools and techniques used	Description
[23]	Alejan dra Consejo et al	2018	Seminars in Ophthalmology	Machine learning	It shows supervised learning is useful to detect various eye-related diseases like glaucoma, dry eye, AMD, etc.
[24]	Sallam Osman Fageeri et al	2017	International Conference on Communication, Control, Computing and Electronics Engineering, Khartoum Sudan	Naïve Bayes, decision tree, support vector machine	For the classification of eye diseases, J48 classifier gives better results than both Naïve Bayesian and support vector machine
[25]	Sadaf Malik et al	2019	Applied Sciences	Naïve Bayes, decision tree, Random forest, NN	For detecting refractive error, random forest algorithm is better than ANN, its execution time was but it takes longer execution time than the decision tree
[26]	Kadir Sabanc et al	2015	International Journal of Intelligent Systems and Applications in Engineering	KNN	Success rates of the state of eye with EEG State dataset was identified using kNN and found by using multilayer perceptron classifiers, highest classification success was can we get with 3 neighbor values and this value is 84.0587%
[27]	Łukasz Piątek et al	2020	Digital Medicine	Machine learning classifiers	In this 23 machine learning classifiers are used to classification of eye states based on EEG recordings and 10 are successful. No one is found best Best algorithm needs to be chosen individually
[20]	Monic a Chang et al	2017	Advances in Artificial Intelligence	Introduction to cognitive science	Shows the meaning or understanding of a concept of cognitive Learning. In future that may be used in detection of many eye diseases

(continued)

Table 2 (continued)

Paper No.	Author name	Year	Publication	Tools and techniques used	Description
[28]	Simmers, Ledgerawy et al	2018	Journal of Image processing and AI	Image Processing and Feature Extraction, Supervised Learning (decision tree)	Use image recognition for detection of amblyopia eye disease
[29]	Joa o Dallyson Sousade Almeidan et al	2012	Computers in Biology and Medicine	Image processing techniques, geo statistical functions and support vector machine	In this strabismus is automatic detected in images with the help of Hirschberg test. This is done in four steps firstly region of the eyes are getting then defining the particular location of the eyes, at the end limbus and brightness are used to identify strabismus
[30]	Chun, J., Kim, Y., Shin, K. Y et al	2020	JMIR medical informatics	Deep learning	An automated system is developed using deep learning to predict the range of refractive error in children using 305 unconventional photorefraction images taken with a smartphone
[18]	Grayson W. Armstrong et al	2020	International Ophthalmology Clinics	Neural network	AI also used in telemedicine, screening and diagnosis of ophthalmic diseases DR, AMD, ME (macular edema), glaucoma, etc
[31]	Yumang, A. N., Marquez et al	2019	9th International Conference on Biomedical Engineering and Technology	Image processing	Digital image processing and horizontal classification system is developed to determine strabismus in patients and classify into different types
[32]	Suriyal, S., Druzgalski, C., & Gautam, K	2018	World Congress on Medical Physics and Biomedical Engineering 2018, Springer	Image processing, logistic regression	Developed computer vision system for calculating the deviation of eyes meant for people with strabismus

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A Comprehensive Analysis on Encryption/Decryption Techniques for IoT Attack Avoidance



Alka Rani and Prashant Singh

Abstract This paper illustrates the methodologies and techniques used in IoT in order to prevent the systems from various kinds of attacks. Cybersecurity demands several encryption/decryption techniques to prevent their system from attackers and keep them safe. It is important to enhance the knowledge of attacks in order to design the model for them. Recent years observe the exponential increase in the number of attacks. It requires a proper classification, so that researchers can understand the characteristics of each attack before creating their algorithms. Due to large number of attacks, it becomes difficult to differentiate between the attacks that put the question on the producing algorithms. This paper depicts the classification of attacks in IoT with their existing solutions.

Keywords Ciphers · Encryption/decryption · Cyber attacks · Cyber security · Internet of Things

1 Introduction

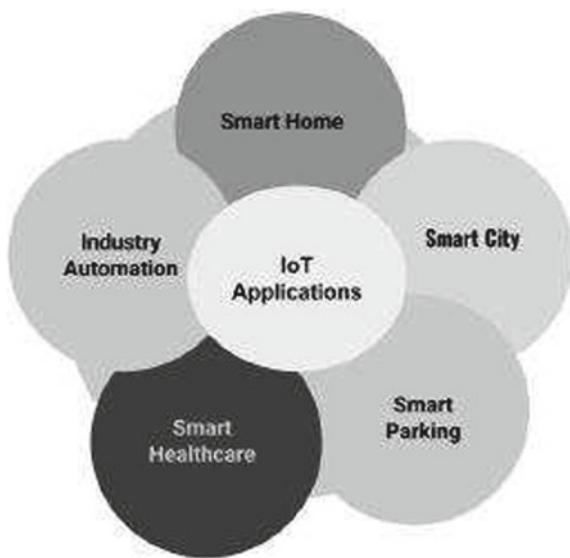
Internet of Things (IoT) consists a variety of electronic components with software, sensors and actuators. It is the embedded form of a heterogeneous collection of ‘things.’ As shown in Fig. 1, IoT applications are commonly included as smart health care, smart parking and smart grids. According to a report published in 2013, International Data Corporation specified that IoT devices deployed with the network system would touch the figure of 41 billion with 2020 with the expeditious growth of 8.9 trillion dollars in a market [1]. The main difference between traditional market and IoT is the absence of any human interference. Applications of IoT devices consider

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Fig. 1 IoT applications [7]

and perform the tasks of creation and analysis of behavioral information of individual person's behavioral information [2]. IoT applications show their greatness by supplying various useful services with a huge benefit to human life. However, their privacy protection methodologies and individual's security demand a huge cost. At the device level, IoT producers failed to implement and deliver a secure and robust system. Therefore, security experts release a warning for the potential risk occurred due to a large number of vulnerable devices connection with the Internet leads to increase the complexity of the system [3]. IoT devices face a huge concern as privacy and security issues that involve the new phase of disruption with different degree of terminating the information of consumers during online privacy. It makes the user concerned on the holding of too many personal information in their databases linked with public or public cloud with certain and valid reasons [4, 5]. In addition, a comprehensive analysis of existing solutions also being present, which can be categorized under four standard IoT communication protocols. Granjal et al. provide these as Application, Network, Medium Access Control (MAC) and Physical [6].

In their research, they explained the mechanisms based on possible cross-layer communication. Sicari et al. presented the recent privacy policies and security trade-offs as existing research challenges [8] in a work. Cui et al. proposed a novel encryption mechanism based on a proxy aided attribute for edge level [9]. It contributes as edge security that makes the devices closer in order to a great reduction in latency of data processing. Dao et al. [10] suggested another authentication protocol based on social networking for less operating power of IoT devices. Here, a specific multi-security level is set as authentication protocol for each IoT applications. Zhou et al. invented an algorithm for granular bulk operations that is an efficient access control mechanism for the interactive IoT devices [11]. Roman et al. [12] investigated on the

distribution of IoT architectures. They suggested a model to track the attacker model and applicable for both centralized and distributed IoT infrastructures. Symmetric key cryptosystem requires a single key for both encryption and decryption that is only known by its user. Another methodology is the encryption through L2D-CASK for sensor data in the domain of FPGA [13]. In this method, hybrid CA rule vector [14] with the key length of 512 bits involved basic XOR operations consisting of either 2 or 3 inputs at an instant. The proposed methodology addressed on the constraints since sensor nodes consists low memory space. Therefore, it completes the operation without degrading the performance as computational and randomness complexities of the encryption. It produces the chaotic sequence that becomes possible due to inherent capabilities of CA [15]. In terms of randomness, this scheme proved as an efficient system for equivalent encrypting and named as DES and 3-DES. The suggested scheme chooses both the key configurations randomly for the execution of selecting the number of iterations for both encryption and decryption. It results as the enhanced robustness in the system [16].

2 Cryptographic Techniques for Secured IoT

Here, this section explains the techniques based on cryptography for secure localization and shielding location information in IoT. Existing schemes utilize to design the applications relatable with IoT framework as RFID or WSN under military services because of the missing of work designed specifications for secure IoT localization. IoT develops the heterogeneity of devices which consist of sensitive nature of location information and connected under same worldwide network that also inherits many of the threats and sets new challenges for user. Broadcast authentication protocol TESLA follows the hash chains as a tool [17].

This concept utilizes the elements with hash chains assigned to definite time-slots. To strengthen the stream ciphers, Rivest [18] used a pattern of backward and forward hash chains. Another system named as BAC systems contains four distinct energy efficiency classes [19]. It has more control capabilities with more fine-grained sensors arranged in a higher efficiency class. Currently, an organization having large building area and complexes can easily comprise tens of thousands of sensors. It generates a good amount of data stream providing the insight the building actions. It leads to the need for more protection from the attackers, specifically during the outsourcing handling of the data. One of the major research projects named as BaaS in the EU FP-7 [20] targets to increase building energy efficiency.

3 Classification of Attacks in IoT

IoT needs to address the security in the designed system, i.e., the most important concerns. Efficient data communication demands high-level security from random

Table 1 Summary of standard cryptography for location information [21]

Scheme	Configuration	Authority	Integration	Shared secret ¹
Check sum			X	
Encryption ² + Signature ²	X	X	X	
Digital signature ²		X	X	
Authenticated encryption	X	X	X	X
Message authentication		X	X	X
Secret key encryption	X	X	X	X
Public key encryption ²	X		X	

¹Requires a shared secret key between the parties implying (a) a pre-shared secret (e.g., hard wired into the devices before deployment) or (b) the use of a key exchange protocol

²Public key cryptography (more expensive to implement)

cyber attacks [3]. Attacks such as Sybil, eavesdropping, message modification, traffic analysis and denial of service (DoS), etc., are harming the people and institutions by obtaining their access information as well as gain financial benefits [1]. The exponential growth of IoT attracts the cyber-attackers with more number and in complex manner. It becomes sophisticate to breach the security with new tools [2, 3] (Table 1).

4 Encryption and Decryption Techniques

Numerous encryption and decryption methodologies are utilized to protect the privacy of the information and data security. Numerous inadequate resources are utilized in traditional technologies just like IoT but are restricted in terms of power capabilities and computation time with the non-provision toward the traditional algorithm. Table 2 illustrates the trending security techniques for recent application layer security.

5 Available Mobile Signature Solution

Mobile signatures are one of them and used as the solutions to develop qualified digital certificates for user authentication. Such qualified digital certificates issued by authorized Certificate Authority and come under the standards of ETSI. It delivers the framework for the validation and creation of further standardization as advanced electronic signatures (AdES) in mobile environments [23]. EAL + certified SIM cards are becoming the available solutions for data privacy. On the subscription to the service by the user, there will be the activation of certificate over the air. Each certificate consists of separate public and private keys. SIM card contains and stores

Table 2 Trending security features in recent application layer for IoT [22]

Techniques	Description
In the application layer, user feature installed with DDoS attack detection mechanism	It is applicable for network and application layer and based on the study of DDoS attacks and its detection efficiency. Due to the ease in execution, application layers consist of more such type of attacks. In this, indiscriminate requests sent by robots that will overload the systems due to such attacks
DPFEE: a high-performance scalable pre-processor for network security systems	In this method, preprocessing step performs as deep packet inspection from the protocols of several areas to extract messages. Anti-denial-of-service (DoS) and network intrusion detection systems (NIDS) have been expounded for secure IoT
SSED: servers under software-defined network architectures to eliminate discovery messages	This research uses software-defined network architecture and aims the removal of discovered information of the ethernet from the central administration
OpenSIP: toward software-defined SIP networking	This study safeguards the application layer signaling protocol and an attempt toward session initiation protocol (SIP) of VoIP-based security
MECPASS: DDoS defense architecture for mobile networks	In this research, a single botnet is enough to launch a flooding attack to interrupt and exhaust the targets. MECPASS expounded to protect DDoS defense architecture for mobile networks
SkyShield: a sketch-based defense system against application layer DDoS attacks	This research protects the application layer from DDoS attacks and presents the sketch-based defense system
An effective mechanism to regenerate HTTP flooding DDoS attack using real-time dataset	It reproduces the flooding of HTTP DDoS attack by utilizing the dataset of real time
Deep learning systems through identification of unknown protocol	By utilizing deep learning detection, it identifies the unknown protocol traffic

the private key. While the directory publishes the public key. It depends on the reception One-Time Password (OTP) or PIN entered by the user in order to get the access of signature. The mobile operator to the service provider directs this signature. Later, the service provider permits the access and check the validation of the service. The step-by-step procedure of mobile signatures for user authentication is shown in Fig. 2.

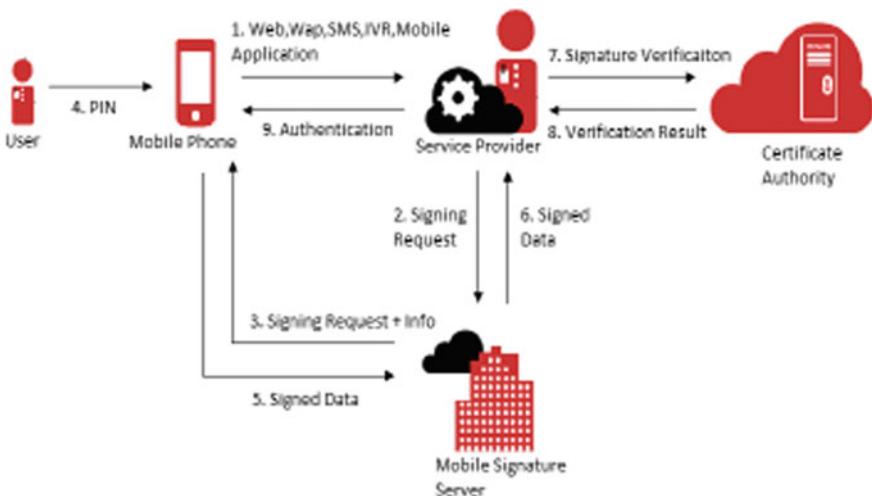


Fig. 2 Illustration of user authentication uses the current available mobile signature solution for the operation [24]

6 Conclusion

In the world of Internet of Things (IoT), cybersecurity field increases tremendously with its importance. Every individual should acquire the knowledge of cryptography with their types of attacks including the solutions. There is a need of the hour in order to protect the data and their privacy of user. The first target of the attackers is on the sensitive data of the user such as their password and username. If the users do not follow the security principles, then the attackers can easily sniff their data. Actual real world requires to provide the training of workers/students from the next generation to learn cybersecurity and their implementation to avoid the attacks. It is important to enhance the knowledge of best existing techniques and practices against cyberattacks for safeguarding the users. Man-in-the-middle (MITM) attack can easily trace the information from insecure networks. In the last, user should always check the site before entering the sensitive information in it as https certificate. Attackers can easily eliminate it by using the strip of SSL. Therefore, user requires to investigate over the Internet about the presence of SSL every time it has to enter any sensitive data. Users need to alert over fake SSL certificates. It becomes quite easy for the attackers to accomplish MITM attack by using the strips of SSL and Ettercap as open/simple source tools. Even the beginners can do such kind of attacks. The user can prevent from these attacks if he is cautious during the browsing over the Internet. He had to double-check for the certificate of SSL or an encryption during the transmission of sensitive information over the Internet.

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Identification of Gray Sheep Using Different Clustering Algorithms



Babaljeet Kaur and Shalli Rani

Abstract Nowadays, with the growth of Internet and the uncontrolled increases in amount of data, the user face problems to retrieve the accurate information. To overcome the difficulty of a user, recommender systems are designed that helps the user to find the relevant results. Recommender system is predication-based tools that suggest the items according to behavior of user. This paper is focused on the limitation of gray sheep user problem in collaborating filtering. The gray sheep users are those whose behavior is not similar with any other user. The existence of gray sheep user effects the performance and accuracy of recommender system. To recognize the gray sheep users problem, the clustering techniques can be used. In this paper, we define about various clustering techniques that can be used to categorize the gray sheep users in the system and improve the performance of recommender system.

Keywords Recommender system · Gray sheep users · Collaborative filtering · Clustering

1 Introduction

Recommender systems (RS) are the software tools that provide the relevant suggestions to the users [1]. The purpose of RS is to deliver the right items to the user that he may like. For example, a user needs to purchase a mobile phone, then the RS aims to provide the most relevant suggestions based on the specifications as required by him. The results are calculated on various parameters like budget, brand, memory, specifications and history of a user about the kind of a products previously bought or liked by him. Such systems use machine learning algorithms on user behavior or past data sets to provide the most suitable recommendations.

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There are two types of RS: personalized and non-personalized RS [2]. In the personalized RS, the items are suggested according to the user behavior. It requires huge amount of historical data. The item is suggested according to what the previously user bought and what kind of items user search mostly. By collecting these two results, then the final list of results is shown to users. The most relevant results are shown to the user. For example, a user needs to purchase a dress, then the recommender checks the history of a user and finds similar users and their purchase history. After combining the results obtained, it shows a list of dresses. However, non-personalized RS requires less interaction with the users and it suggests the most popular items to the user [3]. It shows the same results to all the users and it is also called automatic RS. It is of two types: aggregated opinion method and basic product association method. In the aggregated opinion approach, it suggests the average items to the users. It calculates the sum of rating of all items but sometimes fake users give the false rating then its results are not accurate. To overcome this problem, the product association approach is used. It suggests according to what present in the user cart. For example, homepage of Flipkart, it shows the most attractive items on homepage or the popular items on homepage.

2 Recommender Techniques

- **Statistical filtering technique:** In statistical filtering, it is assumed that common characters have the similar taste [4]. For example, In Punjab, most of the people like the Punjabi tradition but if it is compared with the Himachal Pradesh peoples then they have different tradition choice. The taste is also similar according to the nation, etc., The various parameters are like based on the gender, nation, age, etc., choices or taste can be same.
- **Content-based filtering technique:** It works based on the user profile. If a user wants to buy an item, then it checks the profile of user, like previously what he bought, what type of items he like. Based on the similarity of items then it suggests the results. It works on the ‘show me more what I have liked’ [5].
- **Collaborative filtering technique:** It works bases on the items rating profile. It makes a group of users who bought the similar items [1]. Then, according to the groups, it suggests an item. It makes a relation between two users based on the similar profile or similar items they rate. For example, on the Facebook, the list of suggested friends is shown. It is based on the mutual friends, location, our search history, etc., it is of two types: (a) memory-based and (b) user-based. In memory-based technique, it computes a relation between user and item to produce a preference score that predicts the probability of a user obtaining an item in the future. In user-based method, it generates the recommendations according to the similarity of a user. The first user-based automated collaborative filtering (CF) method was applied on by group lens.
- **Hybrid filtering technique:** It is the combination of two or more techniques and it is used to overcome the cold start problem. By using hybrid filtering technique,

the system becomes more efficient and reliable. For example, News-Dude, it combines both Naïve Bayes and KNN classifier for recommender system.

3 Research Challenges

Recommender system faced with limitations to provide precise recommendations according the user demands. Some of the limitations are like desertedness of database, cold start problem, data sparsity, gray sheep and shilling attacks.

- The problem of desertedness arises when database is used in large proportions. There are some attributes missing in the database. In this situation, User-Item matrix turn into very big as well deserted generating tasks for performance of a RS.
- The problem of cold start occurs when any new user or new item enters the system and it becomes difficult for RS to provide the recommendations [6]. This problem can be separated into three types: new user, new item and new society. The presence of new user more effects the performance of a RS.
- But one of the problems that acknowledged fewer attention is occurrence of gray sheep users. There are three type of user in the RS. White sheep user, black sheep user and gray sheep user. White sheep user is those who have high relationship with other users. Black sheep users are individuals who have less or few similar co-relations with other users. The gray sheep (GS) user is those whose behavior is not similar with any other user [7].

Therefore, when we want to use CF method, precise result cannot be obtained. GS user has two effects on recommender system (a) these users did not get precise recommendations and (b) they have negative recommendations over the other users. Because they did not get the accurate recommendations, so they did not refer to the other user to use the RS [8]. To improve, the performance of RS is to separate the GS users from the other users. One of the approaches for extrication the GS user is clustering method. Clustering is unsupervised machine learning technique. In the clustering method, clusters are made according to the degree of likeness. Most similar user is kept into one cluster and least similar user is kept into another cluster.

4 Clustering Methods

To improve the performance of RS, it is important to remove the occurrence of GS users [9]. Clustering method is one of the methods that separate the GS users, because existence of GS user effects the individual recommendations [10].

- **Hierarchical Clustering Method:** It is cluster analysis technique the method that builds the hierarchy of clusters [11] and it is organized in the form of tree. The root

node contains all the data objects and it is of two types: agglomerative and divisive technique. It may produce the nested of cluster in agglomerative mode, initial with a single different cluster and later on merge them with similar clusters and makes a hierarchy of clusters. In divisive mode, starting with single cluster and later split them into a distinct cluster (according to the similarity and non-similarity) until stopping criteria met.

- **Partial Clustering Method:** Partial cluster method does not execute a hierarchy of clusters and finds complete clusters once as a partition. The partial clustering makes an n number of clusters that contain set of objects, each object belongs to only one cluster. No overlapping of objects in two clusters is allowed. One object can be part of one cluster at a onetime only. Examples of partition clustering algorithms are k-means, graph theoretic and expectation maximization.
- **Clustering Method Using Classification Algorithm:** When any new user entered into the system then RS has not enough information to create recommendations. Classifications approaches are combined with the collaborative filtering technique to recognize the same group of users [12]. The system follows three-phase method for generating the recommendation for new end users. This technique takes a mechanism created on which similarity approaches find neighboring users. The highest level of similarity with the new user is named neighbors of the user. Therefore, each new user is classified into some group and is the ranking estimate approach is answerable for making the rates used for objects. The benefit of this method is, it generates less mean absolute error value as well as increase the accuracy of rating predication.
- **Neighborhood-Based Collaborative Filtering:** This method is also called kNN or k-nearest neighbor, it is used to resolve the cold start problem [4], and it finds the pair of like-minded users based on their similar history of ratings. The three main components in kNN are: (a) data normalization, (b) neighbor selection and (c) determination of interpolation weights. In this approach, the ratings of neighborhood are combined with each other so that active user get accurate recommendations. Prediction of the items depends upon the calculation of mean rates attained from similar users.
- **Centroid-Based Clustering Method:** Centroid-based clustering method are used for personalized RS [13]. It includes the two steps for recommendations. In the initial stage, the comments are composed in the form of user-item ranking matrix and after that they are clustered offline and store in the database for the upcoming recommendations. In the next phase, the recommendation is done for active user based on the similarity and by producing the selected the clusters with the greatest ranking quality. By this method, the efficiency for the active users is improved. This method reduces the cold start problem and GS problem.
- **Fuzzy C-means Clustering to User-Based Collaborative Filtering:** In the fuzzy clustering, each object goes to each cluster with membership weight that is lies between the 0 and 1. To apply the fuzzy c-means in RS, in the first step, the dataset is split into fivefold cross-validation subgroups. We have five dissimilar results according to the five dissimilar subsets [14], we will deliberate the average of five subsets results. In user clustering method, we chose some clustering

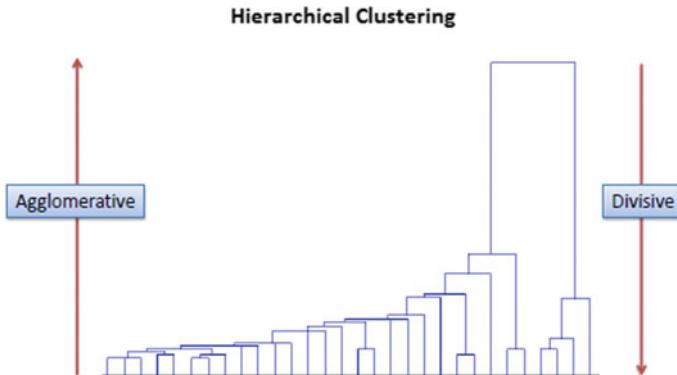


Fig. 1 Hierarchical clustering (saedsayad 2010)

procedures like K-means, SOM and fuzzy C-means in demand to assemblage collected users in clusters, diminishing the variation between elements allocated to the similar cluster. Individual clustering challenge will run independently with different number of clusters set in demand to find the clustering models which can afford the maximum degree of recommendation precision [15]. Fuzzy C-means is used to offer the different membership grade to every user that belongs to different clusters. In demand to describe what other user to consider, we can apply the defuzzification method [16]. In another term, each user is allocated to k cluster with degree of membership, so the defuzzification process is necessary [17].

Figure 1 illustrates that how the cluster formation is done. First, we have data warehouse from that select our dataset or the columns that we want to select. In the next step, the data preprocessing is done like remove the missing or duplicate values. After that the cluster formation is done by using the various distance measures like Euclidean distance formula, etc. Then,, the quality of cluster is checked (Fig. 2).

Table 1 gives a comparison of various clustering approaches.

5 Conclusion and Future Scope

RS are used to support the humans to take the decisions when they have lots of choices are available specially in the Internet era. In the paper, we defined the one of limitation of RS is gray sheep user problem. The gray sheep users are responsible for increased error rate in recommender system. To overcome the gray sheep problem, clustering solution is used to cluster the similar users in RS and the gray sheep user in one cluster. In this paper, we describe the six types of clustering techniques that can be used for identifying the gray sheep user in RS. Table 1 describes the comparison between the clustering techniques and about advantages and disadvantages. All the

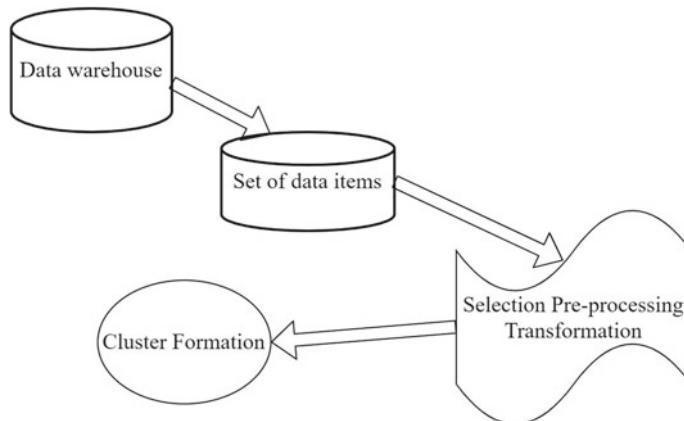


Fig. 2 Cluster formation mechanism

Table 1 Comparison of clustering methods

Method	Advantages	Disadvantages
Hierarchical clustering method	User likings not only limited only to the literature of study; it has learning power	Both accuracy and efficiency can be improved, it has sequential costs
Centroid-based clustering method	The problem of cold start, this reduces the raters and desertedness	It used only in the collaborative filtering method
Neighborhood-based collaborative filtering	It solves the problem of cold start	Unsuitability between positive and negative beliefs
Clustering method using classification algorithm	It increases the precision and reduce the values of mean absolute error	
Fuzzy C-means clustering	It overcomes the cold start problem	Apriori specification of number of clusters

clustering methods try to improve the efficiency of RS and reduce the mean absolute error by using different criteria. One of the limitations of the above techniques is the size of clusters is fixed and it can be variable in the future, so improve the precision of clustering. The future work is how to select the best suitable clustering technique that has less time complexity and increase the accuracy of RS.

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Nature-Inspired Optimization Algorithms for Localization in Static and Dynamic Wireless Sensor Networks—A Survey



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Abstract In the current global economy, localization in WSNs becomes a hot topic and it is attracting many researchers towards itself. WSN plays an important role in tracking objects in indoor as well as outdoor environments. The sensor data is useless until the location of the reporting node is unknown. The main aim of localization in wireless sensor networks (WSNs) is to determine the coordinates of target nodes in the sensing field by applying different approaches. This can be done either by the global positioning system (GPS) or any other methods. Usually, in localization methods, anchor nodes (GPS-equipped) broadcast beacon signals in the sensing field to help target nodes to localize themselves. The terms localization accuracy, localized nodes and computing time are mainly responsible for the performance of WSNs. The transmission range and density of anchor nodes directly affect the localization error. In this paper, the author surveys the various localization techniques optimized by nature-inspired algorithms and compares the salp swarm optimization algorithm with some well-known existing algorithms.

Keywords Wireless sensor network · Localization · Nature-inspired algorithms · Trilateration

1 Introduction

In current world's environment, because of advancement in wireless communication multifunctional sensor nodes play a crucial role in collecting data from surrounding and forwarding it to the base station [1]. The deployment of sensor nodes is done to monitor the physical attribute of environment like temperature, moisture of air and soil, fire in forest area, sound, light monitoring, etc. But there are so many challenges in wireless sensor network (WSN) that restrict the performance analysis of the whole

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network including the lifetime of the network, task scheduling, data computation, QoS, security, routing and localization, out of which localization problem attract so many researchers towards itself. The localization problem is to determine the coordinates of the deployed target node.

There are so many localization algorithms used for the estimated location of the node within the system range either by global positioning system (GPS) or any other methods. Localization accuracy greatly affected the performance of WSNs. The easiest way to know the location of the sensor node is GPS. But in the case of a large network, it becomes expensive due to practical requirements like cost, power, small size, etc., and insists us to prevent the use of GPS in all nodes [2].

In the literature of efficient and cost-effective localization, so many approaches have been proposed by different researchers. These approaches are divided into two categories static anchor-based and mobile anchor-based. Further, these techniques are divided into two categories range-based and range-free localization. The range-based localization techniques include angle of arrival (AoA), received signal strength indicator (RSSI), time of arrival (ToA) and time difference of arrival (TDoA). The range-free localization techniques include ad hoc positioning system (APS), multidimensional scaling (MDS) and distance vector hop (DV-Hop), which with minimum infrastructure determines the position of unknown nodes [3–5].

Localization problems can be solved with the help of nature-based stochastic methods. In this literature survey, to solve the optimization problem in localization, many meta-heuristic algorithms have been used to dramatically improve localization accuracy. Currently, several optimization algorithms such as particle swarm optimization (PSO), firefly algorithm (FA), butterfly optimization algorithm (BOA), artificial bee colony (ABC), salp swarm optimization (SSA) have been employed effectively to determine the position of target nodes in sensing filed. In this paper, the author shows the simulation results of PSO, FA, BOA, GWO and SSA.

2 Literature Review

The systematic literature review of recent localization problems from 2017 onwards.

The author [6] proposed a novel approach to find out the coordinates of the target node in a 3D anisotropic environment with a single mobile anchor node by utilizing applications of PSO, FA and HPSO separately. When the target node falls under the anchor node's transmission range, six virtual anchor nodes are projected surrounding the target node in a circle, out of which the closest three anchor nodes are projected in the shape of the umbrella to reduce the line-of-sight (LoS) problem and flip ambiguity. In 3D, at least four anchor nodes are required. The coverage and accuracy of BBO and FA are poor than HPSO and PSO. The author [7] proposed a bio-inspired algorithm for localization of randomly deployed mobile target node by using the application of PSO. At the edges of the sensing area, six anchor nodes are deployed. Once target nodes fall under anchor node's range, using RSS measures the distance between them is calculated. After that two virtual anchor nodes are projected surrounding the target

node using the trilateration method and to optimize the position PSO is applied. The author [8] proposed a computationally efficient approach based on swarm intelligence in which on the opposite boundaries two mobile anchor nodes move parallel to each other. When target node falls under anchor node's range, two virtual anchor nodes are projected, and they use trilateration to find estimated coordinates of the target node and apply PSO in less convergence time with fewer numbers of iterations. In this way, the entire sensing field is localized. The author [9] proposed an algorithm for localization called group of trimobile anchors (GMTA) which follows an adjustable square trajectory in WSN and greatly improves the localization accuracy by using less anchor nodes equipped with GPS and the position of other two anchor nodes can be calculated by motion and trigonometric equations. These three anchor nodes are connected in the form of an equilateral triangle and applied trilateration. The author [10] proposed a novel approach to reduce the problem of LoS by optimizing the position of randomly deployed mobile target nodes with individual anchor nodes deployed at the centre of the field and use trilateration. Network scalability is the advantage of this algorithm because with single anchor node can localize when the target nodes increases. The convergence time for BBO and FA is higher than PSO and HPSO. The performance of PSO, HPSO and BBO is better than FA. The author [11], proposed an approach in which dynamic mobile anchor node follows Hilbert trajectory. Apply PSO or HPSO to reduce the problem of flip ambiguity and LoS. The author [12] proposed intelligent water drops (IWDs) algorithm for a centralized range-based network. Outside the WSNs, one static sink node is deployed which is connected to processing units. Initially, each node undergoes through position estimation by using multilateration. The simulation outcomes show that this method achieves large localization accuracy as compared to ACO, PSO and genetic algorithms (GA). The author uses [13] salp swarm algorithm (SSA) for optimization to locate the target node in the sensing field. The outcomes of the proposed method are compared with BOA, PSO, GWO and FA. The simulation results depict that SSA has the best performance in terms of localization accuracy, the number of localized nodes and computing time.

3 Nature-Inspired Algorithms

In Literature, there are various optimization algorithms available. Some optimization algorithms are described below:

3.1 Particle Swarm Optimization (PSO)

Kennedy and Eberhart [14] are inspired from the behaviour of birds and developed an algorithm where each particle i has current position X_i , initial speed V_i and moves towards an optimal solution and gathers its particle best (Pbest) and global best

(Gbest) solution in the search area. At every unit of time, particles iterate according to following equations, where V_{i+1} and X_{i+1} have updated speed and position of particle i .

$$V_{i+1} = W V_i + C_1 R_1 (\text{Pbest}_i - X_i) + C_2 R_2 (\text{Gbest}_i - X_i) \quad (1)$$

$$X_{i+1} = X_i + V_{i+1}. \quad (2)$$

3.2 *Butterfly Optimization Algorithm (BOA)*

Arora and singh [15] are inspired by the behaviour of butterflies and invented BOA in which every butterfly produces some intensity I odour in the environment. This odour propagates through medium and other butterflies sensed this odour and this procedure is directly relevant to fitness function f . According to location, this odour changes. When one butterfly senses an odour from other butterfly and it is large than its odour that phase is known as global search. On the other hand, when a butterfly not able to sense odour on others, this phase is known as local odour, and it moves randomly and is known as local search.

$$f_i = aI^\beta \quad (3)$$

where f_i is odour magnitude that perceived odour produces by other butterflies, a denotes modular modality and β depends on modality.

3.3 *Firefly Algorithm (FA)*

Dr. yang [15] was inspired by the brightness behaviour of fireflies and developed the firefly algorithm. As inverse law says that with the increase in distance D brightness intensity B decreases because medium absorbs brightness at a constant rate γ .

$$B(D) = Be^{-\gamma D^2} \quad (4)$$

3.4 Grey Wolf Optimization (GWO)

Dr. Mirjalili [16] was inspired by the behaviour of wolves. Wolves are always in the group of 5–12 and this group is divided into a hierarchy of *A*, *B*, *C* and *D*. Where *A* category involves that dominate and experience wolves who decide on every step and other wolves have to follow that decision. That wolf could be male or female and a wolf does not need to be the strongest one. *B* category includes wolves that help *A* category wolf in decision-making. After *A* category wolf passed away, *B* category wolf is considered to be the next leader. The lowest and non-important part is wolves involved in *C* category. In some cases, the *C* category involves babies and play a scapegoat role. Those wolves do not involve in any of these categories and come under the *D* category. Hunting wolves come under this category, and they help *A* and *B* but dominate *C* wolves.

3.5 Salp Swarm Algorithm (SSA)

Dr. Mirjalili [17] is inspired by the behaviour of salps that are usually found in the sea. Salps are like jellyfish and always move in chain. So, there is one leader salp and other salps follow leader salp. The position of salps is stored in two-dimensional matrix *Y*. The main target of salp is to find food sources *f* in the search area.

$$Y_i^1 = \begin{cases} fY_i + r_1((UB_i - LB_i)r_2 + LB_i)r_3 \geq 0 \\ fY_i - r_1((UB_i - LB_i)r_2 + LB_i)r_3 < 0 \end{cases} \quad (5)$$

where Y_i^1 is the location of the salp leader. r_1 , r_2 and r_3 are random numbers. The values of r_2 and r_3 are in the range of $[0, 1]$. r_1 is responsible for balancing exploration and exploitation. r_1 can be evaluated by the following equation, where l is current iteration and L is a maximum number of iteration:

$$r_1 = 2e^{-(\frac{4l}{L})^2} \quad (6)$$

4 Experimental Analysis

The author compares the outcomes of SSA with existing algorithms such as PSO, BOA, FA, GWO. The experiment is conducted with two types of nodes in the area of $100 \times 100 \text{ m}^2$. One is anchor node having known coordinates and second is unknown nodes whose coordinates need to estimate. The communication range of the anchor node is 30 m. The experiment is conducted under several scenarios with

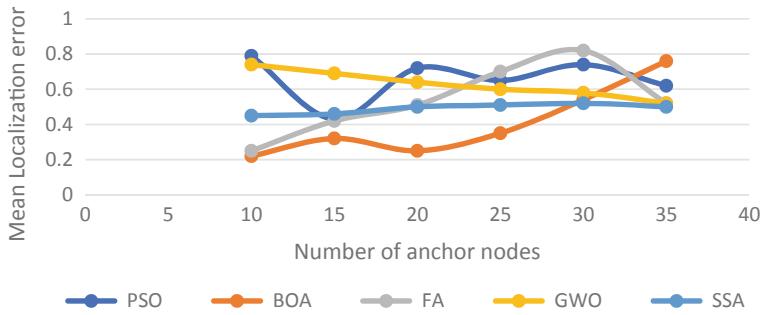


Fig. 1 Localized nodes of various approaches

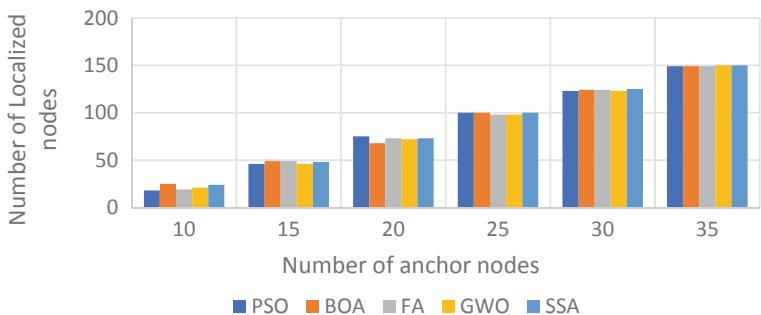


Fig. 2 Localization error of various approaches

different number of anchor nodes and unknown nodes. It has been noticed that when the number of anchor nodes and unknown nodes increased in a given area, the number of localized nodes increases as shown in Fig. 1. Figure 2 shows that with an increase in anchor nodes the localization error maximizes. Initially, FA has the lowest localization error but with an increase of anchor nodes, SSA has the lowest localization error.

5 Conclusion

The localization of sensor nodes plays an important role in WSNs applications. The main aim of localization is to upgrade the localization accuracy with maximum localized nodes. In this paper, the author surveys various meta-heuristic techniques that are used to find the optimal position of the target node. This paper provides a summary of the localization problem solved with various optimization algorithms and compares their results. In distributed localization algorithms, the number of transmissions to sink is less as compared to centralized localization algorithms due

to which sensor nodes consume less energy and lifetime of network increases. Though range-based algorithms are cost-effective due to extra hardware they provide better results as compared to range-free algorithms. Anchor-based system requires GPS in anchors. The large the number of anchors, the large cost of a network. Therefore, in future work, in-network single or two dynamic anchor nodes should follow a specific trajectory to reduce the number of anchor nodes.

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Parallel LU Decomposition Algorithm for Exa-Scale Computing Using Spark Ignite



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Abstract LU decomposition is one of the most efficient algorithms that can be applied to various operations such as the solving of linear equations, finding the determinant of a given matrix and matrix inversion. In any real-time application involving one of the above application scenarios, the matrix size will be gigantic and will not be able to be efficiently decomposed on a single node. In this paper, we propose a scalable algorithm for LU decomposition which is frugal in terms of time. This is accomplished by pipelining block LU decomposition on a multi-node Apache Spark system that is integrated with Apache Ignite. With the introduction of Ignite RDD, the entire dataset is available with all the nodes due to the availability of a shared Ignite cache layer, and only references to memory locations need to be passed across nodes. This is especially significant with respect to exa-scale computing where network latency is a major issue. The proposed algorithm is future-oriented and ready to deal with an efficient decomposition of large matrices with time complexity of $O(N^2)$.

Keywords LU decomposition · High performance computing · Ignite RDD · Data parallelism · Spark Ignite · Time complexity · Exa-scale computing

1 Introduction

Linear equations are can be solved using the matrix method. The inverse of a matrix may be computed to obtain the solution of a linear equation. For example, let us

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consider a set of linear equations denoted as $Ax = b$, the vector A is a matrix of size $n \times n$, x and b are vectors of size $n \times 1$. The solution for the above equation is obtained by calculating the inverse of the given matrix A which is mathematically represented as A^{-1} and x are calculated using $A^{-1} \times b$. Matrix decomposition and inversion have a huge application in many data science operations and network analysis functions. The most commonly used matrix inversion operations available are LU decomposition, Gaussian elimination method, Gauss Jordan, and Cholesky decomposition. All these algorithms are computationally intensive operations and so it fails when applied to Big Data where the size of the data is huge. So, in order to increase the performance and speed up the efficiency of the operation, the parallel computing can be employed. Parallel matrix inversion using message passing interface (MPI) was used in the initial stages. These algorithms are widely used mainly due to the fault tolerant and scalable nature of it. In this paper, we present a LU decomposition-based algorithm for exa-scale computing using Spark Ignite.

1.1 LU Decomposition

LU decomposition is one of the most efficient algorithms that can be applied to various operations such as the solving of linear equations, finding the determinant of a matrix and matrix inversion. In any real-time application involving one of the above application scenarios, the matrix size will be gigantic and will not be able to efficiently decompose it in a single node. In this paper, we propose a scalable algorithm for LU decomposition which is frugal in terms of time. We also provide an analytic proof for the time complexity reduction to $k_1 + k_3N^2/k_2$.

The main logic behind LU decomposition of a given matrix A is to express it as a product of the lower-triangular matrix L and the upper-triangular matrix U , i.e., $A = LU$. This is important since this partition of a matrix into two triangular matrices plays an important role of many data analytic applications and this is in turn used to find the solution for the computationally intensive matrix inversion problem. For LU decomposition, the data is converted into the matrix form. If the given matrix A is a square matrix, then the L and U components can be obtained by applying the Gauss elimination method on A to get the U part and L is a matrix with diagonal elements with 1. Gauss elimination method mainly follows two steps: first step: the zero row should obtain the lower part of the matrix and second step: each row with a non-zero value must be placed on the right side of the first non-zero value in the previous row. After these two steps, we obtain the matrix in the row echelon form. Serial LU decomposition (M): Step 1: $L_1, U_1 = \text{LU Decomposition } (M_1)$, Step 2: $L^{-1}_1 = \text{Inverse } (L_1)$, Step 3: $U^{-1}_1 = \text{Inverse } (U_1)$, Step 4: $X = P_1 M_2$, Step 5: $T = U^{-1}_1 L^{-1}_1$, Step 6: $S = M_3 T$, Step 7: $M_0 = M_4 - SX$.

The paper is organized as a section explaining the Spark, literature survey, the proposed system, analysis and the conclusion and future scope.

2 Spark Ignite

The data storage in database and disks leads to a delay in data accessing and a more efficient way is storing the data in the main random access memory (RAM) of then main server and this is the main idea of in-memory computing. Apache Ignite is RDD Abstraction of Spark for easy sharing of memory among the different Spark workers. The main advantage of Ignite RDD over the typical Spark RDD is that it has a shared in-memory view on data shared across different Spark workers and in other cases the Spark RDD it is not possible. Ignite RDD is deployed in a Spark worker, cluster or job as a view over a distributed Ignite cache. The mode of operation can be either embedded or standalone mode depending on the shared state. Implementation of Ignite RDD is as a view over the Ignite table which is distributed. It can be either within a spark worker, job or separate exclusive Ignite cluster. The deployment of Ignite RDD determines the shard state. The Apache Spark uses SQL syntax for querying but it lacks indexing and that is the main drawback as it is highly time consuming. Ignite Spark supports both primary and secondary indexing and this in turn improves the performance. Data frames concept to organize the data in organized format (table format with columns) as in relational database. Ignite data frame helps in the faster data access and makes the process simpler. It helps in data sharing across the jobs and makes the process of querying faster.

3 Literature Survey

Matrix inversion can be implemented in many software tools like R, Python, MATLAB, Linear Algebra Package LAPACK [1] and LINPACK [2]. But the main limitation of these tools is the data size, it fails to perform when the size of data increases drastically. So, the only solution is developing parallel computing algorithms. An extended version of LAPACK is scalable linear algebra package (ScalAPACK) used for matrix operations in Big Data in supercomputers. Load balancing was done by Bientinesi et al. [3] to improve the ScalAPACK and apply it to find the matrix inversion using Cholesky factorization method. Dynamic scheduler can be used to schedule the task for efficiently inverting the positive symmetric matrices [4], but the main drawback is it cannot be used for general matrices. LU factorization can be used for inverting the square matrices using multicore systems, but it is not effective in multi-cluster systems [5].

Many scientific and engineering problems commonly use Gaussian elimination [6]. Multicore architectures (MAGMA) [7] mainly was for many core and GPU systems. Performance is improved by splitting the small non-parallelizable tasks and larger parallelizable tasks between the CPU and GPU, respectively. Volkov et al. [8] matrix factorization was optimized for GPUs and the performance was improved. Van De Velde [9] multi-computer LU decomposition with pivoting was done. Kurzak et al. [10] LU factorization was accelerated in multi-core systems with partial pivoting.

Tomov et al. [7] proposed a method for hybrid, manycore, GPU system with fewer pivots LU factorization was implemented. Deisher et al. [11] multi-core dynamic load balancing algorithm was developed. In order to obtain high performance architecture-oriented optimizations is to be performed.

4 Proposed System

The proposed system is to develop scalable algorithm for LU decomposition which is frugal in terms of time. The objective is accomplished by pipelining block LU decomposition on a multi-node Apache Spark system that is integrated with Apache Ignite. With the introduction of Ignite RDD, the entire dataset is available with all the nodes as the a shared Ignite cache layer is introduced, and only references to memory locations need to be passed across nodes. This is especially significant with respect to exa-scale computing where network latency is an issue. The proposed architecture is given in Fig. 1 in which there are multiple Spark nodes from 1,2, ..., k and each node is having spark worker and multiple in schedulers and an ignite node. All the nodes are having same shared in-memory for Ignite. The Spark application taken here is the LU decomposition algorithm and the different part of the computation is given to

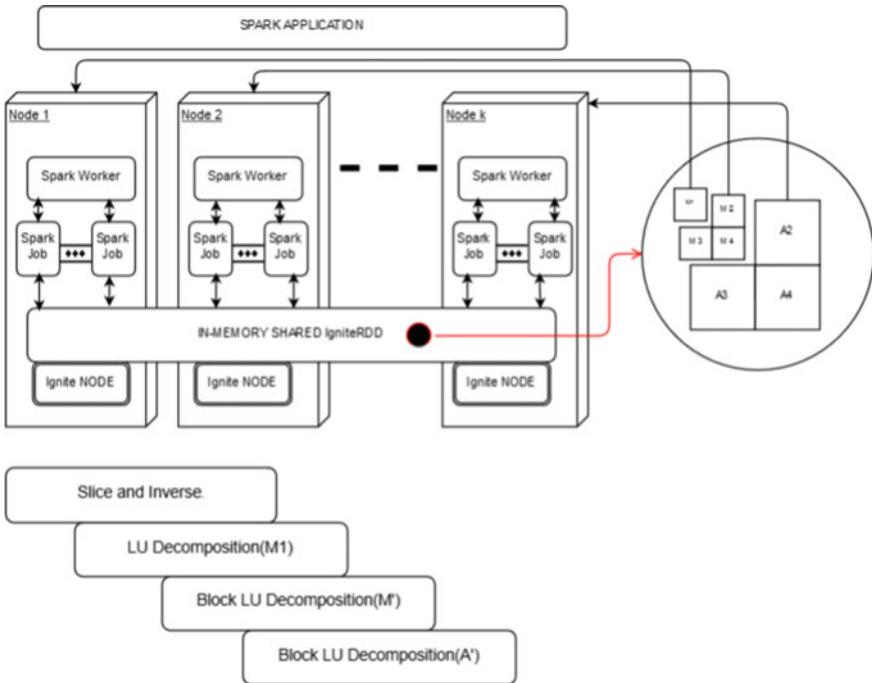


Fig. 1 Proposed architecture

different nodes which perform in parallel. The algorithm is mainly implemented in four steps: slice and inverse, LU decomposition (M_1), LU decomposition (M'), LU decomposition (A'). Algorithm for LU decomposition: The Ignite shared memory is updated with L ; U components and the contents are being iteratively updated. Algorithm for block LU decomposition: Block LU decomposition is computationally intensive task and it has a high of parallelism implemented which helps in speeding up the multiplication process. The algorithm is mainly based on finding the inverse of matrix and LU decompose algorithm. Algorithm for slice and inverse: In this, the entire dataset is loaded to master node and in order to make the decomposed matrix a square matrix padding is used and the padding is applied to both rows and columns to make it drivable by 4.

5 Analysis

Time complexity analysis of the LU decomposition for matrix inversion in the distributed system is performed taking into account the time taken for processing in the CPU and also the communication time for data shuffle. The timing analysis depends on three independent quantity: computational complexity, communication complexity and parallelization extent in the different cores.

All matrix multiplication operations are done with a time complexity of $N/m + \log m$. Using N threads, we parallelize matrix multiplication to $O(N)$. Algorithm 3 has time complexity $\log_2 N$ as the highest complexity loop is a while loop which reduces the iteration counter by half with every iteration and initiates data flow which signals Algorithm 1 to start. Algorithm 1 which starts the LU decomposition procedure has a time complexity of n^2 as the internal for loops are parallelized. As Algorithm 1 is being executed on node containing M_1 , the node containing M_2 , M_3 and M_4 begins its pipelined execution with a pipeline delay of $(2n) (255 \text{ T bps})^{-1}$ as it has access to shared memory which is being constantly updated by the first node. Inverse in Algorithm 2 is t Algorithm 2 is executed in this pipelined manner over every node that contains the data blocks. The overall time complexity is therefore $k_1 + k_3 N^{-2}/k_2$ where k_1 is the pipeline delay, k_2 is the total number of nodes across which the tasks have to be distributed and k_3 is some constant.

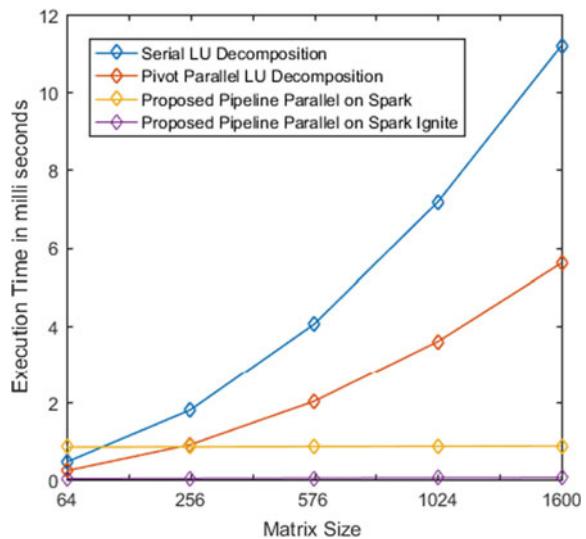
The timing analysis of the four various implementation of LU decomposition algorithm is compared and they are Serial LU Decomposition Algorithm, Parallel Pivoted LU Decomposition, Proposed Algorithm on Spark and Proposed Algorithm on Spark Ignite. The Serial LU algorithm is implemented in executing the seven steps in LU algorithm in serial order. Each matrix is subdivided into 4 matrix (M_1, M_2, M_3, M_4) and the same steps are executed repeatedly for each submatrix in serial order. In Parallel Pivot Decomposition algorithm, the time taken for execution is half of that in case of a serial LU decomposition algorithm since the other three sub-matrices will be parallelly executed after computation of the first submatrix (M_1). In the proposed method, the timing analysis depends on the number recursive calls to obtain a single element from the original matrix and the shared memory delay. The shared memory

delay (calculated based on RTT—round trip time) was found to be around 0.813 ms for the following system specifications where the algorithms were analyzed Intel ® core (™) i-5 1035G1 CPU @1 GHz Processor with 8 Gb RAM, 64 bit OS. The shared memory delay taken in Ignite is 0.001 of the delay taken in Spark since Ignite has in device shared memory and this makes computation faster. Table 1 shows the detailed execution time taken for the four algorithms for the given matrix sizes and clearly shows the execution time of the proposed algorithm is very less compared to the existing methods. And this is more useful in exa-scale computing where the size of the matrix is very large. Figure 2 show the comparison of the proposed method with other existing methods and its implementation in Spark and Ignite.

Table 1 Comparison of execution time of the proposed method

SI No.	Matrix size	Serial LU decomposition (ms)	Parallel pivoted LU decomposition (ms)	Proposed algorithm on Spark (ms)	Proposed algorithm on Spark Ignite (ms)
1	4096	28.672	14.336	0.831	0.018813
2	5184	36.288	18.144	0.832	0.019813
3	6400	44.8	22.4	0.833	0.020813
4	7744	54.208	27.104	0.834	0.021813
5	9216	64.512	32.256	0.835	0.022813
6	10,816	75.712	37.856	0.836	0.023813
7	12,544	87.808	43.904	0.837	0.024813

Fig. 2 Proposed pipeline parallel LU decomposition with existing algorithms



6 Conclusion and Future Scope

Large-scale matrix decomposition and matrix inverse calculation are a basic operation for many Big Data analytic techniques machine learning applications and personalized recommendation systems. In this paper, we propose a scalable algorithm for LU decomposition of large-scale matrices which is frugal in terms. With the introduction of Ignite RDD, the entire dataset is available with all the nodes due to the availability of a shared Ignite cache layer, and only references to memory locations need to be passed across nodes. This is especially significant with respect to exascale computing where network latency is a major issue. The proposed algorithm is future-oriented and ready to deal with an efficient decomposition of large matrices with a time complexity of $O(N^2)$. The execution time for the proposed method in Ignite is very small compared to all other existing methods.

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Common Spatial Pattern Versus Riemannian Features for Motor Imagery EEG Classification for Brain–Computer Interface



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Abstract The rapid growth in brain–computer interfaces (BCIs) technology with its new applications has helped many patients to help in rehabilitation from various diseases. This paper analyzes and compares two feature extraction algorithms (i) common spatial patterns (CSP) and (ii) Riemannian geometry-based algorithm for motor imagery-based EEG classification. Also, this study discusses some of the challenges and limitations of these algorithms and performance evaluation of these two techniques. Publicly available BCI Competition IV dataset IIa has been used to show the empirical result analysis. This shows the Riemannian geometry-based algorithm outperforms the CSP feature extraction algorithm. Riemannian features + SVM classifier gives the accuracy of 74.77% whereas CSP feature + SVM gives the accuracy of 73.82%. Also, we found Riemannian features are trained 3 times faster than CSP features and evaluation is done 4 times faster on Riemannian features.

Keywords Brain–computer interface · Common spatial patterns (CSP) · Riemannian geometry · Motor imagery · Electroencephalography (EEG)

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1 Introduction

The rapid growth in brain–computer interfaces (BCIs) technology with its new applications has helped many patients to help in rehabilitation from various diseases such as motor neuron disease, cerebral palsy, and amyotrophic lateral sclerosis [1]. BCI works as a communicator between the brain and various external peripherals which provides a solution to neurologically disabled patients [2]. The primary purpose of any BCI technology is to capture the signal from the brain and transfer it to control signals for external devices which carry out the desired function. BCI provides an advanced human–computer interaction without muscular tissue or peripheral nervous system [3].

Different signals are used in BCI applications to achieve different command executions. Among these command execution motor imagery (MI) is a popular and widely used command signal [4]. MI is a mental technique in which any individual simulates a part of its body in the brain without actually moving the body part [5]. All MI commands are found in the sensorimotor in the brain which consist of precentral and postcentral gyrus. Signals from the brain can be captured by various techniques like electroencephalography (EEG), magnetoencephalography (MEG), etc. EEG is widely used as a signal capturing technique due to the fact that it is non-invasive. It also has an excellent temporal resolution, cost efficiency, low spatial resolution and can be used by minimal training. It has low signal-to-noise ratio (SNR) which makes it weaker than invasively and semi-invasively acquired signals [6].

Detecting the MI command remains always a big challenge as the brain wave signals are non-stationary and transient signals and encompasses noise and artifacts [7]. The signals may also change with the change in position of the subject. A subject provides high-frequency signal content in upright position and lower-frequency signal while lying down [8].

In this paper, analysis and a comparative study of two feature extraction techniques (i) common spatial patterns (CSP) and (ii) Riemannian geometry have been provided for MI-based EEG classification. Also, this study discusses applications, challenges, limitations, and performance evaluation of these two feature extraction techniques. Section 2 covers the related background literature for MI-EEG-based BCI systems. Section 3 gives the methodology of the proposed comparative study. Furthermore, experimental results and performance evaluation and discussion have been provided in Sect. 4 and conclusion in Sect. 5.

2 Literature Review

Brain–computer interface (BCI) data consists of electroencephalogram (EEG) signals from the brain. For any application of BCI, data are first preprocessed and then split into tests and trained for any further development. In preprocessing, first signals are band passed and then from those signals feature extraction takes place

using different methods like common spatial pattern (CSP), directed transfer function (DTP), etc. Different band range filters are applied to the EEG data; for better results, cohen, 2008, uses bandpass filtration between 0.5–100 Hz and a 50 Hz notch filter with the amplifier sensitivity as 1 mV [9]. Haenschel et al., 2000, uses strong coupling between gamma at 40–80 Hz and upper theta at approx 7–9 Hz [10]. Blankertz et al. and Brunner et al. use CSP features which are obtained by solving generalized eigenvalues and conclude spatial filters are a powerful tool to improve signal:noise ratio [11, 12].

The number of features from the CSP method is very high which leads to low accurate results during classification. For this, we reduce the number of features before applying classification, by selecting them using different techniques. Schroder et al., n.d and Garrett et al. use genetic algorithm (GA) for feature selection with SVM classifier to obtain better results [13, 14]. Kai-Quan Shen et al. compare two feature selection techniques, one with INIT ranking technique and another with the RFE technique with random forest classifier [15]. Bhatti et al. two nonlinear classifiers neural networks and SVM [16]. Deriche and Al-Ani, n.d. and Koprinska compare five feature selection techniques (information gain, consistency-based selection, ReliefF, correlation-based selection, and IR ranking) with 10 classifiers on highly dimensional BCI data [14, 17]. CHEN et al. use RSVP feature selection technique and applied deep learning (CNN) model to improve the result [18]. Chatterjee et al. use adaptive auto-regressive (AAR) feature extraction technique [19]. Farooq et al. use ICA and PCA for dimension and noise reduction [20].

3 Methodology

The dataset used is freely available dataset IV A from BCI competition 2008 [21]. Data contain 48 trials of EEG data for 9 subjects with four MI class labels left hand, right hand, both feet, and tongue. The approach used in this study mainly follows three steps, which are preprocessing/band filtering, feature extraction, and classification. Figure 1 shows the workflow of the approach.

MI movements are mainly present in the premotor cortex of the brain. To attain robust classification, we remove signal data from other irrelevant channels. We mainly use 30 channels to acquire data (Fig. 2).

After collecting the data, a bandpass filter is applied to the data which extracts data from a particular frequency band. Also, bands with high noise can be extracted and filtered. In this study, we have used two sub-bands. Band 1 mu (μ) within 7–13 Hz and band 2 beta (β) within 13–30 Hz [22].

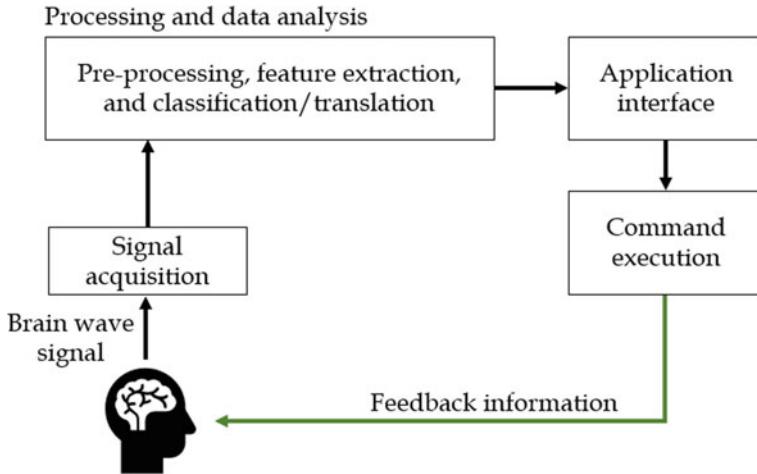


Fig. 1 Basic workflow of a BCI application incorporating signal acquisition, preprocessing, application interface, command execution [11]

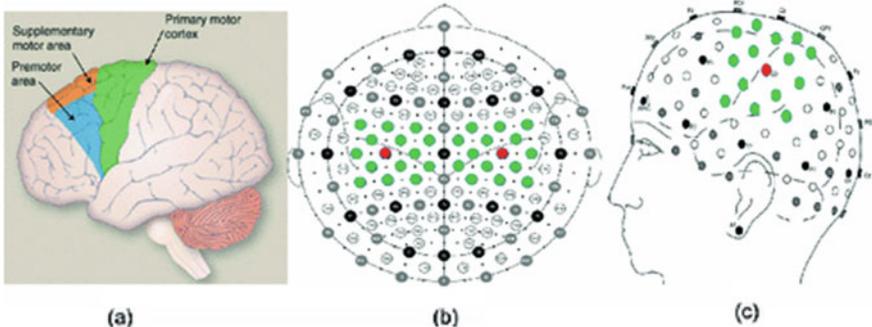


Fig. 2 Placement of electrodes on the cortex to detect MI, green and red dot are the selected 30 channels used to collect signals

3.1 CSP Feature Extraction

In CSP filtering [2], EEG data are transformed into new spaces. Since every frequency band contains different information, CSP allows to extract information from each band. It divides the EEG data by varying variance of each class, maximizing one class and minimizing the other class. For a bi-class data, covariance matrix C is where X is $X \in R^{N_c \times N_s}$, N_s is total time samples, and N_c is total channels.

$$C = \frac{1}{N_s - 1} (X X^T) \quad (1)$$

Then we calculate the mean covariance matrix for all classes where N is total occurrences for each class and C_j^k is covariance matrix.

$$C_{\text{mean}} = \frac{1}{N} \sum_1^N C_j^K \quad (2)$$

To achieve the spatial filter, we need W , which maximizes Rayleigh quotient.

$$W = R^{Nc} \quad (3)$$

All feature is then calculated using

$$f_l = \log \left(\frac{w_l^T X X^T w_l}{\sum_k w_k^T X X^T w_k} \right) \quad (4)$$

To perform multi-class CSP, we perform bi-class CSP on all possible pairs of class variables, in this case for $Y = \{1, 2, 3, 4\}$ all possible combination would be $\{(1, 2), (1, 3), (1, 4), (2, 1), (2, 3), (2, 4), (3, 1), (3, 2), (3, 4)\}$ [23].

Algorithm 1 CSP Feature

Input: EEG signals after preprocessing with 2 class labels.

Output: projection matrix/feature matrix

for $i = 1$ to M do

$P_{Ni} = \text{Cov}(Ni)$ {for calculating Covariance matrix}

end for

$P1 = A(P_{Ni}, Ri = 1)$ {Mean for class label 1}

$P2 = A(P_{Ni}, Ri = 2)$ {Mean for class label 2}

W {Eigenvalue decomposition} = $(P1 + P2) - 1P1$

return W

3.2 Riemannian Feature Extraction

Riemannian feature extraction uses Riemannian geometry [23]. The objective is to study a smooth curve on a tangent surface. $N_c \times N_c$ defines a real symmetric positive space and P_{Nc} as covariance matrices of a smooth differential manifold, which allow mapping between manifold and local tangent. Let $C_{\text{ref}} \in P_{Nc}$ be a fixed reference point and $T_{C_{\text{ref}}} P_{Nc}$ be the tangent space. We use a logarithmic map to project submanifold P_{Nc} to tangent space $T_{C_{\text{ref}}} P_{Nc}$.

$$S = \text{Log}_{C_{\text{ref}}}(C) = C_{\text{ref}}^{1/2} \logm(C_{\text{ref}}^{-1/2} C C_{\text{ref}}^{-1/2}) C_{\text{ref}}^{1/2} \quad (5)$$

$$C = \text{Exp}_{C_{\text{ref}}}(S) = C_{\text{ref}}^{1/2} \expm(C_{\text{ref}}^{-1/2} S C_{\text{ref}}^{-1/2}) C_{\text{ref}}^{1/2} \quad (6)$$

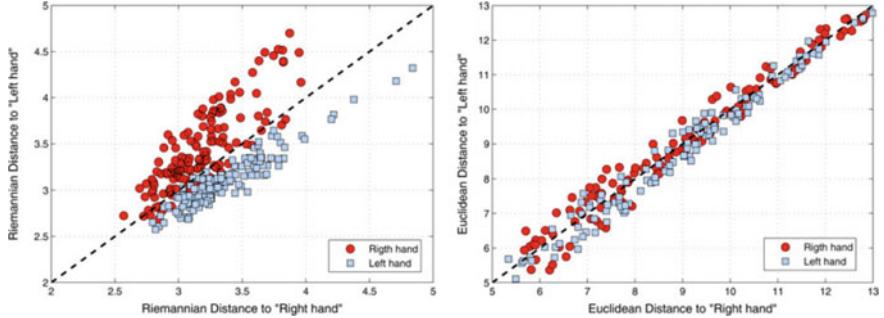


Fig. 3 Left graph shows Riemannian distance to Riemannian mean and right graph shows Euclidean distance to Euclidean mean for covariance matrices

Here, $\text{logm}()$ is matrix logarithm and $\text{expm}()$ is an exponential function. We take two elements C_1 and C_2 from P_{Nc} and compute their inner product. Euclidean distance finds the shortest path whereas in case of Riemannian it finds shortest path along geodesics [22–25]. Figure 3 shows the distance to mean separation on the Riemannian and Euclidean distance formula. This image separates two class data but with this we can see the advantage of using the Riemannian distance formula.

$$E_{\text{euclidian}} = \|C_1 - C_2\| \quad (7)$$

$$R_{\text{riemannian}} = \|\text{logm}(C_1^{-1} C_2)\| \quad (8)$$

After this, we measure covariance metrics, Euclidean uses arithmetic mean whereas Riemannian uses geometric mean. Then, we use kernel approach, in which we formulate SVM

$$f(C) = \beta + \sum_{i=1}^n \alpha_i y_i k_i(C_i, C; C_{\text{ref}}) \quad (9)$$

$K_i(C_i, C; C_{\text{ref}})$ is the kernel function which is

$$k(C_i, C; C_{\text{ref}}) = \langle \Phi(C_i), \Phi(C) \rangle_{C_{\text{ref}}} \quad (10)$$

$$= \text{Tr}(C_{\text{ref}}^{-1} \text{LOG}_{C_{\text{ref}}}(C_i) C_{\text{ref}}^{-1} \text{LOG}_{C_{\text{ref}}}) \quad (11)$$

$$= \langle \tilde{S}_i, \tilde{S} \rangle_F \quad (12)$$

$$= \overrightarrow{\tilde{S}}_i^T \overrightarrow{\tilde{S}}_i \quad (13)$$

C_1 and C_2 are then projected to tangent space from submanifolds taking the reference point C_{ref} .

Algorithm 2: Riemannian Algorithm

Input: EEG signals after preprocessing with 4 class labels.

Output: projection matrix/feature matrix

for i = 1 to channels do

```
    data_filter = butter_fir_filter(data, filter_bank) {Filter_data}
    cov_mat = 1/(n_samples-1) {Compute covariance matrix}
```

end for

P1 {AM of covariance matrices for C1}

P2 {GM of covariance matrices for C2}

for col in range(1,N):

for row in range(0,col):

```
    out_vec[idx] = sqrt2*mat[row,col]
```

```
    idx += 1
```

end for

return out_vec

4 Results

To check which feature extraction method provides more accurate results we have applied two classifiers with fivefold cross-validation to the features extracted by CSP and Riemannian. Results of those classifiers are in Fig. 4.

CSP features give an accuracy of 61.55% using random forest technique and accuracy of 73.82% using SVM technique. In the case of Riemannian features, 51.11% accuracy is obtained using random forest and 74.77% using SVM. CSP + random forest leads with ~10% accurate result as compared to Riemannian + random forest because Riemannian uses a smaller number of features than CSP. Random forest works well with big data rather than small data. The best accuracy obtained is using Riemannian with SVM which is $74.77 \pm 12.8\%$. A number of features used by the CSP algorithm are 11,352, whereas the features used by Riemannian are 10,879. Many machine learning classifiers like K-NN show good results with CSP rather than Riemannian because of a greater number of features. Also, Riemannian extracts 253 features per frequency band whereas CSP extracts only 24. In a single window, Riemannian features can achieve better accuracy than CSP. Average time used in training CSP features with random forest took 78.18 s and 93.78 s with SVM whereas for Riemannian with random forest took 27.13 s and 29.18 s with SVM. This concludes training speed of Riemannian features is three times faster than CSP and similarly for evaluation time we found out Riemannian features are evaluated four times faster than CSP.

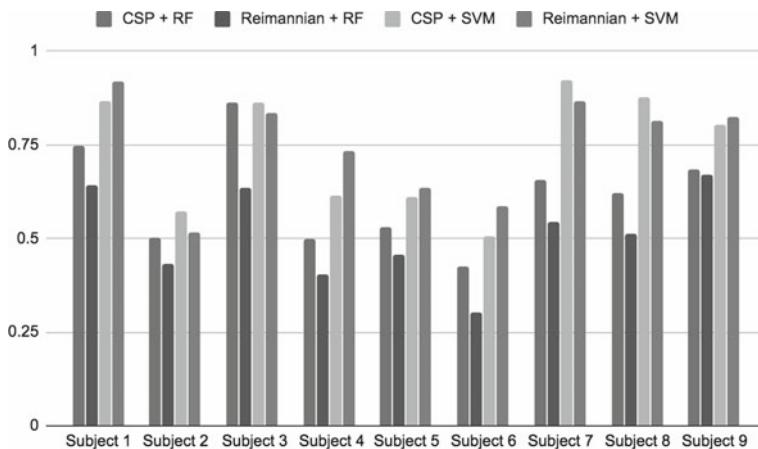


Fig. 4 Accuracies of SVM and random forest classifiers with CSP and Riemannian feature extraction technique

5 Conclusion

In this study, we have compared two feature extraction techniques (i) CSP and (ii) Riemannian. We have evaluated the techniques using two classifiers (i) random forest and (ii) SVM. Random forest shows better results with CSP whereas SVM shows better results with SVM. The final accuracy obtained was 74.77% using Riemannian + SVM features. Also, Riemannian features are faster in terms of training speed and evaluation speed.

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An Overview of the Emerging Technology: Sixth Sense Technology: A Review



Rohan Bari, Amit Kumar Gupta, and Priya Mathur

Abstract Sixth sense technology is a stage dependent on signals utilize that associates our physical world with the advanced data and by utilizing hand motions an individual can communicate with the data in a specific way. This paper gives a diagram in the field of sixth sense technology. Sixth sense technology gives improvement to the physical world around us with advanced data and permits the client to utilize signals to collaborate with the data. The appearance of this rising technology in most recent couple of years has set up the new face in human PC interaction (HCI). The point of this paper is to survey different motions, parts utilized, strategy embraced in sixth sense technology and its application.

Keywords Camera · Projector · Mirror · Microphone · Color markers · Gestures

1 Introduction

We all human beings are sensitive over the five basic sense, i.e., eyes, ears, nose, tongue, and skin. Apart from these five senses, there exists the sense known as sixth sense technology [1].

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1.1 What is Sixth Sense?

Sixth sense is an interface that upgrades our physical world with advanced data and permit us to utilize hand signals to cooperate with that data. It depends on the ideas of giving the composite view and has all around executed its impression. Sixth sense technology has united this present reality objects with the computerized world. The breathtaking sixth sense technology is a blend of numerous choice advances [2].

What makes it rich is the great reconciliation of each one of those advances and presents it into a solitary convenient and efficient item.

It compares advances like hand-motion acknowledgment, picture catching, preparing, control, and so on. It lays the advanced world on this present reality so the two of them become obvious. Motions can be of various sorts, for example.

- Speech
- Hand
- Eye
- Sound
- Symbolic Responses
- Facial expression

1.2 Components Required

For sixth sense technology, there are some essential components:

- Camera
- Projector
- Microphone
- Mirror
- Color Marker
- Mobile computing device

1.2.1 Camera

Camera is a device which considers as a digital eye of the system and is used to capture the image of the real world objects. Presence of this component must be at the top or head of the sixth sense technology pendant. The camera function is similar to the human eye by capturing the images of the object but the only difference is that it provides the digital information of the image of an object.

This camera is equipped for catching the pictures up to the specific range that falls inside its vision and furthermore it gives computerized data about the articles present before it [1, 3] (Fig. 1).

The major functions of the camera are:

- a. Used to capture the user's gestures and movement.

Fig. 1 Camera for sixth sense technology

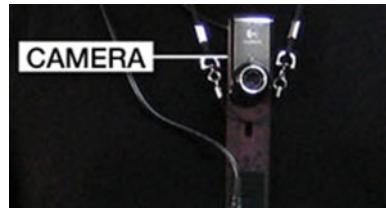


Fig. 2 Projector for sixth sense technology



- b. Captures the incident in front and objects the user interacting in a particular manner.
- c. When the users carry out a ‘framing’ gesture, it captures the photograph of the scene from the front.
- d. By observing the index finger the user can draw on any surface using the drawing application. The zoom in and zoom out features can also be mapped out anywhere.
- e. The scenes that user captures by the camera in present can be arranged on surface later. A portion of the more down to earth models are perusing a paper. Perusing a paper and watching recordings rather than the photographs in the paper, or then again updates of live games while perusing the paper. The gadget can likewise read a clock outline of plane on tickets [3].

1.2.2 Projector

Projector is a device which helps the user to display the information on the wall or any other solid surface. Here, the work of projector is similar to the general projector as it also displays the information on any surface, the projector consists of the battery in it whose backup time is about 3 h. The battery used in the projector is rechargeable for convenience [1] (Fig. 2).

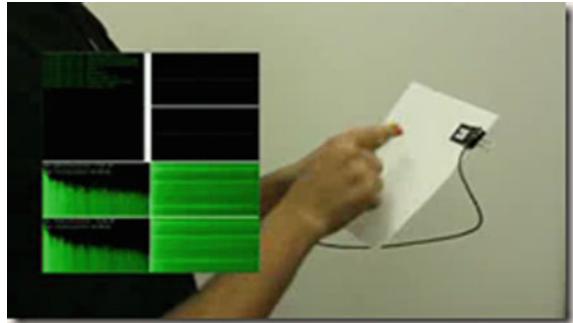
1.2.3 Mirror

Mirror functions in sixth sense technology as to reflect the projection emergence from the projector, and this is done to get the projection emergence from the projector onto the desired surface. Mirror is used to change the position of the projection of image [2, 4] (Fig. 3).

Fig. 3 Mirror for sixth sense technology



Fig. 4 Microphone for six sense technology



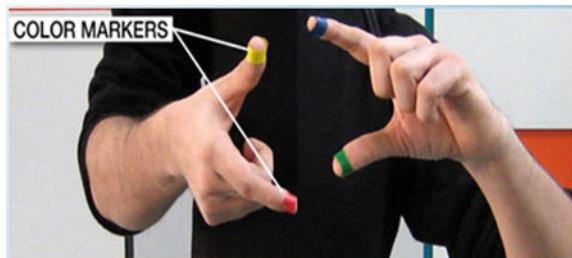
1.2.4 Microphone

The Microphone is considered as an optional component in the case of sixth sense technology. In the system of sixth sense technology, the microphone is line up with the help of clips. The microphone is used when the user wants to make more interactive paper interface. In order to perform this, the clips which are line up with microphone are clipped with paper and then the data are passed to the computing device for processing whenever the user touches the paper [2, 4, 5] (Fig. 4).

1.2.5 Color Marker

These markers are on the tip of the finger. These markers are of different colors, i.e., red, yellow, green, and blue colors. These markers help the webcam to recognize the gestures and detect the motion of fingers. The movement and arrangement of the markers are interrupted into gestures [5] (Fig. 5).

Fig. 5 Color marker for sixth sense technology



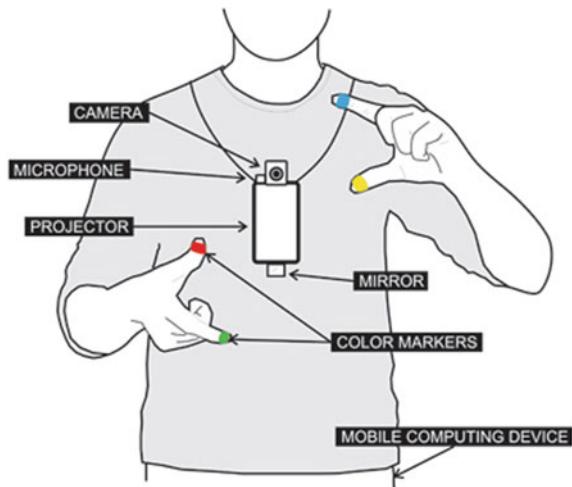
1.2.6 Mobile Computing Devices

This is a device which actually works as the brain of the sixth sense technology. This device like smart phones in our pocket sends and receives the voice and data to anyone with the help of mobile Internet. In this device, the sixth sense technology's software runs [1] (Figs. 6 and 7).

Fig. 6 Mobile computing devices for sixth sense technology



Fig. 7 Components used to implement sixth sense technology



2 Motivation and Background

Beforehand numerous advancements developed, for example, expanded reality, which is to add data and importance to genuine article or then again place. In contrast to computer generated reality, increased reality does not make a reenactment of reality, rather it takes a genuine article or space as the establishment and consolidates advancements that include logical information to develop an individual comprehension of the subject. It is a term for live immediate or circuitous perspective on a physical certifiable condition whose components are expanded by virtual PC produced symbolism. Signal acknowledgment is a term with an objective of deciphering human signals through scientific motions and scientific calculations. PC vision is the science and technology of machines that are worried about the hypothesis behind counterfeit frameworks that separate data from the pictures. As an innovative discipline, PC vision tries to apply its hypotheses and models to the development of PC vision frameworks. The models incorporate with the controlling procedures, recognizing occasions, sorting out data, demonstrating articles or conditions.

As of late discourse coordinated circuits advanced which is utilized generally, in vehicle mechanization and home apparatuses. It facilitates the activity and recoveries the usage time of the manual tasks performed by the human's consistently. The discourse acknowledgment process is performed by a product segment known as discourse acknowledgment motor. The essential capacity of this is to process the verbally expressed information and make an interpretation of it into content which the application gets it. The application at that point can do one of the two things,

- a. The application can decipher the aftereffect of the acknowledgment as an order; right now the application is an order and control application.
- b. If the application handles the perceived content as essentially message, at that point it is considered as correspondence application.

At the point when the client says something, it is known as articulation. An expression is a stream of discourse between two times of quietness. The discourse IC can be utilized for a wide range of information, measurable models, and calculations to change over spoken contribution to content.

3 Working Process of Sixth Sense Devices

During the working of sixth sense, the entire hardware device is placed in the pendant like wearable device which consists of the various components of the sixth sense technology, i.e., camera, mirror, projector, and is connected to the smart phone. Initially the camera recognizes individuals, images, gestures that the user makes by their hands also the projector performs by projecting information on surface present in front of the person. The usage of the mirror is worthy as the projector dangles pointing downward from the neck. The information of the image that had been captured by the camera initially is sent to the smart phone for processing [1, 6].

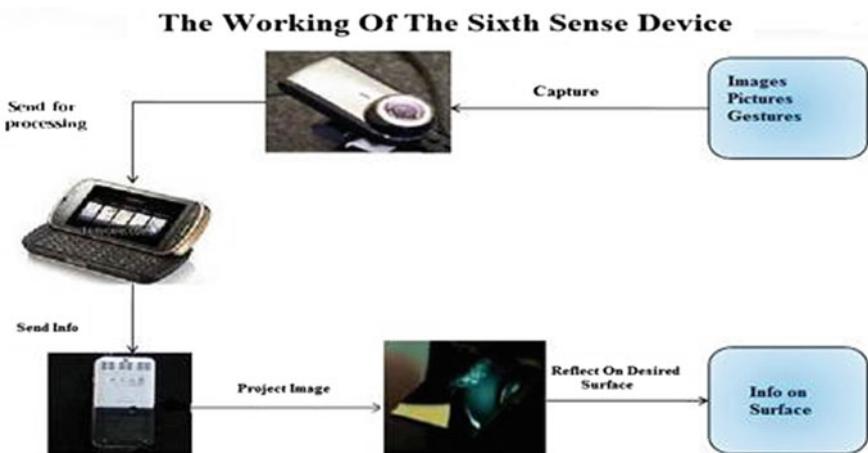


Fig. 8 Working of sixth sense device

To bring out variations on a much higher plane, Mistry uses colored caps on his fingers so that it becomes simpler for the software to differentiate between the fingers, demanding various applications. The camera captures the movements of the finger tips having colored caps over them to form different movements [4]. These gestures can be perceived by the PC vision strategies. The markers demonstration like a tracker. Video information got by the camera and furthermore the areas of the shaded markers are finding by using single PC vision systems can be broken down by the product. An individual can utilize any number of hand motions and developments given that they are for the most part sensibly distinguished and perceived distinctive for the framework to decipher it, if conceivable through one of a kind and changed fiducials. This is conceivable, just when 'Sixth Sense' gadget bolsters multi-contact and multi-client connection [7] (Fig. 8).

The main idea of sixth sense technology is to determine what someone is interacting with and in what manner he or she is interacting with it. This emerging technology obeys the gestures made by the user using hands and results into what we actually want to see and know. We can say that sixth sense technology is the combined technology of computer along with the cell phone [8].

4 Applications of Six Sense Technology

- Motion capture:*** The new camera was lauded by greater part individuals at the hour of exhibition. The photographs can be altered, overseen into displays what is more, shared on any interface. The information is put away inside an inbuilt capacity gadget. At the hour of utilizing a surface, the whole information is taken into that surface and subsequent to altering it is put away in the gadget.

- b. **Capturing photographs using fingers:** The weight of conveying a camera and keeping it free from any potential harm out traveling would now be able to be evaded by just utilizing the Intuition Technology. The intuition PC works as a camera. In the event that you make the square utilizing your pointers and thumb, at that point your image is clicked by the camera.
- c. **Check the brand of the product:** A product of the best brand can be chosen.
- d. **Reviewing flight status:** Any foundation can be utilized to extend a screen, on which the status of flight can be checked by putting the ticket before this technology.
- e. **Time without watch:** Time can be seen only by drawing a hover on the wrist rather than truly wearing a wristwatch.
- f. **3D drawing:** Gives a pencil that permits clients to attract 3D, a great method to learn for the fledglings in the field of 3D demonstrating.
- g. **Call using palm as dialer:** It gives the arrangement of utilizing the hand as a screen onto which the dialer is anticipated, utilizing which an individual can make a call.
- h. **Video newspaper:** It decides the news feature and the showcases the fitting video.
- i. **Zoom in zoom out:** It assists with survey pictures and related things in the manner one needs to see.

5 Advantages of Sixth Sense Technology

As one of the freshest and the most refined advances of the cutting-edge time, the sixth sense has its own points of interest. By the movement of this technology, it will be a daring advance to another period in the cutting-edge science and technology [4, 7, 8].

- a. Sixth sense interface is used to combine the digital information and its object therefore entire world behaves as our own computer.
- b. Hand gestures are used by the user to interact with the digital information in the physical world, multi-touch and multi-interaction are also supported.
- c. Sixth sense is an open-source platform so that data can be accessed directly from the machine into real time.
- d. It is portable, cost effective and map idea can be minded anywhere.
- e. Sixth sense technology can be used by even a native person who has less knowledge or no knowledge about the keyboard and mouse.

6 Disadvantages of Sixth Sense Technology

Sixth sense technology also has some of the major disadvantages in the environment [4, 7, 8].

- a. Making radical utilization of this can cause dependence and hamper public activity too. It will result in lessened humanness.
- b. Interacting with the physical world remembers the presentation of beams for surface like human arms can prompt medical problems.
- c. Need of equipment turns out to be less by utilizing this technology which influences the equipment showcase.
- d. It can influence the vision of the client on account of its particular and better use at evening and in dull territories when contrasted with mornings and splendid spots.

7 Conclusion

The emerging sixth sense technology recognizes the real-time objects in our surroundings, and information of the captured object has been displayed automatically and we can access it in any way whenever we need to. The sixth sense technology applications are useful, flexible for the users to use. It allows the user to interact with the digital information in physical world using natural hand gestures. Use of this can change the way we interact with the real world and give everyone the complete awareness of the surrounded environment. Sixth sense can be used as the replacement of the fifth sense for handicapped peoples and also can be used in industry over machineries. It will definitely revolutionize the world.

8 Future Scope

A couple of future headways might be utilizing concealing markers are rarely again required to fix the camera and projector inside versatile preparing device. At whatever point we place any wearable device on the table, it should allow us to use the table as multi-contact UI. Make use of this advancement in various interest, for instance, gaming, preparing structures, etc., to comprehend the 3D movement following. To overcome with the imprisonments of fifth sense for injured person, some current devices and advances will be discarded and at this point one thing is promised it will make another segment throughout the entire existence of science and development.

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Autonomous Drone Using ROS for Surveillance and 3D Mapping Using Satellite Map



Nitin Jain, Amit Kumar Gupta, and Priya Mathur

Abstract Robot Operating System (ROS) is a framework for Linux which provides ample resources and development frameworks within it that makes robot development easy, flexible, robust and faster. With the use of this technology, this paper basically focuses on development of an autonomous robotic drone using ROS which have two functionalities; one is mapping a 3D view of an environment of a provided satellite map and another is surveillancing over an environment of a provided satellite map. This paper describes the idea and methodology of development of such devices. Such robotic drones can have ample applications which can be re-modified for efficiency in future. ROS provides a greater flexibility of establishing communication and synchronization between various components of a drone whether hardware or software.

Keywords ROS · Nodes · Topics · Messages · Services · 3D mapping · ROS navigation · Operating system (OS) · SLAM navigation

1 Introduction

With the evolving technology of the computer systems, also of embedded systems, technological advancements are prone to happen. The technology gives a robust, reliable and flexible framework for writing robot software. It is a collection of libraries, tools, frameworks, standards, etc., which makes writing functionalities of robots

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easier. All these available facilities make writing the software for robots more convenient, simplifying the job developing typical to complex and robust system behavior covering a broad variation of robotics platforms.

It acts as a robotics middleware, i.e., collection of software frameworks for robotic software development. Though this is not a stand-alone operating system, it runs over the Linux. The installation of ROS comes up with a number of tools and utilities that drive the robots. It provides functionalities designated for a mix-up computing group such as hardware abstraction, device-level control, message enpassing between managing processes that certainly are responsible for utilizing robot functionality.

There are an ample number of devices (sensors, detectors, cameras, etc.) that can be interfaced with our robot module that can sense and acquire many different information from its surroundings and can be used for the applications.

2 Literature Review/Related Work

As discussed in Joscha Fosel et al. [1], it focuses mainly on using SLAM navigation technology on 3D maps instead of 2D maps. Their SLAM system is based on multiple working parameters for range finder, altitude and various sensor data. Their synchronization makes the indoor SLAM navigation system well. Hector SLAM technology had been used which registers 2D laser range finder input with a map with a goal to define 3D pose using that data. They are using occupancy grid maps, and the Hector SLAM algorithm has been designed so that it requires low computational resources.

The concept of looping in mapping has been discussed in Safdar Zaman et al. [2] which states that the mapping process is better if robot scans the area/environment in a loop. Loop here means that the mapping of the environment has to be done in such a way that it comes back to its initial point using different ways, hence traversing the environment through its exteriors. Determining height and orientation of laser scanner should be done carefully so that it can provide scan data as much as possible extracting from the environment.

The system is described in Tomáš Krajník et al. [3]; the methodology has been proposed for autonomous navigation of drone. There are several autonomous behaviors available for the system along with autonomous navigation. They have used a quadrotor (quadcopter). The system has several methodologies for position control, hovering control, visual-based navigation, etc. The system had been already experimented for mobile localization system, autonomous surveillance, position control, etc. [3].

2.1 Robot Operating System (ROS)

ROS is an open-source framework for developing robots. It is not an actual stand-alone operating system; it provides a set of functionalities and tools to build a

robotic application. It is not just limited to robots only, but many of the heterogeneous computer clusters whose hardware is designed to perform robotic functionality are also using ROS due to its flexible development environment and robustness. ROS contains 2100 + packages providing specialized mechanisms for robots by default. ROS provides the features of hardware abstraction, communication between processes (called nodes in ROS), visualization and a lot more. It provides multiple different frameworks for certain different parts which can be used to construct a robot. It provides support libraries and systematic framework for such devices that let us apply devices in the system without having to know in depth about those hardware functions, i.e., it is highly abstract in such terms [4–6].

2.2 *SLAM Navigation Technology*

SLAM stands for Simultaneous Localization and Mapping which is a specialized robot navigation technology that allows mobile robots to automatically navigate through a known area by themselves. SLAM actually makes use of the map created by the robot itself utilizing the SLAM gmapping package which is responsible for mapping the environment. Mapping the environment (creating the map of the area) and making the path toward goal (making trajectory to the goal) on its own are essential parts of the robot's autonomous navigation. To perform such a task, the system uses a computational algorithm (SLAM) which is nowadays an emerging technology in the field of robotics. ROS framework and its related packages provide a robust environment, utilizing the hardware, allowing the robot to do the mapping process and hence localizing (finding the position of self) in the environment [2, 7].

2.3 *Mapping*

Mapping the environment is the process of creating a map of the environment by the robot in which it is supposed to work. Here, we are considering the slam_gmapping which states that the robot can create the map of the environment by itself and is able to localize itself in that environment. To build such a map, it uses a slam_gmapping package which creates a node named slam_gmapping. This slam_gmapping node takes in laser scan data in the form of messages and builds a map. This map can be used for robot navigation, and it can be retrieved (used) in the robot through a ROS topic or ROS service [2, 7].

2.4 Drone Mechanism

Drones are unmanned aerial vehicles (UAVs) which eventually wind up all things regarding drones, from its aerodynamics to materials used, chipset to circuit boards, functioning to the whole runner software. They are generally small in size and highly efficient in working on their own (autonomous). Since they are unmanned, they need to be programmed very carefully. They have propellers which help them in flying into the air by creating compressed air pressure around the device. Their origination had already proved their incredible applications in military, security, surveillance, aerial photography, delivery, etc. There are certain categories of drones which are used for different applications as per the requirement [3, 8, 9].

2.5 Nvidia Jetson Nano Developer Board

Jetson Nano is a 70×45 mm development kit with an onboard processor and graphics card, an ultrafast processing system on a small-sized board with ultimate processing power and utility. It is the power of modern AI which is available for developers, embedded developers and technological enthusiasts. It is a small and powerful computer that lets one run multiple neural networks in parallel for applications like image processing, object identification, classification, segmentation and speech recognition all in a ready and easy to use platform that uses only 5 watts of electricity. The board has its own software components, i.e., it uses Ubuntu 18.04 bionic as its OS platform. It comes up with its own Software Development Kit (SDK) which is used to install the OS and other development components on Jetson.

3 Objective

In brief and simpler terms, our objectives are as follows.

- a. To develop a drone-based autonomous robot which uses GPS satellite map for its navigation system, i.e., not using the map made by the robot itself (might be using SLAM). The drone can be used for surveillance, mapping, delivery, etc.
- b. The drone should be using a Nvidia Jetson Nano board with Ubuntu 18.04 bionic with ROS Melodic Morenia installed in the system. The ultra-fast image processing capability with the power of AI can easily process the map from air within a fast-moving environment which could be highly dynamic.
- c. The process of mapping can be done using lidar which can be used to map the environment. The mapping can be a 3D mapping or 2D mapping which can output either a three-dimensional map of the environment showing terrain or two-dimensional map of the environment showing planar view of a three-dimensional map.

- d. The system will use a GPS map for traveling across the environment instead of a map made using SLAM technology of ROS.
- e. In the drone-based system, however, there are ample projects, and commercially, available ROS systems (robots) have been made serving purposes like restaurant service (waiters), and they are mostly based on 2D mapping using Simultaneous Localization And Mapping (SLAM) technology for a planar surface. Our system is going to consist of SLAM technology, not for planar surfaces but for aerial environments. Being in the air, it can map the ground using the lidar technology.

4 Methodology

This section will describe the methodology which will be used to achieve our objectives. Objective for this development will comprise of the following:

4.1 *Setting up Nvidia Jetson Nano*

There are some of the special guidelines to be followed for setting the Nvidia's Jetson Nano developers board to put it into the field of work.

The board requires:

- A micro USB power supply with power rating of 5 V and 2 A for powering the board
- An ultra-high-speed (UHS) microSD card that must be at least 16 GB for booting the device and as main storage
- A computer display (can be an HDMI or a DP)
- A USB keyboard and mouse.

To prepare the microSD card for nano board, it requires a computer with an Internet connection with skill or reading and writing microSD cards. It requires an image of Nvidia's self-modified Linux (Ubuntu 18.04 bionic currently) which has to be downloaded from Nvidia's Web site. This image then needs to be flashed in the card using *Etcher* for reading and writing the cards with OS images. The brief instructions for the same are given here. When the above-mentioned process is completed, the system is ready for its first boot. Nvidia provided its official SDK software for development purposes. This SDK software is used to install certain plugins, components intended for development purpose. One can install and embed them to the OS as needed [10, 11].

4.2 Clean Installation of ROS on Linux

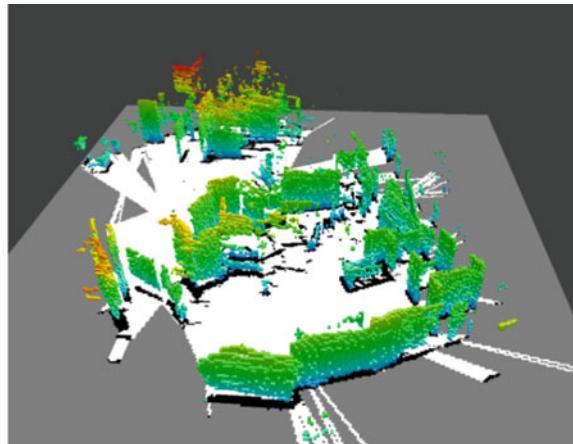
It is the first and foremost step in ROS development. Installation of a compatible ROS distribution with a compatible Linux is important as different flavors of Linux support different versions and packages of ROS. The earliest official release of ROS was named as Box Turtle released in Feb 2010 for Ubuntu Hardy (8.04 LTS), Intrepid (8.10), Jaunty (9.04), Karmic (9.10). The latest version is ROS Melodic Morenia for Ubuntu Artful (17.10), Ubuntu bionic (18.04). All the installation instructions for ROS are provided on their official site www.ros.org mentioning all necessary installations and requirements of dependencies for certain versions of ROS. Since our system (Nvidia Jetson Nano) is using Ubuntu 18.04 bionic, ROS Melodic Morenia will be installed [1, 4, 6, 12].

4.3 Drone

A drone is basically an unmanned aerial vehicle (UAV). It mainly comprises four parts which are ***chassis, flight controllers, electronic speed control and brush-less DC (BLDC) motor***. Choosing the chassis is one of the most important things to be done for developing a drone. It should be weight comprising the limit of smooth and efficient flight of the system. Chassis design also determines the number of BLDC motors and electronic speed control to be used. A flight controller is a circuit used to send in current from the power source of a drone to the electronic speed controller. It also has a receiver for the remote controlling purpose. Electronic speed control is also responsible for conversion from DC (coming from power source battery) to AC on which BLDC motor works. The good synchronization of all these components comprises a perfectly running drone [3, 9] (Fig. 1).



Fig. 1 Drone components

Fig. 2 3D map example

4.4 Dimensional Mapping

Mapping is the process of creating either a 2D or 3D view of some surrounding/environment. Mapping process in ROS essentially uses a scanner (generally laser-based known as lidars) for creating the map of an environment. 3D mapping however makes the map to be able to map the view of the environment in solid view form rather than in the planar form. 3D mapping essentially uses 3 direction coordinates. Such a mapping style helps a lot in getting information about terrain, an approximation in getting distances of differently made/constructed environments and in getting a structure of the environment (Fig. 2).

There are more than one methods for creating a 3D map using SLAM technology:

<https://github.com/googlecartographer/cartographer/issues/1604>

<https://robotics.stackexchange.com/questions/15151/3d-mapping-using-only-a-2d-lidar>

<https://answers.ros.org/question/209617/can-i-generate-a-3d-map-using-2d-lidar-data/>

4.5 Surveillance

The system consists of a mounted camera at the center so that it can capture its surroundings from all angles. Using a GPS satellite map, it can navigate through the environment provided to it. The interfacing of a surveillance camera performing action all round angles will be able to capture the environment. The GPS satellite map then defines the area for mobility of the robot, and it will circulate over that area. The capture of the camera (recording) can be stored or directly controlled through wireless medium for surveillance systems. The satellite map will be useful in many

ways for the drone to capture the scenery. It allows the robotic drone to navigate over such an area that is not mapped using SLAM navigation technology [3].

4.6 Examples of Satellite Map and SLAM Map

See (Figs. 3 and 4).

Fig. 3 Satellite map [13]

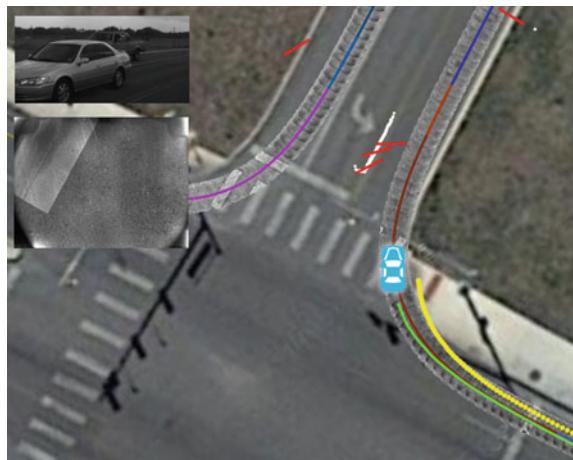


Fig. 4 SLAM map



5 Hardware and Software Requirements

This section is describing the hardware and software requirements for developing our drone.

5.1 *Hardware Requirements for the System*

The following hardware will require to setup a drone.

- a. **Drone.** The unmanned aerial vehicle (UAV) concept should bear a body which could be minimalistic regarding design. The drone body consists of *chassis* which acts as body and platform for placement of other components, *flight controllers* acts as current regulator for regulating current, *electronic speed control*, which is responsible for conversion of AC supply to DC for BLDC motors & *brush less DC (BLDC) motor* which are responsible for drone flight in the air [3].
- b. **RPlidar.** RPlidar is a hardware component that acts as a laser scanner. This is used to detect the obstacles in the defined range of the device. Here, RPlidar is used for 3D mapping using modified SLAM navigation technology for 3D mapping [14].
- c. **Nvidia Jetson Nano Developer's Board.** The developer board is the main component of the whole system as it will consist of the main processor, i.e., the system which runs the Linux with ROS (Melodic Morenia in our case). All the information regarding board setup to running the system has been provided in objectives section of this paper.
- d. **Arduino.** It is used for setting up logical pins in and out connections to and from Jetson Nano board. We need to enable serial communication channels and ensure a proper serial communication protocol like RS-232 for the same.

5.2 *Software Requirements for the System*

The following software will require implementing a drone.

- a. **Ubuntu 18.04 bionic for Nvidia Jetson Nano.** As discussed previously, the Jetson Nano board works on its own modified Linux system software as its OS platform. The installation image of Ubuntu 18.04 bionic operating system is available in the following link [15, 16].
- b. **ROS—Melodic Morenia.** It is the most essential software/framework required to accomplish our task. The version of Ubuntu 18.04 bionic has support for ROS—Melodic Morenia. Instructions for installation are available on the link of their official Web site.
- c. **ROS Packages.** These are used to function certain things in the whole system. These are already made ROS packages (Navigation stack, RPlidar ROS, Mapviz).

6 Outcomes of the Proposed System

This section will describe the outcomes of our proposed system. The proposal will focus mainly on the following:

6.1 3D Mapping Using Satellite Map

The drone system will be provided a satellite map instead of the map that the ROS system makes for navigation using SLAM technology. The map server will be following the *mapviz* package for using the satellite map. Mapviz is extensible by writing plugins to display different types of data. This package will be used as a catkinized package in ROS and hence facilitates the satellite map view. Drone will be autonomous and hence fly on the basis of a valid navigation path followed and provided by the satellite map.

There are certain methods which can be used with normal lidar for 2D mapping using SLAM to create a 3D view of the area/environment. The methods for the same can be found on the following links:

<https://github.com/googlecartographer/cartographer/issues/1604>

<https://robotics.stackexchange.com/questions/15151/3d-mapping-using-only-a-2d-lidar>

<https://answers.ros.org/question/209617/can-i-generate-a-3d-map-using-2d-lidar-data/>

The 3D map so formed will be saved and hence can be used to detect type of terrains and elevations and areas and helps in visualizing better.

6.2 Surveillance Using Satellite Map

The drone can navigate into unknown or known areas using satellite maps, hence eliminating the need of mapping the area at the first place. This can be used as a security measure for a particular area. Since ROS provides a better flexibility and robustness of communication between processes, it can be the most reliable way for ensuring a good security of the area.

7 Conclusion

On the final note, by using the available facilities like ROS, navigation package for ROS, laser scanners, packages for handling 2D and 3D maps, etc., we can successfully construct a drone for the purpose of 3D mapping of an area with pre-available satellite

map. Along with that, it can also be constructed for surveillance purpose by attaching a camera which can record the area under its sight. ROS provides an ease and better flexibility with robustness of communication, and thus, it makes the drone system very reliable considering our purposes. Thus, ROS can achieve a better efficiency with an easier construction & development process.

8 Future Scope

8.1 *Knowing Structure of Unknown Area*

The aerial vehicle is autonomous and unmanned and hence can be easily used to navigate into unknown areas without risking human lives to know its structure. The collected data hence can be used for many applicative purposes. The data so collected can be used for analytical purposes or getting an approximate structural design of the area.

8.2 *Analyzing the Area on the 3D Visual Level*

Three-dimensional visualization of some place can help in studying that particular area in a better manner. Three-dimensional visualization helps in getting more information about some scene or visual. A multi-dimensional model can always provide more information as compared to single dimension. Getting a 3D map of some area will be a task of our system, and hence, it can rather be useful in displaying more information. There are a wide variety of applications for 3D models which are available. 3D modeling is used in film industries, animation and gaming, designing, creating structural models, etc.

8.3 *Surveillance in Unknown Areas*

There are certain situations where human interaction can be harmful; hence, usage of such a device can be very helpful. The device can navigate into unknown areas without any such requirement of pre-navigated data for the area. Since it can work using satellite map, it can walk through the certain space and the camera mounted on the device can do the job. This camera can record or capture or get live view of the scenery and helps in getting the surveillance data from the place. It can walk in through unknown area (not traversed before) without any such lethal risks. This way the simplicity of inter-process communication in ROS and can be surveilling in unknown areas without risking human lives.

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Tumor Detection from Brain Magnetic Resonance Images Using MRDWT-RBFNNC



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and Praween Srivastava

Abstract The automatic classification and detection of MR images (brain) for abnormality play very important role in the analysis and diagnosis of brain disorders. This manuscript proposed an abnormality detection method from brain MR images using the RBFNNC. MRDWT is utilized for the brain image preprocessing and also for feature extraction where preprocessing step comprises of grayscale MR image conversion and removal of noise from MR images. The recognition of abnormalities reveals the detection of benign types of tumors, malignant types of tumors and common brain conditions. Thirteen types of MRDWT-based features of the MR (brain) images were extracted by applying the DWT method which is mean, median, variance, power spectral density (PSD), standard deviation (SD), root mean square (RMS), correlation, entropy, energy, contrast, smoothness, skewness, homogeneity. Ninety-seven MR images were used for testing of the brain tumor of benign, malignant and normal brain condition. The accuracy percentage attained using proposed RBFNNC is 100% as compared with the FFNNC (97.87%) and BPNNC (98.94%).

Keywords Image processing · Biomedical imaging · Magnetic resonance imaging · Discrete wavelet transform · Brain tumor detection · Neural network classifier

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1 Introduction

For the medical expert, the segmentation of brain tumor and also its detection from MR images is very crucial and vital task. The minor error in the diagnosis based on detection may cause the serious problems even cause death to the patients. The death rate of people due to brain tumors is increased in the recent era because of not detecting it or incorrect detection of tumors [1, 2].

There are various types of tumor are categorized by WHO but all tumors are basically categorized into two types based on its nature; these are benign and malignant. Benign tumors are the initial stage tumor which do not spread but it should be removed by surgery, once it is removed do not appear in the same place [3]. Few types of benign tumors such as intestinal polyps may become a malignant tumor, that is why such types of tumors are categorized as precancerous and must be removed before reaching the cancerous stage [4, 5]. Malignant tumors are made up of cancer cells; few cancer cells may pass into lymph nodes or bloodstreams where it may spread into adjacent tissues within the human body [6–8].

Hence, the tumor detection and segmentation at early stage is one of the very challenging areas where many researches are going but still facing problem to get high accuracy.

The objective of this work is to detect the brain tumor at its early stage (benign) with 100% of accuracy on segmented data. In this proposed work, segmentation will be performed first with classical segmentation approach and then segmented images will be given to the neural classifier for tumor detection purpose.

2 Literature Review

There are many research are going on from past few decades for the detection, segmentation and classification of brain tumor at early stage with very high accuracy.

Varuna Shree et al. applied GLCM and PNN in the classification of tumor data into normal and abnormal classes. They used GLCM and PNN together and achieved 95% success rate to detect the abnormality from the brain MR data [6]. DL-based CNN method for the classification of tumor from human brain was proposed by Abiwinanda et al. Feature extraction or manual region segmentation is not required in the CNN classifier, that's the best part of it which makes it fully automated [9]. Muhammad Nazir et al. applied ANN approach to classify the two types of brain tumor benign and malignant. In the 1st step, they preprocessed the images using filtering and then in the next step, feature extraction was done by finding the average color moment from every MR image. In the final step, these extracted features were fed to the ANN to classify the types of tumor with 91.8% accuracy rate [10].

The brain tumor segmentation, by measuring gray and white matter of segmented tissue from the MRI tumor images, is proposed by Zanaty [11] using hybrid techniques based on the combination of FCM, seed growing and Jaccard similarity coefficient. For the segmentation of a brain tumor, the MR image mainly divided into two parts, one which is affected by tumor and named as abnormal tissues and the other part which is not affected is called normal tissue. Coatrieux G proposed a control system based on tampering characterization of medical images [12].

The detection and classification of brain tumors using Berkeley wavelet transformation and support vector machine for MR images are proposed by Bahadure et al. [13]. They have used texture and histogram-based features and achieved 97.72% sensitivity, 96.51% accuracy and 94.2% specificity. Joseph et al. [14] worked on the detection of brain tumor segmentation from MR images based on morphological filtering using a K-means clustering technique.

The above researches contributed a lot in the area of brain tumor detection but still there is a gap in early detection and 100% accuracy. Hence, we have proposed the detection and segmentation of brain tumors at early stage (benign tumor) in three classes benign, malignant and normal based on morphological and statistical features using a radial basis function network with 100% accuracy.

This manuscript is structured as; Section 1 focuses on the introduction, problem statement, and objectives of the work. Section 2 describes the review conducted on previous work. In Sect. 3, the materials and methods used for this work are described. Section 4 explains the preprocessing and segmentation technique used for MRI data in this work. The results and discussion of this work are described in Sect. 5 and in the final Sect. 6, the conclusions and future work are presented

3 Materials and Methods

The proposed methodology of this paper is visualized in Fig. 1. It is mainly divided into four parts; preprocessing stage, segmentation stage, feature extraction stage and a classification stage. The details of each stage are explained in this section.

3.1 *MRI Database*

The collection of data is the first and most important part of any kind of image processing system. The database used for this work is T2-weighted magnetic resonance brain images in the resolution of 256×256 in the axial plane. MR images of the human brain having benign and malignant tumors were downloaded from the Harvard Medical School website, ADNI dataset and OASIS dataset. The T2 weighted MR images have a clear vision and higher contrast as compared to T1 weighted images [15–17]. We randomly selected 94 images for testing where 40 images are of the normal type, 28 images are having a benign tumor and 26 MR

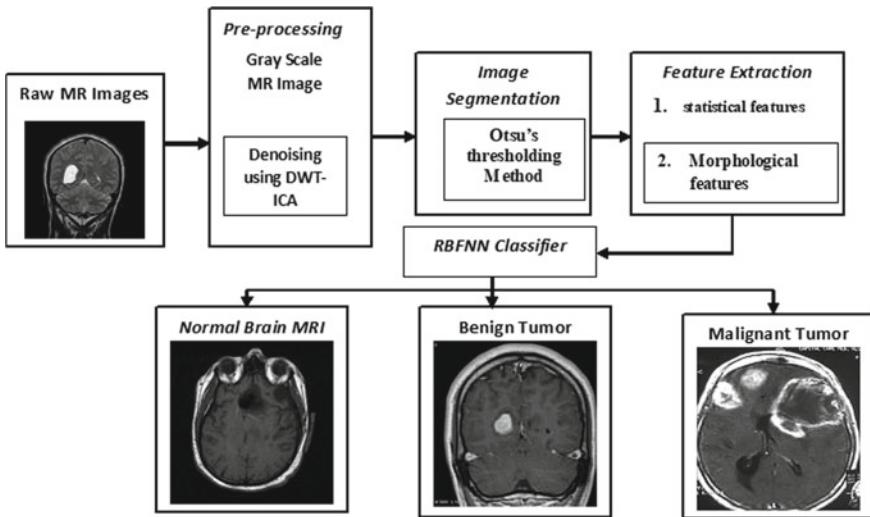


Fig. 1 Block diagram of the proposed abnormality detection techniques using RBFNNC

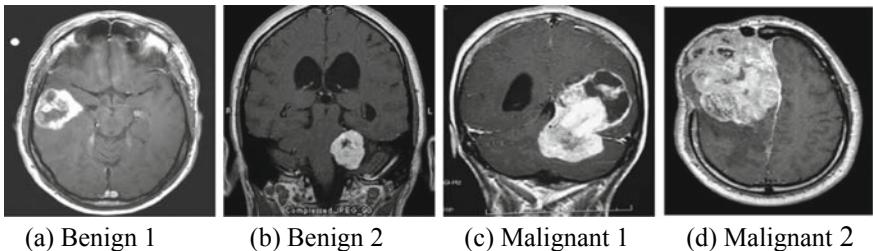


Fig. 2 Benign tumors test images (a, b), malignant tumor test images (c, d)

images of malignant type. The test images used for the segmentation of brain tumors are shown in Fig. 2.

3.2 DWT-Based Image Filtering

The Multi-Resolution Discrete Wavelet Transform Analysis (MRDWTA) is used for the filtering of raw MR images. The reason behind using DW transform over CW transform is that its computation efficiency is so efficient that it is also known as fast WT (FWT). Since images are generally 2D signals, for its processing, two-dimensional WT is used, where 2D-DW conversion is also called “multi-dimensional” WT. The DWT expressed in terms of MW and its scaling factor:

$$g(n) = \sum_k c(k) \Psi_k(n) + \sum_{i=0}^{\infty} \sum_{k=-\infty}^{\infty} d(i, k) \otimes_{i,k}(n) \quad (1)$$

In Eq. (4), $\phi(n)$ is the MW and $\Psi(n)$ is the scaling factor. MW as well as scaling factor is contracted by a factor 2 along the time axis as “ j ” is incremented by one. The index k represents the translations of MW.

The scaling factor and MW must satisfy a pair of recursive equations to form a basis for representing the signals:

$$\emptyset(n) = \sum_l w(l) \sqrt{2\emptyset(2n-l)} \quad (2)$$

$$\Psi(n) = \sum_l s(l) \sqrt{2\Psi(2n-l)} \quad (3)$$

The co-efficient of scaling factor is given by $s(l)$ in Eq. (3) and MW coefficients is $w(l)$ in Eq. (2).

4 Preprocessing of MRI Data

4.1 Grayscale MR Image

A grayscale image is a range of shades of gray without apparent color. The range of image pixels varies from 0 to 255 which is a total of 256 pixels, where the minimum value 0 means complete black color and the maximum value 255 means complete white color. The raw MR images are converted into a grayscale from RGB and the denoised is done using the hybrid adaptive MRDWT-ICA method. Since the converted MR image may consist of some noise, the denoising is performed with the MRDWT-ICA method.

4.2 Image Denoising Using MRDWT-ICA

Image denoising is performed with an adaptive hybrid method using MRDWT-ICA. The detail steps for denoising of medical (MR) images is described in [18]. The denoising using MRDWT-ICA is briefly detailed in the following steps.

- (1) In first step, the centering (normalization) operation to preprocess the image data (MR) has been performed by subtracting the mean vector $M = E(x)$ and image is made variable of zero mean.
- (2) Then the whitening process is accomplished by transforming the image data by making its components of unit variance and uncorrelated with each other.

- (3) The fast-independent component analysis (F-ICA) is applied to obtain a matrix named “ $\mathcal{C}\mathcal{O}$ ” de-mixing matrix.
- (4) Random weight vector “ \hat{W} ” has been initialized which is $N \times 1$ column vector. Define a function.

$$\hat{W}(n)^+ = E\{Xg(\mathcal{C}\mathcal{O}^T X)\} - E\{g_0(\mathcal{C}\mathcal{O}^T X)\mathcal{C}\mathcal{O}\} \quad (4)$$

Here to calculate the value of \hat{W} and variable $\hat{W}(n)^+$ called temporary variable is defined.

- (5) Also define weight matrix for every column by $\hat{W}(n) = \frac{\hat{W}^+}{\hat{W}^+}$, where iteration steps are “ n .”
- (6) Check the data is being converged or not? If no, return to fifth step.
- (7) Maximize the matrix $\mathcal{C}\mathcal{O}$ that also maximize the source “ S ” which is the non-gaussianity measurement. Then the noisy image source is acquired using equation:

$$\hat{S}_{Noisy} = \mathcal{C}\mathcal{O} \times Z \quad (5)$$

- (8) The MRDWT is used for the noisy IC estimate and using third coefficient of daubechies (Db3), it is decomposed at fifth level. Then thresholding method $V = \sigma \sqrt{2 \log N}$ VisuShrink is used, where level of noise variance is “ σ ” and pixel number of images is given by “ N ” [19, 20].
- (9) The mixing matrix named “ A ” is calculated from the use of Eq. (5) by utilizing the $\mathcal{C}\mathcal{O}$.
- (10) At final stage, the filtered image (MR) is found from Eq. (6).

$$\tilde{X}_{Denoised} = A \times \tilde{S}_{Denoised} \quad (6)$$

4.3 Segmentation of MR Images

In this stage, thresholding is done along using an appropriate thresholding technique. The process of dividing or splitting a digital image into multiple segments is called segmentation. In the threshold segmentation method, the image pixels are partitioned based on the intensity and then it is separated.

Global thresholding: If the threshold only depends on gray level and the threshold value is solely related to the character of the image pixels.

Local thresholding: When threshold value depends on two threshold values, this type of thresholding is known as local thresholding. The local thresholding method divides the raw image into many sub-regions, and then it selects the threshold value T for each sub-region.

4.4 Otsu's Thresholding

In this paper, the otsu method is used for thresholding for the segmentation of MR images. The object variance and the background's variance both are exclusive of the variance of the entire image in the Otsu method. Otsu's method is based on the discriminant analysis and it basically divides the image into two independent classes “ B_1 ” and “ B_2 ” at gray levels “ m ” such that $X_{1_1} = \{0, 1, 2, 3, \dots, r\}$ and $X_2 = \{r + 1, r + 2, \dots, s-1\}$ here, “ n ” is the overall value of gray levels of the MR image. Assume total pixels number in the given MR image is “ k ” hence the i th pixel of the image is represented by k_i

The gray-level occurrence probability is defined by $P = \frac{k_i}{k}$ “ B_1 ” and “ B_2 ” are two classes of MR image demonstrating the region of interest of tumor detection and the background of the image; hence, the probabilities of the classes X_1 and X_2 are given as

$$P_1(r) = \sum_{i=0}^r P_i, \quad P_2(r) = \sum_{i=r+1}^{s-1} P_i = 1 - P_1(r) \quad (7)$$

The mean gray level of the image and its background pixels are given by

$$m_1(r) = \sum_{i=0}^r i.P\left(\frac{i}{X_1}\right) = \sum_{i=0}^r i \cdot \frac{P(i)}{P(X_1)} \quad m_1(r) = \frac{1}{P_1(r)} \sum_{i=0}^r i.P_i \quad (8)$$

4.5 Detection Stage

In this stage, the morphological actions are taken on the segmented images. Morphological actions of image processing are the operation related to shape, size, contrast, intensity or the feature of the image. It is to be found at all probable places of the image and matched with the respective neighborhood pixels. Few procedures examine in case the component “fits” inside the neighborhood, whereas remaining examine does it bisect or “hits” the neighborhood [1]. The tumor present in the brain is segmented and it is shown in the white color segmented image. The tumor segmentation using Otsu thresholding is displayed in Fig. 3.

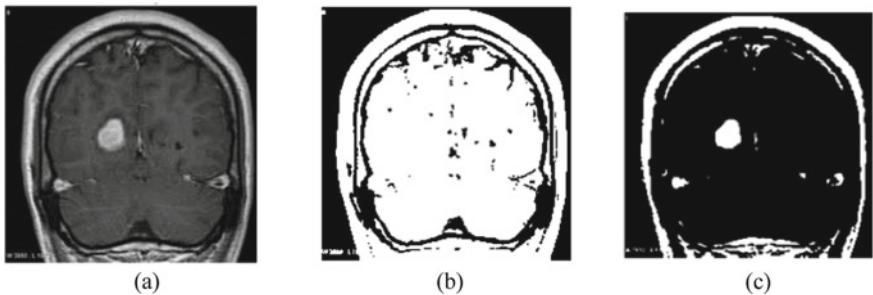


Fig. 3 **a** Preprocessed MR image. **b** Threshold image. **c** Segmented image

5 Result and Discussion

5.1 Radial-Basis Function Neural Network Classifier (RBFNNC)

The RBFNNC is proposed to classify the abnormal tumors from the MR images of brain. The reason for selecting the RBFNNC as a proposed classifier because it has rate of learning as compared to other classifier is higher [21].

It consists of multilayered neurons with different hidden layers; also, RBFNNC is a nonlinear hybrid neural network.

The first layer that is input layer of the RBFNNC transfers the input features to the hidden layer; at that time, the activation function is created at the second stage (hidden layers) based on connected radial basis function.

In the final step, the output is produced by output (O/P) layer based on the nature of classification and also the O/P is the combination activation function and hidden units linearly [22]. Assuming weight vector $W = [w_1, w_2, w_3, \dots, w_n]^T$ and the input vector is represented by $h(x)$ and it is the function of “ x ” with $\phi = 1$. The RBFNNC performance behavior is expressed by the function.

$$\check{f}(x, w) = \sum_{i=1}^{n_1} w_i \varphi_i(x) , \text{ Where, } \varphi_i = G(\|x - \mu_i\|), i = 1, 2, \dots, n_1 \quad (9)$$

Mainly in image classification problems, Gaussian function is used as the basis function in the RBFNNC [23]. The RBFNNC proposed is to classify the O/P in three classes from the brain images (MR) that is normal class, benign class and malignant class [24].

5.2 Feature Extraction

The feature extraction of MR images was done using DWT. The extraction of features is mainly divided into two parts, first statistical features and second morphological features. Statistical features include: mean, median, variance, power spectral density (PSD), standard deviation (SD), root mean square (RMS), correlation, whereas morphological feature includes: entropy, energy, contrast, smoothness, skewness, homogeneity. For this work, 13 features were extracted using DWT among them 8 are statistical features and 5 are morphological features. The 13 features were extracted from each MR image.

5.3 Classification Result Using RBFNNC

Table 1 demonstrates the classification result of the brain tumor using a proposed RBFNNC, BPNNC and FFNNC and the result is simulated in MATLAB software package 2015a. The database is having three types of MR images, normal, benign class and malignant class. Brain tumor detection of MR images was done using a neural classifier and segmentation techniques. The raw MR image was first preprocessed using MRDWT-ICA method and then thresholding is applied to it. The Otsu thresholding technique is used for the thresholding process. After thresholding, the segmentation of the brain tumor has been done of MR images. After image segmentation, the detection of a brain tumor is done and it is mainly divided into two parts. In the second stage, the classification of a brain tumor was done into three classes normal, benign and malignant. Before classification, the feature of MR image was extracted; these are of two types, morphological and statistical. The total 13 types of the feature were extracted and it is given as the input to the neural classifier. The classification result was tested using three types of classifier, first one is a feed-forward neural classifier (FFNNC), second back propagation neural network classifier (BPNNC) and third is radial basis function neural network classifier (RBNNC).

The classifiers outcome for the detection of MR images were evaluated with the help of several parameter metrics. Seven evaluation metrics are used for comparing the result of three types of classifier applied for detecting the tumors of the brain images (MR). Proposed RBFNNC performance was compared with FFNNC and BPNNC for detection of abnormality. The result is calculated and tabulated in terms of precision percentage (% Pr), sensitivity percentage (%SE), positive predictivity percentage (%PP), specificity percentage (%sp), classification error percentage (%CE), F-score percentage (%F-score) and overall accuracy (%). RBFNNC has an excellent overall % accuracy compared to the proposed FFNNC (97.87%) and BPNNC (98.94%), based on the MR dataset used as input for them. Also from Table 1, it is observed that all three classifiers (RBFNN, BPNN and FFNN) provide 100% accuracy for benign tumor detection in the context of all evaluated performance matrices.

Table 1 Performance comparison of the proposed RBFNN classifier with BPNN and FFNN classifiers

6 Conclusion and Future Work

The automatic detection of abnormality of brain MR images with proposed RBFFNC has been addressed in this paper. The segmentation of images and detection of a brain tumor are mainly divided into four parts; preprocessing stage, segmentation stage, feature extraction stage, and a classification or detection stage. Denoising of the MR images is performed using a hybrid MRDWT-ICA technique and Otsu thresholding method is used in the segmentation stage. Feature extraction is also accomplished using MRDWTA and a total of 13 types of the feature were extracted. RBFNNC is used for the detection of brain tumors and the performance comparison analysis has been done with BPNNC and FFNNC that means outcome of classification was compared with two types of classifier, first one is a FFNN and second is BPNN. The proposed RBFNNC accomplished best performance (100%) in terms of all evaluation metrics as compared to FFNNC and BPNN on MR dataset.

For the future work, the large dataset will be used to verify the accuracy of the classifier. Also, the deep learning CNN model will be used and a hybrid approach for optimization purpose can be used.

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CPU Scheduling in Operating System: A Review



Parag Agrawal, Amit Kumar Gupta, and Priya Mathur

Abstract Developing CPU scheduling algorithms in operating system and understanding effect of various algorithms in practice can be difficult and deadly because of the requirement to update the operating system and test operating system kernel code and quantity the succeeding presentation of operating system on a consistent workload. As processor is the important resource, CPU scheduling turns out to be significant in fulfill the operating system (OS) design goals. The intention ought to be permitted whatever number as could reasonably be expected running processes or task at all the time in order to make best utilization of CPU. This paper includes a short comparisons and examination of numerous CPU scheduling algorithm by arranging estimations for a singular processor CPU and provide which algorithm is generally fitting for the particular condition. Utilizing this depiction, it turns out to be a lot more obvious what the effect is in the working context and why an different preparation of measures is a contender for the allotment of the CPU at numerous situation. The target of the investigation is to examine the exceptionally effective CPU scheduler for working framework.

Keywords Efficiency · State diagrams · CPU- scheduling · Performance · Algorithm

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1 Introduction

In the single processor framework, just each procedure can run in turn; any other process or task must wait until the CPU is waiting for processes and can be suspended. The goal of multiprogramming is to have approximately method execute consistently, to amplify CPU efficiency [1]. CPU booking implies process appointed to CPU for a specific time of interim. We realize that scheduling bypass starvation of every job within CPU also allotting of process or task to CPU done by scheduler. In multi-tasking & multiprocessing, the procedure by which the occupations or procedures are allotting to the CPU is called as booking. Its principle motive is to use the most extreme, throughput and furthermore limit the holding up time, reaction time [2–4].

1.1 Schedulers

CPU of any system processes the task in it, and all that tasks are stored in the list termed as Ready List. There is a part of the system which helps the CPU to select the process or task form the ready list to process them completely that part of the system is known as the Schedulers. The scheduler is responsible for the completion of all the tasks and processes in the system. Based on selecting the task or process from the number of tasks available in the system the scheduler is of following 3 types:

a. **Long-term Scheduler:**

The long-term scheduler also identified as the job scheduler, the main objective of that type of scheduler is to determine which task or process will undergo for processing in CPU. So, this scheduler selects the process or task form the queue and loads them into the memory of system for processing or execution. Processes or tasks are loaded into the memory of the system for the CPU scheduling.

b. **Mid-term Scheduler:**

The mid-term scheduler or medium-term scheduler is used to arrange the tasks and processes in the memory, to do that it uses part of the swapping of tasks and processes. Additionally, it can remove the tasks or processes from memory. The swapping part consist of mainly two functions these are “swapped-in” and “swapped-out”.

c. **Short-term Scheduler:**

The short-term scheduler (also called as the CPU scheduler) is responsible for selecting the task or process for the allocation of the CPU. After the clock interrupts, I/O interrupt, OS call or any other type of signal receives the short term scheduler select the task or process from the ready queue or ready list and process them.

1.2 *Scheduling Criteria*

Various CPU scheduling algorithms runs on the basis numerous rules defined for the scheduling algorithm, and the result of an exact calculation might be provision of one property of procedures over another. In selecting which algorithm to use in a certain situation, we have to think about the parameter of numerous types of algorithms. A numbers of criteria have been proposed for searching at CPU scheduling algorithms. Which define the selection of scheduling algorithm for a particular situation? The criteria are described as follows:

- Utilization or Efficiency:** The CPU ought to be best used by assigning the significant process or tasks; with the goal that it ought to not be ideal. [5].
- Throughput:** It is the property by which we can identify the how many task or processes are completed in per unit time [5, 6].
- Turnaround time:** It is the all -out time taken by task or by process from accommodation of the process to the completion of that process. Turnaround time ought to limit the hour of clients who hang tight for the yield [5, 6].
- Waiting time:** It ought to be limited as it is the all-out time spent by the task or by the process in ready list [5, 6].
- Response Time:** It is the time interval after submission till response. It ought to be negligible if there should be an occurrence of intelligent clients [5].
- Fairness:** CPU ought to be unprejudiced and every process ought to get its reasonable time for execution [5, 6] (Fig. 1).

2 Basic Scheduling Algorithm(s)

- **First come First Serve:** Modern operating system is not used FCFS CPU scheduling algorithm. It is a non-preemptive scheduling algorithm. In non-preemptive scheduling algorithm if CPU holds by the process, process leave the CPU

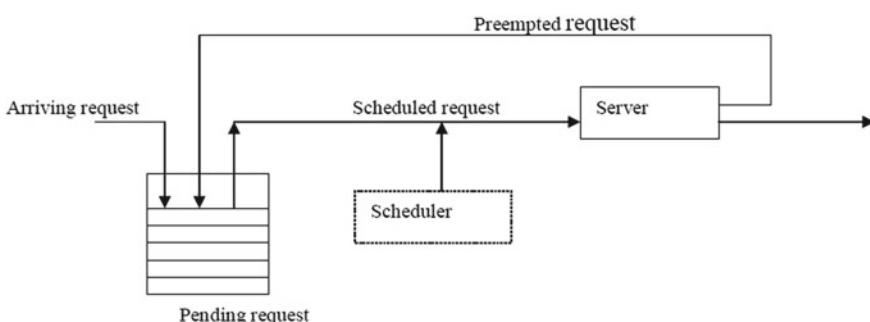


Fig. 1 Schematic of scheduling

after completes the execution. In FCFS scheduling algorithm which process arrive first then that process hold the CPU first [6].

- **Shortest Job First:** in this algorithm CPU is allot first to the shortest CPU burst time. It is also a non-pre-emptive CPU scheduling algorithm this algorithm tries to reduce the average waiting time. This algorithm is better than FCFS. Pre-emptive scheduling algorithm is better than non-pre-emptive because pre-emptive has abilities to switch the CPU to another process.
- **Round Robin:** It is used in time shared system. Round Robin is the pre-emptive scheduling algorithm but switch the CPU to another process after a fixed measure of time which is the static time quantum [6]. This algorithm is same as FCFS but in preemptive manner. This algorithm fare to all process for execution but more overhead required.
- **Priority Based:** The OS relegates a fixed priority rank to every process. Low priority processes get hindered by incoming high priority process [1].

2.1 First Come First Serve

It is the least complex CPU Scheduling algorithm. The criterion of this algorithm is “the process that demands first, holds the CPU first” or which procedure enter the prepared line initially is served first. The outstanding task at hand is prepared in the request for appearance time, with no seizure. When a procedure has been submitted to the CPU, it runs into fruition without being interfered. Such a system is reasonable on account of littler procedures yet is very unjustifiable for long an immaterial activity. Since FCFS doesn’t include setting exchanging in this manner it has negligible overhead. It has low throughput since long procedures can keep processor involved for quite a while making little procedures endure. Thus, holding up time, turnaround time and reaction time can be low [7].

Characteristics:

- Since context switches just happen upon process end, and no revamping of the procedure line is required, booking overhead is minimal.
- There is no any priority defines in this algorithm so each procedure will occupied the CPU for whole it’s to in the end total, therefore no starvation.
- Turnaround time, waiting time and response time is giant.
- Any Process with highest CPU execution time can occupy CPU, regardless of whether any process CPU execution time is too small. Therefore, throughput goes low [8] (Fig. 2).

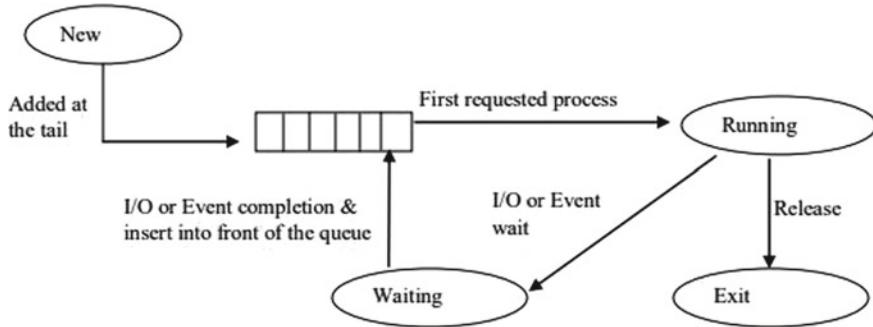


Fig. 2 FCFS CPU scheduling

2.2 Shortest Job First

Right now, execution time occupations are appointed to CPU. In this technique the scheduler kept the jobs in a queue such that the head of line has the most limited occupations and the tail has the longest employments. In SJF the average waiting time is limited since it forms the little employments before it accepts the noticeable ones as in. In this algorithm the jobs with conspicuous execution time will never be executed. According to the scheduling technique is describes which is based on this technique. In a task is divided into two mandatory and optimal portions, the optimal part is schedule using shortest job first [2].

Characteristics:

- The actual problem with the SJF algorithm is, to discover the length of the following CPU request.
- Starvation is conceivable, particularly in the occupied CPU system with many processes with small Burst Time being run.
- It limits the average waiting time since it opts minimum size processes previously it opts larger ones for services. While it limits the average wait time, it might train processes with longest service time requests. If the ready queue list is saturated, then the process with huge assistance times will in general be remains in the ready queue list while small processes receive services. In outrageous case, when the framework has minimal inactive time, processes with long service time will never be serviced. This total starvation of long processes is a genuine obligation of this algorithm [8] (Fig. 3).

2.3 Round Robin Scheduling

The round Robin scheduling algorithm relegates the time slice or quantum for each process. The ready process is kept in queue and new jobs are infix into the tail

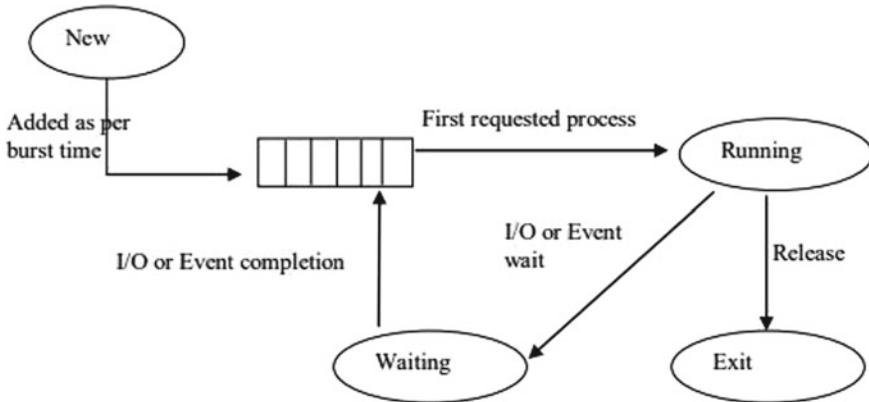


Fig. 3 SJF CPU Scheduling

of the queue. In this algorithm the CPU productivity will low when set the time slice too short, and too long time will cause poor response time. Round Robin is the old, simple algorithm and particularly structures for the time-sharing system. It is the powerful and great responsive but the waiting time and turnaround time are wicked because of the determined time amount nature. The scheduler gives a determined time slice to each job and rehashes them in cycle. It is much the same as to the FCFS but pre-emption is performing to switch them among the processes. In Round Robin scheduling the equality is given to each process, process gets equal time of the CPU because of time quantum, so it is superior to other scheduling algorithms and it provides low turnaround time, waiting time. The new dynamic quantum scheduling algorithm is proposed. a new round robin algorithm is presented which decrease context switching and provides better waiting time, turnaround time then RR scheduling algorithm [9–16].

Following advances are given for RR scheduling algorithm: -

- Step 1: A queue is kept up by scheduler for ready processes, swapped out processes and list of blocked processes.
- Step 2: Recently made process has Process Control Block it is add to the end of ready queue. Terminating process of Process Control Block is discarding from the scheduling data structure.
- Step 3: Select the Process Control Block by scheduler is always from the head of the ready queue.
- Step 4: When time quantum is finish by a running process then this process is included toward the end of ready queue.
- Step 5: Following action is performed by event handler:
 - (a) When a process makes swapped out or input-output request then its PCB which is in the ready queue is removed and moved into the blocked/swapped out list.

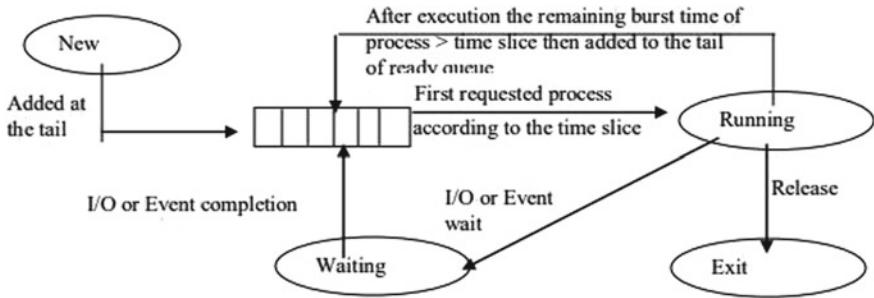


Fig. 4 Round robin CPU scheduling

- (b) When process completed its input-output operation then its PCB is moved at the end of ready queue [6].

Characteristics:

- Allotting the quantum too small leads to too much context switches and lower the CPU efficiency.
- Allotting the quantum too large, leads to bad response time and approximates FCFS.
- Due to long waiting times, deadlines are once in a while met in an unadulterated RR system.
- RR scheduling comprises extensive overhead, especially with the small-time unit [8] (Fig. 4).

2.4 Priority Based Scheduling

The operation system doles out fixed priority to each process. The low priority is hindered when the high priority processes are arrived. The high priority processes have a smaller waiting time and the starvation can occur to the low priority processes. The priority queuing scheduling algorithm can provide. The improved priority scheduling algorithms are presented it also discussed in static and dynamic scheduling algorithm the lower priority process is postponed. It likewise portrays the longest pre-empted process in ready queue and on it micro scheduling model in ready queue is built up. A priority scheduling algorithm are describing, the process is schedule based on their antecedence rate and allocate to processor equating with the subsisting programming algorithm based on its duration and resource employment [2].

Characteristics:

- Starvation can happen to the low priority process.
- The waiting time continuously increments for the equivalent priority processes.

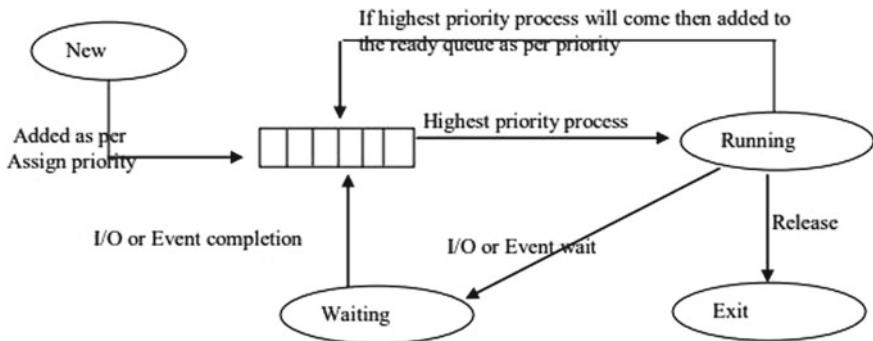


Fig. 5 Priority CPU scheduling

- High priority processes have small waiting time and response time [1] (Fig. 5).

3 Computation of Gantt Chart, Waiting Time and Turn-Around Time

Consider the accompanying arrangement of processes, with the length of the CPU-burst time in milliseconds is shown in Table 1

- i. **First Come First Serve** (Fig. 6)
- ii. **Shortest Job First** (Fig. 7)
- iii. **Round Robin**
Allot time quantum of 5 ms for each process (Fig. 8).
- iv. **Priority Scheduling** (Tables 2, 3 and 4; Fig. 8 and 9)

Priority is allotting for each process as follows.

Table 1 Processes with burst time

Process ID	Burst time (ms)
P0	12
P1	2
P2	3
P3	2
P4	6

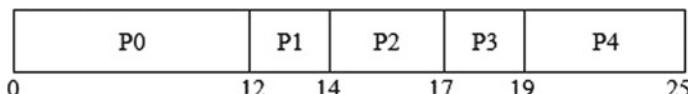
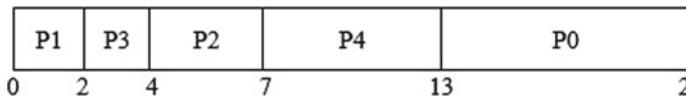
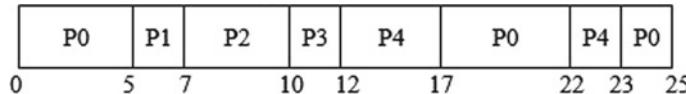


Fig. 6 Gantt chart for FCFS

**Fig. 7** Gantt chart for SJF**Fig. 8** Gantt chart for RR**Table 2** Processes with burst time and priority

Process ID	Burst time (ms)	Priority
P0	12	3
P1	2	1
P2	3	3
P3	2	4
P4	6	2

Table 3 Turn-around time for each process and average turn-around time for each scheduling

Process ID	Turnaround time (ms)			
	FCFS	SJF	Round robin	Priority
P0	12	25	25	20
P1	14	2	7	2
P2	17	7	10	23
P3	19	4	12	25
P4	25	13	23	8
Avg. turnaround time	17.4	10.2	15.4	15.6

Table 4 Waiting time for each process and average waiting time for each scheduling

Process ID	Waiting time (ms)			
	FCFS	SJF	Round robin	Priority scheduling
P0	0	13	13	8
P1	12	0	5	0
P2	14	4	7	20
P3	17	2	10	23
P4	19	7	17	2
Avg. waiting time	12.4	5.2	10.4	10.6

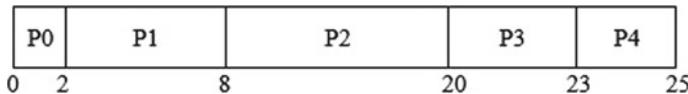


Fig. 9 Gantt chart for priority scheduling

4 Conclusion

This paper factually dissects and thinks about different scheduling algorithms according to their CPU overhead, throughput, turnaround and waiting time of the process. The First Come First Serve (FCFS) has least throughput, high turnaround time and waiting time. Shortest Job First (SJF) contains mid-range CPU waiting time with high throughput but mid-range turnaround response time in comparison to other scheduling algorithm. Round Robin (RR) contains most waiting time of CPU but mid-range throughput, turnaround time with most response time, which is all, depended on the time slice has been chosen. Round Robin is also suffers from the selection of time slices. Priority Scheduling contains mid-range CPU waiting time and having least throughput but most turnaround time, response time. Priority Scheduling is also suffers from the starvation.

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Applications of Hybrid Particle Swarm Optimization Algorithm: A Survey



Nishita Bhatia, Piyush Chauhan, and Hitesh Yadav

Abstract Particle swarm optimization algorithm is based on the natural behavior of fish schooling or the birds flocking. This algorithm offers good performance in a variety of domains. PSO also offers optimal solutions to various real-life problems. In recent years, researches have been carried on to make this algorithm more efficient through hybridization with other algorithms. Such modified systems and their applications have been summarized in the paper. The purpose is to organize the literature related to past 10 years of hybridization of PSO. This paper mainly presents the amount of work done in this field, thereby indicating the amount of work which can be further done to enhance this technique and to generate more optimal solutions of a problem.

Keywords Genetic algorithm · Simulated annealing · Evolutionary algorithm · Particle swarm optimization · Back propagation · Ant colony optimization

1 Introduction

PSO is mainly a kind of algorithm used to produce an efficient model; here, we find the best solution out of various possible solutions. Nature always acts as the best source for inspiration, concepts, principles and mechanisms. One such nature-inspired meta-heuristic algorithm is the particle swarm optimization. The social behavior of fish schooling or bird flocking is the inspiration behind this algorithm. This algorithm was put forward in 1995 by Dr. Kennedy and Dr. Eberhart. However, this algorithm requires more computational time, and along with it, more tuning of parameters is required. Also, it requires very good programming skills for the modification of this algorithm for different types of applications. Due to these reasons, PSO is hybridized along with many other algorithms and techniques to develop a system which is suited

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to provide better optimal solutions. Such modified systems have a great deal of real-life applications. Lim Chee Ming et al. put forward a hybrid model of GA with PSO for the concurrent model of cellular manufacturing system [1]. Song et al. defined a hybrid PSO-SA algorithm which is feasible and an effective method which improved the quality of searching solutions and is used to get control of the issue of resolving job shop problem [2]. Kao et al. developed a hybrid algorithm based on ACO and PSO which is very useful for finding the solutions to the capacitated vehicle routing problems (CVRPs) [3]. Backpropagation (BP) algorithm is generally used for training of neural network. Hu et al. proposed the improvement of BP algorithm for training the feed-forward neural network by combining the back propagation algorithm with particle swarm optimization algorithm. The improved method (PSO-BP algorithm) is very beneficial in forecasting traffic flow and is much more suitable for traffic prediction in real time [4]. Izakian et al. proposed a hybridization of fuzzy C and fuzzy PSO means which is used to form a good clustering model [5]. PSO can also be hybridized with other metaheuristic algorithms for optimization of software product line [39].

Other algorithms include invasive weed optimization, artificial immune system algorithm, honey bee mating optimization, etc. These proposed hybrid models in the papers are summarized below in a table where year of publication, problem addressed and the algorithms and its applications have been discussed for a respective author (Table 1).

2 Conclusion

This review has summarized the development of PSO during the last 10 years. The review shows that hybrid PSO can be applied to a variety of domains and it provides optimized solutions to all the problems. This algorithm has been really efficient in solving many real-life problems. The hybridized PSO is simple, flexible, less sensitive, easy to implement and very versatile. Such hybrid systems have a wide variety of applications which include power system problems, optimal solution of NP hard problems, wireless sensor networks, internet technology and multimedia classification, image processing, scheduling problems, classification of cancer and many others. PSO is proven to be really helpful in the engineering and optimization community and also to the researchers that are currently working in this field and the ones that are going to work in this area.

Table 1 Combination of PSO with metaheuristic algorithms

Year	Author	Problem addressed and algorithms used	Application
2008	Li et al. [6]	GA and PSO and support vector machine as a classifier	Used for classification of cancer and lower down cost of redundant genes
2008	Ge et al. [7]	Combined PSO with AIS	Used for electronic packaging through modeling
2009	Zhang et al. [8]	Combination of DE and PSO	Used in the field of data mining, classification and engineering process control
2009	Tao et al. [9]	Tent-map-chaotic approach to PSO (TCPSON)	Used for dispatching of load economically
2009	Niknam [10]	Combination of DPSO and HBMO	Used to solve the multi-objective distribution feeder reconfiguration (DFR)
2010	Zeng et al. [11]	PSO is hybridized with cooperative line search algorithm	Optimized global and local search ability
2010	Kanakasabapathy et al. [12]	Hybridization of evolutionary tristate with PSO	Used in pumped-storage hydroelectric plant
2010	Jin et al. [13]	Hybrid real-binary particle swarm optimization (HPSO)	Used in designing of radar absorbing materials (RAM)
2010	Kong et al. [14]	A hybrid PSO model for optimization of LS-SVM parameters	Real-time data analysis and production rate prediction
2011	Huang et al. [15]	Hybrid model based on GA and PSO algorithm	GPS and autonomous robot navigation
2011	Salehi et al. [16]	Simple artificial immune system (SAIS) is hybridized with PSO	Identification of the emails in the category of spam or non-spam
2011	Foong et al. [17]	Hybrid harmony-PSO based methodology	Extractive text summarization
2012	Cai-hong et al. [18]	PSO is combined with ISODATA	Used for segmentation of remote sensing images
2012	Shi et al. [19]	Glow-worm Swarm Optimization (GSO) is hybridized with PSO	Used to solve different kinds of engineering optimization problems
2013	Dhas et al. [20]	Hybridized model-based gravitational search algorithm and PSO	Used in PV systems to track maximum power point

(continued)

Table 1 (continued)

Year	Author	Problem addressed and algorithms used	Application
2013	Xiaoguang et al. [21]	PSO is hybridized with ACO	Used in cloud computing
2014	Wang et al. [22]	Hybrid discrete PSO algorithm (HDPSO)	Used for three-dimensional robot path planning
2014	Saleem et al. [23]	Hybrid PSO-HIL methodology was designed for control tuning	In pneumatic systems
2014	Jemaa et al. [24]	Fuzzy PSO-based approach	Wind and solar energy systems
2015	George [25]	Hybridization of PSO with ACO	Cloud computing
2015	Li et al. [26]	Hybridization of PSO with GA	Used in PID controller
2015	Meena et al. [27]	PSO was hybridized with bacterial foraging algorithm	Used in multi-area system to control load frequency
2015	Utkarsh et al. [28]	Hybridization of PSO with standard GA	Internet technology and multimedia applications
2016	Pal et al. [29]	PSO is hybridized with ACO	Used for discovering classification rules in data mining, CVRP
2016	Li et al. [30]	A VND is combined with Genetic-PSO	In flight path planning
2016	Wang et al. [31]	K-means based on SA combined with PSO.	Used in data analysis mainly in clustering of data
2016	Gharghan et al. [32]	ANN-PSO algorithm.	Used for tracking a person, environment, health care, agriculture management
2017	Rajaguru et al. [33]	Hybridization of ABC and PSO and bayesian linear discriminant analysis	Used for the classification of oral cancer's risk level
2017	Ma et al. [34]	PSO-ELM hybridization is done	In thermal system like coal-fired power unit
2017	Liu [35]	GA, PSO, and ABC optimization	Used in wireless sensor networks (WSN)
2017	Abderrahim et al. [36]	Hybridization of PSO with tabu search	The proposed system is used to solve NP hard problems
2018	Kang et al. [37]	Hybridization of PSO with an opposition based strategy	Used to solve optimization problems with lots of noise
2018	Li et al. [38]	Hybridization of second-order cone programming with PSO	Used for optimization of sparse conformal arrays and its designing

(continued)

Table 1 (continued)

Year	Author	Problem addressed and algorithms used	Application
2020	Chhikara et al. [39]	Multiple metaheuristic algorithms along with PSO	Used for optimization of software product line

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Review on Zero-Knowledge Proof Method



Maanas Midha, Amit Kumar Gupta, and Priya Mathur

Abstract Zero-knowledge proofs (ZKPs) enable knowledge to be verified while not revealing that knowledge. They, thus, have the potential to revolutionize the approach knowledge which is collected, used and transacted with. Every transaction encompasses a “verifier” and a “prover.” In every transaction using ZKPs, the prover makes an attempt to prove issue to the verifier while not telling the verifier anything about this thing. By providing the ultimate output, the prover proves that they are ready to cipher one thing while not revealing the input or the process method. Meanwhile, the verifier solely learns concerning the output. In this paper, we work on zero-knowledge proof and analyze all the zero-knowledge proof, and the major focus will be on the main parameters involved in evaluating zero-knowledge proof, comparison of different types of technologies which can be used in the zero-knowledge proof and with a brief difference of all the different techniques of it.

Keywords Soundness · Completeness · Zero-knowledge · ZKP · Transaction · Authentication · Password

1 Introduction

A zero-knowledge proof is a digital protocol that allows for data to be shared between two parties without the use of a password or any other information associated with the transaction. In its most basic sense, a zero-knowledge proof (also commonly referred to as ZKP) can be thought of as a protocol through which a digital authentication

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process can be facilitated without the use of any passwords or other sensitive data. As a result of this, no information, either from the sender's or receiver's end, can be compromised in any way. This is quite useful, especially since such a level of safety provides tech enthusiasts with an avenue to communicate with one another without having to reveal the content of their interactions with any third party. The idea underlying zero-knowledge proofs first came in 1985, when developers Shafi Goldwasser, Charles Rackoff and Silvio Micali presented to the world for notion of "knowledge complexity"—a concept that served as a precursor to ZKPs.

As the name suggests, knowledge complexity acts as a metric standard to determine the amount of knowledge required for any transaction (between a prover and verifier) to be considered valid. Informally, a zero-knowledge argument involves two parties, the prover and the verifier, and allows the prover to prove to the verifier that a particular statement is true, without revealing anything else about the statement itself. Statements are of the form $u \in L$, where L is a language in NP. We call w a witness for a statement u if $(u, w) \in R$, where R will be a polynomial time decidable binary relation which is associated with L . There, we require that the zero-knowledge argument is to be complete, sound and zero-knowledge.

- a. **Completeness:** A prover must have a witness w for $u \in L$ which can convince the verifier of this fact.
- b. **Soundness:** A prover cannot convince a verifier when $u \notin L$.

Zero-knowledge: The interaction must not reveal anything to the verifier, except that L . It should not reveal the witness of the tester w . Our main goal is to create a system of arguments for the satisfaction of the arithmetic circuit AN ; that is, a circuit consists of additive and multiplicative gates on a finite field Z_p . Furthermore, we would like to have the security of this argument only on that assumption of a different index: This can give everyone solid and intelligent security guarantees since there are no family attacks superior to the generic ones for the subgroups of happy elliptic curves. The main arguments alone support the distinctive assumption that Groth's protocol supported algebra [Gro09b] and with its variant of Seo [Seo11]. Each of those protocols has a communicative complexity proportional with the root of the circuit size. Since then, this radical complexity appeared as a barrier to several arguments based on the logarithm for circuit satisfaction (Figs. 1 and 2).



Fig. 1 Zero-knowledge proof

Applications of ZKP

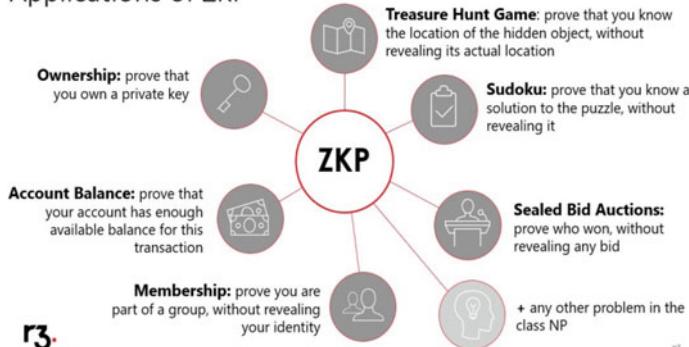


Fig. 2 Applications of zero-knowledge proof

1.1 Related Work

Zero-knowledge tests were conducted by Goldwasser et al. [GMR89]. There, it is useful to distinguish between zero-knowledge tests, with applied mathematical force and zero-knowledge topics with machine force. Normally the tests will have only zero knowledge of the machine, while the arguments can have a good zero knowledge.

Goldreich et al. [GMW91] have shown that all the languages in NP have a zero-knowledge test, while Armor et al. [BCC88] show that all the languages in NP have zero-knowledge topics which have a good knowledge of zero.

Gentry et al. [GGI+14] used an absolutely homomorphic coding to build zero-knowledge tests in which the quality of communications corresponds to the scale of the witnesses. However, tests cannot normally have smaller communication than that of the token size, unless surprising results are obtained on resolution quality of SAT instances [GH98, GVW02].

Kilian [Kil92] has shown that unlike zero-knowledge tests, zero-knowledge topics will have a terribly low communication quality. However, its constructions were based on that of PCP theorem and failed to produce a sensitive theme. [In Bootle, Jonathan, et al.] “Efficient zero-knowledge arguments for arithmetic circuits in the discrete log setting.” *Annual International Conference on the Theory and Applications of Cryptographic Techniques*. Springer, Berlin, Heidelberg, 2016. This offer of AN, an honest subject with zero knowledge for the satisfaction of the arithmetic circuit, has supported separate power assumption that only complex power communications need. His plot has good integrity and excellent honest knowledge somewhat zero. Solidity is a procedure and is based on that of discrete logarithmic assumption. They, thus, require a logarithmic number of movements, and each of them has a linear procedural complexity. In Geoffroy Couteau, zero-knowledge test is for secure computing. Encryption and security [cs.CR]. PSL University Review, 2017. English, NNT: 2017PSLEE065, tel-01668125v2. They study of zero-knowledge tests, a cryptographic primitive that only allows you to test an advertisement, while it shows

nothing on the other side of it truths and its applications to ensure processing. Specifically, they initially introduce a substitute type of zero-knowledge test, known as implicit zero-knowledge topics, which falls within two existing notions, interactive zero-knowledge tests and non-interactive zero-knowledge tests. There was a new notion which is identical because it secure the computation protocols, however it was designed from primarily identical cryptologic assumptions because the former, that results security guarantees. In Vadhan, Salil Pravin. *A study of statistical zero-knowledge proofs*. Diss. Massachusetts Institute of Technology, 1999. This thesis shown careful investigation of applied math zero-knowledge proofs that area unit zero information proofs during which the condition that the booster “learns nothing” is understood in an exceedingly sturdy applied math sense. The authors has shown that, the category SZK of issues possess such proofs which has 2 natural complete issues. These questions mainly concern the approximation of the applied mathematical distinction or the entropic distinction between two “effectively sampled” distributions. Therefore, they provide a new characterization of SZK unrelated to interaction of zero knowledge. With which, they also need to simplify the study of statistical zero knowledge, as questions about the entire class SZK can be reduced to examining these two particular complete problems. Martín-Fernández, Francisco, Pino Caballero-Gil, and Cándido Caballero-Gil shown authentication based on non-interactive zero-knowledge proofs for the internet of things. *Sensors* 16.1 (2016): 75, this paper describes the design and analysis of a new scheme for the authenticated exchange of confidential information in insecure environments within the Internet of Things, which allows a receiver of a message to authenticate the sender and compute a secret key shared with it.

The proposal is based on the concept of a non-interactive zero-knowledge proof, so that in a single communication, relevant data may be inferred to verify the legitimacy of the sender. Besides, the new scheme uses the idea under the Diffie–Hellman protocol for the establishment of a shared secret key. The proposal has been fully developed for platforms built on the Android Open Source Project, so it can be used in any device or sensor with this operating system. This work provides a performance study of the implementation and a comparison between its promising results and others obtained with similar schemes—in Feige, Uriel, Amos Fiat, and Adi Shamir, “Zero-knowledge proofs of identity” and *Journal of cryptology* 1.2 (1988): 77–94. In this paper, they extend the notion of zero-knowledge proofs of membership to zero-knowledge proofs of knowledge. After formally defining this notion, they show its relevance to identification schemes, in which parties prove their identity by demonstrating their knowledge rather than by proving the validity of assertions. They describe a novel scheme which is provably secure if factoring is difficult and whose practical implementations are about two orders of magnitude faster than RSA-based identification schemes. In the last part of the paper, they consider the question of sequential versus parallel executions of zero-knowledge protocols, define a new notion of “transferable information,” and prove that the parallel version of identification scheme (which is not known to be zero knowledge) is secure since it reveals no transferable information.

2 Motivation

One motivation is philosophical: The notion of a proof is basic to mathematics and to people in general. It is a very interesting question whether a proof inherently carries with it some knowledge or not. Another motivation is practical: Zero-knowledge proofs have found many applications. Most practical applications fall into two types:

- **Protocol design:**—A protocol is an associated grade rule for providing interactive parts through which some goals can achieve. For example, we have a tendency to see the Diffie–Hellman key exchange protocol. In this protocol, we will assume that each party follows some sort of instructions related to the protocol, and therefore, the only factor that concerned us was a passive evasion of individual evasion. However, in crypto, we often need to design protocol that must achieve security, even when one of the parties “betrays” and does not follow the instructions. It is often a difficult problem because we do not know the way exactly that in which way, the party can cheat. There is one of the ways to avoid cheating which is to do the following: If Alice does a protocol with Bob, to show Bob that he is not cheated, he will send Bob with all the inputs he has and Bob will verify by himself that if one executes prescribed instruction on these all inputs, you can actually get the outputs that Alice sent. However, this way is generally not acceptable for Alice: There is only reason why they are running this protocol is that they do not completely trusts each other, and therefore the input that they may have had in secret, and he or she is not needed to share them. Zero knowledge provides an answer to the current puzzle. Instead of causing her with contribution, Alice will show with the zero with which she has followed the instruction. Bob is convinced, but he will not be learning something about his contributions that he had never understood before. In fact, it is possible to prove it in very general way, essentially applied to all cryptographic protocols. Therefore, there is a general technique (invented by Goldreich, Micali and Wigderson, GMW) which is to design cryptanalytic protocols. First, presumably, everyone must follow the instructions and will therefore be “forced” to follow the instructions by using a zero-knowledge test system.
- **Identification scheme:**—A slightly less complicated and simple application is that of identification scheme. Suppose if we want to regulate accesses to the metals department, the first way to try is to give approved people with a secret PIN code and must have a box on the door wherever the PIN code is entered. A negative aspect of this may be that the box will remain open for few times, and if anyone can examine it, they may be ready to read yours memory and extract the keys from everyone. Therefore, for a security post, it is so much better if that box does not contain any secret information and, even that if someone enters a “fake box,” they may not learn something about that the secret PIN code. Zero-knowledge proofs help in many ways:
 1. The box contain an instance of a tough downside. For instance, that box shall contain a number n while not it is factoring.

2. It generates the licensed folks the answer to the number of instances. For instance, they will get the factoring of n to $n = p * q$.
3. The licensed folks can influence that Box they understand the resolving in zero-knowledge. (Of course, there is a matter of however does one prove with that you simply understand one thing; however, this was additionally shown by GMR (and any developed by others).

3 Notation and Definition

Zero-knowledge proofs are cryptographic protocols that will allow a prover to prove that they have some knowledge of a certain kind, without being able to reveal any additional information about that knowledge. For example, I might want to prove that I know a secret preimage w for some hash $h = \text{hash}(w)$, without revealing what that secret w is.

Digital signatures are a bit like a zero-knowledge proof: “I know a secret key, and this is how I wish to spend my bitcoins.”

The following is the general form of Camenisch-Stadler notation, which is a convenient way to express the goals of a zero-knowledge proof scheme:

$$\text{ZK PoK } x\{(w) : L(w, x)\}$$

The value x here is called the “statement.” It consists of public information, known to both the prover and the verifier. The value w is called the witness. The witness is typically secret information, known only to the prover, and kept hidden from the verifier. The predicate L is called the language and represents the condition that the statement and witness must satisfy.

Roughly speaking, this says “I know a witness w , such that the predicate $L(w, x)$ holds for w and x . ”

More vocabulary:

- **(Arguments vs. Proofs)** Arguments are only secure against a computationally bounded (i.e., polynomial time) adversary. Given unbounded computing power, a malicious prover could fool a verifier in an argument scheme. This distinction does not usually have a practical consequence. A computationally unbounded adversary could break the rest of our crypto anyway.
- **(Proof of Knowledge vs. Computationally Sound)** Many statements are trivially true. For example, for an arbitrary digest h , there (most likely) exists some preimage w such that $H(w) = h$, even though in general it is hard to find w given h . Usually, what we care about proving is that the prover “knows” a witness. It is difficult to formalize what “knows” means. We formalize this notion by requiring that the prover can be modified to produce a witness.
- **(Interactive and Non-Interactive)** Interactive proofs may require back-and-forth messages sent between the verifier and prover. In a non-interactive proof, the

prover generates a single message (called the “proof”) which the verifier can check directly.

4 Conclusion

The contributions presented in this thesis focus on the design and the analysis of zero-knowledge systems and target their applications to secure computation. In addition, this paper provides us detailed description of notations of zero-knowledge proof and definitions in it. It also covers the related work of zero-knowledge proof. It covers the motivation behind this zero-knowledge proof; it has many applications, and most application falls into two categories—protocol design and identification scheme. This paper highlights the definition of zero-knowledge proof with basic information of all the rules.

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A Secure Electronic Voting System Using Blockchain Technology



K. Dhinakaran, P. M. Britto Hrudaya Raj, and D. Vinod

Abstract By voting, people can decide the direction of change and development since the people have a sense of “Ownership of Government”. Voting is a very important process in any democratic country. For a secure voting, blockchain technology used by electronic voting is more effective and secure. Many digital services are being developed by the blockchain technology. The investigation on the blockchain topic is still proceeding; however, the research mainly focuses on its legal and technical issues, but this novel concept can be taken advantage of and can be used to create advanced digital services. This paper is going to grip the open-source blockchain technology, and we are going to propose an e-voting system based on this technology. We are using the SHA-256 hash function to keep the voter anonymous, and we are enabling the dual authentication process while the voters’ cast their vote. This will result in the minimalization of malicious activities since it is safe, reliable, secure, and trustworthy.

Keywords Blockchain · Electronic voting system

1 Introduction

The most critical way that an individual can alter governmental decision is through voting. But in traditional ways of voting like ballot, EVM machines the casted votes

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are prone to alteration and electoral fraud. In addition, those who cannot reach the polling stations in their allocated time cannot cast a vote. The solution to all these problems is a safe, secure and easily accessible e-voting system supported by blockchain technology [1].

2 Literature Review

2.1 Electronic Voting Systems

David Shaum introduced the primordial electronic voting machine in ahead of time of eighties. Public key cryptography was used in this system through which the voters cast their votes and kept the voters anonymous [2]. Blind signature theorem was used. Polling stations were used for voting instead of the paper ballot voting system as the first system [3]. But the second system uses mobile and allows the users to cast their vote anytime and anywhere using their mobile phones or any other devices remotely which has an Internet connection. This will certainly increase the number of voters since the e-voting makes casting a vote a lot easier and more favourable [4].

- **Estonian I-Voting System:** The ID card allows for both secure authentication and legally binding digital signatures which was made compulsory. SHA1/SHA2 signatures were created using the ID card. Here, multiple times the voters can cast the vote, but only, the last one will be considered as valid. Vote buying can be prevented by using this method [5].
- **Norwegian I-Voting system:** The electronic voting system is used by Norway for its 2011 country council elections. Due to the security reason, the country discontinued its electronic voting system in 2014 [6].
- **New South Wales I-Voting System:** I-voting system has been used by the New South Wales election conducted in 2015. The system is different than that of the Norwegian I-voting system. For a voter to cast their vote, the voter must undergo a series of steps involving pin generation and authentication.
- **Malaysian I-Voting system:** Malaysia People's Justice Party conducted the leadership election with the electronic voting in 2018. It suffered numerous technological difficulties, and they had to postpone many polls due to the poor system.

2.2 Drawbacks and Security Issues

The major drawbacks of the Norwegian and the Estonian electing method are that the code used for casting a vote is prone to liability of critical parts of code. Transparency is also crucial in the Estonian I-voting since the code is close. A trusted election depends on an open-source e-voting system. There is no dual authentication

in the system. So, there is a lot of room for the voters to make error [7]. I-Voting systems make it unprotected to cyberattacks or (DOS) denial of service. Every earlier mentioned system is attacked by state level that is possible as the network traffic is controlled by the intelligence agencies all over the world [8, 9].

Our proposed system will overcome all these drawbacks by using open-source code which is used to develop the e-voting system using blockchain.

3 Proposed System Using Blockchain

Blockchain is distributed ledger technology (DLT) that allows to store data globally on thousands of available servers. Blockchain has high failure tolerance, so it can be used in our proposed voting system. Table 1 describes the structure of blockchain voting method.

An algorithm has been designed by the National Security Agency (NSA) in 2001 which is widely being used and known as (SHA-256) Secure Hash Algorithm. The hash function is a one-way cryptographic. SHA-256 is a fixed size for any size of source text. The SHA-256 may take any size of plain text as an input, and it is encrypted to a 256-byte binary value.

Figure 1 shows that when you input any type of data like password, text it goes through the hash algorithm/function and comes out as a new value.

The requirements of our e-voting system are demonstrated below,

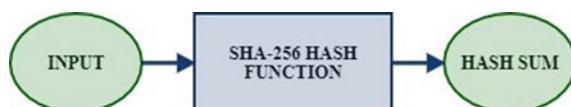
Authentication—The system will validate voters' identities with the database that has been already verified. While discharging a vote, the user needs to undergo dual verification process so that there is very little room for error and the casting of vote is done only once for every user.

Obscurity—The voter will remain obscure during and after the election. No one can establish a link between the voter and the ballot.

Table 1 Structure of the voting blockchain

Field	Description	Size
Block size	The size of the whole block	4 bytes
Block header	Encrypted hash	60 bytes
Vote transaction	Number of transactions	1–9 bytes
Transaction	Contains the transactions saved in the block	Depends on the transaction size

Fig. 1 Working of SHA-256 hash



Precision—Every vote should be precise, as it was unable to modify, remove or duplicate.

Verifiability—The system should be testable as to check whether it counts all votes properly. The voter will get a SMS to his registered mobile number about the details of his vote.

3.1 Representation of Overall Process

- **Registration:** The user needs to enrol into the system with the accreditation which had already been provided by the government authorities like his voter ID. The credentials will go through the blockchain to the verification phase.
- **Verification:** The system will verify all the details that had been entered by the user, and only if all the information is correct, his/her name will be added to the voter's list which again will go through the hash function and will get published.
- **Vote casting:** The voters will cast their vote using their devices which are supported by the internet. The users must go through a dual authentication process while casting their vote.
- **Encrypting and Counting votes:** The votes that are casted will go through the SHA-256 as to remain anonymous to who cast the vote. We use one-way hash function SHA-256. So, no voters information can be retrieved. The received votes will go to an analytical machine which analyses valid votes and count them.

Result: The validated and counted votes from the analytical machine will securely be transmitted through the blockchain and will have the results to the conducted election, and the results will be published. The overall process is shown in Fig. 2.

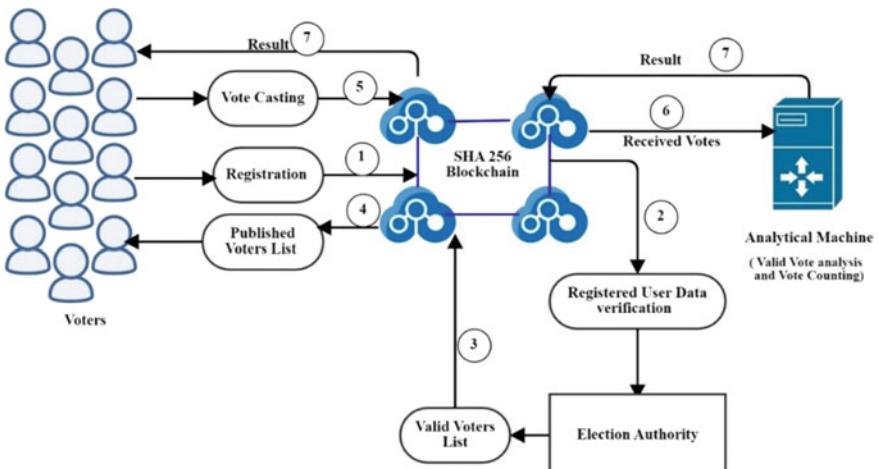


Fig. 2 Architecture of the overall process

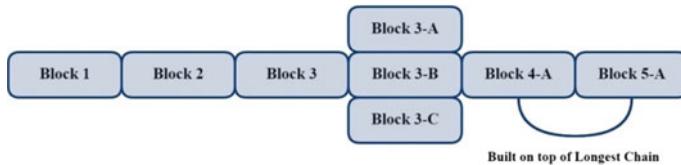


Fig. 3 Longest chain rule

4 Concusses in the Blockchain

Our proposed system based on e-voting and blockchain is a decentralized system. So, the problem of concuss may occur. The concuss occurs when the system obtains tremendous votes from different users at the same time. This problem can be solved with the help of the longest chain rule.

Let us take the three Blocks 3-A, 3-B, and 3-C. The system will add Block 3-A to the descendant to the Block 3, and when Block 3-B is inaugurated, the system waits. When Block 4-A is initiated to the system, then the Block 3-A will be considered as the valid block in the blockchain which keeps on building the chain. Block 3-B and Block 3-C are considered as orphan blocks [10]. Since the orphan blocks (Block 3-B and Block 3-C) have the details/votes as same as the other blocks, they will be examined when votes are counted. Figure 3 is described as the chain rule of blockchain.

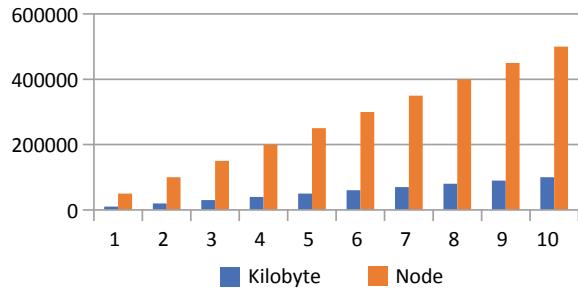
5 Implementation and Result

The simulation of our system was done with the help of Python programming using software called PyCharm Community. The receiving of votes, the storage, counting, and publishing of votes remained anonymous and secure because of the blockchain technology. The blocks (votes) contain ID of node, ID of the next node, votes record, digital signature, preceding hash, and timestamp. On any network, if the node is down, then the system succeeds with the next node by continuing the sequence. Overall, the system is secure and ingenious.

Every number of nodes present has undergone reliability testing with essential capacity parameters. Let us assume that the number of nodes represents the place where the election is being conducted and the number of nodes verified ranging from 1 to 500,000. The generated data is shown in the below graph Fig. 4; many numbers of nodes are commensurate to the volume required in the recording process of this e-voting.

The system took longer time to work as the nodes increased. ID of node, ID of the next node, votes record, preceding hash, digital signature, and timestamp were the attributes of the data block containing all nodes. In this reproduction, if the node becomes down on the network, then it cannot transmit the block and disables the nodes. Then, the system has succeeded with the next node by continuing the

Fig. 4 Possibility of data storage in database



sequence. The counter time for every node expires, and then, the node knows its turn has arrived “My Turn = TRUE”. Figure 4 shows the possible data processing in number of nodes in the proposed system.

6 Conclusion

The electoral voting system is the best way to cast a vote; using the blockchain technology like proposed in our paper, we can make the voting process secure. Reliability of the system is considered, and as the nodes increased, the time for the system to work was also increased in the simulation. The system continued the sequence even if a node is down to the following node due to the counter time. The dimensions necessary for the recording process can be known by the number of nodes as they are proportionate. The recording of voting result by using hash values makes the system more secure. The limitations given will be addressed in the future reference papers.

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ARIMA Versus ANN—A Comparative Study of Predictive Modelling Techniques to Determine Stock Price



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Abstract The stock market price is one of the best indicators to showcase economic status of a country. As it is the concern of investors and the companies, there is a necessity to have a strong monitoring mechanism to predict and track the share prices. Though the prices are dynamic in nature and the learning curve is changing rapidly, robust mechanism has to be in place to facilitate prediction. Machine learning, a technique of learning using past data, seems to be a perfect platform which can capture the dynamic and changing landscape of stock market prices. Among the multiple analysis methods used in the market for prediction, time series analysis is a novel method in predicting the share prices. This study has attempted to predict the share price of ICICI Bank Limited, the private multinational banking and financial services firm using traditional time series method ‘autoregressive integrated moving average’ (ARIMA) and machine learning algorithm ‘artificial neural network’ (ANN) to understand the best method for prediction. The predictive performance of the both the models was compared using root mean-squared error metric. The findings of the study showed that the accuracy of traditional ARIMA model comparatively better and hold good for predicting the share price.

Keywords Stock price · Prediction · Forecasting · ARIMA · Artificial neural network

1 Introduction

Stock market prices are highly dynamic, sensitive and volatile, influenced by many factors. These factors not only include the domestic, industrial and economic environment but also the global, economic and political conditions [1]. The prediction of prospective share prices is not only complex, but also extremely challenging. However, it is important to identify tools and techniques to accurately predict these

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stock prices as it is essential for investment gains. There are many stakeholders for whom this prediction is very crucial including institutional investors, speculators, brokers, etc. In recent times, intelligent predictive models and powerful programming packages [2] commonly called as machine learning algorithms are used in stock markets for financial time series forecasting. This study compares the traditional time series forecasting models with machine learning algorithms like artificial neural networks and recommends the best-fit model for stock market prediction.

2 Literature Review

Forecasting is usually undertaken by the stock brokers with the help of some basic information which is accessible in the public domain. Over a period of time, stock brokers used technical analysis [3], fundamental analysis [4] and time series forecasting [5] for predicting stock prices. In early years, prediction techniques such as stochasticity [6], moving averages, exponential smoothing [7], autoregressive models, discriminant analysis and correlations were used [8]. Later advanced statistical techniques were used which included autoregressive conditional heteroskedasticity [9], generalized autoregressive conditional heteroskedasticity [10], autoregressive moving average (ARIMA) [11].

The different machine learning algorithms used in stock market prediction include support vector machines (SVM) [12], multidimensional k-nearest neighbour model [13], artificial neural network (ANN) [14], deep neural networks [15], hybrid model [16] and sentiment analysis [17]. While the SVM is used for pattern recognition, ANN uses complex relationships of variables in prediction and sentiment analysis used in the published news articles to capture sentiments of people to predict stock prices. Many studies have recently been undertaken using ANN optimized by grey wolf technique [18], long short-term memory (LSTM) [19] to predict stock prices. Most of these studies used only the daily closing price for prediction and the error rates in this case are high [20]. They usually predict the future trend and not the future price. The main issue to be addressed is accuracy; i.e., how much the predicted values are closer to the actual value. A falsely predicted value can impact the decisions made which might bring financial and/or reputational loss to the organization or to the individual. This study implements two models on the dataset and makes suggestions with respect to their accuracy.

3 Research Methodology

This project uses the past data relating to the stock to predict the future value. The data was extracted from Yahoo! Finance website (<https://in.finance.yahoo.com/>) [21]. Opening price of the stock, closing price of the stock, the highest price, and lowest price, total number of shares, increase or decrease in stock prices of a leading private

sector bank in India was collected for the purpose of the study. The first step for applying machine learning algorithm is to partition the dataset into two parts: training data and testing data [22]. For this study, 75% of the data is partitioned as training dataset using which the prediction model is built and 25% of the data is used for testing.

4 Model Building

4.1 Forecasting Stock Trend Using Artificial Neural Network

Neural networks are a machine learning framework that attempts to mimic the learning pattern of natural biological neural networks using neuron or perceptron. A neuron has one or more inputs, a bias, an activation function, and a single output. Bias is added to the perceptron to avoid the issue where all inputs could be equal to zero. But the predicted output is not accurately the same as the actual output leading to an error in the prediction. In neural network modelling, the possibility of this error could be reduced by updating the biases and weights. The error in each neuron initiates the necessary changes to the weights. The derivatives of every node help minimize errors at each step. As a first step, the pattern of share prices in the training and test dataset is analysed using the plots (Figs. 1 and 2). The distribution shows that there are many fluctuations in the prices.

The steps involved in forward propagation neural network algorithm are as follows. Two user-built functions sigmoid() and derivative of sigmoid() are set up. The variables needed for neural network are initialized. The weight and the bias matrix of the hidden layers are denoted by ‘wh’ and ‘bh’, and the output layer by ‘w_out’ and ‘bout’. The inputs, weights and bias are added along with the activation function. This resultant prediction is compared to the actual output, and the error is calculated. The error thus calculated is broadcasted back to the network. This results

Fig. 1 Training dataset

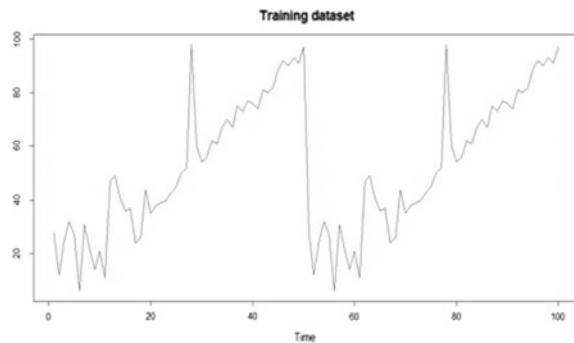
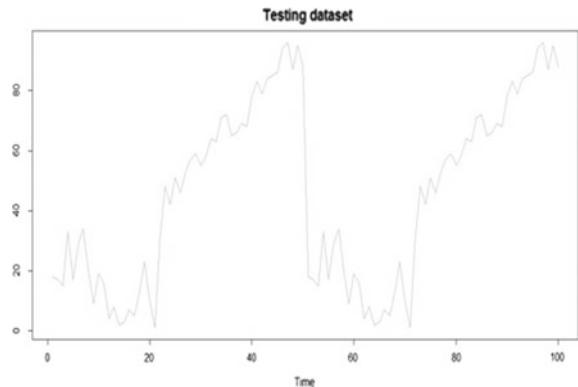
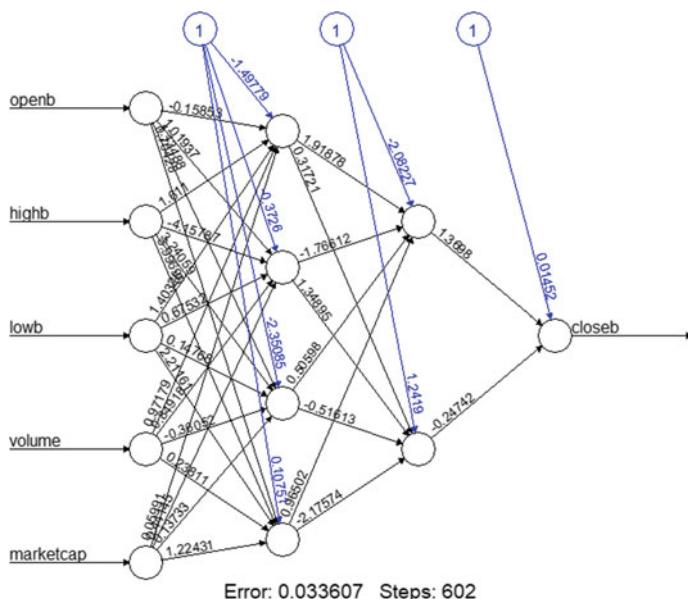


Fig. 2 Testing dataset

in the bias as well as the weights being updated accordingly in the hidden layer and output layer. The resulting neural network model is given in Figure.

After the model is built using the training dataset, it is used to predict the stock prices on the test data set. The plot of the actual vs. predicted values is shown in Fig. 3. The blue line in Fig. 4 shows the actual values, and red line indicates the predicted values. From the plot, we notice that there is just a slight deviation between the actual and predicted values which could be due to then dynamic nature of the market.

**Fig. 3** Neural net model for the dataset

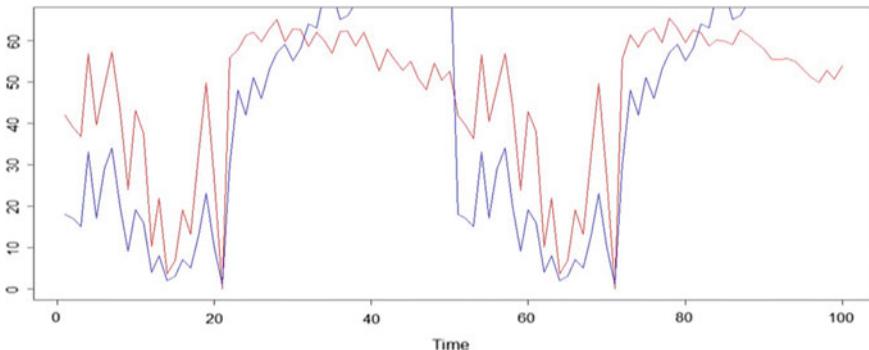


Fig. 4 Actual versus predicted values

```
> Err
[1] -23.999 -22.107 -21.779 -23.852 -22.582 -20.055 -23.190 -23.491 -14.972 -24.037 -21.563 -6.213 -13.900
[14] -1.548 -3.945 -12.092 -8.189 -20.048 -26.741 -16.465 1.000 -25.891 -9.732 -19.128 -11.052 -13.787
[27] -9.783 -8.068 -0.720 -7.829 -4.675 5.423 0.952 11.047 15.034 2.832 3.710 10.408 6.004
[40] 20.237 30.305 21.114 28.729 32.248 31.016 43.164 47.856 32.413 44.670 35.514
```

Fig. 5 Mean error values of ANN model

The accuracy of the model prediction is done by calculating the mean error, which is the difference between actual stock value and the predicted stock value. The calculated mean error values are shown in Fig. 5.

4.2 Forecasting Stock Trend Using ARIMA

In ARIMA model, the past four months data relating to closing price of ICICI Bank have been considered for the ARIMA forecasting. The distribution of the data is shown in Fig. 6.

The data should not depend on the characteristics of the time period during which the data series is collected. There should not be trend or seasonality in the data and the variance should be constant. Hence, the data is checked using augmented Dickey–Fuller test and ensured that it is stationary without any predictable pattern. The results of the augmented Dickey–Fuller test are given in Fig. 7. The p value given in the output is 0.01 which is less than 0.05. Therefore, it is concluded from the results that the data series is stationary. With respect to the steps portrayed above, differencing has been performed.

The ARIMA model helps to describe the autocorrelation in the data. It explains how much is today's price dependant on yesterday's price or day before yesterday's price. ARIMA model is based on three parameters—p, d, q. Autoregression means that the current observation depends on the observation from the past. The order is determined by 'p', and the value is derived from PACF plot. Integrated refers to the stationarity of the series. Moving averages indicates that current observation is based

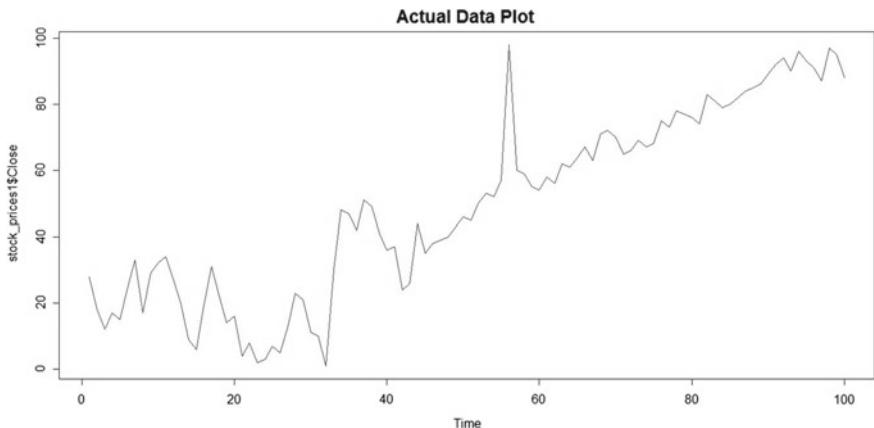


Fig. 6 Actual data plot

Fig. 7 Results from the ADF test

```
Augmented Dickey-Fuller Test
data: stock_diff
Dickey-Fuller = -9.965, Lag order = 4, p-value = 0.01
alternative hypothesis: stationary
```

on the forecast errors from the past. The value is derived from ACF plot, and the order is determined by ‘q’. The order sets so populated are

- Model1 = arima(traindataset, order = c(0,2,2))
- Model2 = arima(traindataset, order = c(1,2,0))
- Model3 = arima(traindataset, order = c(1,2,2))

From the above sets of order, the third one (*traindataset, order = c (1,2,2)*) holds the maximum order value for which the coefficients have been derived and further points being forecasted. The coefficients value derived from the model is indicated in Fig. 8.

After finding the highest order value, using the (*fit.arima*) function, the forecast was done from the values derived. The forecasted graph populating the future movements based on past series of data is indicated in Fig. 9.

```
call:
arima(x = train, order = c(1, 2, 2))

Coefficients:
      ar1      ma1      ma2
    0.0030  -1.9967  0.9998
  s.e.  0.1216   0.0710  0.0710

sigma^2 estimated as 2.833:  log likelihood = -142.22,  aic = 292.43
> |
```

Fig. 8 Results showing the coefficients value for the maximum train order

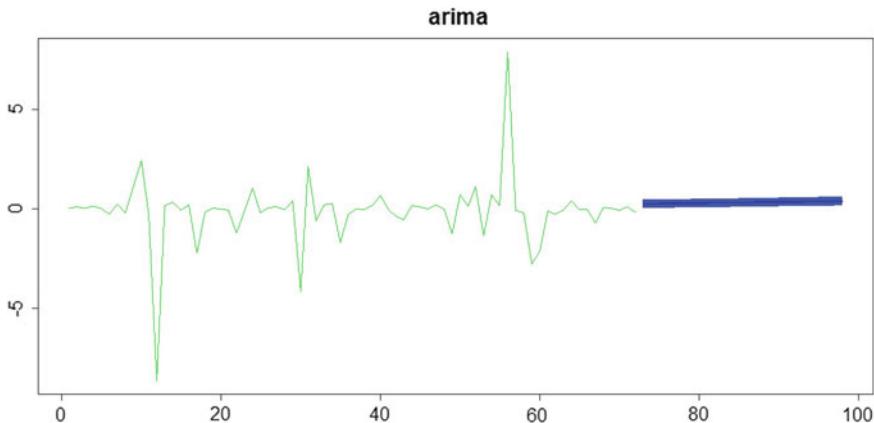


Fig. 9 Trend showing the forecast for ICICI Bank

```
> print(err[])
[1] 0.861050128 1.882988599 -0.039423028 -0.695485183 0.619110051 -2.383350538 -4.442563978 -1.639280239
[9] -1.920628999 -0.577248827 2.133765310 -0.852839378 -0.935431818 -0.375271521 -0.112302304 -0.364960036
[17] -0.001154251 -1.828727584 1.154602503 -0.068954577 -0.649759630 -0.372550281 -0.336252998 -0.392824450
[25] -0.208822537 -0.317529857
```

Fig. 10 Results showing the mean error value populated in the forecast

After the process of successful forecast, the next step is error detection. Here the error value has been calculated for the forecasted points which have been derived by the algorithm, $err[b] = test[b] - value[b]$; The mean error of ARIMA model is shown in Fig. 10.

5 Model Comparison

The root mean square error (RMSE) is the most common performance measures used by researchers [22]. The measure is used to compare the predicted values with that of the actuals. The RMSE values of ARIMA model and ANN model are given in Table 1. The root mean square error value of ARIMA model is 26%, and ANN model stands at 35%. It is observed that the root mean square error value of traditional ARIMA model less compared to ANN model. Thus, the forecasted values are more accurate in ARIMA model compared to ANN.

Table 1 RMSE of ANN and ARIMA models

Measure	ANN Model	ARIMA Model
RMSE	0.35514	0.263017

6 Discussions and Conclusion

The purpose of the current study was to discover which predictive model was best suited for the predicting the stock market prices. The study concludes that traditional ARIMA model is able to forecast the stock prices more accurately than the ANN model. This finding is consistent with the study done by Ayub and Jafri [23] where they argue that financial time series are not absolutely linear or nonlinear and justify the use of ARIMA for superiority and profitability in prediction. But Cao et al., [24] concluded that neural networks have better predictive performance when compared to other linear models. This study contradicts the results of Cao et al. [24] and reiterates the results concluded by Kumar and Thenmozhi [8] and Pandey and Bajpai [25]. The results of this study will give insights into investors who are looking to invest in stocks. Further, studies could be carried out on developing hybrid models combining the traditional forecasting techniques with more complex machine learning algorithms.

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Internet of Things, Cyber Physical System, and Data Analytics: Open Questions, Future Perspectives, and Research Areas



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Abstract Due to recent/rapid development in technology, i.e., from wired to wireless, the communication among human and devices/machines has been move-shifted to a new level. Some new technologies/concept has been created in current day-to-day life. Internet of things and cyber physical systems are one among them. Generally, Internet of things is about connecting “Things” (objects and machines) to the Internet and eventually to each other (also called Internet connected things) while cyber physical systems (CPS) is integration of computation, networking, and physical process. On another side, Internet connected things (ICTs) allow integration of service with connecting physical objects like fridge, air conditioner (AC), etc. IoT makes its data and services available more open. Internet of things (IoT) refers to the fundamental part of a CPS which is connection and communication of entities through Internet. IoT technology interconnects of all types of devices to the Internet that enables them to exchange data, optimize processes, and monitor devices. This interconnection of things is of great benefits for the industry/organizations, the economy of a nation, and the end user/consumer. It forms new systems and services by creating a network of sensors, actuators, and devices. At last, the efficient tools (like Apache Hadoop, Apache Spark, Apache MLlib, MongoDB, R Programming, Neo4j) we used in big data analytics based on popularity, feature richness, and usefulness are being discussed. Hence, this work provides a detail discussion about the terms (discussed above) like Internet of things, cyber physical systems, its importance in various applications, importance to humanity/benefits to society, issues, challenges and research

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gaps, etc., in detail and also conclude this interested topic with several future research directions for future researchers (who are working in these computing environments).

Keywords Internet of things · Cyber physical systems · Big data · Data analytics · Smart devices

1 Introduction—Internet of Things and Cyber Physical System

Internet of things is about connecting “Things” (Objects and Machines) to the Internet and eventually to each other, while cyber physical systems (CPS) [1] are integration of computation, networking, and physical process. CPS is more related to physical objects and machines, while the IoT is a little bit more abstract and allows the integration of service and not only physical objects. CPS is more concentrated on concrete development scenarios and does not target of providing data outside the original scenario. IoT makes its data and services available more open. All IoT devices are cyber physical systems, but CPSs are not necessarily connected to the Internet and thus, not necessarily IoT devices. Cyber physical system (CPS) is a mechatronic system [2] in which entities are connected to each other through wired or wireless solutions with means of information and communication technology. Note that synonym for CPS is Industry 4.0 (i.e., a fourth generation of Industrial Revolution).

Cyber physical systems collect a vast amount of knowledge of the environment by using sensors. These sensors are connected to all the distributed knowledge in the environment. This process can enable a more accurate action and task. In a proper definition, cyber physical systems consists of computation, communication, and control components tightly combined with physical processes of different domains such as mechanical, electrical, and chemical.

1.1 *Internet of Things*

IoT technology makes them beneficial for the industry, the economy, and the end user. New systems and services can be formed by connecting the sensors and actuators and devices in a network. There are four innovative terms in trend which are Industries 4.0, Smart Factories, Cyber Physical Production Systems (CPPS) [3], and Internet of things (IoT). If IoT is the basic infrastructure, then on top of that comes CPS, CPPS, and IoS, and the whole is Industries 4.0.

- **For example, Cyber Physical System (CPS):** The interplay between computational devices that interaction with dynamical systems (differential equations),

issues regarding discretization of these equations, and lack of proper bit representation of continuous time in cyber world and how to work around this seem to be the common thread. Most commonly referred to application are smart grids.

- **For example, Internet of Things:** One common example used is “smart” refrigerators which can use sensors to find the amount and type of food in the refrigerator and can automatically order food through the Internet. Another example is smart traffic lights, where different lights can communicate over the network and collectively figure out how best to route traffic. As you can see, there is no direct actuation of the physical world (at least in a dynamical systems setting).

Hence, the remaining part of this paper is organized as:

- Section 2 discusses literature work related to Internet of things and cyber physical systems.
- Section 3 discusses motivation behind this work, interested/useful facts/points behind writing this article.
- Section 4 discusses importance of Internet of things and cyber physical systems in past, present, and future.
- Section 5 discusses several one popular use cases related to Internet of things and cyber physical systems.
- Section 6 discusses introduction of data and data analytics
- Section 7 discusses role or importance of scope of data and data analytics in this smart era.
- Section 8 discusses several essential tools required for analysis.
- Section 9 discusses many critical issues and challenges in Internet of things, cyber physical systems, and data analytics
- Section 10 discusses an open discussion in detail. This section discusses the role, necessity of data, data analytics, big data analytics, data science, with several point of views.
- Section 11 will conclude this work in brief.

2 Literature Work

Conspicuous hybrid architecture is proposed in [4, 5] with components, multilevel organization, and the implementation mechanism. However, in architecture models the infrastructure of communication system is not specified. Due to its effect on organizational and architectural models, the communication architecture specification is important. The infrastructure of communication defines how architecture-level interacts, how architectural components communicate, how they access distributed data, and how behavior are carried out. In current trends, there is a huge growth in the communications infrastructure. The use of communication patterns as a key for component-based robotics was taken into consideration by different groups [6, 7]. They agree mostly with the following communication requirements, which can be found in a more detailed description [7]:

- Components must communicate with each other asynchronously via a predefined interface.
- Value should be passed to the communication objects.
- Modular or interchangeable components.
- Components need to be wired dynamically during operation.
- All communication and synchronization problems must be covered within the communications structure.
- Communications systems must provide the time required for interaction with predictability.

Furthermore, from my point of view, the design of the communications framework must take account of the various time limitations between hybrid architecture reactive and deliberative. The responsive stage performs tasks that have to respond to environmental changes. For instance, a task which prevents obstacles should react to the nearby sensor signals within a time limits determined by the robot speed, with all these tasks requiring hard real-time constraints. Traditionally, hard real-time execution is resolved by previously planning the execution of the processes. Yet new models are needed to solve challenging execution in real time [8] a system with dynamic changes and where processes are not a priori known (or open-label systems as mobile robot moves through unpredictable behavior in an unknown environment). The solution tendencies to describe structures that adjust dynamically by delegation or deterioration of their output and through periods for noncritical tasks to other nodes [9]. All the details correlated with its temporal information must be supported by a communication system. Therefore, tasks can use their time properties to verify useful data. Time information calculations tend to use mechanisms of temporary firewalls [10]. This strategy is focused on adding delays when all communication loads are accumulated. Presently, few architectures that follow these patterns such as GenoM/Kheops [11], CoRoBa [12], ORCA [13]:

- **GenoM:** Tool which helps to construct real-time software architectures. There is a judgment stage and a practical level of execution in the general architecture. Kheops is a practical level reactive control tool. In order to guarantee the execution in real time, Kheops requires an information base composed of proposal rules.
- **CoRoBa:** It is a computer reusability-based multi-mobile robot control system. It uses CORBA as a middleware for interaction and does not target hard applications in real time. There is inadequate mature implementation of the CORBA module design.
- **ORCA:** It is an open-source framework designed for mobile robotics for component-based software engineering (CBSE). A standalone system is an ORCA component. It interacts via a number of well-defined interfaces with other components.

Hence, this section discusses literature work that is concerned to form a combination of information that is mostly object linked in order to achieve placement of intelligent sensor. It provides an initial, easy, and efficient solution that uses mobile computer agents that communicate through a communications network

using different link buses to ensure time limitations. Now, next section will discuss motivation behind writing this article with respect to IoT, CPS, and data analytics.

3 Motivation

Due to the recent development in technology and shifting of industries toward Internet of things (IoT) and cloud computing, many revolutions have been seen in the previous decade. Cyber physical systems make an environment using variety of Internet connected things together to perform tasks efficiently. Users perform and complete their tasks through wireless and wired connections (including unique addressing schemes in the smart things), these devices interact with each other and cooperate with other things to create new applications/services and reach to common goals of customers/users. Today's IoT is being used in many applications like military affairs, including aerospace, military reconnaissance, intelligence grid system, intelligent transportation, intelligent medical, environmental monitoring, industrial control. We can say big data also play its role to provide useful and effective decisions. Internet of things devices are collecting information of users or other devices/machines using its intelligent analysis. To integrate the collected information with the Internet and other networking, the system can provide efficient analyses results/outcomes which can fulfill demand for intelligent communications and decision support in many sectors. The popular use case in this research paper has been discussed in Sect. 5; i.e., the way smart cities will think with integration of IoTs (in near future). Hence, our motivation behind writing this paper is that such behavior or decisions (generated with information technology in background) can provide a practical, strong, and perfect application system for public management, public services, and public industry, improve governmental service efficiency, and improve people's quality of life. Hence, Industries 4.0, Smart Factories, Cyber Physical Production Systems (CPPS), and Internet of Things are the necessity of future technology.

Hence, this section discusses motivation behind writing this paper related to IoT and CPS emerging areas. Now, next section will discuss importance of IoTs and CPS with explaining their uses in solving some real-world's problems.

4 Importance of Internet of Things and Cyber Physical System

Internet of things is a network of physical objects, which uses sensors/embedded technology to communicate with other devices. IoT devices sense other devices or interact with other smart devices based on their internal states or the external environment [14]. Generally, internet connected things with other smart devices via cloud, i.e., accessing service anytime and anywhere. The use of platforms is being driven by

transformative technologies such as cloud, things, and mobile. On another side, cyber physical systems (CPS) represent the next-generation embedded intelligent information and communications technology (ICT) systems that are interconnected, interdependent, collaborative, autonomous and provide computing and communication, monitoring/control of physical components/processes in many applications. CPS as a multidimensional and complex system is a comprehensive calculation, network, and physical environment. Cyber physical system is the combination of computing, communication and control technology, the close integration of the information world and the physical world is realized.

Today we are entering into a revolution, i.e., IoT-based CPS infrastructure. Generally, along with the application of IoT in daily routine of people and progress of society, it also has importance in military affairs, including aerospace, military reconnaissance, intelligence grid system, intelligent transportation, intelligent medical, environmental monitoring, industrial control, etc. The medical services can be provided in either wired or wireless way. These services can be made more authentic and safer by using an application referred to intelligent medical system (IMS). Using Internet of things, road, bridge, intersection, traffic signal, and other key information will be monitored in real time in the area of intelligent transportation system (ITS). The large amount of information of many businesses/applications is analyzed and released for further processing, for example, real-time information of roads from road vehicles can be shared through IoT devices (Internet connect devices). This information can be used to check the real-time status of road management which in turn can observe the key areas in the system. The real-time information can be used to control the urban traffic by providing the current information. One of the applications of IoT is its use in industry. By the means of network, the objects can be identified, positioned, and monitored. IoT devices can be used in Medicare (bio-medical) applications, to send alert message about health of a patient, i.e., to respective doctor.

As discussed in Sect. 3, IoT is a fundamental function of CPS revolution or fourth industrial revolution. Some major changes will be there in near future

- Shaped by a design focus;
- Enabled by ubiquitous networks;
- Driven by application ecosystems;
- Enabled by different modalities such as flying drones, wearables, and ingestible technologies;
- Reshaping industries through the adoption of autonomous computer systems, robotics, and 3D printing;
- Changing the nature of employment and restructuring the economy.

Now, the importance of data and Big Data also is discussed in this section in brief.

Why Big Data Analytics (BDA) is important?

How much data is being generated by a person in his entire life? Such large amount of data may be helpful in making some interesting patterns on our life, which may help others to solve large/complex problems. So, we prefer Big Data Analytics for analyzing this big data.

- Low Cost. Some technologies of Big data provide the advantage of storing large amount of data at low cost. These technologies such as Hadoop and cloud-based analytics also try to find more efficient ways of doing business.
- Making faster and better decision. In businesses, for analyzing of information, the analyzing ability of new sources of data can be combined with the speed of Hadoop and in-memory analytics. This would enable the businesses to make decisions based on what they have learned.
- New products and services. With the ability to gauge customer needs and satisfaction through analytics comes the power to give customers what they want. Davenport points out that with big data analytics, more companies are creating new products to meet customers' needs.

For Big Data, several competitive advantages are Create New Revenue Streams, Data Safety, Perform Risk Analysis, Re-Develop Products and Dialogue with Consumers. On another side, most product, marketing, and analytics teams live in constant pursuit of the question, "How are customers using the product, if at all?" Without Behavioral analytics, teams are getting difficulties stuck using insufficiently detailed demographic data and so-called vanity metrics. Some behavioral analytics tools used for consumer's behavior are: Bay Dynamics, Bottomline Technologies, Cynet, Dtex Systems, E8 Security, Exabeam, Fortscale, and Gurucul Risk Analytics.

Hence, this section tells us how IoT and CPS are changing life of people, loss of industries. Now next section will discuss how these both technologies can be more useful in near future or can change future transportation lifestyle of human beings.

5 Use Cases—Internet of Things and Cyber Physical System: From User's Perspective

Internet of things is the new and growing technology, which connects other smart devices to solve real-world's problem, i.e., through communicating via Internet with exchange data, optimize processes, monitor devices. On another side, cyber physical systems consist of computation, communication, and control components tightly combined with physical processes. Now, a popular example or a use case using of both technology (together, as new revolution) can be discussed as:

5.1 Smart City

A smart city involves many applications in it like smart homes, smart grids, smart transportation, smart drainage system. There is a huge requirement of IoT devices for providing services with lower latency and fault tolerance. IoT devices provide such services conveniently to users/people using information technology. In today's world, the major concern is developing smart cities. When information technology

is used as background, it can develop a practical, strong, and perfect application system for public management, public services, and public industry. This in turn may lead to the improvement in the efficiency of governmental service and can also improve the quality of life that people live. The main criterion of a smart city is to provide ability to process reliable information. It could also provide a combination of resources providing information and management capabilities in order to achieve more coordination among the parts of the system. People, objects, networks, and industry become interconnected and mutually aware through interdisciplinary, cross-sectional, multilevel, and cross-regional cooperation, resulting in a formation of new models and new forms of urban development. These components combining together make smart cities efficient and easy to use (by citizen of a nation). Note that these components are called main functions or wisdom of smart cities.

But, due to the rapid development of big data and current popular information technology, the problems include “how to efficiently use systems to generate all the different kinds of new network intelligence” and “how to dynamically collect urban information,” etc., problems are on emerging (every day). Internet of things and powerful computers (like Turing machines, GPU-enabled system, etc.,) can imitate urban operations along with the operation with reasonable safety regulations. However, achieving sustainable development for a new urban area/generation currently requires major breakthroughs to solve a series of practical (genuine) problems which cities faces normally.

But these examples face many attacks every day and highly vulnerable/critical to new updated software. Note that cyber security consists of technologies, processes, and controls designed to protect systems, networks, programs, devices, and data from cyber-attacks. When we face some critical attacks on smart/IoT devices, we need to provide some effective and efficient mechanisms. For example, NPCIL (in India) faces some malware attack in October 2019, also some attacks in 2010 in Iran by Stuxent [15]. Hence, this section discusses a popular use case of Smart City using IoT and CPS. It shows that we can use integration of these technologies/evolutionary technologies in solving some real-world problems in near future. Now, next section will discuss “How data comes into picture with IoT” and “How it can be helpful for future in terms of data analytics.”

6 Introduction—Data and Data Analytic

It (data) has given birth to data science, which has further branched into machine learning, artificial intelligence, deep learning, and more. Big data accelerates the process of synthesizing and contextualizing generated information in conjunction with the cloud and enables how new knowledge can be assessed, acted upon, and shared based on whether it was generated from a user or a computer.

Automated machines (D2D/M2M) will connect autonomously to each other and can work perform every day task (without human intervention). This will be a major change in manufacturing industries, leading to uses of CPS. IoT and CPS build upon

well-established protocols and use enterprise grade cloud hosting. There are multiple benefits of Big Data analysis in cloud.

- Improved analysis
- Simplified infrastructure
- Lowering the cost
- Security and privacy
- Virtualization.

A detail about data and required machine learning techniques for this large data or Big Data have been discussed in [16]. In which we determined that (in near future), we require higher connectivity interdisciplinary technologies and analytical intelligence to make smart decisions. This data is too much useful because billions and billions devices are taking part in many applications or solving real-world's problems. Now, next section will discuss role and importance of data analytics in many existing and possible applications in this smart era (or near future). Companies will use to analyze customer's data to improve retention rate (via churn prediction) in businesses.

7 Role/Importance/Scope of Data Analytic in Smart Era

As big data generated by IoTs devices and it increases and keep increases. Then opportunities to handle this vast data also increase. Many different roles are initialized/created for fulfilling the requirement of customers/industries/organizations. Some of them are included here as:

- Big Data Engineer
- Big Data Analyst
- Big Data Analytics Architect
- Big Data Solution Architect
- Analytics Associate
- Metrics and Analytics Specialist
- Big Data Analytics Business Consultant
- Business Intelligence and Analytics Consultant.

Also as discussed in Sect. 7, this big data is used to improve customer's retention rate. Churn prediction is one of the most popular Big Data use cases in business. It consists of detecting customers who are likely to cancel a subscription to a service. Similarly, several other tools discussed in [16] and used to analyze different types of data (belongs to different applications). For example, for genetic data analytics we use Empowering the Development of Genomics Expertise (EDGE) version 1.5, MDRE, etc. Similarly, for behavior analytics, we use tools like Bay Dynamics, Cynet, Exabeam, Fortscale, and Gurucul Risk Analytics. Later, this data use analytic process and presents content to us according to our moods, patterns/habits (via using browsed patterns).

With technologies like artificial intelligence, machine learning, and IoT also relying solely on Big Data, this is really the technology of the future. For reader's convenience, in [16] authors have discussed about machine learning and big data and every little information related to this. The future of Big data is bright and will attract more and more businesses. Now, next section will discuss about existing/available tools for performing analytics on vast amount of data for different applications.

8 Essential Tools Required to Do Analysis/Analysis Big Data

As discussed in [16], many tools have been discussed in detail. And we find out that IoT is the main function for future revolution (Internet--related revolution) with CPS. All these emerging technologies that are already part of our life. Their adoption and use are expected to be more and more pervasive, making them important components of the future Internet. It is a novel paradigm where Big data, IoT and CPS are merged together to solve some real-time problems and seen as problem solver for many application scenarios. Following tools [16] are used to for analysis purpose (mining data), machine learning tools:

- KNIME
- RapidMiner
- Orange
- Apache Mahout
- Weka
- Apache Spark
- Others like R, C ++, etc.

Some examples of machine learning tools with Application Programming Interfaces (API's) include:

- Pylearn2 for Python
- Deeplearning4j for Java
- LIBSVM for C.

Note that data analyst extract valuable insight from large amount of data. As Data/Big Data are increasing, so the opportunities are also increasing. Generally, three basic dominant types of analytics are descriptive, predictive, and prescriptive analytics. Now, next section will discuss several open issues and popular (critical) challenges available in IoT, CPS and analyzing Big Data.

9 Issues and Challenges in Internet of Things, Cyber Physical System, and Data Analytics

In the past few years, there has been a trending development in Big Data which has led to the emergence of cloud. Big data using cloud has been the most feasible choice for many companies to access the large amount of data. However, the intersection of both Internet of things and big data has created new challenges like data storage, integration, and analytics. The term “Industries 4.0” refers to the fourth industrial revolution. It originates from a project in the high-tech strategy of the German government, which promotes the computerization of manufacturing. That includes the integration of logistics and production. If IoT is the basic infrastructure, then on top of that comes cyber physical systems (CPS), cyber physical production systems (CPPS), Internet of value (IoV), Internet of vehicles (IoV), and Internet of services (IoS), and the whole is industries 4.0. IoT issues [17] are like privacy, security, trust, and standardization. CPS Issues are like privacy, data ownership, and security. Note that in common, IoT and CPS have security and risk management issue.

Attacks on connected systems (cyber/physical) from nation-state actors and non-state actors are also an increasing threat. Note that safety is an integral element of trust in an IoT-based CPS system and a variable that can impact any entity (connected to the Internet/external network/world), but it is not a perfect solution. Devices will increasingly communicate and operate autonomously and independent of human oversight. For example, recently a motor vehicle involved in an alleged hit-and-run accident where the car/vehicle reported about the accident to the respective authority (i.e., to police). The driver of the vehicle did not intend to report that accident, yet her connected vehicle/did so autonomously. The regulatory landscape for IoT is evolving and regulators struggle to understand and support the rapid emergence of new services, products, and business models. The regulatory landscape includes licensing and spectrum management, switching and roaming, addressing and numbering, competition, security and privacy. IoT-based environment can save many lives, but it also raised several other serious concerns like tracking the footprints of users, leaking of user's information to unauthorized user.

Now, next section will provide an open discussion with considering some real scenarios (real-world's examples), then will listed some research gaps in BDA, IoTs and CPS, and also will suggest some future research directions with respect to the same.

10 An Open Discussion: Discussing Research Gaps and Future Research Directions (Opportunities for Future)

There are many implications for unified CPS and IoT/IoT-based CPS infrastructure which include many opportunities for research communities (related to CPS and IoT) to work together, i.e., to develop unified, new, hybrid discrete and continuous methods for CPS and IoT design, operation, and assurance. These researchers will be able to highlight the importance of tight logical-physical linkage in near future, for example, robust sensing and actuation, secure systems, sound digital models, etc.

On another side, machines now interact and interface with other machines as well as human beings in new ways. The combination of artificial intelligence (AI), machine learning, the cloud, and IoT means that systems of machines will be able to interact with human beings, learn about them and adapt to their wants and needs. But, complete dependency on these smart devices may loss more than what we get. For example, in Hollywood movie “Die Hard or Live Free,” villain tries to control on each and every systems of a country and use all devices according to his plans. Hence, issues in IoE (in the next 10 years) will be security, privacy, and reliability would allow us to have open social and political discussions. Blockchain can be used in internet of things and cyber physical systems to provide secure communication/infrastructure to business or industries.

10.1 *Blockchain Benefits*

Blockchain is a new concept, decentralized in nature, used to provide maximum trust to users (without using nay intermediary). Some benefits of Blockchain are: greater transparency, enhanced security, improved traceability, increased efficiency and speed, reduced costs will attract many industries, and organizations. Today’s many new ways of applying the blockchain technology are arising nearly every week, but not all of them are realistically implementable. These projects are testing the ground of acceptance, testing how far they can get with this technology, exploring advantages and also disadvantages of this flexible technology.

Now coming to benefits of IoT devices, infection rates of any diseases through getting pre-alert message by smart devices can be reduced to a certain level. Big Data helps and enables some innovative business models (increased contextualization and optimization). Some issues like dark data, leaking of privacy, and generation of data (at a rapid rate), not-having sufficient analytics tools, and black box problem of deep learning techniques [18] for IoT devices, we will face in near future. In summary, future of big data is clear and unshakeable. For future research directions, we need following area to cover.

- In near future IoT, machine learning, artificial intelligence, and many more technologies will come together to change the world [19].
- HR analytics, where HR associates are up skilling to Big Data analytics for optimized decisions on wage differences, appraisals, recruitment, budgeting, and retrenchment.
- Genomic analytics will be also a hot topic in near future.
- Also, disease example in Sect. 9 can be extended like vehicle can provide information accident to police, doctor, and insurance people.
- Internet of value or denaturalized web is also an aim of scientists/researchers in future.
- Work from anywhere or anywhere working will be a major change in near future.

In summary, designing or providing security in at the beginning and throughout a connected device's lifecycle. Also, future CPS needs to be scalable, distributed, decentralized allowing interaction with humans, environment, and machines while being connected to Internet or to other networks. Adaptability, reactivity, optimality, and security are features to be embedded in such systems, as the CPS are now forming an invisible "neural network" of the society [20]. So, readers are invited to go through the interesting issue one again and start their research work on the same. Hence, this section discusses an open discussion on importance of Big Data Analytics (BDA) in Internet of things (IoTs), and cyber physical system (CPS) environment or in these emerging technologies. Also, it lists (identifies) several research gaps in the same and suggests several future research directions. In last, this work will be concluded with several interesting facts and information for future readers.

11 Conclusion

Generally speaking, the cloud allows users to perform work and access information with a safe Internet connection at any time and from anywhere (to improve efficiency and resource reuse). Cloud-based services may also include applications for medical image archiving and security services, allowing healthcare providers to exchange clinical data across a secure network. Note that an approximately of 1.3 million people is killed via road accidents (every year worldwide). With respect to this, IoT devices or smart devices technology can collect, analyze, and automate appropriate responses and actions to real-time data from sensors and other devices in homes or other properties in a secure manner [21]. This kind of infrastructure called cyber physical systems, whose operations are monitored, coordinated, controlled, and integrated by a computing and communication core. We can see that IoT is a key function of this revolution (evolution). Together this, big data analytics comes into picture for Internet of things, to generate effective decisions, to check behavioral economics (via behavioral analytics).

There are multiple benefits of Big Data analysis in cloud, like improved analysis, simplified Infrastructure, lowering the cost, security and privacy, and virtualization

[22]. Hence, this research work discusses several useful terms about Internet of things, cyber physical system, its uses in near future, also discusses several open uses, challenges with future research directions. In that, we notice that in IoT and CPS, some issues are: center on risk, security, geopolitics, trust, and privacy. For future work, risk management and preventing breaches or damages in IoT and CPS are some popular issues to overcome.

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Performance Analysis of Undersampling Approaches for Solving Customer Churn Prediction



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Abstract With the increasing growth of technologies and digitization in telecom industries, retention of customers has been a serious concern. The prediction of customer retention/customer churn is a challenging task for telecom industry. This problem greatly affects the revenue of telecommunication industry. A good customer churn prediction model is needed to reduce the revenue loss and to rapidly increase the business. However, the development of good model is a challenging task due to the imbalanced nature of data, large size of data, high-dimensional features, and many more. In this paper, we focus on imbalanced data distribution by presenting a solution in balancing it in a very effective way. We employed undersampling techniques using decision tree and with boosting. Thus, this paper outlines the various undersampling techniques using single and ensemble classifiers in solving the customer churn prediction problem.

Keywords Churn prediction · Machine learning · Class imbalance · Sampling · Undersampling techniques · Ensemble techniques

1 Introduction

The term ‘customer churn’ is defined as a customer terminates his/her usage of service from the service provider. It is been frequently used in telecom industries. Over the last decade, telecommunication industry witnessed rapid growth in service subscription. By the beginning of year 2015, the number of cell phone customers has arrived at about 8 billion around the globe roughly same as total population [1]. Therefore, the major problem faced by the telecom industry is retention of customers in order to maintain good revenue. Also, it is broadly acknowledged that holding of existing

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customer is more valuable than finding new customer. As, acquiring a new customer is costly affair pertaining to certain factors like satisfaction of demands, loyalty with the service providers, and many more. So, retention of existing customers is very important for service providers and does not involve any expenses but only concern is to address the customer's concerns in time. Further, by holding long-term customer the industry benefits not only in terms of profit but also the existing customers can refer new customers. Therefore, the telecom industry needs an effective customer churn prediction model to detect the churners and it became an important research topic. The customer churn prediction model is a binary classification problem where in minority/positive class consists of churners and majority/negative class consists of non-churners. Voluntary and involuntary churns are two main categories of churners [2]. Voluntary churners are those customers who make a decision to quit their services from the service providers. It is very difficult to decide/determine these types of customers. The second type, involuntary churns are those customers whom the organizations decide to discard from the service because of many reasons such as non-payment, fraud or non-usage of phone. The former is tougher to identify in general. It occurs when a decision was made by the service user to terminate his/her service with the provider. Several machine learning algorithms focus on the classification accuracy improvement to predict minority class. A need for automated churn prediction model to predict customer churn is much needed by telecommunication industry. In this paper, we employed various undersampling techniques using decision tree and with ensemble methods (Boosting) to investigate the customer churn prediction problem in telecom. Furthermore, we trained the resultant data using single and ensemble technique. The paper is organized as follows. Sect. 2 gives an overview of the customer churn prediction literature. We present numerical experiments and result in Sect. 3, and Sect. 4 concludes the paper.

2 Literature Survey

Many techniques in the literature were proposed to predict customer churn prediction in telecom industries. Most of these approaches/techniques applied machine learning algorithms to predict churn. As data is imbalance in nature, many techniques were proposed in the literature [3–5]. Gavril et al. [6] presented machine learning technique to predict the prepaid customers churn using 3333 customers data. The data consists of more than 20 features including the number of messages (both incoming and outgoing) and voicemail for each service user and a dependent variable called churn with binary outcomes (Yes/No). They applied principal component analysis (PCA) for dimension reduction. To predict the prepaid churn, three machine learning algorithms were used: neural networks (NN), support vector machine (SVM), and Bayes networks. The AUC metric was used to measure the algorithm performance. The author stated 99.10%, 99.55%, and 99.70%, respectively, for the above algorithms. A neural network model was proposed by He et al. [7] to solve customer churn problem for large Chinese telecom industry. The dataset was

huge with 5.25 million customer's records. They achieved an overall accuracy nearer to 91.1%. Idris [8] proposed genetic programming using AdaBoost for churn prediction. The model was tested on Orange and cell2cell datasets. The accuracy reported by the model was 89% for cell2cell dataset and 63% for Orange dataset. Huang et al. [9] stated that applications of big data techniques improve the performance of the churn prediction model. They test the model on China's largest telecommunication company using random forest algorithm. They proved better Area Under Curve (AUC) results. Author [10] proposed rough set theory for customer churn prediction in mobile industry. As revealed in this paper rough set classification algorithm out-performed the other algorithms like linear regression (LR), decision tree (DT), and neural network (NN). Various researchers studied the imbalance nature of the customer churn data as a major concern. Amin et al. [11] proposed rules-based genetic algorithms and compared six different over sampling (OS) techniques to balance the telecom data. The results outperformed with that of other over-sampling algorithms. Burez et al. [12] present comparison study using different sampling techniques such as random sampling, gradient boosting model, and weighted random forests using AUC and lift metrics, and the results showed better performance for undersampling techniques than other techniques. The various techniques studied in this work are as follows: Tomek link undersampling technique is used to eliminate boundary instances considering them to be getting misclassified most often. By definition, two instances y_i and y_j , where class of y_i is equal to class of y_j , are said to form Tomek link pair, if there is no instance k such that $d(y_i, y_k) < d(y_i, y_j)$. Basically, instances creating Tomek-link pair, promote noise along the data distribution. Hart [13] proposed C-Nearest Neighbour (CNN) undersampling technique using nearest neighbor method. Wilson's edited nearest neighbor rule (ENN) [14] identifies noisy data and removes instances whose class differs from the majority class of the three nearest neighbors. The author stated that ENN retains most of the data, while maintaining a good classification accuracy. The author proposed near miss, wherein the data samples from C clusters initially and determines the number of selected majority class samples for each cluster. The sampling based on clustering with near Miss-1 selects the majority class samples whose average distances to M-nearest minority class samples in the ith cluster are the smallest. Random undersampling [15] is a popular method that aims at balance skewed distribution through eliminating majority class samples randomly.

3 Numerical Experiments and Results

The dataset is openly available on Internet and widely used in the literature for customer churn prediction in telecom. Table 1 shows the information about the characteristics of the data used in the work. Orange dataset without preprocessing is provided online and has an imbalance ratio (IR) of 7.3%.

Table 1 Telecom datasets characteristics

	Orange
Total instances	50,000
Total features	260
IR rate	7.3%

3.1 Performance Measures

In this section, we present the important evaluation metrics to assess the performance of the classifiers when trained on telecom datasets. F-measure, Area Under Curve (AUC), and accuracy-based methods are used to evaluate the prediction performance. The formula for calculating F-measure is shown in Eq. 1, whereas AUC is computed as shown in Eq. 2.

$$F - \text{Measure} = 2 * (\text{Precision} * \text{Recall}) / (\text{Precision} + \text{Recall}) \quad (1)$$

$$AUC = \frac{1}{2} \times \frac{\text{TruePositive}}{\text{TruePositive} + \text{FalseNegative}} + \frac{\text{TrueNegative}}{\text{TrueNegative} + \text{FalsePositive}} \quad (2)$$

3.2 Results

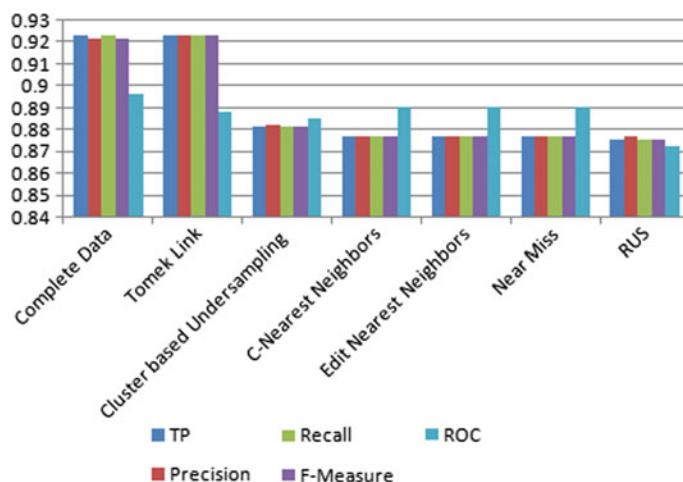
In this section, we compared the results using different state-of-the-art techniques, namely Tomek link, cluster-based undersampling, C-nearest neighbors, edit nearest neighbors, near miss, RUS on single (J48), and ensemble (AdaBoost) classification algorithms. The metric used are AUC, F-score, and G-Mean. Tables 2 and 3 show the results of different state-of-the-art techniques compared with two different classification algorithms.

Table 2 Performance results of J48 classification algorithm

Classification algorithm (J48)	TP	Precision	Recall	F-measure	ROC
Complete data	0.923	0.922	0.923	0.922	0.896
Tomek link	0.923	0.923	0.923	0.923	0.888
Cluster-based undersampling	0.881	0.882	0.881	0.881	0.885
C-nearest neighbors	0.877	0.877	0.877	0.877	0.89
Edit nearest neighbors	0.877	0.877	0.877	0.877	0.89
Near Miss	0.877	0.877	0.877	0.877	0.89
RUS	0.875	0.877	0.875	0.875	0.872

Table 3 Performance results of AdaBoost classification algorithm

Classification algorithm (AdaBoost)	TP	Precision	Recall	F-measure	ROC
Complete data	0.93	0.929	0.93	0.929	0.945
Tomek link	0.936	0.935	0.936	0.935	0.948
Cluster-based undersampling	0.895	0.895	0.895	0.895	0.945
C-nearest neighbors	0.896	0.897	0.896	0.896	0.95
Edit nearest neighbors	0.896	0.897	0.896	0.896	0.95
Near miss	0.896	0.897	0.896	0.896	0.95
RUS	0.904	0.905	0.904	0.904	0.94

**Fig. 1** Performance results of J48 classification algorithm

From the experimental results, we observe that the performance of the Adaboost algorithm using different undersampling techniques is consistent. Figures 1 and 2 show the comparison of various state-of-the-art techniques using two different classifiers. From the results, we observe that ensemble (AdaBoost) algorithm outperforms when compared with single (J48) classifier. It is also observed that the classifier shows bias toward majority class and shows high-performance results.

4 Conclusion

In this paper, we conducted a study using various undersampling techniques on customer churn prediction problem. We investigated undersampling techniques using decision tree and with boosting. Thus, this paper outlines the various undersampling techniques Tomek link, cluster-based undersampling, C-nearest neighbor, edited

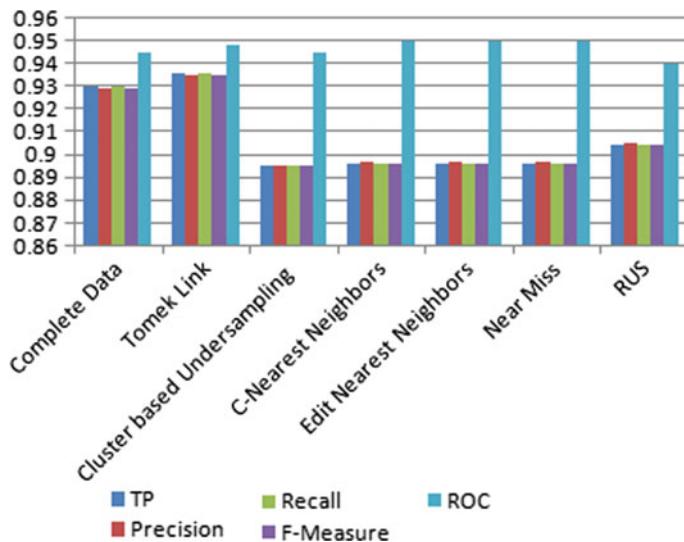


Fig. 2 Performance results of AdaBoost classification algorithm

nearest neighbor, near miss, random undersampling using single and ensemble classifiers in solving the customer churn prediction problem. From the results, we observe that ensemble (AdaBoost) algorithm outperforms when compared with single (J48) classifier.

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Deep Learning for Medical Image Recognition: Open Issues and a Way to Forward



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Abstract In the recent decade, deep learning has taken lead over available analysis techniques. Today's deep learning is used in diversified sectors like health care, traffic management, agriculture, etc. The expectations of researchers or people concerned with deep learning are very high. On another side, healthcare sector is totally different from other industry. It required serious attention, care of people and services (regardless of cost) towards patients; here, issue is a matter of patient's life. Also, this sector requires a high budget and many people to work in parallel, to provide efficient services to each patient. The interpretations of data in the medical field are vested in the hands of medical experts, and this proves to be quite restrained because of the intervening sophistication, wide ranging varieties spread across a number of compilers, etc. The great victory of deep learning in real-time applications has led to the creation of striking results with extreme accuracy and precision, hence paving way to the spotlight in futuristic health sector applications. In this paper, we discussed state-of-the-art deep learning architecture and its optimization used for medical image segmentation and classification. Also, this sector discusses several useful components like open issues, challenges deep learning-based methods for medical imaging and future research directions.

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1 Introduction

Deep learning is a developing pattern of information investigation and has been named as one of the 10 innovation technologies of 2013 [1]. The enhanced version of artificial neural network is deep learning which consists of more layers that allow precise predictions on data and higher abstraction levels [2]. In the current year, only one tool in machine learning is a current trending tool that is deep learning in imaging and computer vision domains.

1.1 *Feedforward Neural Networks*

The foundation of most deep learning models is deep feedforward networks and also known as multi-layer network of neurons (MLN) [3]. These model networks are known as feedforward as the information only travels on input nodes, through the hidden layers (individual or multiple layers) and then through the output nodes. Feedback connections are not usable in MLN, so that the network output will be returned. Such networks are described by a combination of several basic models (sigmoid neurons). Some special cases of feedforward networks are convolution neural network (CNNs) and recurrent neural network (RNNs) networks. The multi-layered neuron network contains a multitude of sigmoid neurons. MLNs are able to manage data that are not linearly separable. The layers between the input and output layers are referred to as invisible. The hidden layers are used to deal with the dynamic nonlinear relationships between input and output. These networks are mainly used to monitor supervised machine learning activities, for which we already know the objective, that is to say to the outcome that we want our network to achieve and are extremely important to machine learning and form the foundation to a wide range of commercial applications. The role of these networks has been greatly affected by areas such as computer vision and natural language processing (NLP).

1.2 *Convolution Neural Networks*

The development in deep learning computer vision has been developed and improved over time, mainly through a specific algorithm, i.e. a convolution neural network. Another type of neural network is convolution neural network (CNN) [4] which is used by machines to picturize things and perform image classification, image recognition, object detection and instance segmentation tasks are some of the most

common areas of CNN use. We have a set of inputs for our convolution operations, and based on all previous outputs and weight, we determine the value of the present input. The CNN (ConvNet/CNN) is a deep learning algorithm that allows an image to be entered, assigns the importance to various aspects/objects in the image (learnable weights and biases) and can distinguish between one aspect and the other. The required preprocessing in a ConvNet is considerably lower in other classification algorithms. While handmade filters with sufficient training are manufactured in primitive methods, ConvNets are able to learn these filters. ConvNet's structure is identical to the communication pattern of neurons in the human brain, influenced by Visual Cortex organization. In a restricted area of the visual field only, individual neurons respond to stimuli, known as the receptive field. The entire visual area is covered by a collection of such fields. With the application of the appropriate filters, a ConvNet can successfully capture the spatial and temporal dependence of an object. The network can be equipped to better comprehend object complexity. The ConvNet's role is to reduce images in a more easily processable form without losing features critical to good prediction. This is critical when designing an architecture that is not just good in learning but can also be scaled to large datasets.

1.3 Deep Models [5]

Deep learning has shown its power and has stood up to be one of the nascent fields of growth across a number of fields. It is of utmost important for every person who is new to this field to grab and conceptualize the true essence of deep learning and its other models. It mainly includes controlled and uncontrolled models. The supervised models are moulded by the examples of some data sets while the unsupervised models are bestowed with input data alone and do not posses any particular results from which they can learn. Supervised models possess regression and classification task and develop a formula for the same while unsupervised models are often exposed to gathering and association rules. Classic neural networks (multi-layer perceptions), convolutional neural networks (CNN), recurrent neural networks (RNNs) come under supervised models and unsupervised models include self-organizing maps (SOMS), Boltzmann machines, auto-encoders, etc.

Hence, the remaining part of this work is organized as follows:

- Section 2 discusses work related to medical image recognition, detection, etc., in the previous decade, etc.
- Section 3 discusses our motivation behind writing this work (i.e. on medical-related sectors/applications).
- Section 4 discusses medical image detection and recognition
- Section 5 explains about medical image segmentation in detail.
- Section 6 discusses a medical image registration
- Section 6 discusses about computer-aided diagnosis and disease quantification in detail.

- Section 8 discusses various tools and methods existing/available for deep learning for medical applications.
- Section 9 discusses various open research issues, challenges faced in medical care/medical imaging and opportunities for future as including research directions.
- Finally, Sect. 10 concludes this work with various research gaps and future enhancements.

Hence, in this work, our main goal is to fill many identified research gaps in current era through providing an effective literature on medical image recognition research and its related areas.

2 Related Work

This work joins the information on big data and machine learning and applies the simple algorithms of machine learning to take care of the issues of medicinal big data, for example, huge amount of information, wide multifaceted nature and difficulty in maintenance. It allows doctors to improve patient treatment by accurate assessment and forecasting accurately [6]. When we take an insight into the supervision of medical images, computer-aided detection (CAD) takes the prime spot, and it is highly beneficial to deep learning. Candidate lesions are found in the standard approach to CAD [7] either through supervised methods or by traditional image processing methods such as filtering and computational morphology. Candidate lesions are generally fragmented and feature large handcrafted techniques. Classifiers are essential to spot the vectors and to check the authenticity of the lesion. Deep learning can be directly implemented by deploying it to train CNN functioning on certain image patches dotted on the candidate lesion. This method is used by many publications, and prominent one is Setio et al. [8]. They have involved the combination of pulmonary nodules which were created earlier on 3D chest CT scans and then separating the 2D patches into nine different routes; each of these candidates acquires a unique combination of CNNs. There is a slight improvement in contrast to the classic CAD system previously published for the same job. Roth et al. [9], CNNs were used to improve the three existing CAD detection systems for sclerotic spine metastases on body CT, colonic polyps on CT colonography and CT body lymph nodes. They also used previously developed candidate detectors and 2D patches in three directional orthogonal, and up to 100 random rotated viewing systems. CNNs were used for enhanced CT detection. CNN projections on these 2.5D visions are then aggregated in order to achieve more accuracy benefit. The randomly rotated 2.5D views are a way of representing a de-compositional image from the original 3D data. On these 2.5D views, the CNN forecasts are then aggregated for further precision gains. In all three CAD systems using CNNs, the tolerance for lesion detection increased by 13–34%, indicating that the solution was general and observable. It was almost impossible to improve this size by using non-deep classifiers such as support vector machines committee.

Further, Dou et al. [9] detected susceptibility weighted cerebral microbleed scans by MRI. They use 3D CNNs, replacing a two-stage approach to detect candidates with a CNN. In comparison to several classical and 2D literature strategies that have been re-implemented and trained and evaluated by the researchers on the same dataset, they show improved results for their 3D CNN. Sirinukunwattana et al. [11], in his path of logical images, identified and listed nuclei. Instead of determining if the core pixel of the patch was a cell nucleus, they model the production as the high peak close to the centre of each nucleus and elsewhere. They implement the usage of a CNN which acquires minute patches as the input. Along with this, they incorporate a merger of super facing these patches in the test phase, thus resulting in spatially constrained CNN which creates enhanced results in comparison to the previous approaches. Furthermore, this constrained CNN leads to improved solutions which often underly the CNNs and the traditional technique-based approach. In [12], Anthimopoulos et al. emphases on identifying interstitial lung disease patterns from 2D chest CT scanning patches. They are one of three gatherings in this issue [13] and [14] by using public dataset from [15]. We train a CNN to identify 32-32-pixel patches into one of seven categories and report higher accuracy than three previously published methods using handcrafted features. The subject of concern is also lesion detection in several other articles of this issue, but the focus of those papers is wider or zooms on particular methodological issues.

3 Motivation

In current era, many learning algorithms or discovery tools are available to refine data. These tools extract useful value or info ration form a large number of data/billions of maples. Numerous data mining techniques or statistical testing approaches can be taken into account and implemented for the monitoring and supervision of reproducibility issues. In the previous decade, it was relay a difficult task to extract this large amount of data. But, today due to technological advancements and shifting of people towards smart era/use of smart devices, more and more data is generating everyday. To extract useful data, for curing diseases and saving lives of maximum people, we start to work on efficient learning techniques, which are used by many research groups and communities worldwide.

Deep learning is one of popular learning techniques and being used in many applications, especially in health care or bio-medical imaging. For example, we have MRI, CT-ccan, etc.; here, deep learning can be useful to predict diseases previously, i.e. chance of occurring/possibility based on probability (in near future) or can provide prefect (optimal) solution based on its refining process (i.e. by hidden layers). Hence, keeping such things in our mind and saving as many lives is our primary aim, so we choose this area and topic to write our thoughts. In this paper, we will

discuss topics like medical image detection and recognition, medical image segmentation, medical image registration, computer-aided diagnosis and disease quantification, open-source tools, models/algorithms available for deep learning for medical applications/bio-medical applications today with including several opportunities for future researchers, etc.

4 Medical Image Detection and Recognition

The process of identifying the elements in medical image is image detection and recognition. The pictures are volumetric in many situations, and effective parsing is therefore a must. A common strategy used in this case involves marginal space learning [16], the main reason being its efficiency and quick detection and spotting of organs. It is very close to deep learning [17] and is highly robust and efficient as it has its probable boosting trees replaced with network neural boost cascade. Nevertheless, it is important to process the entire volume in order to detect anatomical structures with reliability. [17] drives even more productivity by replacing the search process with an artificial agent that uses deep reinforcement learning to identify anatomical points of interest. The approach can detect hundreds of landmarks in just a few seconds in a full CT range.

Further, Bier et al. [18] proposed an interesting method by which anatomical landmarks were detected in 2D X-ray screenings. They use a deep network to train 3D-annotated landmarks in projection-invariant feature descriptors. The so-called region-proposal neural networks are another popular detection method. Tumours in mammographic images are identified accurately by the method in [19].

The identification and recognition are also used in many other ways, and a wide range of literature is available. We are reporting only two additional applications here. In histology, cell detection and classification are important tasks that are explained by Aubreville et al. [20] are tackling through directed networks of spatial transformers that allow the detection to be refined prior to actual classification. This technique benefits from the role of mitosis classification, for other image classification tasks, convolutional neural networks are very efficient. In [21], their job is to identify images automatically in confocal laser endoscopy which contains motion artifacts.

5 Medical Image Segmentation

Image segmentation is incredibly profited by the ongoing improvements in deep learning. Image segmentation involves the determination of contoured organs or other structures with at most precision and finesse. Here, we put forth the reports of Holger Roth's Deeporgan [22], the brain MR segmentation CNN by Moeskops et al. [23], a complete convolutional multi-vitality 3D U-net introduced by Chen et al. [24], and Breininger et al. [25] stated U-net-based stent segmentation in X-ray projection

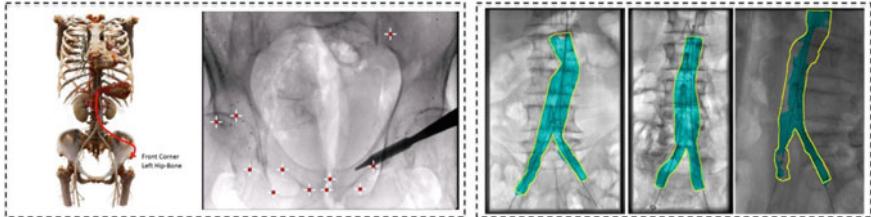


Fig. 1 Detection and segmentation [17, 18 and 25]

domain as envoy example. In [26] shown segmentation using deep convolutional networks works in 2D for histopathologic images. Fu et al. [27] followed a concept by mapping a neural network from Frangi vesselness. This shows that they can change kernels for the specific vessel segmentation function of ophthalmic fundus imaging in the first step of the algorithm. Segmentation algorithms used by RNN for image segmentation in medical field demand attention. In [28], Poudel et al. proved this for recurrent fully CNN on multi-slice MRI cardiac data, the another author Andermatt et al. proved the efficiency of GRUs for brain segmentation [29].

In Fig. 1, the left side demonstrates the identification of artificial agent monuments; after Ghesu et al. [17], Bier et al. [18] shows X-ray transform-invariant landmark detection. Breininger et al. [25] on the right side is the U-net-based segmentation of the stent. Note that the authors [17, 18 and 25] are permitted to reproduce the images.

6 Medical Image Registration

While most of the perceptive tasks of image detection and classification have gained great attention in terms of deep learning applications, the registration of images has not yet seen this large increase. There are many interesting works in the literature that shows clearly that many opportunities exist as well. One common issue with point-based registration is to identify good feature descriptors that can correctly identify the points. Wu et al. are proposing to use auto-encoders to mine in unsupervised way have good features [30]. Schaffert et al. [31] push this further and use the registration metric as a loss function to learn good functionality. The 3D-pose estimate directly from 2D point features [32] is another method for addressing 2D/3D registration problems. Definitions of deep learning methods can also be found for full volumetric registration. The quicksilver algorithm can model a deformable registration, and directly from the image appearance uses a patch-specific prediction [33]. Another approach in modelling is the registration issue as an agent- and enhancer-learning control problem. For comprehensive registration, Liao et al. proposed to do this in aligning all quantities, predicting the next optimum movement [34]. So method also can be extended with a numerical deformation model for non-rigid registration [35]. In this scenario, movements are in the deformation model vector space. For instance,

also point-based registration issues are applicable to agent-based approaches. Zhong et al. prove this with imitation learning for intraoperative brain shifts [36].

7 Computer-aided Diagnosis and Disease Quantification

One of the biggest issues in medical image processing is diagnoses in computer-aided diagnosis. Here, we not just act to quantify evidence for diagnosis in a supportive role. Rather, it is necessary to predict the diagnosis itself. Decisions must therefore be made very carefully and decisions must be reliable. The analysis of chest radio graphs includes a large amount of radiological work which is routinely performed. Reliable support is therefore highly desirable to prevent human error. Diamant et al. use transfer learning techniques in [37] to provide an example of this. In the reading of volumetric optical coherence tomography data, ophthalmologists are charged with a similar workload. Google's Deep Mind recently suggested to help the referral decision process [38]. Many other studies have been found here, including automated cancer assessment in confocal laser endoscopy of the head and neck tissue [39], deep learning for mammograms [40] and skin cancer identification [41].

8 Open-Source Tools, Models/Algorithms Available for Deep Learning for Medical Applications

These artificial intelligence technologies push your deep learning to next level. Here is a list of eight best open-source AI technologies that you can use to take your deep learning projects to the next level [42]. These tools are included here as:

- (a) TensorFlow: TensorFlow is an open-source training application that was initially released in 2015 and can now be widely used and implemented across a number of platforms. It is one of the most popular and commonly used deep learning frameworks. Google has developed TensorFlow to support research and production goals, and several companies, including Dropbox, eBay, Intel, Twitter, and Uber, are now widely using it. In Python, C++, Haskell, Java, Go, Rust and JavaScript, TensorFlow is available. Packages for third-party programming languages are also available. The system allows you to use flowgraphs to build neural networks (and even other software templates).
- (b) Caffe/Caffe2: Feedforward network open source and suitable for image processing.
- (c) Theano: Open source is made up of most sophisticated neural networks that came into existence in 2007 at the Numerical University of Montreal.
- (d) Pytorch: Open-source deep learning framework, which was originally developed at the New York University in 2002. Facebook and Twitter are commonly used. Ideal for ConvNets and a rich RNN package.

- (e) CNTK: it is an open-source tool. Cognitive toolkit from Microsoft and recognized in the speech culture.
- (f) Google cloud machine learning platform: Allow the use of TensorFlow in Google cloud platform to build and train machine learning models. It is a commercial tool.
- (g) Amazon machine learning: It is a commercial tool. Cloud-based use of machine learning technology services for users.
- (h) Microsoft Azure: Machine learning library. It is a commercial tool.
- (i) IBM Watson analytics: It is a commercial tool. Cloud-based data exploration, visualization and predictive analysis of machine learning tool.

The most popular deep learning models are explained below [5]:

Classic Neural Networks: It is also known as multi-layer perceptions. American psychologist Frank Rosenblatt designed the model of perceptron in 1958. Its singular nature enables it to adapt through a series of inputs to basic binary patterns, simulating the learning patterns of a human brain. The classical neural network design consists of more than two layers (refer Fig. 2).

Convolutional Neural Networks (CNNs): In order to deal with a greater degree of complicity around preprocessing and information computation, a more sophisticated version of classic artificial neural networks is built up using convolutional neural network. CNNs have been developed for image data and could be the most powerful and scalable image classification problem template. CNNs have not been especially developed to use non-image data, but with non-image data they can also produce astonishing results. There are four components to create the CNN after you have imported your data into the model:

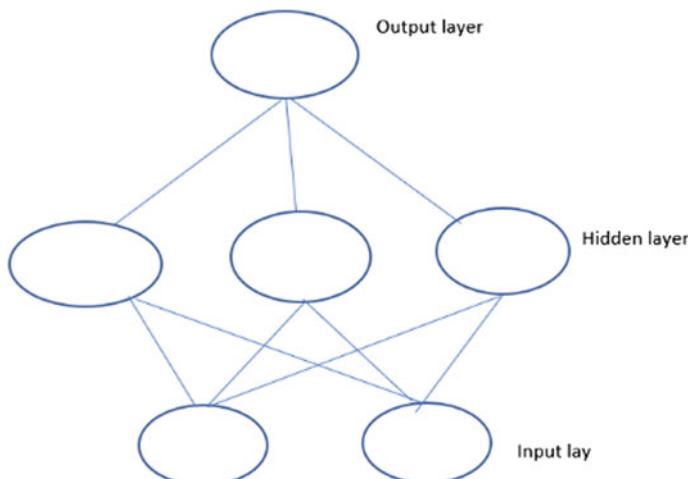


Fig. 2 Classic neural network

- (a) Convolution: a process by which maps from our input data is formed. The filter maps are then used with a function.
- (b) Max-pooling: helps our CNN to detect a picture when updated.
- (c) Flattening: CNN can read the data flattening in an array.
- (d) Full connection: the secret layer that measures our design loss function.

Recurrent Neural Networks (RNNs): Recurrent neural networks (RNNs) for predicting sequences have been developed. LSTM (long short-term memory) is a common RNN algorithm, with many possible applications:

- (a) One by one: one entry mapped to one exit. For example, classification of image
- (b) One to many: one input mapped to an output set. For example, image subtitling,
- (c) Many in one: The input sequence generates a single image. For example, sentiment Analysis (multiple words binary output)
- (d) Many to many: a sequence of inputs generates an output sequence. For example: video classification (division of the video into frames and labelling of each frame separately).

Self-organizing Maps: The self-organizing maps or SOMs function with unsupervised data and typically help to reduce dimensionality (reduces the model's number of random variables). For a map of its own structure, the output dimension is always two-dimensional. Therefore, the output is reduced to two dimensions if we have more than two input features. They are assigned weight for each synapse that connects the input and output nodes. Therefore, the representation in the model competes for each data point. The closest node is the BMU, and the SOM changes its weight to get closer to the BMU. As the model progresses the BMU neighbours continue to decline. The nearer a node to BMU, the greater its weight.

Boltzmann machines: One aspect is similar in the four models discussed above. Such models work to some degree. Even if SOMs are unsupervised, they continue to work as directed models in a specific direction. By address, I mean: Input-Hidden Layer-Output. By way of direction. The Boltzmann machines do not follow a specific direction. In a circular hyperspace, all nodes are connected to each other, as in the image. In addition to working with defined input parameters, a Boltzmann machine can generate all models' parameters. This model is called stochastic and varies from all the above-mentioned deterministic models. The Boltzmann restricted machines are more convenient.

Autoencoders: Autoencoders work with automatic encoding of input-based information based on activation function and then with output decoding. The input features are condensed in smaller categories by a kind of bottleneck. So the autoencoder model defines and leverages the data to achieve the output, if some inherent structure exists within the data.

Types of Autoencoders:

Few types of Autoencoders discussed here in brief as:

- **Sparse Autoencoders:** Sparse autoencoders have nodes that are hidden larger than input nodes. They are still able to discover important data features. A generic sparse autoencoder is displayed where a node's obscurity matches the activation level.
- **Denoising Autoencoders:** By adding some noise, denoising autoencoders create a corrupted copy of the data. It helps to avoid copying the input to the output by the autoencoders without knowing about the information. Autoencoders of this type take up a slightly tarnished input during training sessions to retrieve the authentic input. Thus, the model grasps a vector field which is suitable for mapping the received data into a reduced dimensional manifold, thus describing the natural data to eradicate external noises.
- **Contractive Autoencoders:** The main aim of a contractive autoencoder is to possess a stable, well-trained representation which is very insensitive towards small data variations. The robust nature of data representation is achieved by imposing a penalty sanction to the loss function. Contractive autoencoder is a better choice to practice useful feature extraction than denoising autoencoder. This model learns an encoding that has identical encoding inputs. We are therefore pushing the design to learn how to compact an input quarter into a smaller output portion.
- **Stacked Autoencoders:** A neural network consisting of many layers of sparse autoencoders where each hidden layer's output is connected to the next hidden layer's input.

Deep Belief Network

Deep belief network (DBN) is a probabilistic deep learning algorithm that is unsupervised. DBN is a profound neural network category consisting of a multiple layer of both directed and non-directed edges of a graphic model. It is made up of various layers of secret units where each layer is connected to each other but units are not connected. It is a stack of autoencoders or restricted boltzmann machine (RBM).

9 Issues, Challenges and Opportunities Towards Deep Learning in Medical Applications

Despite successful results achieved through deep learning architectures, the clinical application of deep learning in health care remains a number of unresolved challenges. They stress the following key issues in particular [43]:

These issues put forward a number of chances for betterment and upcoming research ideas and methodologies. Keeping these in mind, we pin point the following paths which are likely to guarantee the future of deep learning in the medical sector.

Thus, this elucidation opens up numerous challenging tasks and an ocean of opportunities with deep learning in the medical sector (Tables 1 and 2). Now, next section will conclude this work in brief with including some interesting research gaps for future researchers.

Table 1 Open challenges towards deep learning in medical applications

S. No	Challenges	Description
1	Data volume	Deep learning refers to a group of computational models which are highly intensive. A very popular example is the completely interlinked neural multi-layer networks which embodies numerous parameters for precise calculations. A great deal of data is available to achieve this goal. In addition, while the minimum of training materials are not tough to direct, here is a general rule that at least ten times the number of samples as network parameter. This is also one cause for the success of deep learning in the fields that collect large volumes of data (e.g. computer vision, speech, natural language) easily. Health care is however a different area; we currently have around 7.5 billion people worldwide, with most of them having access to primary health care (as of September 2016). Therefore, we probably still won't have as many patients as we want to develop an integrated deep learning model. Therefore, it is much more complex to understand disease and its complexity than other activities, like the identification of objects or speech recognition. In consequence, the amount of medical data necessary to train an efficient and robust deep learning model would be considerably more than in other media from the perspective of big data
2	Data quality	Generally, in all domains the data will be clean and well structured. But, in healthcare domain the data is extremely miscellaneous, not cleared, noisy and incomplete. An efficient and superior deep learning model with huge and varied data sheets are to be trained and moulded while considering the plausible threats like data sparsity, redundancy and the lack of values
3	Temporality	In the course of time, the diseases continue to evolve and improve. However, numerous present-day deep learning models which are even present in the medical arena, do possess static vector-based inputs which generally do not control the time parameter. Creation of deep learning perspectives which can tolerate temporal health care data is a necessity which calls for the creation of new solutions
4	Domain complexity	In contrast, the issues in biomedicine and health care are more complex than in other fields of practice (e.g. image and speech analysis). The diseases are extremely heterogeneous, and for most diseases, their origins and development are still not fully known. In fact, in a realistic medical setting, the number of patients is generally limited, and we can not request as many patients as we want

(continued)

Table 1 (continued)

S. No	Challenges	Description
5	Interoperability	Although in a number of application domains deep learning models have been successful, they are sometimes considered as black boxes. In other deterministic areas (for the end user can objectively validate the tags assigned to the images), it may not be a problem, however, but it is important not only in health care for quantitative algorithms performance, but also the reason the algorithms work. In fact, such model interpretability (i.e. which phenotypes drive the prediction) is critical to convince physicians of the actions the prediction system recommends

10 Conclusion

Today's due to recent development of technology, many changes have been seen in current era. Big data is popular one in among all game-changing technologies/concepts. As narrated in this paper, big data is the new oil for many sectors. Especially for e-healthcare, big data is helping a lot, i.e. in determining useful and productive decision for curing disease in early stages. Moreover of this sensitive applications, today's big data has more potential/power to impact many other sectors from social science to political science, from financial industry to business, from medical science to public health, from health care to genetics, and from personalized medicine to patient/custom-centred outcomes. As future, deep learning can be used in previously mentioned listed applications. The emerging field of big data science provides new opportunities to us like biomedical data science, etc., but these enhancements come with many challenges in all fields. For example, in biomedical and health science fields, which make improved understanding of human life, health, diseases and behaviour possible, are facing issues like not having efficient tools/methods to analysis this big data, also security of user's personal information and leaking of user's privacy are few names listed here. But, it is sure that big data has involved various levels of human life: individuals to community and industrial to university to government.

Hence, as summary of this paper/article, we used many useful articles that are representative of a line of work; this helps us provide a critical analysis of challenges, i.e. preparing Tables 1 and 2.

In this work, we have discussed several challenges which have not been identified in the past by previous researchers (all issues together) towards bio-medical imaging, including the lack of long-term confidentiality protection, the over-reliance on non-collusion assumptions, the challenges presented by making strong data representations assumptions, as well as the lack of solutions applicable to current medical image detection, recognition and segmentation. Also, we discussed several open-source tools, models/algorithms which are available for deep learning for medical applications/bio-medical applications today with including several opportunities for

Table 2 Future research opportunities towards deep learning in medical applications

S. No	Opportunities	Description
1	Feature enrichment	We will accumulate all possible features so as to spot and discover novel techniques processing, given the limited number of patients worldwide. Data sources to generate these features must contain, and must not be restricted to, wearable devices, environments, online surveys, online community, genome profiles, omic data such as proteoms (such as social media information reported on patients for pharmacovigilance [44, 45]). Successful incorporation of highly dispersed data and getting a knack of using it the right way in deep learning is an extremely important focus point from the research aspect
2	Federated inference	Each hospital has a patient population of its own. Developing deep learning models with the help of patients from a number of spots while assuring safety and security of their identity and information is a critical issue. As a consequence, training deep models securely in this federated environment will be another important research subject interfacing with other mathematical domains, such as cryptography (e.g. homomorphic encryption [46] and secure multiparty computing [47])
3	Model privacy	It is even more challenging to preserve the privacy of deep learning models, as there are more parameters to be protected and several recent works have pushed the fronts in this area [48, 49]. Nevertheless, taking into account all personal information likely to be handled by deep models in clinical applications, the implementation of smart technologies for next-generation health care needs to consider these risks and try to implement a differential privacy norm
4	Incorporating expert knowledge	Taking into account a majority of the personal details and data which are likely to be configured by deep models in clinical approaches, the implementation of smart tools for futuristic healthcare requirements to account for these risks and try out a varied standard for privacy. Semi-supervised learning, a perfect method for learning from huge quantities of unlabelled samples with only a few labelled ones is likely to possess greater strength due to its capacity to handle both labelled and unlabelled samples [45]

(continued)

Table 2 (continued)

S. No	Opportunities	Description
5	Temporal modelling	Knowing that the parameter of time is an important factor in majority of the healthcare issues, especially in those which involve EHRs and supervision of devices, training time-linked deep learning model which is highly important for the better outlook of the patients conditions. Temporary deep learning is therefore key to solving problems of health care. To this end, we expect RNNs as well as memory-coupled architectures (for example [50]) and attention mechanisms (for example [10]) to play the most major role in improving deep clinical architecture

future researchers. This work will be more useful to our future readers (with a straightforward manner) in the future, for example, to assess progress in the field, also for many research communities as a guideline for future work.

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An Enhanced Local Neighborhood-Based Niching Particle Swarm Optimization Algorithm for Multimodal Fitness Surfaces



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Abstract This paper aims to introduce a niching technique based upon simple local neighborhood-based PSO for multimodal optimization. The corresponding algorithm known as Enhanced Local Neighborhood Based Niching Particle Swarm Optimization (ELNPSO) algorithm has shown promising results when used in conjunction with multimodal optimization problems, which has been established by comparing the performance with three other multimodal optimizers tested upon eleven different multimodal benchmarking functions.

Keywords Niching · Multi-modal optimization · PSO · Local neighborhood

1 Introduction

Multimodal optimization has found a heavy interest amongst many researchers currently where it is aimed to detect and preserve of multiple optima of an objective function. So many examples of practical optimization problems can be listed that contain multiple optimal points and it seems logical to find all of them available for the following reasons. Sometimes an optimal solution currently favorable may not remain so with the passage of time. Thus, the user has needs to switch to another equivalent solution if the same is available. Sometimes, physical (and/or) cost constraints limit the suitability of using the optimal results. In situations like this having the knowledge of multiple solutions (local and global), one can go for the implementation with another optimal solution quickly without sacrificing the system performance. Multiple optimal solutions are sometimes used for finding some hidden

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properties of the fitness landscapes under study. If a single optimal-finding algorithm is it must be repeated several times in the hope of finding a different optimal solution.

With the aid of population-based approach, Evolutionary Algorithms (EAs) [1, 2] provide more efficient and advantageous ways for multimodal optimization as compared to the classical optimization techniques. The term *Niching* [3–6] has been coined as a technique for search and store the well-disposed parts of the solution space possibly around multiple solutions with the aim of avoiding convergence to a single solution.

Some of the earlier works involving multimodal problems with EAs are the watershed work of Goldberg and Richardson [7], where a niche-preserving technique was used alongside a standard Genetic Algorithm (GA). Some of the popular niching techniques used alongside EAs are fitness sharing [7], crowding [8], restricted tournament selection [9], and the like.

This article presents a simple local neighborhood-based PSO for multimodal optimization. PSO is a novel stochastic search and optimization algorithm that emulates the collective intelligence of natural creatures commonly observed in a school of fish or a flock of birds. PSO [10, 11] has attracted the attention of many investigators all over the world. Many improved variants of PSO like CLPSO [12], DMSPSO [13], UPSO [14], APSO [15] etc.

The PSO algorithm has been used in the multimodal optimization process lies in the extensive explorative nature over the bound-constrained search space along with the capability to perform local search. The proposed Enhanced Local Neighborhood-Based Niching Particle Swarm Optimization (ELNPSO) algorithm has shown exemplary capability for convergence to local and global peaks. This has been established by comparing the performance with three other multimodal optimizers tested up one eleven different multimodal benchmarking functions. Proposed algorithm involves only one parameter which updates in every iteration for better and fast searching—a neighborhood radius (D_{\max}).

The rest of the has been organized as follows. Section 2 describes the proposed variant of PSO termed as ELNPSO in sufficient details. Section 3 presents the experimental results of performance comparison with existing multimodal evolutionary optimizers and discusses the results in details. Finally, Sect. 4 concludes this paper.

2 The ELNPSO Algorithm

2.1 The PSO Algorithm

The PSO algorithm is dependent upon the social interaction amongst the particles which are the independent agents looking for the optimal solution in a fitness surface. The PSO algorithm requires to define the solution space and the model of the fitness landscape. The first step of the PSO algorithm is to randomly initialize the position and the velocity of all the particles. Every particle is supposed to have a velocity which

is adaptable to the current fitness of the same. Each particle possesses a memory element which stores the best position that it has visited. The particles are attracted towards the better position in the search area over the course of the optimization process. The movement of each particle is governed by the aggregated acceleration towards its best previously visited position and towards the best individual of the entire swarm.

2.2 Description of the ELNPSO Algorithm

This ELNPSO algorithm has been developed with the *lbest*-PSO as the basis where each particle instead of being connected to the whole population is connected to only a few with a particular network topology. The commonly used topologies are the ring or the wheel topology. The ELNPSO algorithm tries to enhance the *lbest*-PSO with a niching parameter. For a particular particle the neighborhood particles are selected based on a distance measurement D_{\max} . Two particles are in the same neighborhood if distance between them is less than or equal to D_{\max} as defined in Eqs. (1) and (2)

$$D_{\max_{\text{initial}}} = \frac{1}{5 * D} \|x^u - x^l\|, \quad (1)$$

where x^l and x^u are the lower and upper bounds on each dimension of each particle having D dimensions and $\|\cdot\|$ is the Euclidian norm. The value of D_{\max} is updated in the rest of the iterations as follows.

$$D_{\max} = \frac{\min (\text{Euclidian dist. between two best optima found so far})}{2}; \quad (2)$$

A simple neighbor selection criterion is implemented based on the generation of a binary random number to select which supports the dynamic nature of the neighborhood. For a particular neighbor particle if the generated number is 1 then the it becomes the part of the neighborhood. Otherwise the particle is simply ignored.

A *scattering* scheme is needed here to enhance the ability for efficient search. When the optima positions are crowded with a number of particles then some of the particles are kept there and the rest of the particles are scattered around for better local search. The steps of the process are listed in the Table 1. The steps for the ELNPSO algorithm are given in the Table 2.

Table 1 Steps used for scattering

Step 1. Count the number of Particles at a location.
Particles x and y are considered to be at the same location if
$\text{Dist}_{xy} = 0.001 * D_{\max}$
Step 2. Retain the 3 best particles of that particular location.
Step 3. Check the location of the other particles whether they belong to lower or upper bound side of the dimension compared to the best particle in the neighborhood
Step 4. Implement the scattering as follows
For a particle on the lower bound side in the i th dimension
$\text{Position}_{\text{updated}}^i = \text{Position}_{\text{best}}^i - (\text{Position}_{\text{best}}^i - \text{lower}_{\text{bound}}^i) \times 0.5 \times \text{rand}(1)$
For a particle on the higher bound side in the i th dimension
$\text{Position}_{\text{updated}}^i = \text{Position}_{\text{best}}^i + (\text{upper}_{\text{bound}}^i - \text{Position}_{\text{best}}^i) \times 0.5 \times \text{rand}(2)$

3 Experiments and Results

3.1 Numerical Benchmarks

The performance of the ELNPSO algorithm has been compared with eleven multi-modal test functions of varying characteristics [11, 16]. For comparison purposes the ELNPSO algorithm has been tested alongside some state of art algorithms like Crowding DE (CDE) [8], Speciation-based DE (SDE) [17], Fitness-Euclidean distance Ratio PSO (FER-PSO) [18].

The different population size and maximum number of functional evaluations (FEs) selected are tabulated in Table 3. The values of acceleration constants (c_1 and c_2) and inertial weight (w) are taken as: $c_1 = 1.494$; $c_2 = 1.494$; $w = 0.793$.

The accuracy parameter ε ($0 < \varepsilon < 1$) has been defined for each of the eleven benchmark functions. If the difference between the known and found optima is below ε then the peak is considered to be obtained. A comparison based on *Success Rate* has been tabulated in Table 4 where

$$\begin{aligned} \text{Success Rate} = & \text{ the percentage of runs in which all} \\ & \text{global peaks are successfully found.} \end{aligned} \quad (3)$$

The best results have been displayed in bold letters in Table 4. It is observed that the ELNPSO achieves 100% success rates in 10 out of 11 functions. In f_{10} only the success rate is found to be 91%. Compared to this the CDE, SDE and FERPSO achieve 100% success rates in total 3, 5 and 5 number of functions only. Thus, ELNPSO behaves as the best in this comparative study.

Table 2 The pseudo code of ELNPSO Algorithm

N: population size
Dim: Dimension
D_max: *MAX_distance*
S: Compare Decision. It can take only 2 values ‘1’ and ‘0’. (N.B. ‘1’ means it can be considered for comparison and ‘0’ means otherwise)
l_best_i: local best of *ith* particle.
n_best_i: neighborhood’s best of *ith* particle.
Max_FEs: Max fitness evaluations, stop criterion

Initialize *N* particles (position and velocity)
FES=0;
Initialize *D_max* using eqn. 4.
Velocity_initial= *D_max* * rand()
Initialize local and global best position fitness values as –infinity.

While *FES*<= *Max_FEs*
 FES= *FES* + 1;
 Calculate each particles *fitness*;
 For *i* = 1 to *N* Find *l_best* of *ith* particle. ; End
 For *i* = 1 to *N*
 For *j*=1 to *N*
 S = (randomly selected value from the set {1, 0})
 If (distance between *ith* & *jth* particle) <= *D_max* and *S*=‘1’
 Compare their *l_best* and update *ith* particle’s neighborhood’s best Position.
 End
 End
 End
 For *i* = 1 to *N*
 For *d*=1: *Dim*
 If *rand*<0.75
 $v_i^d = w * v_i^d + c_1 * rand1_i * (l_{best_i}^d - x_i^d) + c_2 * rand2_i * (n_{best_i}^d - x_i^d)$
 $v_i^d = \min(\max(v_i^d, -v_{max}^d), v_{min}^d)$
 $x_i^d = x_i^d + v_i^d$
 Else $x_i^d = l_{best_i}^d$ End
 End
 End
 Determine the *min_fitness* among all particles.
 Update *D_max* using eqn. 5.
 If more than 3 particles are at same position, perform scattering using eqn. 6 or 7. End
End

Table 3 Population size and maximum number of FEs for test functions

Function number	Population size	Maximum number of FEs
<i>f₁</i> – <i>f₇</i> , <i>f₁₁</i>	50	5000
<i>f₈</i> – <i>f₁₀</i>	100	20,000

4 Conclusion

In this paper a new approach to multimodal optimization has been attempted which extends the concepts of the well-known *lbest*-PSO. The same has been tested upon

Table 4 Success rates for test functions (f_1-f_{11})

Function	ε	r	ELNPSO	CDE	SDE	FERPSO
f_1	5E-2	0.5	100	100	100	72
f_2	5E-2	0.5	100	100	100	100
f_3	5E-2	0.5	100	100	96	20
f_4	1E-6	0.01	100	28	72	84
f_5	1E-6	0.01	100	72	100	100
f_6	1E-6	0.01	100	28	60	100
f_7	1E-6	0.01	100	60	100	100
f_8	5E-4	0.5	100	0	72	72
f_9	1E-6	0.5	100	0	100	96
f_{10}	1E-5	0.5	91	52	32	100
f_{11}	1E-4	0.2	100	56	48	60

eleven well established multimodal benchmark functions alongside three state-of-the-art algorithms. The results establish the supremacy of the proposed ELNPSO algorithm over others in terms of *Success Rate*.

An extension of the current work can be planned as to test the ELNPSO algorithm in terms of other performance parameters like Average Number of optima found, Peak accuracy and Statistical tests like Wilkoxon's rank sum test etc. These comparisons will establish a better supremacy of the proposed algorithm over the competing ones.

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Convolutional Neural Network Based Arrhythmia Classification with Selective Features from Empirical Mode Decomposition



Saumendra Kumar Mohapatra and Mihir Narayan Mohanty

Abstract Deep learning is one of the advanced classification technique and has been used in many machine learning applications. In this piece of work, authors have attempted to classify four types of long duration arrhythmia electrocardiograms (ECG) using convolutional neural network (CNN). The data is taken from MIT-BIH arrhythmia database and features are extracted using empirical mode decomposition (EMD) technique. For most informative contents average power (AP) and coefficient of dispersion (CD) are evaluated from six intrinsic mode function (IMFs) of EMD. These selected features are considered as the input to the CNN classifier. The performance is shown in the result section and it is found that the classification accuracy is 95.98%.

Keywords ECG · Arrhythmia · EMD · IMF · CNN

1 Introduction

For analysing any kind of cardiac disorder electrocardiogram (ECG) is one of the important process. In order to start the diagnosis of a cardiac patient it is important to analyse the ECG accurately. Different cardiac abnormalities can be easily detected from the ECG analysis. Arrhythmia is one type of cardiac illness which can also be detected from ECG waves [1]. In case of arrhythmias the heartbeat rhythms either goes fast or slow. The factors for arrhythmia are smoking and consumption of alcohol, mental strain, diet, diabetes, etc.

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It is a challenging task to detect and start the diagnosis process of this awful disease at an early stage. Automatic analysis of clinical reports generated through multiple pathological tests can reduce the diagnosis time as well as human interference. Different machine learning techniques can be taken for this automatic ECG analysis system. The main challenge for developing this automated diagnosis system is the proper analysis of the data and accuracy. Numerous cardiac data mining techniques were also used by the researchers for getting a satisfactory result.

Due to the non-stationary nature of the ECG signal, EMD is considered in the proposed work for decomposition and feature extraction. Total six number of Intrinsic mode functions (IMFs) are considered as the basic feature. In order to extract useful feature, average power (AP) and coefficient of dispersion (CD) are found from these six IMFs. AP is the mean by which the signal is characterized for reusing important information of the signal. CD of a signal signifies variation of coefficients. Here in the proposed work CD is used for building a feature vector by calculating the probability distribution of the IMFs. Convolutional neural network(CNN) is used for classifying these selected ECG features.

2 Related Literature

Machine learning based ECG classification can assist the cardiologist for the early diagnosis of cardiac diseases. Several machine learning have been applied for the classification of the cardiac signals.

Authors in [2] have applied higher-order statistics and spectra (HOS) for classifying normal and coronary artery disease. HOS bispectrum were extracted from each signal. For reducing the dimension, PCA was used in their work. Two different classifier K- nearest neighbor (KNN) and decision tree were applied for the classification purpose. Support vector machine (SVM) based ECG classification was done by the authors in [3]. Combination of genetic algorithm (GA) and binary particle swarm optimization (BPSO) technique were selecting the relevant features [4] and those selected features were again classified by using SVM.

Deep learning is one of the advanced classification systems and performs better as compared to other types of classifier with huge amount of data. ECG classification using deep learning approach was introduced by different researchers since last few years. It is a challenging task to detect the ECG signals which are corrupted by noise. A CNN based automatic normal and noisy ECG classification model was developed by authors in [5]. They have classified five different categories of ECG beats by using a nine-layer CNN. Their model was trained with both augmented and highly imbalanced data and from the result it can be noticed that classifier was performing better with augmented data. A deep learning approach based long-duration ECG classification system was presented in [6]. They have proposed a 16 layer CNN model for predicting the arrhythmia classes. For detecting different ECG segments an 11 layer CNN structure was introduced by the authors in [7]. Their proposed CNN model was detecting four types of arrhythmia from the ECG signal collected from

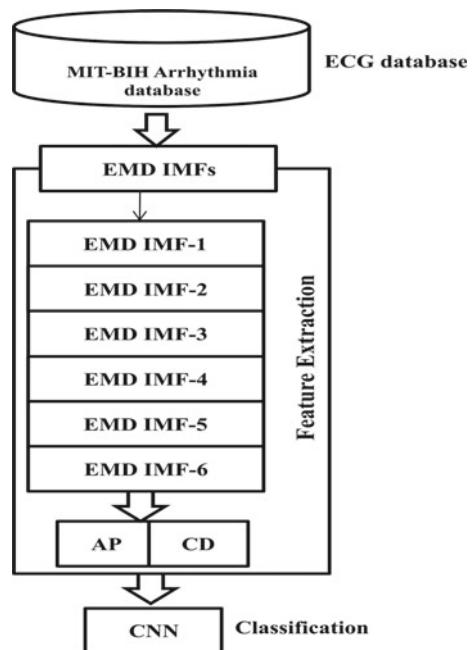
three different databases. A deep belief network for automatic feature extraction and classification of ECG signal was proposed by the authors in [8]. The fine-tuning process was carried out for enhancing the performance of the deep belief network and the performance was better as compare to traditional classification method. An optimal recurrent and convolutional neural network was proposed for analysis of different waveform of the ECG signals [9].

Since there are some open issues, those can be addressed suitably, for development of models to classify biomedical signals in robust and accurate ECG manner. Deep learning-based classifiers are based on automatic feature extraction approach. Here in the proposed work the EMD features were extracted from the long duration ECG and then the classification is performed with these previously extracted features. The performance of the classifier is found better with EMD features as compared to automatic feature extraction using CNN.

3 Proposed Methodology

Most of the medical dataset are dispersed, widespread, and assorted. The proposed work provides an automatic ECG classification system and is based on EMD and deep learning approach. In Fig. 1, the proposed framework for automatic ECG, classification is presented. ECG signals were collected from MIT-BIH-Arrhythmia

Fig. 1 The proposed ECG classification framework



repository [10]. This database contains 48 number of ECG signals with 360 Hz sampling frequency. Total four types of ECG signal such as Normal, Left Bundle Branch Block (LBBB), Atrial premature beats (APB), and Right Bundle Branch Block (RBBB) are available in this database.

3.1 Empirical Mode Decomposition

Empirical Mode Decomposition (EMD) is a suitable technique to decompose any signal. Exclusively it is most useful for non-stationary signal decomposition. The signal is decomposed into a number of intrinsic mode functions (IMFs) and residual by shifting process [11, 12]. Some predefined functions are required for representing the signal in traditional data analysis methods like Fourier Transform and Wavelet Transform. But EMD relies on a fully data-driven approach and does not require any predefined function [13]. Steps involved for EMD is described as follows:

- Step I: Consider the signal $s(t)$ and determine both maxima and minima.
- Step II: Find out the upper $e_u(t)$ and lower $e_l(t)$ envelopes of the signal $s(t)$ using the cubic spline interpolation technique [14].
- Step III: Find out the envelope mean $e_m(t) = \frac{e_u(t)+e_l(t)}{2}$.
- Step IV: Extract the detail $d_1(t) = s(t) - e_m(t)$.
- Step V: If the mean of $d_1(t) = 0$ and the number of extrema is equal or differ by at most one from the zero-crossing then $d_1(t)$ is an IMF otherwise repeat step I until satisfying the condition.
- Step VI: Find out the residue $r_1(t) = s(t) - d_1(t)$. Last residual will be considered as the trend.

After obtaining all the IMFs from the input signal $s(t)$, again it is reconstructed by:

$$s(t) = \sum_{i=0}^n d_i(t) + r_n(t) \quad (1)$$

where n is the number of IMFs and it is orthogonal to each other.

Average power (AP) of the first six IMFs is calculated for summarizing the information of the signal. This can be used as the feature vector for classification. In the proposed work AP is calculated by:

$$AP = \frac{\text{IMF}_l^2(1) + \text{IMF}_l^2(2) + \text{IMF}_l^2(3) + \text{IMF}_l^2(4) + \cdots + \text{IMF}_l^2(N)}{N} \quad (2)$$

where $l = 1, 2, 3, 4, 5, 6$ and N is the length of each IMF.

Again the coefficient of dispersion (CD) is calculated and it measures the relative variation of a signal. Mostly it is used to measure the variability in two or more series.

CD of first six IMFs is calculated by relative dispersion. The CD feature vector is obtained by Eq. 5.

$$\mu = \frac{1}{N} \sum_{n=1}^N \text{IMF}_l(n) \quad (3)$$

$$\sigma = \left[\frac{1}{N} \sum_{n=1}^N \text{IMF}_l(n) - \mu^2 \right]^{1/2} \quad (4)$$

$$CD = (\sigma / \mu)^2 \quad (5)$$

3.2 Convolutional Neural Network (CNN)

Convolutional neural network model is one of the popular artificial neural networks and can be used for classification purpose. In general a CNN is the composition of convolutional layers, and each convolutional layer is followed by a pooling layer. The feature map from the previous layer is convolved by using the filter presented in the convolutional layer. After completion of the convolution process, it passes through the activation function for getting the activation to the next layer. The output of the convolutional layer can be calculated as

$$C_j^{i,a} = \sigma \left(d_a + \sum_{m=1}^M w_m^a x_{i+m-1}^{0a} \right) \quad (6)$$

where $x_i^0 = (x_1, x_2, x_3, \dots, x_m)$ is the input vector and m is the total number of ECG segments. j is the layer index and d is the bias of the feature map. σ is the activation function. M is the filter size. w_m^a is the weight for m th filter index [15].

Max pooling is one of the common pooling layer used in CNN. Fully connected layers are used after the convolutional layers having full connection to all the activations in the previous layer. The objective of using fully connected layer to force all the outputs of the neural network to sum up to one. Activation function maps an output to a set of inputs. An activation function is generally employed after every convolutional layer. In the proposed CNN Rectified linear unit (Relu) activation function is used in the hidden layers whereas Softmax is used in the output layer.

4 Results

Four types of ECG has been considered for classification using CNN. ECG data is collected from the MIT-BIH database and corresponding signals are shown in Figs. 2 and 3. After successive decomposition using EMD, first six IMFs are taken for calculation of AP, and CD. In Fig. 4 the IMFs of corresponding ECG is displayed.

The original data set is divided into training and testing set. About 90% ECG data is considered for training and rest 10% data is taken for testing purpose of the CNN classifier. The classification performance of the CNN classifier with EMD feature is presented in Fig. 5. The accuracy is quite better as compared to CNN without EMD.

The performance is also measured with different parameters as accuracy, specificity, and sensitivity. These parameters can be calculated from the confusion matrix. In Table 1 confusion matrix of the CNN classifier with EMD feature is presented. In Table 2 the performance of the CNN classifier is presented. The obtained result is also compared with some earlier work and presented in Table 3.

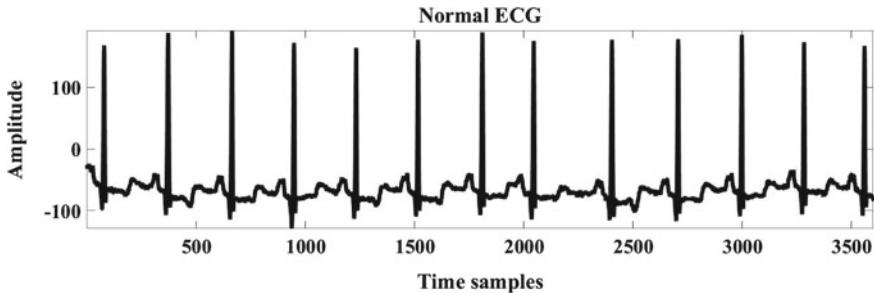


Fig. 2 Normal ECG signal

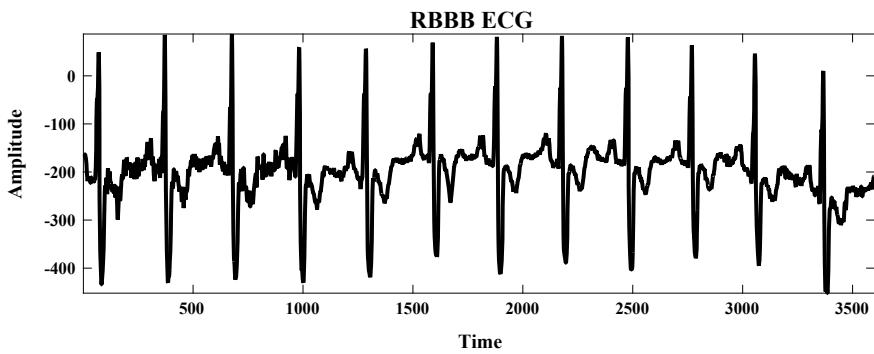


Fig. 3 RBBB ECG

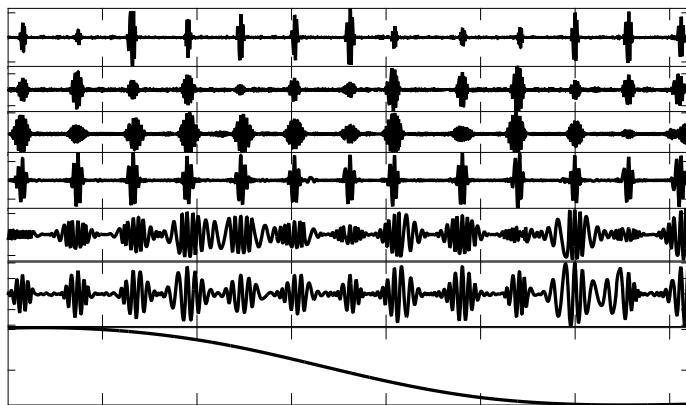


Fig. 4 IMFs and residual of normal ECG

Fig. 5 Classification accuracy archived from CNN

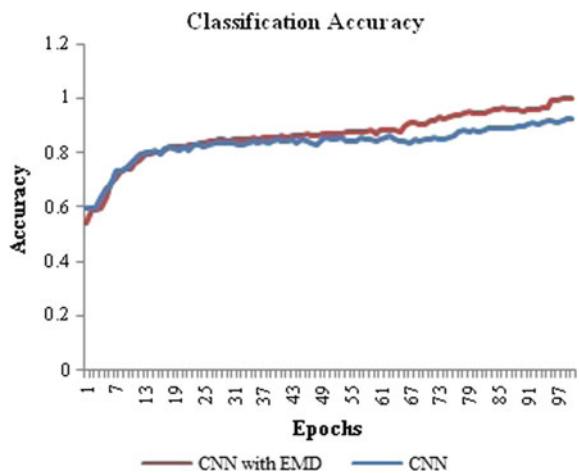


Table 1 Confusion matrix of CNN classifier

Beat type	Normal	LBBB	APB	RBBB
Normal	495	5	8	0
LBBB	0	66	2	0
APB	40	8	200	2
RBBB	1	1	1	24

Table 2 Classification result of CNN classifier

Class	Sensitivity (%)	Specificity (%)	Accuracy (%)
Normal	97.44	88.08	93.55
LBBB	97.05	98.12	98.12
APB	80	98.17	92.84
RBBB	88.88	99.75	99.41
Average	90.84	96.03	95.98

Table 3 Comparison of the result obtained from the proposed work with other methods

Reference	Features	Classifier	Accuracy (%)
[3]	PCA	SVM	79.17
[4]	BPSO+GA	SVM	81.46
[7]	Convolutional	CNN	94%
Proposed work	EMD	CNN	95.98

5 Conclusion

Computer-aided diagnosis system can identify the problem earlier before any critical stage. CNN based classification of four types of arrhythmia ECG signal is performing satisfactorily in this work. The EMD based signal decomposition technique is performing better as compared to other methods. Further extension can be done for classifying different types of cardiac abnormalities by using other features with more numbers of hidden layers.

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Artificial Intelligence—A Revolution for Smarter Systems



K. Akash Sriram and Swetha S. Kumar

Abstract The main objective of applying artificial intelligence and technology to the field of education is to drive efficiency, personalization and streamline tasks. The primary objective of this paper is to leverage the best attributes of machines and teachers and create an environment in which they can work together for the best outcome of students. This paper is on the fact that the students of today will need to work in a future where AI is the reality. Thus, it is important that our educational institutions expose students to this technology.

Keywords Artificial intelligence · E-wallet · Cloud support · Smart canteens · Personalized education

1 Introduction

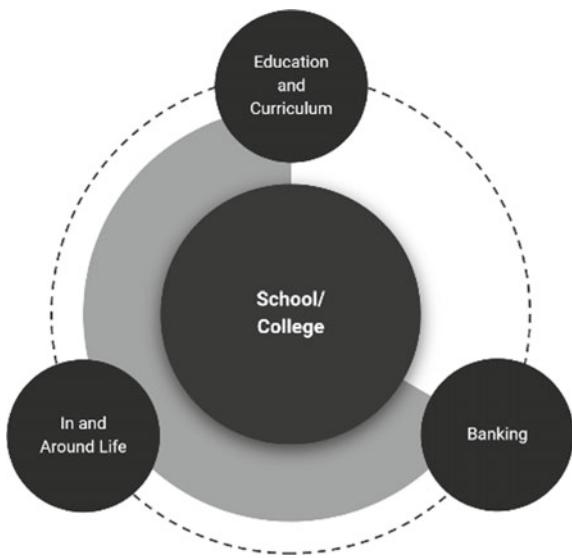
In this new era of mobile phone and smartphone technology when the daily user count is increasing at the rate of thousands per day, newer technologies are coming to aid the students. AI has already been applied to education primarily in some tools that help develop skills and testing systems. As AI educational solutions continue to mature, the hope is that AI can help fill need gaps in learning and teaching and allow schools and teachers to do more than ever before. AI can drive efficiency, personalization and streamline admin tasks to allow teachers the time and freedom to provide understanding and adaptability—uniquely human capabilities where machines would struggle. This would establish our primary motive to introduce the concept of a collaboration of humans and machines through a software. Our

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Fig. 1

idea focuses on a single software, through websites, computer and mobile applications, where the vision for AI in education is one where they work together for the best outcome for students, by leveraging the best attributes of machines and teachers.

Since the students of today will need to work in a future where AI is the reality, it is important that our educational institutions expose students to and use this particular piece of technology through the curriculum process (Fig. 1).

2 Education and Curriculum

A. Smart Content:

The first and primary objective of our software is that it attempts to condense textbooks into useful tools for examination preparation such as true or false questions, and important lecture notes. “Smart content” is converting digitized guides of textbooks into customizable learning digital interfaces that can be introduced at all levels, from elementary to post-secondary to corporate environments.

Creating smart digital content platforms, completely with content delivery, practice exercises, and real-time feedback and assessment can be done with a customized universal software or mobile application that can be installed into a personalized computer for all students and even collaborated into the website. This software could also be executed by allowing educators to design digital curriculum and content across devices, integrating rich media like video and audio, as well as self- or online instructor assessment. This provides a personalized learning cloud platform designed for the modern college, in which teachers can design customizable learning systems

with apps, gamification and simulations, virtual courses, self-assessments, video conferencing and other tools. Learning platforms for the modern college systems are designed to allow students to master additional skills and receive continuous and automated feedback and, when used strategically, have the potential to help improve performance and increase knowledge and skills.

Usually, smart system content developed is distributed through applications; however, this is often not essentially the only method. In our case, however, the design of a smart content includes distribution through packaged parts, just like the consumer application or a software. The consumer hardware can be a mobile device or a PC. However for specific content, mobile applications may have its own serious limitations due to the process power and memory constraints.

B. Personalized Learning:

Customized learning based on an individual student's particular needs has been a priority for educators for years, and our technology is advanced to allow a level of differentiation that is impossible for teachers who have to manage 60 students in each class. There are several companies such as Content Technologies and Carnegie Learning that are currently developing intelligent instruction design and digital platforms that use AI to provide learning, testing and feedback to students from pre-KG to college level that gives them the challenges they are ready for, identifies gaps in knowledge and redirects to new topics when appropriate. As AI gets more sophisticated, it might be possible for a machine to read the expression that passes on a student's face that indicates they are struggling to grasp a subject and based on that it will automatically modify a lesson to respond to that challenge. The idea of customizing curriculum for every student's needs is not viable today, but it will be for machines powered by our software.

C. Student Support:

Pearson has already suggested that in future students will have an AI lifelong learning companion. Essentially, this next generation of students will grow up with an AI companion that knows their personal history and school history. Therefore, it will know each student's individual strengths and weaknesses.

In addition to acting as a personalized learning companion, our software will also be able to help students with special needs by adapting materials to lead them to success. For instance, studies are already showing positive results for AI teaching ASD students, social skills. Any learning material can be customized to help any student irrespective of their mental or physical capabilities assuring the best brought out of each one of them.

D. Tutoring and support outside the classroom:

Our software is also focused to provide personalized tutoring for students outside of the classroom. When students need to reinforce skills or master ideas before an assessment, AI will be able to provide students with the additional tools they need

for success. It will also work in identifying classroom weaknesses. For instance, our software will identify when groups of students miss certain questions letting the teacher know which material needs to be retaught to which specific student. In this way, AI will also hold teachers accountable and strengthen best teaching practices.

Ask any parent who has struggled to help their teenager with algebra, and they will be very excited about the potential of AI to support their children when they are struggling at home with homework or test preparations. Tutoring and studying programmes are becoming more advanced thanks to artificial intelligence, and soon they will be more available and able to respond to a range of learning styles.

E. Universal access for all students:

The tools provided by our software can help make global classrooms available to all including those who speak different languages or who might have visual or hearing impairments. For instance, presentation translator is a free plug-in for PowerPoint that creates subtitles in real time for what the teacher is saying. This also opens up possibilities for students who might not be able to attend school due to illness or who require learning at a different level or on a particular subject that is not available in their own school. AI can help break down silos between schools and between traditional grade levels.

F. Cloud Computing:

As we have a tendency to be explicit within the introduction of this work, with the large growth of the quantity of scholars, educational contents, services that may be offered and resources created, the challenges for smart content systems grow with an exponential rate. The challenges relating to this subject regarding optimizing resource computation storage and communication needs and coping with dynamic concurrency requests highlight the requirement of the utilization of a platform that meets scalable demands and price management. These surroundings are cloud computing.

Cloud computing technologies permit the tutorial establishments to induce access to computing on demand, particularly people who do not have the technical experience to support their infrastructure. Cloud computing makes it attainable for nearly anyone to deploy tools that may scale on demand to function several users as desired. Customers will access the service anytime, anywhere, share information and collaborate additional simply and keep their information hold on safely within the infrastructure.

G. Cloud Models:

1. *Public cloud:* The general public cloud infrastructure is accessible for public use for both students and teachers. All materials with respect to the curriculum, syllabus will be opened out to both parties. The students can access it from any part and any time with or without the permission of the admin. The contents may include the lesson videos, study materials such as articles and papers, notes, podcasts, manuals, handouts and textbooks. The admin will hold sole permissions of who and when this can be accessed.

This will also pave way to universal access to materials to all students and help create a global classroom atmosphere.

2. *Personal cloud:* The personal cloud infrastructure is operated for the exclusive use of an individual or a group. A particular group of students working on a project may have collected notes, and such can be uploaded accessing permission to the members of the particular group only. Another example is a professor expecting project submissions from a specific class can open a folder and request all students of that class to upload their projects, which is accessible to the professor and the respective team members alone.

H. Teacher Support:

An educator spends a tremendous amount of time grading homework and tests. Our software can step in and make quick workout of these tasks while at the same time offering recommendations for how to close the gaps in learning. Although machines can already grade multiple-choice tests, they are very close to being able to assess written responses as well. As AI steps into automate admin tasks, it opens up more time for teachers to spend with each student. There is also much potential for AI to create more efficient enrolment and admission processes.

In addition to helping with grading, our software will also provide support for teachers in other ways. Some of the routine tasks can be managed with a laptop application, as well as communication with students. For example, one college professor successfully used an AI chatbot to communicate with students as a teaching assistant for the entire semester without students knowing they were not talking to a human.

3 Banking

The technological revolution that the banking sector has been witnessing across foreign, private and public sector banks seriously has made banking easier and more accessible. Cash is no longer king in a payment point of view. Cards and consumer finances are becoming the dominant modes for settling bills in urban India. This paves way to make one more very important establishment in educational institutions, which is A Personalized E-Wallet.

Number of Internet users in India increased by 730 million by 2020, as per data of NASSCOM and AKAMAI Technologies “The Future of Internet in India Report”. Today, 30% market share in total mobile transactions is done through E-wallets. Electronic wallets are issued by banks, big e-retailers, third-party independent payment companies and mobile operators.

Nevertheless, the younger generation can be exposed to the banking industry through this concept as such.



Fig. 2 .

I. Mobile Phone: The Enabler

The digital revolution has transformed banking with digital taking precedence over physical banking. The M-wallet can be installed in the students' mobile phones. The M-wallet can be loaded with Rs. 10,000 with just a mobile number and an email verification process. A full KYC can jack up the wallet balance to Rs. 100,000.

J. The E-Wallet Framework:

Every student would be provided with a particular account number that denotes his/her account. The framework is represented in Fig. 2.

1. This allows you to shop at any merchant of your choice and also permits withdrawal of money. These wallets are just as similar to a savings bank account.

An open account is a basic type of account that allows you to deposit money, keep it safe and withdraw funds, all while earning interest. Open accounts offer easy access to your cash. Once you are ready to spend money, you can withdraw cash or transfer funds to any regular account, to pay by cash, debit card or an electronic fund transfer. You can make cash withdrawals from your savings account at the college or any ATM. This open account pays interest on money in your account. As a result, your money keeps multiplying in small additions, typically every month.

When it comes time to contribute money to your open account, you could use cash, cheque, E-transfers and DDs.

The open accounts can also be used in the business of lending. They could also be used to provide personal loans, peer-to-peer loans, and lines of credit and funding for starting a college-related project also.

Another option for earning more interest than your savings account is the certificate of deposit (CD). The open accounts require that you commit to leaving your CD funds untouched for a certain amount of time. In exchange, you earn more. Terms usually vary from six months to four years, and longer maturities usually pay more.

Once your term in the institution comes to an end, the open account is transferred to an FDIC insured bank or any financial institution for further use. This helps students get an exposure to banking at a tender age and prepares them for the better.

2. *Closed Wallet:* This is typically issued by the institution and allows the user to use the wallet only for those particular purposes demanded by the institution itself, e.g. fee payments.

The system software seamlessly integrates with the closed wallet transactional pages, thereby allowing school administrators to create, allocate and charge custom fee structure for different students in different classes and sections. Moreover, it simplifies the payment process for parents/students by facilitating them with online payment gateways to pay fees remotely from any location via UPI, net and mobile banking, debit card, credit card. The parents can also transfer money well in advance into this account, and the students could use their access to pay the fees when required. Adapting to this system for digital e-transactions helps institutions as well as parents/students to track and trace cash flow, invoices, receipts and other essential documents, thereby averting carelessness and errors. The expected benefits and advantages through our system are:

- (i) Pay at any time and from anywhere.
 - (ii) Maintain a complete record of payment transactions.
 - (iii) Lighting fast transactions.
 - (iv) Instant invoice/receipt generation.
 - (v) Avoid standing in line for fee payments.
 - vi. Readily available and time-saving.
 - (vii) Accessible anywhere 24/7.
 - (viii) Mobile convenient.
3. *Semi-closed Wallet:* With the use of this wallet, the users can shop or pay at other merchants/sites within the institution, e.g. stationery stores, canteen, etc.

Traditional canteens are based on cash, manual calculations and manual record keeping of credits which in today's time is an inefficient way to operate a business. We aim to bring a change to the existing system by creating a mobile application which manages the canteen menu, and it also helps the faculty and students order their food prior to their lunch break which helps them surpass the crowd. The online ordering feature shall be available to users who are registered logged in and have a valid balance in their E-wallet. On the other hand if students and faculty wish to have their lunch from the cafeteria, this application using AI also gives a real-time estimated crowd density, which in turn turns out to be beneficial not only for students and faculty but also for the cafeteria to increase its sales. The user can pay for the food using the E-wallet linked to the cafeteria account. Since the E-wallet is prepaid, it can be recharged at the rechargeable counters present in the college campus by paying cash or by transferring from the open account.

The items of a placed order shall be displayed on the screen in the kitchen which indicates the cooks to prepare the items, and the message “ORDER PLACED SUCCESSFULLY” shall be displayed on the user screen.

When the order is delivered, its status is updated. When the status of the order is updated to “COMPLETE”, it goes off the screen. Customer does not have to wait in

long queue. This proposed system reduces the paper work and requires only a simple recharge of E-wallet.

One of the greatest advantages of such a system is DATA. Today, businesses can collect data along every point of the customer journey.

The exact information of what the individual orders, the frequency of his orders and including the calorie intake count is being registered. All this information can be used to push his favourite products which will boast sales. The average money an individual registers in his E-wallet can be used to determine how big of a spender he is. A student when he crosses his limit of maximum calorie intake or his budget will be sent a personalized notification to alert him, and this data will be obtained with the help of data analytics.

The same feature applies to other merchants such as stationary stores inside the campus as well.

4 Conclusion

The access of the Internet has almost become universal. There are some who question whether strong AI will ever be achieved, and others, who insist that the creation of super-intelligent AI is guaranteed to be beneficial. We believe research today will help us better prepare and also enjoy the benefits of AI, simultaneously providing a great deal of exposure to the students in the particular area who are definitely the future bearers of the vision we hold today. While the idea we propose will not replace teachers altogether, it is possible that it will redefine the way teachers teach and students learn.

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We submit this paper with great humility and utmost regard.

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Online Document Verification System



Mansi Sharma, Divyanshu Singh, Amar Tyagi, Mehak Mishra, and Sharmila

Abstract In this modern era, there has been a need for a reliable and fastest mode to verify the certificate to reduce the level of duplicity. It also reduces the certificate verification time which has been done manually till now. Document or certificate verification plays an important role, whereas a document or certificate issued by an authority will be verified for its authenticity. In a typical system, it will be performed through interchange of mails or post, and it is not effective and efficient process due to human intervention. So in our system, we organize a common database for admin access and for user access so that it can be operated more frequently and it will be more secured as there is no need of any third party to involve in between as it is a direct communication between client and user, and by which we can also get to know which document is altered or real or fake by checking it and verifying it at our admin side and then only one can upload their document to the portal.

Keywords Database · MySQL · Certificate · Encrypting · Token · Authenticate · Online verification and validation

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1 Introduction

One of the most often used means of exchanging information among people is the Internet. This method of electronic data transmission breaks all the barriers. Furthermore, everyone can be able to browse the same Web sites and have the equal chance for user to experience the Internet. In other words, the Internet should be easily accessible by everyone. Online document verification system gives the direction of the future document authenticating development. Promotion of online document verification system will improve the speed and quality of services of document authentication.

Its framework is centralized on the need to adopt automatic online verification system that will save the barriers of manual verification method. This will enable anybody “to verify an institution certificate online, without having to come down to the school/institution to do so or to carry original document everywhere.” The user needs to log into the verification gateway and provide the certificate number to verify the authenticity of the certificate/document. If the document number is valid, then the document will be displayed with the message that the document submitted by the user is valid and authenticated. But if the document number is invalid, the following message will be displayed on the screen invalid document as per our records as we do not have information of this person, and it is either you made a typing mistake or the owner has not provided the correct information, verify and try again. The main objective of the system design is as follows:

Efficiency: It includes comprehensiveness, less time and accuracy of the desired system.

Flexibility: It has the ability of the software to cope with any changing requirement of user.

Usability: This is the ability of the software that it can be easily used and can learn or tolerate with long-term operation by the user.

Security: It is an act of securing or to protect data and involves hardware integrity. System analysis requires having a secure platform to preserve the system from damage, error and unauthenticated person.

The main contribution of this paper is as follows:

- To implement an online document verification system.
- To remove manual method/paperwork, though the user/institution have to keep their documents safely.
- To provide easy accessibility of various documents.
- To save time and resources.

2 Literature Review

Since the postal web world (2003), libraries have been seen as in risk of substitution. The web is becoming a big origin of information giving an in-depth inclusiveness

that leads to a mark on the value of libraries and their collections [1]. This review will not reflect on these later roles, but will focus on the certainty of changing technology, the rising digital media and the changing social landscape that has changed user's expectations of the online verification system. Digital libraries are located in different locations, so environmental components have also been explored for their influence on users' awareness, acceptance and use of practices; often, the social situations or backgrounds around the online verification system are very distinct; for example, they vary from institution to institution [2].

The test of whether a product or service, or program complies with a regulation, requirement, specification or condition is called certification [3]. Authentication is a way to judge a document its authenticity and its validity. Valid documents are verified by their valid stamps and a verified signature.

"Nowadays, the standard certification process is a written process, and in this process the institution/organization seeking to verify the result will have to attend the university or submit a written request to confirm the result."

The call will further go to library directories for safe files to look for the duplicate certificate, this is not really effective and efficient process, also sometimes files get lost while moving from one office to another, and in some cases, it gets missed or is difficult to locate [7].

3 Existing System

3.1 *Digital Locker (Microsoft)*

A digital locker or cyber locker is an online file or digital media storage service. It stores music, videos, movies, games and other media. The name was used by Microsoft as a part of its Windows Marketplace in 2004 [4]. By storing files in a digit locker, users are able to access the stored file with the help of Internet connections. Most (but not all) digital locker services require a user to sign up. Prices range from free to paid and various combinations of them.

Digital lockers, as opposed to simple storage services, are typically associated with digital distribution.

3.2 *Digital Locker (by Government of India)*

Digital locker is one of the key strategies under the Digital India Program of the Government of India. A beta version of the program was released on February 10, 2015, by Department of Electronics and Information Technology (Deity) [5].

Digital locker aims to reduce the use of virtual documents and authorize the sharing of e-documents across the organizations and the agency. The distribution of e-texts

will be done through registered documents after verifying its online authentication [6, 7].

4 Proposed System

This proposed system is based on the online verification or access of all the necessary documents of a person at anytime and anywhere easily. The necessity of the proposed system is as follows:

- Easy to carry documents online.
- Safe, secure, easy to use.
- No waiting in longer queue for verification of documents.
- Fast and efficient way of verification.
- Can act as a basic medium for every database.
- Chances of losing documents can be eradicated.

The specification of this proposed system is as follows:

- **Aadhaar Verification**—The verification of documents of a person should be done through its Aadhaar identity only. Login should be done only when OTP is generated on the registered mobile number.
- **Security**—Fully secure because of Aadhaar verification and OTP process. Only authorized user can access the documents, and automat logout system should be there (i.e., there would be only a small access session per login).
- **Online Management**—The documents are available and attached to the Aadhaar and can be monitored through it. Updating and deletion of documents are easy. Attachment of new documents is easy.
- **Easy to Carry**—Carrying the documents online is easy and efficient way of holding it. It is always stored on that database online. Burden of carrying hard copy is exhausted. Submission is easy.
- **Safe and Secure**—Chances of loosing and wear and tear off of documents (hard copy) is reduced or basically exhausted. The safety and security of the document verification are ensured with the help of setting the time limit to access the verification account and automatic logout the account after the time period.
- **Fast and Efficient**—Accessing of documents is easy and in a fast way. It is also time saving, therefore efficient way. It replaces the heavy and lengthy process of document verification which consumes a lot of time and saves time and money both. Figure 1 shows a dataflow diagram of online verification system.

5 Result and Analysis

The system requires various hardware and software. Hardware consists of operating system (Red Hat Linux), workstation, etc., the software consists of Python, web

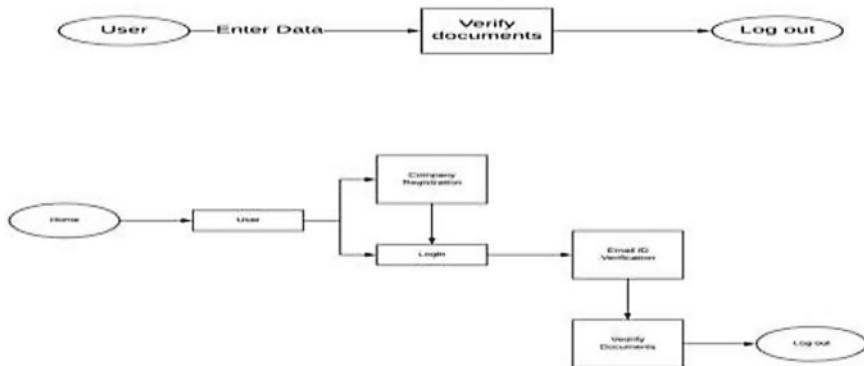


Fig. 1 A dataflow diagram of online verification system

server, XAMPP-win32-7.0.9-0-VC14-installer for (Apache Web Server), and the functional requirement is webpage and the android application.

The system will verify the documents and certificate like Aadhaar card, mark sheet, other government id, etc. The document is stored in the database, only the admin can access the database, user can upload the document, and the further process is done by the other authorities like mark sheet of CBSE is verified by CBSE authorities, etc.

5.1 *Login and Registration for Online Verification System*

This is first user interface which will be used for further process regarding online verification system. It consists of registration page for the new user and login page for the existing user. This interface of the system will come when the user clicks the “forgotten password.” In this phase, the verification link for password will be sent to the registered email id, and the user can reset password from that link. Figure 2 shows login and verification system to change password.

5.2 *Document Verification*

This interface will come after a successful registration in the system now, user can select the name of the document from the screen and then can successfully upload it on the system, and the system will further verify that document. The token is generated for the verification purpose, when any corporate or any other user is checking our documents. The token is randomly generated for 60 min, the corporate can only check our document, and they do not have any access regarding the deletion and updating

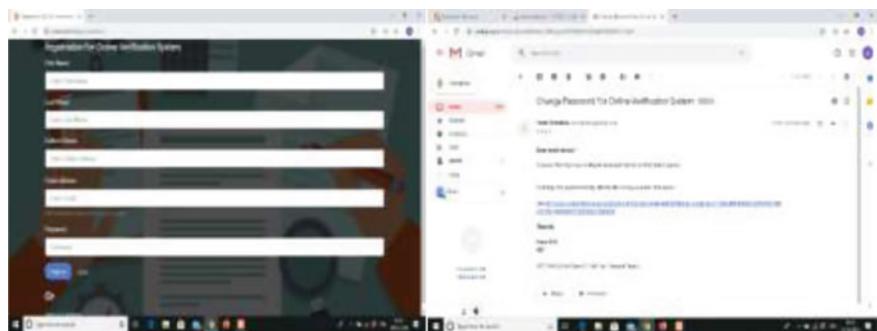


Fig. 2 Login and user notification and verification system for online verification system

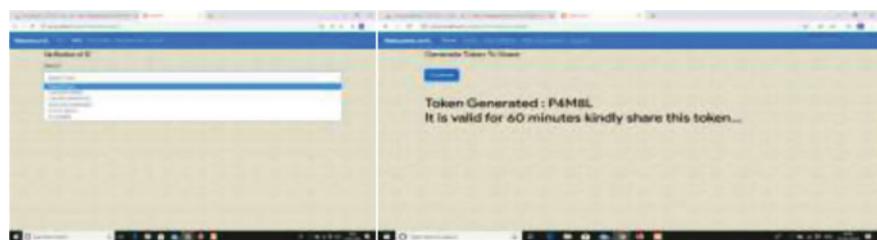


Fig. 3 Document verification and token generated for verifying document

of any documents. Figure 3 shows document verification and token generated for verifying document.

6 Conclusion

The proposed system offers the real possibility that various documents can be kept in safe environment. This paper looks at one of the areas where more power is needed. We first give the online platform to store the documents, using which a user can easily carry his/her documents without actually carrying them. Online verification system will be a useful research tool that will open up new proficiency for verifying and confirming certificates before accepting it. It saves time and decreases errors to a minimum by comparing a manual method with a reduction factor. Secondly, one can easily verify the authenticity and validity of the documents submitted by the person. The authorized access can only be given after OTP verification. Hence, this system provides two facilities to the user like storing documents online and verifying them online as well as they would be secure also. As a future scope, we are developing an API which can be used to scan the barcode that is present in our documents like 10,12 or any government identity and by that scanning we can directly upload it in

our portal. By this, we can stop tempering originally generated documents and it is much more easier for the user to access.

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A Survey on Various Cryptography Techniques for Image Encryption and Decryption



Roopal Mathur, Amit Kumar Gupta, and Priya Mathur

Abstract In today's world, the use of digital applications and multimedia is a necessity. And, for the communication of multimedia data, security is also needed. So, to secure multimedia data such as videos and images, the various cryptographic techniques can be used. These cryptographic techniques include encryption and decryption techniques. Hence, over a medium of the channel, while transferring these multimedia data encryption techniques are used that convert the original image into ciphertext which is not readable to the unauthorized user and then communication is done successfully. In past years, many encryption techniques are proposed and discovered for the protection of confidential and important data. In this paper, various encryption techniques have been surveyed and discussed in detail.

Keywords Encryption · Decryption · Cryptography · Security · Confidential · Image

1 Introduction

In today's era, digitization is on its boom. The computer read only 0 and 1 format. This characteristic defines that multimedia content (sound, text, and pictures) are converted in the form of 0 and 1 which is called digital form. These digital data are processed by computer that is called digitization. When these images, sound, and text are sent over an unsecured network, security plays an important role. Data security protects the data contained in images or sound so that no unidentified user or

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unauthorized user can access it. Hence, for the protection of images, text, a technique called encryption can be used. Hence, the process of changing the plaintext data into a non-readable or untestable form namely ciphertext is known as encryption and the process of transforming ciphertext to plaintext is known as decryption. Cryptography is the combination of encryption performed at sender side and decryption performed at receiver side. Cryptography is a technique which secures data and information from any internal or external attacks. In this paper, various encryption techniques have been discussed in detail [1, 2].

There are various terms related to cryptography. They are as follows [3]:

- **Plaintext**—It is the simple alphanumeric message that is written by a person who wants to send from one end to another end.
- **Ciphertext**—It is the message which is produced when converting plaintext using some algorithm and cannot be human-readable before transmission of the actual message.
- **Encryption**—It is the process of transforming an original text into ciphertext.
- **Decryption**—It is the process of transforming ciphertext into the original message, i.e., plaintext.
- **Key**—The key is the similar concept like we use a lock with key to safe our things. In the history of cryptography, the key is used to encrypt the plaintext to transform in ciphertext and decrypt the ciphertext to recover the plaintext. The key may be in any form like alphanumeric, digit, or may be the combination of these two. The key always keeps secret.

1.1 *Types of Cryptography*

The cryptography can be classified into two categories on the basis of key used. Either any cryptographic algorithm is symmetric or asymmetric. The following section is briefly described both types of algorithm.

(a) **Symmetric-key cryptography**

Privacy plays the main role in symmetric algorithms, therefore any cryptographic algorithm, in which a common key is shared by both participants for encryption or decryption. These types of cryptographic algorithms are classified in the categories of symmetric-key cryptography. The shared key must keep it in secrecy. Accordingly, no third party is allowed to know the key; otherwise, the safety is lost. The symmetric algorithm is characterized by not consuming too much computing power [2].

(b) **Asymmetric-key cryptography**

In the cryptographic algorithm, different keys are used for encryption as well as for decryption by participants. These types of cryptographic algorithms are classified in the categories of asymmetric-key cryptography. The key which are used in asymmetric-key cryptography is namely known as public key and private key. The

Fig. 1 Symmetric-key encryption

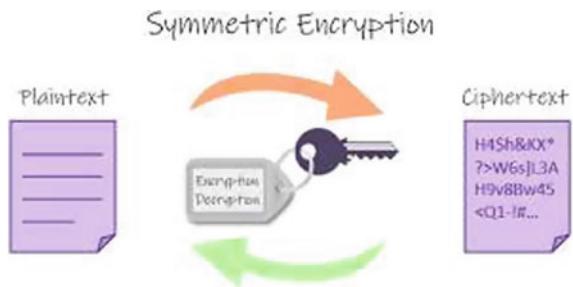
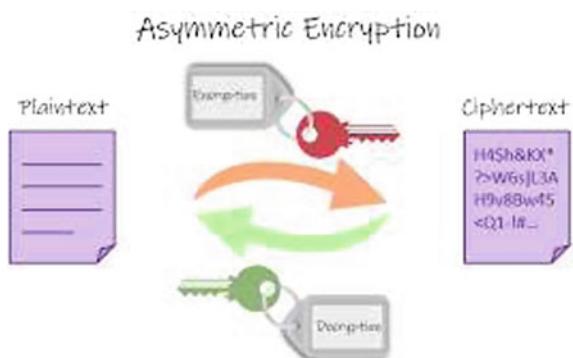


Fig. 2 Asymmetric-key encryption



pair of public key and private key that is matched will be used in the public-key cryptography algorithm. The public key is needed not to be kept secret but the private key is kept always safe [3] (Figs. 1 and 2).

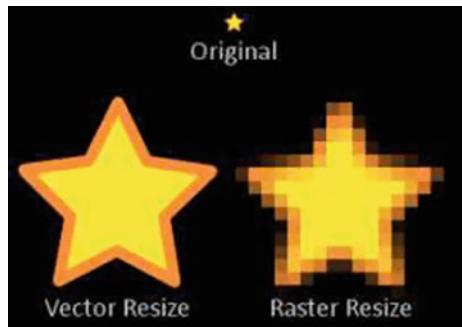
1.2 Image Cryptography

It is known that a computerized picture (**or a digital image**) is a picture made out of picture components, otherwise called pixels, each with limited, discrete amounts of numeric portrayal for its power or dim level that is yield from its two-dimensional capacities took care of as contribution by its spatial directions meant with x, y on the x-hub and y-hub, individually [4].

A digital image is of two types:

- (a) Raster image
- (b) Vector image
- (a) **Raster image:** **Raster images** consist of picture elements known as pixels. The advanced picture contains a fixed number of lines and segments of pixels. Pixels are the smallest unit of a digital image that can be displayed on the digital device such as computer. The pixels are put away in PC memory as a

Fig. 3 Raster versus vector image



raster picture or guide. It is basically a two-dimensional exhibit of little whole numbers. These sorts of pictures are made by different kinds of information gadgets and strategies, for example, scanners, advanced cameras, and so forth. Raster pictures likewise comprise of different document designs, for example, JPEG, TIFF, PNG, BMP, GIF, and so forth.

- (b) **Vector image:** Vector pictures result from scientific geometry. Right now, it comprises of both extent and heading. These are associated with by-lines and bends to frame polygons and different shapes. Every 16 oz has an unequivocal situation on the x-hub and y-pivot and decides the bearing of the way also. Vector pictures additionally have different picture groups, for example, SVG, EPS, PDF, and so on [4].

This image shows a comparison between the raster image and the vector image. When the image is magnified, the vector image is clear and on its definite position while raster image when magnified, its pixels get displaced from its original location and the image becomes blurry (Fig. 3).

1.3 Requirements of Image Encryption

Image encryption requires the capacity to get the pixels of the first picture. We have to make a solid encryption picture to such an extent that it cannot be hacked effectively and also has faster encryption time to such an extent that scrambled picture is moved quickly to the individual. Additionally, the faultlessness in the picture we acquire in the wake of decoding it.

1.4 Need of Image Encryption

These days, data security is getting increasingly significant in information stockpiling and transmission. Pictures are broadly used in different techniques. Image encryption

assumes an important task in the field of hiding of data. The picture encryption technique makes the data incoherent. Henceforth, no unauthorized user or unapproved client, including server directors and others, can access the first message or some other kind of transmitted data through open systems, for example, the Web. For image encryption, we have used various encryption algorithms. These are being surveyed and discussed below.

2 Methodology

In this section, we look a brief literature work which is presented by researcher. Different types of cryptographic techniques are applied to the different types of data according to the level of security to be provided. For text, various cryptographic techniques are the same but for images and videos, different cryptography techniques can be used. Various encryption techniques for images are:

- A. Pawar and Harkut [5] presented a paper entitled as "**Classical and Quantum Cryptography for Image Encryption & Decryption.**" In 2018, in this paper, the researcher has overviewed and thought about the current work and ideas of classical (or old style) cryptography (CC) and quantum cryptography (QC) used for image encryption and decryption (unscrambling). Every encryption and decryption (decoding) procedures have their advantages and limitations. Right now, it is centered around selecting the best cryptography method to be used for picture encryption and decryption with the goal that analysts can get a thought regarding the decision of productive cryptography procedures. At that point, they inferred that quantum cryptography is more secure than that of the old-style cryptography approach as it is dealing with standards of quantum mechanics and the highlights gave by the quantum bits approach. Quantum cryptography is useful to play out the safe trade of interactive media information like recordings and pictures. The Quantum cryptography is in its underlying phases, extra work should be done to improve its presentation and conquer its impediments same as the issues to execute it. Also, to expand the correspondence extend and the bit move rate.
- B. Kester and Koumadi [6] presented a paper entitled as "**Cryptographic Technique for Image Encryption based on RGB Pixel Displacement.**" In this paper, the researchers built up a figured calculation to create the figured picture and to decode the figured picture. This calculation makes it feasible for encryption and unscrambling of the pictures dependent on the RGB pixel dislodging. The transposition and reshuffling of the picture in ventures between the procedures have ended up being viable as far as the security investigation. The extra exchanging of RGB values in the picture document after the RGB part moving has demonstrated the expansion of security of the picture against every single imaginable assault available at present. They likewise centered around the work of open key cryptography in the encryption of pictures as their future degree.

- C. Amalarethnam and Geetha [7] presented a paper entitled as “**Image Encryption and Decryption in Public Key Cryptography based on MR.**” In this paper, the researchers proposed another encryption calculation dependent on the enchantment square shape. Right now, the picture is changed over into squares of single bytes and afterward, the square is supplanted as the estimation of MR. Additionally, the control parameters of the enchantment square shape (MR) are chosen randomly by the client. In this way, the picture is being scrambled with open key cryptography calculations, for example, RSA, ElGamal, and so on. The exploratory outcome shows that the proposed calculation can effectively scramble/unscramble the pictures with isolated mystery keys, and the calculation has a decent encryption impact. Ciphertext created by this technique will be totally unique when contrasted with the first picture record and will be reasonable for the made sure about transmission over the Web. Along these lines, this model gives an extra degree of security to an open key calculation and effective usage of memory. The future improvement is required right now to decrease the extra time required for the development of an enchantment square shape and pressure pictures.
- D. Zhang et al. [8] presented a paper entitled as “**A Fast Image Encryption Scheme Based on AES.**” In this paper, the researchers have verified a quick picture cryptosystem dependent on AES. Right now, the picture is isolated into information squares of size 128 bits. The main square of the plain picture is arranged by an underlying vector. At that point, AES in figure square fastening mode is utilized to scramble each square consecutively. The underlying vector and figure pictures are transmitted to the decoding side through the open data channel. The decoding side uses the mystery key and starting vector to unscramble the figure picture to acquire the first picture. The method of recreation shown that the picture cryptosystem, which can be utilized as the correlation storm cellar of recently proposed picture cryptosystems dependent on clamorous frameworks. Henceforth, the tried framework can be utilized as the correlation storm cellar of recently proposed picture cryptosystems. Those picture cryptosystems whose encryption/decoding speed is slower than the AES-based plan in a similar PC should be improved.
- E. Gupta [1] presented a paper entitled as “**Different Image Encryption and Decryption Techniques and KA Image Cryptography.**” In this paper, the researcher surveyed diverse encryption strategies and proposed another calculation KA encryption method. It helps in improving picture encryption. KA encryption procedure encodes the picture in two stages. To begin with, it applies various procedures on picture lines and segment shrewd pixels. Second, it at that point partitions the entire picture into various parts and afterward applies various activities. KA procedures are helpful systems on the grounds that here for the most part picture information is changed over into content information as per ASCII code. Hence, when an unapproved individual decodes this ciphertext information then it is extremely hard to comprehend whether it is picture information or content information. Since the entire picture information is sent over a system as form of content information, various cryptography strategies

are applied on both pictures, the content information which is created after the change of a picture in content information.

3 Conclusion

Various encryption techniques are surveyed and presented in this paper so that researchers can be more familiar with various encryption techniques. Not only this, but it also shows the merits and demerits of different encryption techniques as well as many papers proposed new algorithms also. So in this paper, it shows how efficiently an algorithm works for different images. Hence, I conclude that each encryption algorithm is good and efficient for different types of data and also fulfills the purpose of cryptography (confidentiality, fidelity, security, etc.).

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A Subjective Quality Assessment of Objects Based on Visual Attention



Tamanna Sahoo and Bibhuprasad Mohanty

Abstract Subjective assessment of visual quality for the evaluation of the most attentive object of a video scene is very crucial for developing and validating any objective measures. In this paper, we present a subjective evaluation scheme for a visual attentive object in a video frame. A total of 223 viewers were asked to identify objects which attract most visual attention in a particular scene, for 20 such different scenes. The viewer's opinion score was rated as per the ITU recommended 5-point discrete scale and was composed with an objective model for visual attention as developed by Itti's et al. The trajectory of viewer's choice decided by mean opinion score(MOS) and that of Itti's model indicate that the objective model is best suitable for salient visually attentive objects, but not for moving objects. The reason may be attributed to the fact of feature selection for the objective model.

Keywords Subjective assessment · Mean opinion score · Trajectory and salient

1 Introduction

In recent years, the subjective data evaluation of video and image quality has become an important part of various image synthesis-based applications like image editing, image retargeting and 2D to 3D conversion [1] and fields like broadcasting [2]. The most popular subjective assessment measures for video quality [9] have been recommended by the International Telecommunication Union (ITU) [3]. To validate video or image quality by the subjective assessment, various methodologies (like the single stimulus, double stimulus, pair comparison), type of rating scale, number of rating points or categories and type of rating asked participants are the important

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factors [4]. Recently, many objective models (computer algorithms) have been validated using subjective assessment. Similarly, in this paper, one of the traditional and famous biologically inspired computational model (namely Itti's model) [5] has been evaluated using subjective assessment. Here, many varieties of frames from videos of change detection dataset have been acquired and subjective assessment based on human visual attention and computational visual attention based on trajectory created by Itti's model has been compared. The trajectory paths are validated by creating a path deviation and percentage of path deviation.

The remainder of the paper is prepared accordingly. In Sect. 2, a brief description of the assessment environment and its processing has been discussed. Further in Sect. 3, the experimental results and the details of the subjective assessment are presented and discussed which is followed by a conclusion where the shortcomings of objective model based on Itti's model have been discussed and further improvement on the proposed work has also been explained in Sect. 4.

2 Subjective Assessment

2.1 Assessment Environment

For subjective assessment of the moving objects, we have restricted our option for visual attention, mostly, to moving object available in the chosen frame. We have randomly chosen 24 numbers of frames from different video clips available in [6] and selected objects of our choice. This exercise has been carried out in a view to restrict our computation only to a limited number of options thereby avoiding a huge number of excess multiples. Two hundred twenty three numbers of viewers of age group (19–42) were chosen from the inside and outside of university. One hundred ad forty eight numbers being female and 75 numbers of male viewers. Being more sensitive to color, intensity and brightness, (since our computational model based on Itti's algorithm relies heavily on these features) female viewer's opinion seems to be more aligned with the model.

2.2 Viewer's Opinion Collection

For a given image and given selected objects (as shown in bounding box A, B, C, D in Fig. 1), the viewers were asked to exercise their preference in descending order of most attractive/attentive (highest priority) to least attractive (least priority) within that frame. Such user's opinion are then used to deduce a trajectory in the descending order of preferences based on visual attention and is tabulated (Table 1) as 'direct'.

In Table 1, the direct user opinion is computed according to human viewer's score. Further the maximum score of the particular rating is chosen as a condition to obtain

Fig. 1 Example of one question from the questionnaire

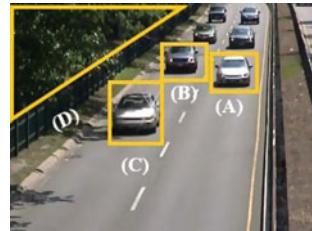


Table 1 Table for direct user opinion for Fig. 1

Object/rating	4	3	2	1
D	0	49	0	174
C	158	65	0	0
B	12	109	53	49
A	53	0	170	0
Max	C	B	A	D
Mean viewer's score	80.56	57.77	33.587	46.33

the most attentive object. It is further normalized using the formula 1 and the mean viewer's score is calculated using formula 1.

$$\text{Mean Viewer's Score(MVS)} = \frac{100 \times \left(\left(\frac{\text{Highest score} \times \text{Rating}}{223} \right) + 2 \right)}{6} \quad (1)$$

2.3 Data Processing and Mean Opinion Score(MOS)

The viewer's opinion regarding the visual attentive object in a particular frame is recorded. The 5-point discrete scale [7] was chosen to award a score of 4 to the most attentive object in descending order up to score of 1 to the least attentive object. '0' is awarded when a viewer's opinion does not match with the reference object (in given bounding box). Because of the participation of limited numbers of viewers on the subjective survey, by computing the mean opinion score (MOS) for an image frame. We have adopted the raw data processing methods as suggested by [8].

Let us define:

N = Number of viewers = 223; $n = 1, 2, 3 \dots, 223$

M = Number of objects = 4; $m = A, B, C, D$.

For each object in a given image, do the following:

1. Compute the opinion score (OS) by awarding a score from 0 to 4 as per 5-point discrete scale as per viewer's preferences.

2. Convert OS into normalized opinion score(NOS) such that

$$\text{NOS} = \frac{100(\text{OS} + 2)}{6} \quad (2)$$

The score will be normalized within the range of [50, 100].

3. Compute the MOS such that

$$\text{MOS}_m = \frac{1}{N} \sum_{(n=1)}^2 \text{NOS}_i \text{ for } m = A, B, C, D \quad (3)$$

3 Assessment Performance and Analysis

Since all the objects chosen from each individual images from the database are subjectively selected by us, it was necessary to keep in mind the attentive selection of objects in that image accordingly present the options before the viewer. The trajectory obtained from the direct opinion of viewer's is taken as a reference trajectory, and it has been compared with trajectories obtained from mean opinion score and Itti's visual attention model [9]. The trajectories are evaluated using the percentage of path deviation which is the path deviation from the reference path obtained from the user's opinion with the maximum deviation.

$$\text{Percentage of Path Deviation (PPD)} = \frac{\text{Total number of deviation}}{\text{Maximum deviation} (= 3)} \times 100 \quad (4)$$

The following percentage of path deviation is calculated for the mean opinion score obtained from the subjective assessment with respect to MVS presented in Table 2. It is also calculated for objective-based computational model with respect to MVS and MOS presented in Table 3.

Table 2 PPD for subjective assessment

Image (I)	Trajectory by MVS (II)	Trajectory by MOS (III)	Deviation path with respect to MVS (IV)	PPD (V)
Image 01	$C \rightarrow B \rightarrow A \rightarrow D$	$C \rightarrow A \rightarrow B \rightarrow D$	3	100
Image 02	$B \rightarrow D \rightarrow A \rightarrow C$	$B \rightarrow D \rightarrow A \rightarrow C$	0	0
Image 03	$A \rightarrow D \rightarrow B \rightarrow C$	$A \rightarrow D \rightarrow C \rightarrow B$	2	66.666

Table 3 PPD for objective-based Itti's model

Image (I)	Trajectory by MVS (II)	Trajectory by model (III)	Deviation path by the model			
			with respect to MVS (IV)	PPD (V)	With respect to MOS (VI)	PPD (VII)
Image 01	$C \rightarrow B \rightarrow A \rightarrow D$	$C \rightarrow A \rightarrow D \rightarrow B$	2	66.66	0	0
Image 02	$B \rightarrow D \rightarrow A \rightarrow C$	$B \rightarrow A \rightarrow D \rightarrow C$	3	100	3	100
Image 03	$A \rightarrow D \rightarrow B \rightarrow C$	$A \rightarrow C \rightarrow D \rightarrow B$	2	66.66	2	66.66

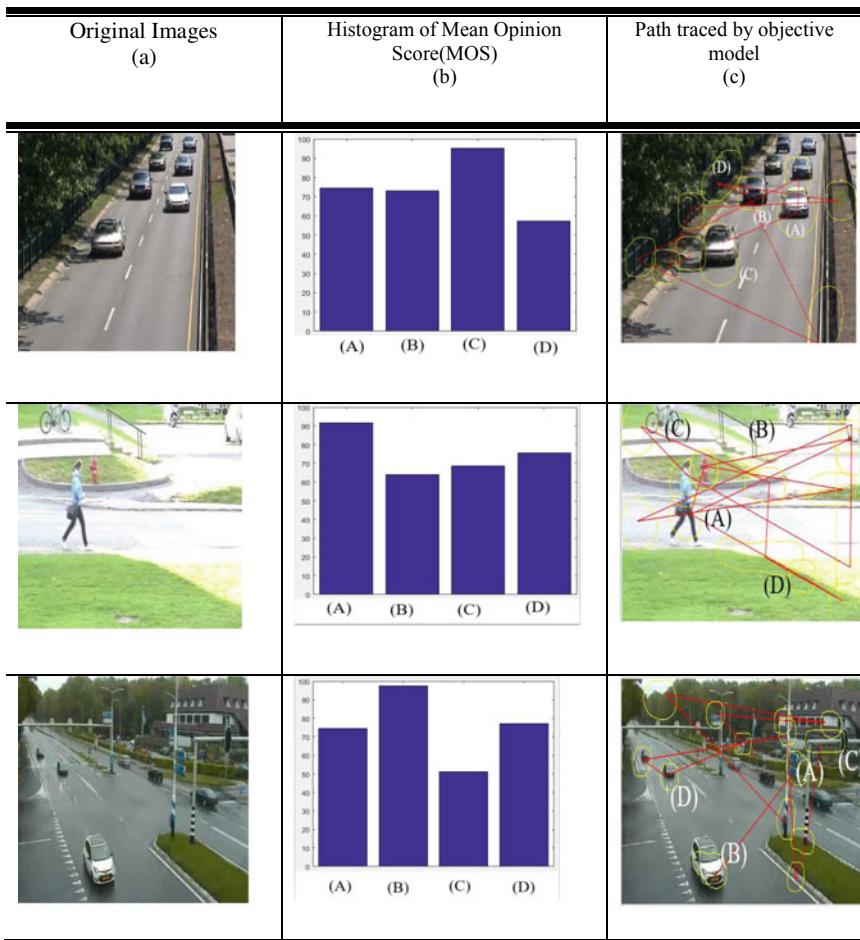
**Fig. 2** Results of subjective assessment and objective model

Fig. 2 present below shows the results of trajectory path obtained using histogram of MOS from subjective assessment and trajectory path from objective-based Itti's model, wherein Fig. 2a represents the original images 01, 02 and 03 chosen from change detection dataset [6]. Figure 2b represents a histogram of mean opinion score of the subjective assessment and provides the trajectory accordingly. Figure 2c represents using trajectory obtained from Itti's visual attention model where it follows numerous paths and detects non-salient objects more than the desired salient object through trajectory which is a major drawback of this method.

4 Conclusion

The creation of the trajectory path from most attentive to least attentive through visual attention by the human viewer's and computational model is one of the main purposes of this paper. The trajectory path created using an objective-based model of visual attention and mean opinion score obtained from a subjective assessment of a human viewer's depicts that later method produces accurate results as it is produced statistically. But, the objective model fails to find the order of salient objects accurately and it takes a series of the path to ultimately find the salient object. The deviation is due to feature selection by the objective model as suggested by Itti's, which does not take care of motion information. Hence, sometimes the percentage of path deviation is 100% as compared to MOS (subjective assessment). This leads to the requirement of further improvement of the computational model by implementing certain features in the objective model which can immediately locate the salient objects.

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Regression Analysis on Macroeconomic Factors and Dividend Yield on Bank Nifty Index Returns



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Abstract The study has examined an impact of macroeconomic variables and dividend yield on Bank NIFTY Index. It analyses the relationship amongst macroeconomic variables and dividend yield. The study used quarterly data from 1 January 2010 to 31 December 2019. It employed statistical measures like regression analysis to analyse the impact of independent variables (macroeconomic factors and dividend yield) on the dependent variable (Bank NIFTY returns) and multicollinearity tests to understand the relationship amongst the independent variables. The observations concluded that GDP, government bond yield and dividend yield have a significant impact on Bank NIFTY returns but CPI does not have a significant impact on Bank NIFTY returns. We can also conclude that all the independent variables are not correlated to each other. The study suggested to policy makers, in India, that they should maintain economic stability through policies of growth that will eventually boost the banking sector and the economy.

Keywords Bank NIFTY · Regression analysis · Autocorrelation · Multicollinearity · Durban Watson test

1 Introduction

A stock index or stock market index is a measurement of a section of the stock market. From among the stocks listed on the exchange, some similar stocks are selected and grouped together to form an index. Thus, an index is a solid indicator of the changes in the market. Various indices in India are Broad Market Indices, the BSE Sensex, the Nifty Index, Sectoral Indices, Nifty Auto Index, Nifty Bank Index, Thematic Indices, etc., [1]. There are various factors affecting the indices like liquidity, capitalization, dividend yield policy, microeconomic factors (inflation rate, interest rate, bank rate, etc.) and various macroeconomic factors, political, social and even global factors [2].

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The economic growth, expressed by the GDP growth, has multiple effects among which is the increase of bank activity [3]. Increase of bank deposits and loans has a positive impact on bank profitability. When the economic activity decreases, the demand for loans and deposits decreases and negatively affects the profit margins [4].

An econometric model is used to assess bank-specific and macroeconomic factors. The results indicate that profitability of banks in India is affected by both internal and external factors. There were also factors that had no influence such as bank size and ratio of priority loans to total loans [4].

The authors examine bank-specific and macroeconomic factors that would determine the liquidity of Indian banks. The data examined is estimated from 59 banks over a period of 13 years, from 2000 to 2013, and to better understand the affect, numerous statistical tools are used including OLS regression, fixed effect and random effect. Their findings revealed that bank ownership does impact liquidity of banks and both bank-specific (except cost of funding) and macroeconomic (except unemployment) factors have a very tangible impact on bank liquidity, respectively. Moreover, factors such as bank size and GDP were found to have a negative impact on bank liquidity [5].

Researchers have also worked towards understanding the relationship between returns and volatility of the Bank Index and the NSE NIFTY. The data used is the stock prices of the 12 banks of the index, and it is for a period of 1 year (2015–16). Statistical tools including standard deviation, beta and correlation are used in the process. The study concluded that comparing volatility has a very practical application for investors depending on their risk profile [6].

In another study, authors have applied statistical analysis on top five private banks traded in NSE during the year 2013–2014. It was observed that the causes for the changes in equity prices are due to market fluctuation and are based on the closing price of the equity price [7]. Researchers have also found that there is a very small impact of interest income, advances, deposits, borrowings and a slightly higher impact of Bank Nifty Index on share prices [8]. In his study, the author emphasizes that stock market volatility is caused by number of factors such as change in inflation rate, interest rate, financial leverage, corporate earnings; dividends yield policies, bonds prices and many other macroeconomic, social and political variables such as international trends, economic cycle, economic growth, budget, general business conditions, credit policy [3].

Baranidharan and Vanitha [9] have analysed correlation between macroeconomic variables and the Indian Stock Market. The BSE Sensex is the chosen stock market index, and the monthly data has been taken from BSE as well. The factor analysis is used for reducing the number of variables and computing them into common factors. The factors are labelled as macroeconomic, capital market performance and macroenvironment. The overall conclusion of the study was that macroeconomic variables do have a very strong impact on the Indian stock market.

This study [10] focuses on the relationship between the return, volume and volatility in the National Stock Exchange in India. GARCH model helps in capturing the tendency in financial data for volatility clustering. The volatility in indices of the

stock markets ideally is stimulated by macroeconomic factors, political environment, foreign exchange rates, growth rate and economic state of a country. However, there are numerous other factors affecting the market volatility; the influence of some may be stronger than others [11]. This paper aims to

- Examine the impact (if any) of macroeconomic and dividend yield on Bank Nifty returns in the Indian stock market.
- Analyse the relationship (if any) amongst the macroeconomic variables and dividend yield of bank NIFTY.

Section 2 explains the proposed methodology followed by experimental results in Sect. 3. Sect. 4 concludes the study highlighting scope for future work.

2 Proposed Methodology

This study is a type of descriptive long-term research as the purpose of the study is to better understand the impact of various variables on 10 years Bank Nifty returns. Under descriptive research, the research design chosen is longitudinal as the study focuses on a section of population over a long period of time. The time period chosen is 10 years from 1 January 2010 to 31 December 2019. Bank Nifty was chosen out of all the indices of Indian stock market because this index is the most volatile. The proposed work is explained under following sub-headings (a) variables considered and (b) regression analysis.

2.1 Independent and Dependent Variables

The various variables used for study are as described below and shown in Table 1.

Table 1 Derivation of independent variables

Derivation of all the independent variables	
<i>Banking industry/company factors (external factors)</i>	<i>Derivation of the factor</i>
Dividend yield	Bank nifty dividend yield
<i>Macroeconomic factors (external factors)</i>	<i>Derivation of the factor</i>
Inflation	Inflation growth rate (CPI)
GDP growth	GDP at constant price
Government bond yield	183-364 govt. securities yield

- The dividend yield is the ratio of a company's annual dividend when compared with company's share price. The dividend yield is represented as a percentage term.
- Formula: Gross dividend/index market capitalization * 100 [1].
- The CPI is an index that measures the rate at which the prices of consumption goods and services are changing from month to month (or from quarter to quarter) [12].
- GDP measures the monetary value of final goods and services, i.e. those that are bought by the final user produced in a country in a given period of time (say a quarter or a year). $GDP = \text{Private consumption} + \text{gross investment} + \text{government investment} + \text{government spending} + (\text{exports} - \text{imports})$ [13].
- Independent variables are those which are not influenced by any other variable. Dependent variables (response variable) are the variables of inquiry, and their value depends on another variable. In this study, the dependent variable is the Bank Nifty returns. Bank Nifty represents the 12 most liquid and large capitalized stocks from the banking sector which trade on the National Stock Exchange (NSE) [1] (India, 2020).

2.2 Regression Analysis

Statistical tools like linear regression are used to examine the relationship between the dependent variable (Bank Nifty returns referred as “y”) and various independent variables (GDP, CPI, dividend yield, etc., referred as “x”). For “m” variables, the relationship can be expressed through Eq. (1).

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_m x_m + \xi_i \quad (1)$$

where $i = 1 \dots m$, m is number of variables

$\beta_0, \beta_1 \dots, \beta_m$ are regression coefficients ξ_i is the error (residual) of i observations.

The beta coefficient is the degree of change in the outcome variable for every 1-unit of change in the predictor variable [14].

Prediction equation:

$$\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_i \quad (2)$$

where \hat{y}_i is the predicted value of the dependent variable y .

$\hat{\beta}_0$ is y intercept,

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x} \quad (3)$$

$$\hat{\beta}_1 = \frac{SS_{xy}}{SS_{xx}} = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2} \quad (4)$$

$\hat{\beta}_1$ is the slope and x_i is the independent variable.

SSE stands for “sum of squares due to error”—this is simply the sum of the squared residuals, and it is the variation in the Y variable that remains unexplained after considering the variable X . It is also called residual error.

3 Experimental Results and Analysis

In this study, effect of various predictor variables (CPI, Government bond yield, GDP and dividend yield) on response variable (BNK returns) is analysed through regression technique.

The Hypothesis for this study is defined as follows:

Null hypothesis, H_0 = Predictors have no impact on response variables

Alternate hypothesis, H_a = Predictors have an impact on response variables.

3.1 Data Collection

The Bank Nifty represents the 12 most liquid and large capitalized stocks from the banking sector which trade on the NSE [15]. The macroeconomic factors (GDP, CPI, Govt. bond yield) have been collected through secondary sources of last 10 years from the websites of Reserve Bank of India (RBI) and International Monetary Fund (IMF). The industrial or company-specific data has been extracted from the website of National Stock Exchange (NSE) of India and moneycontrol.com [1]. The original data extracted for macroeconomic factors and Bank Nifty returns was mainly on daily or monthly basis. This data was further converted into quarterly and yearly basis by taking average of the period. The following experiments are conducted on the data.

3.2 Descriptive Analysis on Quarterly Data

From the descriptive statistics Table 2, we infer that Bank Nifty return, government yield, GDP and dividend yield have a negative kurtosis (less than 3), and thus they are platykurtic. The CPI has a positive kurtosis close to 3, thus is mesokurtic. Skewness is the degree of distortion from the symmetrical bell curve or the normal distribution. A symmetrical distribution will have a skewness of 0. According to the Descriptive statistics, Bank Nifty return are moderately positive skewed as it lies between 0.5 and 1. CPI is greater than -1 which implies the data of CPI is highly skewed. Government yield, GDP and dividend yield data are fairly symmetrical as it lies between -0.5 and 0.5

Table 2 Descriptive statistics

Descriptive statistics						
Particular		BNK returns	CPI	Govt. yield	GDP	Div. yield
<i>N</i>	Statistic	40	40	40	40	40
Range	Statistic	30215.1085	145	7.29140267	3719830	1.510274
Mean	Statistic	22278.5999	108.860833	6.41841753	1844800.853	0.96526138
	Std. error	1496.5409	6.80286775	0.29303444	216329.7929	0.06529029
Std. deviation	Statistic	9223.37204	43.0251122	1.85331255	1368189.742	0.41293203
Variance	Statistic	89585386.4	1851.16	3.435	1.87194E+12	0.171
Skewness	Statistic	0.62	-0.27	-0.461	-0.091	-0.342
	Std. error	0.374	0.374	0.374	0.374	0.374
Kurtosis	Statistic	-0.993	2.928	-0.591	-1.58	-0.779
	Std. error	0.733	0.733	0.733	0.733	0.733

3.3 Assumption of Linear Regression

We use regression to analyse the impact of the independent variables that are CPI, GDP, govt. bond yield and dividend yield on the dependent variable, i.e. Bank Nifty returns (BNK returns) on quarterly based data. The following assumptions are checked before applying regression.

A. Linearity

It is the relationship between the predictor variable and the outcome variable. The graph below shows a linear relationship between predicted bank nifty returns and the actual bank nifty returns. The scatter plot below does not depict any curvilinear relationship, confirming the linearity between the two variables (Fig. 1).

B. Absence of Multicollinearity

When independent variables have very high intercorrelations amongst themselves, it is referred to as multicollinearity. Multicollinearity is also tested by looking at the variance inflation factor (VIF) in the table below. There is no multicollinearity if the VIF for all factors is below 10, which is the case for all independent variables in Table 3. Therefore, we accept the null hypothesis (H_0); i.e., there is low correlation between the independent variables.

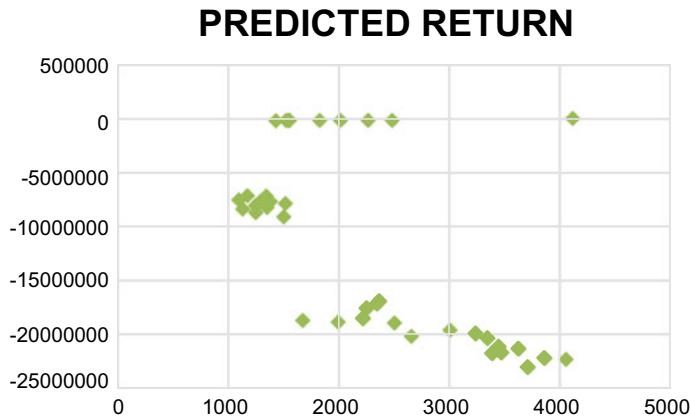


Fig. 1 Scatter plot of predicted and actual bank nifty returns

Table 3 Correlation between independent variables

Variables	cpi	Govt. yield	gdp	Div. yield
VIF	2.106	1.798	3.164	1.955

C. Durban Watson Test

Autocorrelation is used to examine the impact of past prices on the future price of a security. The Durbin Watson Test is a statistical test for autocorrelation. The value of this statistic ranges between 0 and 4 always. Here are the inferences from the test could be:

If the value of the DW Statistic is 2.0, no autocorrelation can be inferred.

If the value of the DW Statistic ranges between 0 and 2.0, positive autocorrelation can be inferred.

If the value of the DW statistic ranges between 2.0 and 4.0, negative autocorrelation can be inferred. From the table, we can infer that the value of Durbin Watson test is 1.69, which indicates low autocorrelation.

The table above gives the summary of the regression model from which we analyse and interpret the value of R square, adjusted R square and the Durbin Watson test (Table 4).

3.4 Multiple Linear Regression Analysis

In this study, effect of various predictor variables (CPI, GDP, Govt. yield and dividend yield) on response variable (BNK RETURNS) is analysed through regression technique. The hypothesis for this problem is defined as follows.

Table 4 Value of Durbin Watson test

Model summary ^a						
Model	<i>R</i>	<i>R</i> square	Adjusted <i>R</i> square	Std. error of the estimate	Change statistics	Durbin-Watson
					<i>R</i> square change	
1	0.901 ^b	0.811	0.789	4342.648579	0.811	1.69

^aDependent variable: BNK RETURNS^bPredictors: (constant), DIV YIELD, CPI, GOVT. YIELD, GDP**Table 5** Regression model

Model summary ^a						
Model	<i>R</i>	<i>R</i> square	Adjusted <i>R</i> square	Std. error of the estimate	Change statistics	Durbin Watson
					<i>R</i> square change	
1	0.901 ^b	0.811	0.789	4342.648579	0.811	1.69

^aDependent variable: BNK RETURNS^bPredictors: (Constant), DIV YIELD, CPI, GOVT. YIELD, GDP

R-squared value is analysed to ascertain the value of the impact of the predictor variables on the response variable (Bank Nifty returns). The *r* value is 0.90 which is close to 1, and the *r* square value is also high

0.81 which indicates that there is a significant impact of GDP, CPI, govt. bond yields and dividend yields all together. But, individually it is concluded that CPI does not have a significant impact on Bank NIFTY returns, whereas GDP, govt. bond yields and dividend yield have a significant impact on Bank NIFTY returns

Null hypothesis H0 = predictors have no impact on response variables. Alternate hypothesis Ha = predictors have an impact on response variables (Table 5).

4 Conclusion

The present study examined the impact of macroeconomic variables and dividend yield on Bank NIFTY Index. Correlation amongst all the independent variables is very low which indicates that the variables do not have a relationship between them, fulfilling the assumption of absence of multicollinearity. The regression being 0.90 indicates that there is an impact of macroeconomic factors and dividend yield on the Bank nifty returns. Furthermore, by analyzing the *p* value of individual independent variable, it is inferred that GDP, govt. bond yield and dividend yield have a significant impact on Bank NIFTY returns but, CPI does not have a significant impact on the returns of Bank NIFTY. The study achieved the main objectives, and results

concluded that there is no correlation amongst macroeconomic variables and dividend yield for quarterly data of 10 years. The macroeconomic variables and dividend yield have a significant impact on the returns of Bank NIFTY.

The study can be expanded to include other macroeconomic variables and industry-specific factors, and the study can be conducted on data of daily or monthly bank NIFTY returns. Further research can be conducted to examine the impact of different variable to build a more predictive model.

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Unconstrained Multiple Face Tracking Using Convolutional Neural Networks



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Abstract We are in the digital world. In this digital world, computer vision technology plays major role. Computer vision is used as key technology in various fields like safety and security applications. When we speak about computer vision, face detection and tracking play one of the major roles. While detecting human face, it is very important to analyze and collect human facial features. When we detect face, it is important to detect multiple faces. When we try to detect multiple faces, it is necessary to collect each face features differently. Then using these face feature, we need to detect face region. After face detection, facial features are given as an input to face tracking. There are numerous approaches for detecting and tracking human faces. Still there is need of an efficient approach which can detect and track human faces accurately. So in our proposed face detecting and tracking approach, we use cascaded convolutional network model. Using this network model, we will be able to detect multiple faces in various background environments. At the end of this paper, we will compare the results of our proposed approach with various other approaches. Proposed approach delivers best results in various complicated environments.

Keywords Human face detection · Human face tracking · Convolutional neural network · Cascaded convolutional neural network · Cascaded shallow network

1 Introduction

In real time, many applications use human face detection and tracking method. All face detection and tracking approaches mainly work on single face. Some of face detection and tracking approaches fail to give accurate results when there is an

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occlusion. An image or frame contains multiple images and needs to be analyzed more accurately. Because each face in an image need to be treated as different entity. There are many multiple face tracking and detecting algorithms. Much of these algorithms are not designed to run in real time or these approaches fail because of its efficiency in detecting and tracking multiple faces [1]. Detecting multiple face is much needed in many situations like security systems, automated devices, and many more. In existing approaches, there many snags because of high quality information. To overcome these issues, there is a need of efficient approach which can easily capture the facial features and analyze them. Proposed algorithm is motivated by the issues from the existing methods. There is a much need of a algorithm which detects and tracks multiple human faces [2]. In this approach, video stream is captured from a device, and then, captured video is divided into fixed length of frames. In the next stage, face features are analyzed and evaluated.

Multiple face tracking approach is simple real-time multi-face tracker which is implemented based on convolutional neural networks (CNNs). This approach comprised of three parts: face detection, feature extraction, and tracking. In proposed method, the multi-task cascaded convolutional networks (MTCNN) face detector [3] is employed to detect faces in each frame. Initially, CNN feature map is acquired for each face once at the beginning of the tracking step in a simple one-stage CNN. Shallow feed-forward neural network is used to calculate face similarity between frames given these feature maps. Different shallow network designs are compared. Multiple face tracking approach uses proximity in addition to this similarity measure to decide which faces from the previous frame(s) to match in the current frame. In proposed approach, it can be observed that the run time of our tracker was close to stable for tracking up to 7 faces. It did degenerate somewhat in tracking 36 faces at the same time. Another main contribution is to show that proposed simple multi-face tracker yields very competitive results compared with other recent and far more advanced multiple face tracking algorithms.

2 Related Work

In the multiple face tracking, detecting and tracking of multiple face objects is challenging because it involves the continuous tracking of each face object while distinguishing different objects and handling mutual occlusions. A common strategy in many approaches is tracking by detection where a detector identifies face object occurrences in each frames and a graph or optimization problem is solved to match the detection result in neighboring frames, referred to as the data association step [4].

Many trackers use a face detector as the first step, and the performance of the detector is crucial to obtain good tracking results. The Viola–Jones [5] face detector (VJ detector) is the classic fast and accurate face detector for this task. However, deep network-based detectors have since outperformed Viola–Jones. Region-based convolutional neural networks, R-CNN [6] is an object detection method based on

CNN by Girshick et al. It abandoned the sliding window paradigm (using detection window to scan input images), but adopted the selective search method to select some of the candidate windows, compared with the VJ detector, using the candidate window result, the detector can estimate where the object may be and how many objects there are in the input image. Faster R-CNN detection algorithm was developed by Shaoqing et al. [7]. Faster R-CNN has some improvements compared to the R-CNN detector. Li et al. [8] presented the cascade CNN face detector, which can be considered as a combination of traditional face detection technology and deep networks. This face detector contains a number of classifiers which are organized in a cascade. The cascaded CNN face detector uses neural networks as classifiers for each level rather than using AdaBoost as in the VJ detector. Zhang et al. [9] presented an improved cascade design by using multi-task learning in their MTCNN detector. Instead of only using CNN layers to calculate the confidence of each face window as done by Li et al., the MTCNN detector also uses the CNN layers to calculate a bounding box regression and facial landmarks localization at the same time. As proposed work is focusing on face tracking in real-time video, a fast detector to correctly initialize the location of each face is very important, and we use the fast and effective multi-task cascaded neural networks (MTCNN) [10] face detector.

3 Feature Map Extraction

The architecture of our multiple face tracking system is shown in Fig. 1. Proposed approach consists of three blocks: face detection, feature extraction, and tracking. The face detection locates all faces in each frame. Frame t is the current frame and frame $t - 1$ is the previous frame. At the beginning of the tracking, each detected face receives a label in the order of the detection result. Each face image is then cropped from the input frame to pass through the feature extraction block to obtain a feature

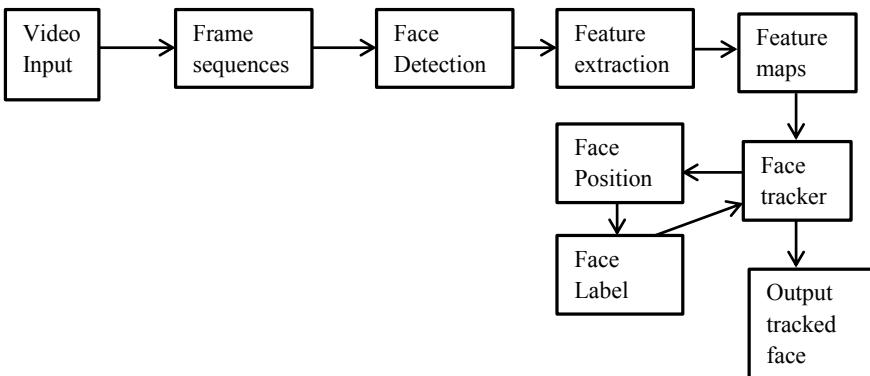


Fig. 1 Architecture of multiple face tracking

map for each face as shown in Fig. 1. In subsequent frames, the tracker will match the faces of the current frames with the faces of the previous frame. This local matching is based on a distance constraint and the feature maps of the faces. A matching face will inherit the label from the previous frame. If no match for a face in the current frame is found, it is assumed to be a new face, and it will be assigned a new face label. The major novel step in the proposed tracking approach is the matching based on the feature map. Initially, features are calculated with a refined network layer similar to the detection step. It is also explained about the study matching of these features with a simple normalized inner product, as well as with a shallow feed-forward neural network. Proposed system only uses one network to obtain the matching result. We make the decision which network to use at the beginning of the program. Then, the system uses only that selected network to do face matching in the tracker block for the whole tracking process.

- A. Face detection: In multiple face tracking approach, we implement and train the multi-task CNN (MTCNN) face detector [11] for proposed multiple face tracking system. The MTCNN face detector uses a cascade structure to combine three CNN sub-networks. MTCNN uses an image pyramid as input to the initial network, the P-Net. The P-Net scans the scaled image densely to get candidate windows with a size of 12×12 pixels. It is trained to filter out non-face windows. The remaining windows are the input to the next cascade which is the R-Net. The R-Net uses windows of 24×24 pixels and performs another filtering step to rule out non-face windows. Finally, the last cascade, the O-Net, examines the remaining windows with a size of 48×48 pixels and makes the final determination if the window shows a face along with the regression result for five facial landmarks (eye positions, nose tip and mouth corners). The bounding box for each window is found with regression on an offset for the window. The bounding boxes from the O-Net are the face positions used in our tracking system. In proposed approach, WIDER FACE [12] is used to train this face detector and test the results on the FDDB face detection benchmark [13]. However, we could have simply relied on the publicly available trained MTCNN network.
- B. Feature extraction: The feature map extraction step calculates the inputs for the tracker block. In order to obtain a feature map which is strictly inside the bounding box, we use a CNN layer that we call FNet which is identical to the O-Net of the detector but does not perform bounding box or facial landmark regression. We crop the bounding box of each detected face in the current frame and feed it as the input into the F-Net. The structure of the F-Net is identical to the O-Net except for the final classifier and regressor. The F-Net input is a 48×48 pixels window which is inside the bounding box of the detected face. Note that this is a different input window than for the O-Net because of the bounding box regression in the O-Net. The output of the F-Net is a 256×1 feature map vector. Training the F-Net is similar to training a face detection CNN layer. We initialize the F-Net with the weights from the O-Net which has the same layers. For training, we keep the face classifier from the F-Net and

then simply remove the classifier in the forward application of the F-Net. This allows us to use face and non-face images for fine tuning the F-Net. Instead of integrating the feature extraction step into the tracker, we calculate the feature extraction as a separate step in advance of the multi-face tracker. Because of this, system needs to calculate the features for each detected face only once, rather than repeating the feature calculation for each possible match considered by the tracker. It reduces run-time cost and enables a simple design of the tracker block. Our design separating feature extraction and matching is in contrast to Siamese networks that have been successfully used in single object tracking before [14, 15] but are costly for multi-object association.

C. Face tracker: The face tracking block contains four steps:

1. 1 Propinquity of the tracker will use face positions from the last frame called $t - 1$ and the current frame t to filter out unlikely matches with Intersection over union (IoU) value which is less than 0.5.
2. 2 Reformatting of feature maps after the proximity, all feature vectors of the remaining faces will be put into a square image-like feature map, i.e., each 256×1 feature vector will be formatted into a 16×16 one-channel grayscale floating point feature map. Two of these feature maps are combined as a two -hannel image and input to the shallow network for the similarity calculation in the tracker.
3. 3 In shallow feed-forward network, the network calculates the similarity score between two detected faces.
4. 4 At the last stage, label assignments are done. In this, the faces in the current frame will inherit the label of the face from the previous frame which is having the highest similarity score.

In order to ensure run-time efficiency, only three variations of a shallow simple feed-forward network are considered. These three networks differ in the number of hidden layers. When it is compared with harder tasks such as object recognition and face identification, these networks only need to calculate the similarity of two feature maps. In particular, the tracking network does not need to calculate face features which enables their very simple design. We train these shallow networks with the Boston head tracking dataset [16]. This dataset contains more than 100 videos, where each video sequence contains only one person, i.e., one can easily construct the ground truth for training. After cropping the faces from the video dataset, we transfer the training data into feature maps, which is the input for training our shallow tracking networks. We can also substitute these shallow networks, i.e., steps 2 and 3 in our tracker by simply calculating the cosine similarity between the feature vectors.

4 Evaluation Data and Criteria

Frontal, turning, and fast: This evaluation dataset consists of three videos recorded by a fixed camera and has been commonly used [16–19]. The first two videos “frontal” and “turning” involve four people moving around causing frequent face occlusions. We use the ground truth for “frontal” and “turning” provided by Wu et al. with the statistics as shown in Table 1.

Another very commonly used video for multi-face tracking evaluation is YouTube videos. This video is more challenging than the sequences due to the fact that there are many camera cuts and scene switches in the video. As such it does not evaluate directly our intended application scenario; however, it is included it in the current evaluation to give a more complete picture of the quality of results achievable with proposed approach. Tracking of multiple faces in YouTube video is shown in Fig. 2. Tables 1 and 2 show the statistics of this video (Fig. 3).

Shallow network evaluation: Results of the proposed approach achieves with a similarity measures based on the three different shallow networks and with the cosine similarity without using any proximity constraint. For completeness, it also includes tracker performance with only a proximity constraint without any similarity measure. The evaluation results are similar with Network 1, Network 2, Network 3, and cosine similarity. Proposed multiple face tracking approach is compared with three other existing multiple face trackers [16–20]. We rely in our comparison on the scores reported by the authors of the comparison methods for a fair comparison.

Table 1 Evaluation Comparison with Algorithms: Success rates

Video sequence number	Camshift (%)	CF-CNN (%)	CF-CNN-K (%)	CNN_Multi-Face (%)
VSN_06	6	79	93	98
VSN_19	29	57	63	91
VSN_44	67	73	84	98
VSN_67	83	91	94	97
VSN_81	92	93	96	100



Fig. 2 Tracking of multiple faces in a crowd after applying proposed method

Table 2 Comparison of performance of each method

Method	Time taken (ms/frame)
Camshift	194.684
CF-CNN	258.571
CF-CNN-K	293.815
CNN_Multi-Face	301.684

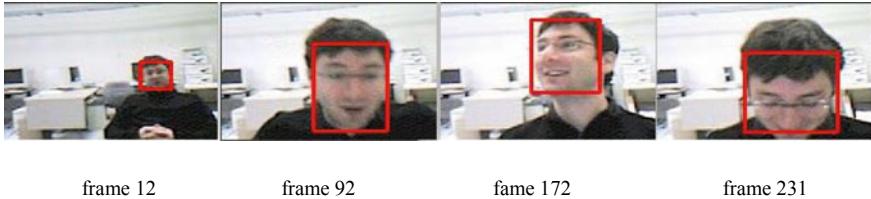


Fig. 3 Tracking results after applying proposed method on NRC-IIT dataset

Proposed algorithm is applied on video sequences obtained from NRC-IIT facial video database and our own videos recorded with webcam. Figure 3 shows the tracking results on NRC-IIT dataset [21]. Table 1 gives the comparison of proposed method with other existing methods. The values presented in table are the number of frames with true result, and Table 2 gives summary of results obtained on the videos.

Using NRC-IIT dataset, accuracy comparison is executed. Tables 1 and 2 show the evaluation comparison with three recent tracking algorithms [21, 22] based on the evaluation method by Li et al. [23] on the video frontal and turning. From Tables 1 and 2, it is clear that proposed tracker can track all the ground truth tracklets with mostly tracked results. However, proposed tracker needs more computation time when frame size increases. From this table, we can see that the MT (number of mostly tracked tracklets) of multiple face tracker result is much higher than for other algorithms at the cost of higher identity switches (ID). However, the results are somewhat difficult to compare as the comparison methods only report results for 4 out of 7 persons and only for tracklets with a minimum of 20 frames. Nevertheless, it is possible to conclude that proposed tracking approach achieves competitive results.

Sample results from the sample frames in Fig. 1, we can find that in the video frontal, our results are all correct. In the sample frames period, no identification shift (IDS) occurs. Tracking results are all correct in the example frames, even though there are occlusions of faces. Proposed approach handles occlusions equally well. Further the run time of a tracker, the stability of the runtime when the number of faces being tracked changes is a concern for real-time trackers. Our multi-face tracker has a close to stable run-time cost for tracking different numbers of faces. In order to demonstrate the performance of the proposed method, we compare multiple face tracking with other approaches. However, if the number of faces in the video increases significantly, the run-time cost will start to increase marginally. It is concluded that

in practice, the run-time cost of multiple face tracker will only sub-linearly increase with the number of faces being tracked.

5 Conclusion

The simple solution to track multiple face is multiple face tracking which runs in real time, and its run-time cost is approximately stable in many tracking conditions. After face detection with the cascaded MTCNN, we extract deep features for each face with a simple single stage CNN which we store in a feature maps. The tracking network will use the feature maps to match faces but will not need to re-calculate feature maps. Compared with face recognition which commonly uses very deep neural networks to process all the faces each time when recognition occurs, our design separates the feature extraction from the tracking process greatly reducing the run-time cost. For matching the feature maps, we show that we can obtain state-of-the-art results on two commonly used evaluation videos according to two common evaluation metrics. These results are obtained with a shallow feed-forward network which again emphasizes real-time performance and simplicity. In our comparison, we even show that a simple cosine similarity score can be used in the feature matching with only a slight reduction in tracking accuracy. Proposed simple tracking approach is limited when large scene changes occur due to switching camera view-points or video cuts in broadcasting.

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Intelligent Horn: An Elegant Solution to Noise Pollution



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Abstract Due to urbanization and industrialization, noise pollution in metropolitan areas has become the main cause of major health problems. Researches from various fields show that honking is one of the major causes of noise pollution. Thus, noise pollution due to honking has to be handled efficiently. In this project, a technique is used which is used to reduce the noise pollution due to honking without neglecting the main objective of honking.

Keywords Noise pollution · Honking · Geofencing · IR transmitter · And receiver

1 Introduction

One of the major factors that cause noise pollution in metropolitan cities is vehicular traffic. It is usually seen in the cities that no matter what is the situation people continue honking. Even though they know that it is of no use to honk, they continue doing the same. Noise pollution is a major issue in our society that influences human and animalia health, and it may also affect the efficiency of humans to work. Day by day, the vehicular traffic is increasing which has resulted in the rise in vehicular traffic which thus leads to more honking resulting in noise pollution. The intensity of noise due to vehicular honking can cross 100 decibels during peak hours of vehicles

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which is around 5 h every day. Noise pollution has created harmful and disturbing effects in human health like hypertension and stress-related several health problems.

In this paper, by using geofencing technology and IR communication, the honking technology is enhanced. By creating a virtual boundary using the geofencing technology, when the vehicle enters this virtual boundary, honking is made such that it can be intimated to the intended vehicle. By this technology pedestrians, nearby hospitals, etc., can be zoned out by unnecessary honking.

2 Motivation

Vehicular traffic adds to about 55% of the total metropolitan noise. The intention behind using a horn is to alert the vehicles or people in the vicinity of the vehicle [1]. However, unwanted use of the horn creates a high-intensity noise signal. With the undesired noise pollution that is caused in the traffic signals, human health and behavior are adversely affected. The purpose of the project paper is to evaluate and sustain traffic noise and the impact of honking in the urban environment in reducing noise pollution through honking [2, 3]. Fig. 1 gives an information on noise intensities in various major cities of India that are collected from various newspapers.

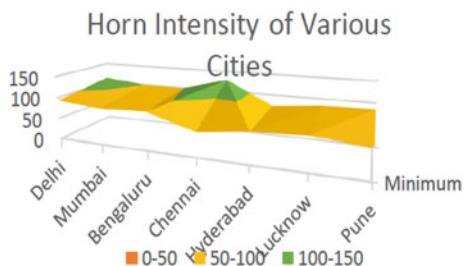
Nerkar and Nerkar [4] suggested solution to subdue the problem of noise pollution due to honking which can be achieved in different ways such as

1. Bluetooth communication: Drawback is taking time to pair and one to one communication after pairing, hence not a practical solution for real-time application.
2. Radio waves. The drawback is directionality cannot be achieved even if the real-time application is possible.
3. Wi-Fi: Again pairing requires a connection from the nearby building which fails the objective for mobile automobile application.

Hence to attain the objective, above-mentioned techniques cannot be used either independently or with embedding together.

The nearest method is just the novel based which is mentioned in the reference, and this paper proposes the original practical algorithm and hardware of toy system.

Fig. 1 Noise intensities in various cities



3 Design Methodology

Geofencing Technology: Geofencing is a position-based guide which is used to activate or deactivate desired response when the movable device passes through the imaginary boundary known as a geofence, defined around a geographical area [5].

To use geofencing technology, an designer must define an virtual boundary around a desired urban location. This is as simple as drawing a circle of about 100 m to several kilometers radius around a given location on. This imaginary geofence will then switch a response when an device passes the boundary line.

Ultrasonic sensor: An ultrasonic sensor is a device that estimates the distance of a target object by transmitting ultrasonic sound waves and transforms the rebounded sound into an electrical signal.

To measure the distance between the sensor and the object, it is directly proportional to the time taken by the sound from time of emission to time of reception by transreciever module. The equation is given by $D = 0.5 \times T \times R$ (D = distance, T = time, and C = velocity of sound which is approximately 343 m/s).

GPS module: GPS signal is used to determine the three-dimensional position: latitude, longitude, and altitude using GPS satellite ranging. When the location is known, a radius of a few meters/kilometres is measured with the location of device to center of geofence.

IR transmitter: This consists of an LED that radiates the infrared (IR) signal. This is received by the photodiode or phototransistor, which functions as an IR signal receiver at receiving module. When transmitter gets triggered, a code is immediately transmitted.

IR Receiver: The receiver can be a photodiode or a phototransistor. Based on the amount of IR light falling on, it passes more or less current. When the IR transmitter transmits the IR signal, the receiver receives that signal and decodes it. An infrared phototransistor can be triggered only by IR light, whereas in photodiode it can be triggered by normal light also. Thus, a phototransistor is preferred to be used as in receiver.

Rain Sensor: A rain sensor constitutes of a PCB module and driving circuit which acts as switching device that is triggered when raindrops fall on PCB. It is used detect an action of rainfall. In this project, it is used to as second priority to disable smart horn mode.

Relay: A relay is an electrical switch that operates by using electromagnetism to achieve a switching mechanism. In this project, the relay is used to switch the honking mode from conventional horn to smart horn.

Microcontroller AT Mega-328: It is an advanced virtual RISC (AVR) microcontroller which processes the data up to 8-bits and 32 KB built-in memory (Fig. 2).

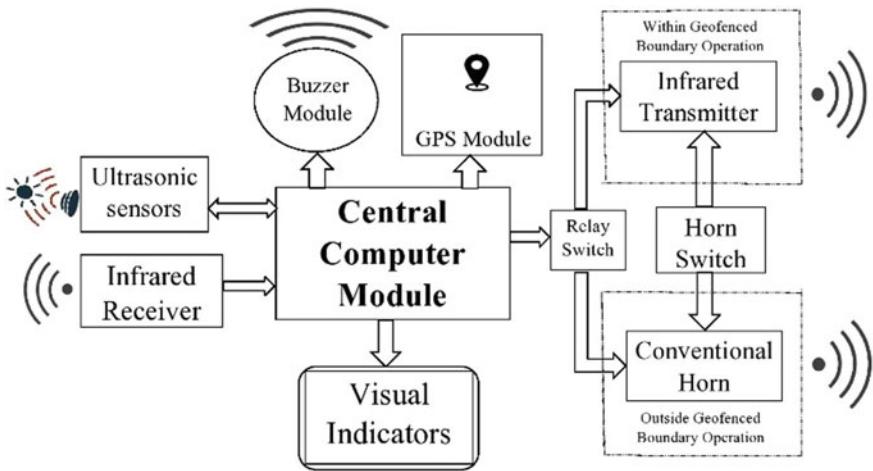


Fig. 2 Framework of the smart horn system

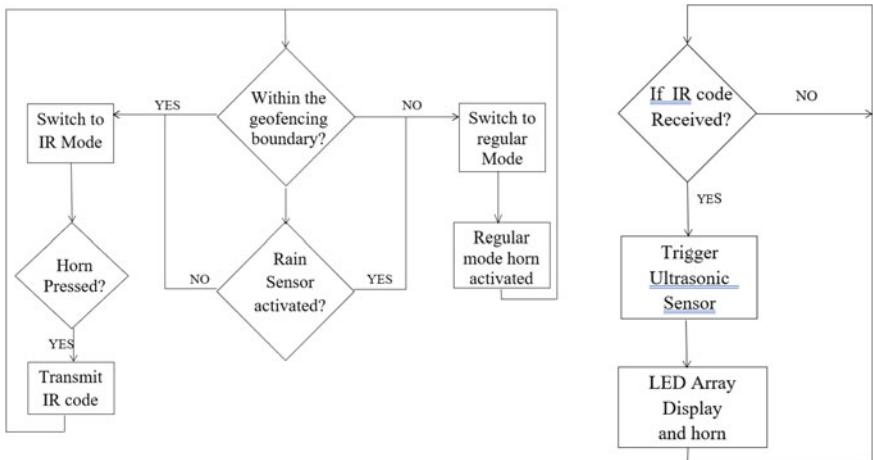


Fig. 3 Transmitter and receiver flow diagram

4 Flow Chart and Algorithm

The operation of the system is divided into two types. The algorithm is set to design these two modes based on the geographical bifurcation as rural and urban areas with reference to vehicular population. The two areas are divided using a technique of virtual boundary and fencing called geo-ence. The geofence can be of a regular geometric shape. The shape and size of the boundary can be varied for various cities. It can have any shape, but the commonly used is a circle. For complicated situations, one

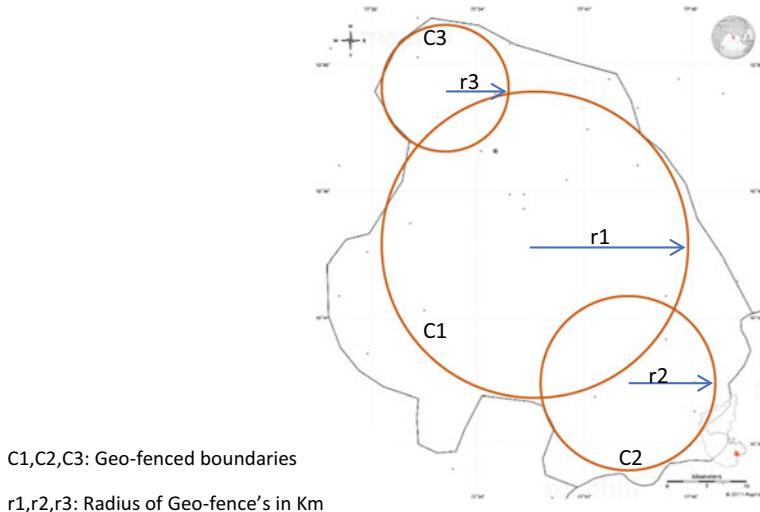


Fig. 4 Representation of geofencing [Figure of Map [6]]

can use polygon-based shapes for geofencing. If the required geography is irregular, then multiple fencing can be defined for single city as shown in Fig. 4 (Fig. 3).

5 Working

A geofence is an imaginary perimeter marking a real geographic area. It can be viewed as an imaginary fence. The area it encircles can vary from a big city to a small area, for example, a building. It is an imaginary boundary around a real-world location. It is formed by setting a radius about a fixed coordinate on the map, using GPS latitude and longitude value. This way the geofenced boundary can be set.

In the IR mode, when the horn is pressed, the IR transmitter transmits the predefined code to the vehicle which is in front of it.

The receiver keeps monitoring for the signal from the transmitter of the preceding vehicle. When the receiver detects the transmitted code, the receiver decodes the code, thus the horn is activated and the sound is detected only by the intended receiver. When the vehicle moves out of the geofenced boundary it is switched to the regular horn mode.

This project also provides the option of shifting into the regular horn to face situations that may appear abruptly due to human or animal intervention. This is done with the help of a relay.

When the IR receives the code, the ultrasonic sensor is activated which indicates the digitally quantized rage between the transmitting and receiving vehicles. This

distance is indicated to the driver with the help of a led array display. Based on the distance between the vehicles the LED lights glow.

The ultrasonic sensor measures the distance up to the closest object that appears in front of it. During heavy rainfall, there is a chance that it may give a wrong distance measurement. To avoid this false measurement of distance a rain sensor is included, this rain sensor is triggered whenever the vehicle is within the predefined geo-fenced boundary and when it rains the sensor is triggered and the control is automatically switched over to the regular horn.

6 Conclusion

The above mentioned project is a solution for overcoming noise pollution due to vehicular honking to a significant level. We conclude that in this proposed system, the smart horn will significantly help in diminishing the levels of noise pollution. Most importantly, the proposed system is practically feasible as well as implementable, and its cost will be reduced in mass production.

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A Novel Agent-Based Methodology for Job Scheduling in Cyber Physical Systems



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Abstract Cyber physical systems (CPS) is the most extensive inventions in the field of information and computer technology. CPS utilizes the computers to perform tasks efficiently in connection to physical world. CPS can be expressed as an association of computers and networks with the physical process, also tightly integrated with internet and uses cloud for storage and computation. This paper proposes a software agent architecture for efficient job request scheduling in a cloud and improved response in a CPS environment. Intelligent agent architecture for scheduling interconnects various software agents and work without any human interference; acts on behalf of others to make the cyber physical system operate in an intelligent fashion. As it is well known that cloud is an essential paradigm widely used all over the world to handle multiple concurrent jobs and also to bring down their computational and operational expenditure, there is always a need for a highly functional scheduling architecture aimed at timely job completion, which is detailed in this paper.

Keywords Cyber physical systems · Cloud computing · Request scheduling · Intelligent agents

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1 Introduction

1.1 Cyber Physical System

The term ‘cyber’ denotes to information and computer technology, whereas a cyber physical system (CPS) refers to the environment where computers are connected to physical devices used by people, and these devices are controlled or monitored through computer-based algorithms integrated with Internet. The potential of CPS changes various aspects of life; a few examples of CPS are smart grid, intelligent manufacturing, smart city, robotic surgery, implanted medical appliances, and autonomous vehicles [1]. CPS consists of cooperative and autonomous subsystems that are connected to each other in highly reliant ways. Components such as computer hardware, software, and physical machines in CPS is exclusively and intensely connected to operate on various environments by revealing multiple, distinct behavioral modalities, and interacts with each other with reference to the context. CPS is in turn connoted as systems of computational collaboration demanding connection with physical world and, in the meantime, provides ongoing services like data accessing and processing through Internet [2].

CPS, a new enjoin of systems engineering, combines different engineering competencies with application and technical domains sectors. The organizational and physical processes are controlled and monitored in CPS through various technological and application domains with higher incorporation of its business dependability. It needs substantial interaction and involvement among users, continuous monitoring, performance optimization, adapts and evolves constantly in response to change in its deployment, timely configuration, and environment. It also has hierarchical assessment systems with higher intensity of autonomy on global, national, regional, and local with interconnected and distributed fashion of systems. CPS technology is innovated from earlier disciplines like embedded systems, in which the software is embedded in devices, but its objective is not only small-scale computation like toys, home appliances, and few medical devices. The work process of CPS takes place by embedding the expertise of human into a software, process it in a local machine, and transfer to cloud through networks, accordingly providing its modeling, design, and functionality.

1.2 CPS Applications

S. No.	Applications	Method	Uses
1	Production system CPS [1]	CPSS—cyber physical production systems	Manufacturing devices, regarded as fourth industrial revolution

(continued)

(continued)

S. No.	Applications	Method	Uses
2	CPS human loop [3]	Pilot experiment—cloud walker	Provides assistance through mobility for QoS factor in health care
3	Cloud-based cyber physical systems [4]	Virtualized technology	Provides scheduling VM in cloud-based CPS for energy conservation
4	Health care CPS [5]	Health care CPS built on cloud and big data	Applications for patients centric health care provisioning
5	Wireless medical cyber physical system [6]	DRTV—User-friendly domain-specific language	Provides formal methods to verify run time temporal properties and gives medicine guidelines assistance
6	MCPSSs [7]	LP-based two-phase heuristic algorithm	An architecture to provide faster and dependable connection between devices in medical, networking, and computational systems
7	CPS system to monitor photovoltaic array control [8]	Cyber-enabled sensory analysis and fusion	Improves efficiency of renewable energy systems
8	CPS online learning[9]	Topic-oriented learning assistance (TOLA)	Enable students to learn online and provides guidelines in learning with various aspects like efficiency, accuracy, complexity, and facilitating the improvement in quality of online education
9	Natural disaster [10]	Data-driven CPS	Detects the natural disaster landslides, without degrading energy consumption and performance and then verifies the systems effectiveness
10	CPS sensors of autonomous vehicles [11]	Traffic flow modeling solution	Provides effective first-hand traffic information to improve and make intelligent driving decision

1.3 CPS Architecture

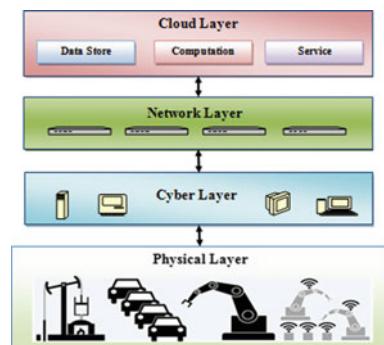
CPS is the amalgamation of physical, network, storage, and computational layer as shown in Fig. 1. The architecture is four-layered architecture which consists of physical things, cyber layer, network layer, and cloud layer for storage and computation. The CPS and cloud system are interlinked disciplines, cyber to connect physical things with computers and cloud for storage and computational processes.

The human usable things are consolidated in the physical layer, which is connected with cyber layer, so that every action performed in physical layer are monitored and controlled by this layer and associative actions are performed. CPS uses network layer through which computers are connected to Internet and access cloud for data storage or computation. The final layer is cloud layer, which is responsible for providing various services to CPS like storing the data generated through devices or performs computation if the devices any processing. As this layer often receives multiple requests simultaneously, there is a need for an efficient mechanism to address and service all the requests in a reasonable time frame.

2 Data and Computational Cloud

Cloud is a combination as well as the subsequent generation of cluster and grid computing, and it is also a collection of parallel and distributed systems. Cloud provides services through Internet using pay as per usage model. The next altitude of distributed, parallel, and grid-based system is cloud which has its own providers and consumers with highly provisioned computing resources; in accordance to the consumer's service request, a virtualized environment is created, and request processing takes place [12]. In that virtual environment, resources like servers, processors, network switch, and data store are connected for computing user job

Fig. 1 CPS architecture



request. Enormous progress has been experienced by cloud in several domains like hospital, education, industries, social media, and financial sector, etc., due to its ubiquitous nature.

Massive storage is another excellent facility offered by the cloud providers, which contains collection of coherent data store to store user's data. Cloud uses variety of servers at different locations, and its physical, logical, virtual environment are usually hired, managed, allocated, and repaired by its hosting company. The cloud resources availability and accessibility are maintained and controlled by its host company like repairing, monitoring, access entry, provisioning, and its request acknowledgment. The cloud providers take care of giving their resources to anyone with high end user access facilities either by any of the ways, as desktop application client, Web client, mobile client, or any cloud storage gateways.

2.1 Characteristics of Data and Computational Cloud

- High resource pooling—has collection of computing resources pool, with multiple consumers to access resources.
- High network access—capabilities to access high-end heterogeneous system with thick and thin clients to access the resources in different locations.
- High self-service—consumers are provisioned with high end resources like network, storage, server, and applications.
- High measurable service—controls the resources and metering capability based on service provider and consumer.
- On-demand self-service—consumers are provisioned with computer resources as and when needed, can use Web-based self-service portal to view a service catalog and request service. Requests are processed without the intervention of provider.
- Rapid elasticity—resources like computing capabilities, storage, and infrastructure are elastically provisioned and released as per the consumer requirement.

3 Agent-Based Computing

The agent is the word coined from Latin language means agreed to act or represent on behalf of human [13]. An innovative paradigm in software applications development is software agents, and it has been established for multifaceted software systems with superior authoritative abstraction. Agent-based computing created a revolution in IT and software industry by providing intelligence to solve any sort of problems without user intervention. The term software agent is coined as it is a knowledgeable system with ability to sense the environment and provides required solution proactively; it is an autonomous system, provisioned to collaborate with any component; it is an adaptive system that learns every aspect and reacts accordingly, and it is a mobility system with the potential to work in any platform [14].

Fig. 2 Agent principles

One that acts or has the power or authority to act or represent another or the means by which something is done or caused; instrument. Software agents are computer programs capable of flexible, autonomous action, the most complex form; agents may persist over time, capable of timely internal context dependent reaction to sensed events, plan and initiate unique series of actions to achieve stated goals and communicate with other agents or people toward those ends.

Fig. 2 shows the agent principles; it has three characteristics, skills, knowledge, and interfaces. Skill plays a major role in agent architecture; it defines the agent capability and the user expectation. Agent needs to have adequate skills to process the request accordingly. An agent is developed and embedded with skill to work in its environment; it contains a base pool and learning capacity. The user selects the best set of skills for application based on performance, cost, and other business transactions. The next part of agent is knowledge, which has complex rules, the rule refinement process, and assumed conditions [15]. Final part of the agent model is interface that refers to interaction among various components of agents and also with outside components. It contains two categories, the application interfaces to connect and process the data from various other application sources, whereas user interface is a template to connect with the user. The user interface observes the user's style of handling interactions and builds rules for the agent in order to emulate the user.

4 Agent-Based Model for Cloud CPS

The cloud environment is basically heterogeneous in nature, starting from cloud providers, who gives a variety of provisioning in cloud resources to consumers with different job requirements and finally resources with different types of servers, processors, and connected network devices. Another excellent feature of cloud is its

openness, which permits anyone to access the resources in cloud at any time, and can leave cloud if their job completes.

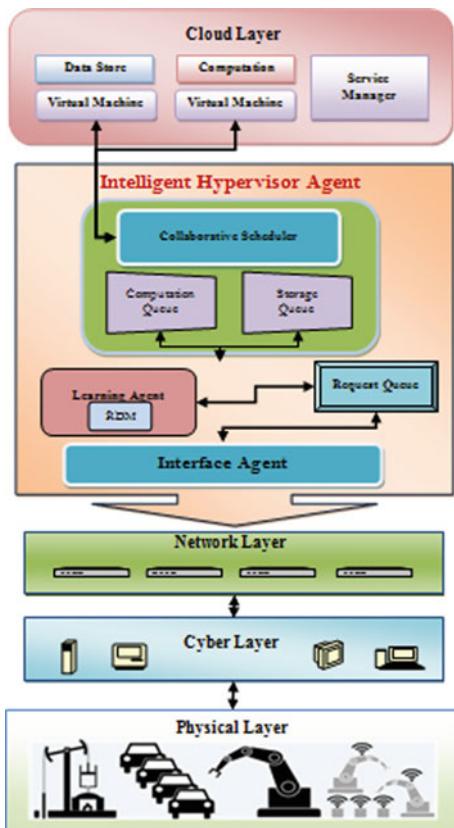
Research Objective

The objective of this research work is to propose an intelligent agent hypervisor architecture for efficient VM placement to PM in a CPS cloud.

Methodology

Cloud computing has a dynamic specification like high heterogeneity of resources (processor, memory, storage, and so on), network interactions, and job requests [18], and so on. In order to handle this heterogeneity, a multi-agent architecture is proposed, which works with multiple agents like interface agent, learning agent, collaborative agent, and intelligent agent. The request for physical machines from the user end is connected to cloud environment through the multi-agent architecture. Fig. 3 shows the agent-based model to improve the efficiency in cloud environment.

Fig. 3 Agent model for cloud CPS



4.1 Interface Agent

The first and primary agent placed in the hypervisor is the interface agent; it provides an application interface through which user submitted job requests are received by the learning agent which learns the preference of each user through their request and offers dynamic assistance. Efficient user interface in the environment gets the submitted requests along with their resource specification. Interface agents receive the various requests from the network layer and update the request in request queue, which is a pool to store the requests.

4.2 Learning Agent

The learning agents learn from their own observations and experience, and maintain its knowledge. Learning agent uses the request description method (RDM); it is a rule elicitation process. RDM is an essential part of learning agent, and it contains the types of heterogeneous jobs submitted to physical machine. RDM is a specification that focuses on the description of computational task request. RDM describes the types of request job like request name, resource requirements to compute, and time taken for execution. The job is categorized into computing queue or storage queue accordingly.

4.3 Intelligent Hypervisor Agent

Intelligent hypervisor agent is an autonomous and proactive system placed in a cloud environment that contains a collection of agents to facilitate its process [16]. The intelligent hypervisor gets a request from request queues, and based on the request identifies, the physical machine from cloud and creates the virtual machine (VM). The hypervisor checks the availability of physical machine, if yes, creates the VM, if not gets the PM from top of the rack (TOR) [17] and creates VM, and then, submit the job to collaborative scheduler. Figure 4 shows the functionality of TOR, the switching network architecture, which contains equipments like servers, machines, signal connector, and connecting switch located in same rack. All the equipments are connected to in-rack switch, and the rack switch is connected to aggregation switch of the service provider.

An intelligent agent is adaptive in nature and acts as a negotiator between scheduler and cloud resources. An intelligent agent works as a hypervisor and is responsible for assignment of PM and VM optimization and allocation of jobs, and monitoring of the jobs with resources. The intelligent hypervisor uses the fat tree topology techniques for job, and tree representation includes various nodes in cloud environment, the nodes like physical machine, virtual machine, aggregation switch, edge switch, and

Fig. 4 Top of rack architecture

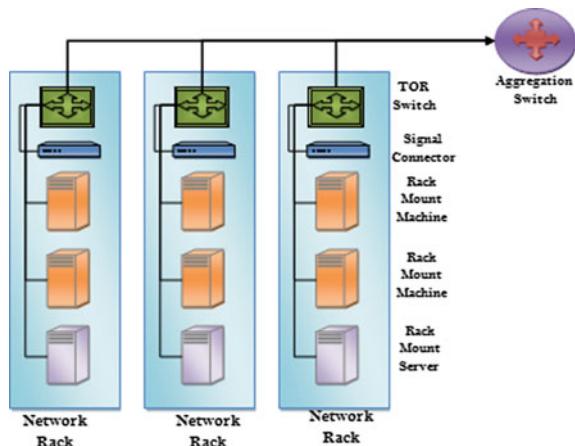
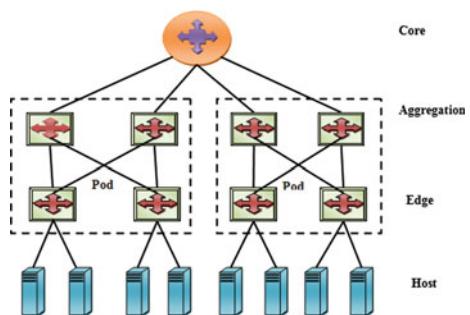


Fig. 5 Fat tree topology



core switch, Fig. 5 shows its tree representation. The request from request queue is taken, submitted to core switch of fat tree, which is responsible for job allocation, identification of the appropriate aggregation switch and connects to the edge switch, which in turn connects the VM to the PM.

4.4 Collaborative Scheduler

Collaborative agent collaborates with other agents and forms agency to complete its task. The term agency in software agents states that every agent works in association with group of other agents or any components, and hence, the collaborative scheduler works in collaboration by forming agency, formed by four entities like learning agent, intelligent agent, and request schedule and submission to hypervisor. Two types of scheduling are performed in this architecture, to allocate jobs to storage machine or computational machine. The major aim of this architecture is to give better and speedy response to users in allocating job request to associative

resources. Collaborative scheduler [18] connects to the machines in cloud; learns and senses the machine availability, load capacity, resource provisioning, and its location with connection switch [19]; checks the resources; uses optimization algorithms for resource allocation. The architecture is developed to perform higher level of resource [20] scheduling like single-machine resource scheduling to resources in multiple machine with various sorts of job scheduling like jobs with single-machine resources [21], jobs with different resources in different machine with assortment of job categories like open access, random access, flow access, work flow access, priority access, and multi-objective access.

5 Conclusion

Cyber physical systems is the latest and growing technology in the field of information and communication technologies, and it works in association with physical machine by providing computational support without human intercession. The computation in CPS is performed by embedding the software capabilities to physical world and connected through electrical and communication devices. The CPS is highly harmonized with Internet and performs the desired functionality with the support of the cloud. In order to cater the multiple requests arising from multiple users, there is a need for an effective architecture. This architecture is developed using multiple agents; agent is a software entity which possess attributes such as reactivity, learning, adaptiveness, decision making, autonomous, and collaborative, and provides proactive solution to its environment without human intervention. The multi-agent architecture for CPS proposed in this paper is a collection of various software agents, and each agent gets connected to other agents in order to facilitate efficient job request scheduling in the cloud for improved performance in a cyber physical environment.

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Wearable Healthcare Device for Elderly Person



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Abstract Due to a rapidly increasing aging population and its associated challenges in health and social care, the healthcare cost is hit the roof. There is a necessity to monitor a patient from a distant location. It is observed that people aged 65 and older has Alzheimer's disease. Basically Alzheimer disease is brain disease that slowly destroys brain cells and old age persons start forgetting things and past events. Many families spend more than 1 lakhs of rupees an year caring for someone with Alzheimer's. Many old age peoples die due to the Alzheimer disease because they forgot to take medicine on time and sometimes they fall down accidentally. With the worrying scenario, we developed a portable, easy to use and cost-effective system which used a panic button, if person needs any help then he press the button alert message send to their caretaker. The objective of the paper is to build a wearable device, a system which can help both patients and caretakers.

Keywords Healthcare · Alzheimer · Sensors · Arduino · Infineon sensor Hub Nano

1 Introduction

Remote healthcare monitoring systems for the elderly people have drawn significant attentions. There are some specific health issues with elderly persons or sick people which cannot be ignored. Not only the elderly people need a helping hand, but the chronic diseases people and who are ill need someone to take care of them. According to World Health Organization (WHO), the elderly population (people above the age of 60) of the world has drastically increased in the past decades and it has been predicted that it may reach 2 billion by 2050 [1]. Worldwide there are more than 10 million old people. By the year 2050, another fifteen developing countries are expected to have 10 million old people [2]. Chronic diseases could be prevented

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through healthy diet, prevention of tobacco products, and regular physical activity. However, when established, chronic diseases result in limitation of mobility and physical activity of the affected persons, with a slow, progressive, and sometimes unseen entry mechanism. Usually, the solo observable effects are the reduction of the amount of autonomy and also the loss of mobility. Thus, as a consequence, monitoring physical activity may be a valuable parameter so as to define if persons are performing enough physical activity so as to forestall chronic disease or if they are manifesting early symptoms of these diseases [3].

2 Literature Review

Many researchers are carried out their work on healthcare devices for old age person. Hema L.K et al. (2016) designed a smart wearable wrist band which monitor the fitness of an old person and observe whether the person wearing it is in a very medical emergency and automatically aware their members of the family and doctor if necessary [4]. Al-khafajiy et al. (2019) focus on the power to trace a person's physiological information to detect particular disorders which can support in early intervention practices [5]. Godfrey A. (2017) presented applicable biomarker in aging and pathological research with assessment objectives [6]. John Barton et al. (2015) reviewed the methods of measuring physical activity of elder person, acceptance of wearable devices which describes and compares existing commercial products encompassing activity trackers tailored for older participants [3]. Deepika S. et al. (2017) used Ambient Assisted Living and Ambient Intelligence technologies which offers support to elder people in living self-governing and secure life by developing advanced ICT-based products, services, and systems [7] Fariborz H et al. (2007) addressed the severe necessities of high-density and moderate-mobility situations such as energy-awareness, self-healing, low data delivery delay, and transmission reliability. [8].

Manohar, A et al. (2007) developed a low power, microcontroller-based patient bed monitoring system which is used sensor-based method which provides an effective low cost alternative for minimizing the harmful effects of bedsores which is prevalent in hospital intensive care units and assisted living environments during rehabilitation [9]. Juang J. Y et al. (2008) designed health monitoring system with few ZigBee devices to measure one user's physiological data [2]. Steele R. et al. (2009) show idea of WSNs for monitoring of health is encouraging for researchers [10].

3 Methodology

We all are aware with embedded technology. During this research work, we used the technology to trace maturity person by using Blynk App. Basically, this application helps to elder person's siblings or their caretaker. They can use this app in any Android smartphone within which the app communicates with microcontroller using Bluetooth module or WiFi module. Similarly, all the sensor regularly send the information to microcontroller using Bluetooth module. The information is often within the kind of pulse rate and altitude of device. Basically, Infineon sensor hub is developed by Infineon technology by which it can detect the pressure using altitude of wearable device; if an individual falls, then the altitude decreases that the pressure increase by this idea; it detects that the person gets fall. Then the sensor connected with the device sends an alert to their caretakers and lovely ones so their caretakers takes action as soon as possible and check the patient is fine or not. We trained our module with the help of the machine learning algorithm. When heart rate of the patient is sharply increasing or decreasing, then it automatically sends the message to their caretakers so they take the patient to the hospital which reduces the chances of the heart attack.

The beauty of the work is that it has inbuilt Li-Po battery in microcontroller that gives supply to the all the component. In our device, we are working to remind the patient and display that the time to take medicine, time to exercise, and various daily routine tasks, etc. So, patient did not forgot their tasks and do the tasks according to the time which keeps them healthy. The proposed block diagram is shown in Fig. 1. The objective of the work is to

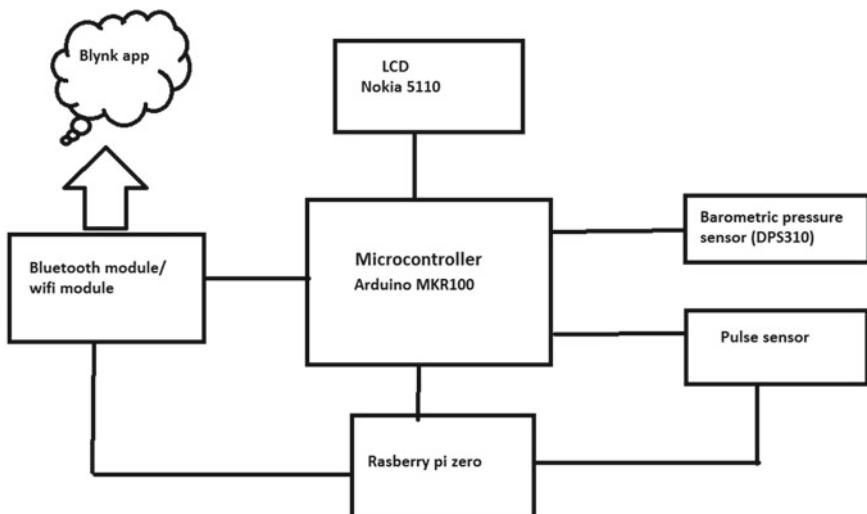


Fig. 1 Block diagram of proposed system

- Remind the patient to carry out the tasks, which he/she has to do daily activities such as exercise, medications, etc.
- Monitor the location where the patient is in the house.
- Aware the caretakers in case of any sort of emergency.
- Show the time for different activities.

3.1 Components Used

The current work used the components, powerful Arduino MKR1000, pressure sensor Infineon sensor Hub Nano, Nokia 5110 LCD, Bluetooth Module HC-05, pulse sensor, bread board, jumper wire, and spark switch are shown in Figs. 2, 3, 4, 5 and 6.

Fig. 2 Arduino MKR1000



Fig. 3 Infineon sensor Hub Nano





Fig. 4 Nokia 5110 LCD

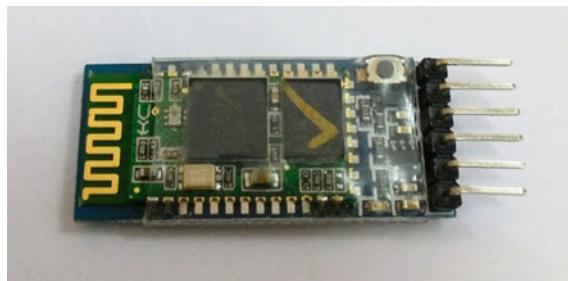


Fig. 5 HC-05

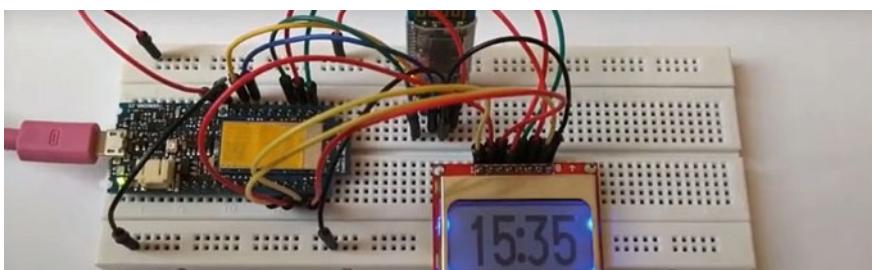


Fig. 6 Hardware circuit of wearable healthcare device for elderly person

3.2 Software Used

Arduino IDE and Blynk App.

4 Conclusion

In the recent era, technology is ruling the manhood. In this research, a universal healthcare prototype system for patient as well as hospitals and caretakers has been designed. The device is directed to a process in which we can take care and monitor the process of the patient who is suffering from the Alzheimer disease and we can monitor heart rate of the patient through the wearable device. In the recent times, Alzheimer disease is rapidly increases among the people many people spend a lot of money to cure this disease. The device is portable, easy to use for an elder patient, and cost effective.

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Identification of Nutrition's Deficiency in Plant and Prediction of Nutrition Requirement Using Image Processing



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Abstract Agriculture plays a important role in the Indian economy. 70% of rural population is dependent on agriculture as well as 17% of total GDP is contributed from Agriculture sector and provides employment to over 60% of the population. As the Indian population increasing day by day, the demand of increasing food production is also increasing to. The total area to under cultivation decreasing over the past years. Thirteen essential minerals and nutrients are requiring to grow and survival of plants and crops. All this nutrient is supplied from the soil. If adequate nutrients are not supplied to the plant, it will affect the growth and quality of plant. Nutrients are very important for the plant growth, 13 essential nutrients required for plant survive and growth. These nutrients are taken from soil. Soil nutrients deficiency affects the quality and growth of the plants. Nutrients deficiency symptoms always visible in the plant leaves. These symptoms are like leaf colour and textures, interveinal chlorosis, uniform chlorosis, marginal chlorosis, necrosis, distorted edges, reduction in size of the leaf, etc. Nutrient deficiency symptoms seen on the old and new leaves are different for different nutrients. Mineral nutrients are classified into macro and micronutrients. For plant survival, large amount of macronutrients and small amount of micronutrients are required. Macronutrients and micronutrients nutrients are essential to the plant, but excessive use of nutrients harms the crop production as well as wastage of money. To increase crop production with proper amount of nutrition need to be feed up to the plant at hungry stage. Excessive use of fertilizer creates so many problems like soil pollution, soil hardness, loss of foreign currency, etc. Early stage nutritional detection system can give sufficient time to use organic fertilizer which helps in pH balance and land preparation cost.

Keywords Sensors · Smart agriculture · Sensor technology · Nutrients · Image processings · SVM etc.

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1 Introduction

India's population is mostly depend on agriculture directly or indirectly and it plays important role to feed the world's largest population. Small population plays important role to feed rest of Indian population that is nearly 22% of the country's. Agriculture has various aspects to taken care of economical, sociological, biological and environmental factors for crop yields such as temperature, type of soil, humidity, moisture in soil, water, etc. and nutrients requirement.

Smart agriculture or precision farming is the solution for the above problem. We can measure the temperature, humidity, water as well as nutrients requirement of the plant with the help of sensors and image processing. There is not much scope for improvement in traditional farming and methods that are being used. The farmers do not have complete control of their crops which is restricting 100% productivity but with the smart farming method, it is possible to some extent [1].

Plant diseases can be broadly classified either infectious or noninfectious. These classification and quality assessments are basically depend upon feature of the plant leaf such as its appearance, size, cracks, texture, colour and surface where human unable to analyze with naked eyes. Plant shows the symptoms of nutritional deficiency in their leaves which will be occurred due to deficiency of mobile [phosphorous (P), potassium (K), nitrogen (N) and magnesium (mg)] and immobile nutrition's [(manganese (Mn), copper (Cu), sulphur (S), calcium (Ca), iron (Fe), calcium (Ca) and boron (B)]. Mobile nutrients include mobile nutrients move from older leaves to fresh leaves when deficiency of nutrition's occurs. Due to nutrition transmission from older leaves to newer leaves, deficiency creates in older leaves which can be visualized in older leaves. If the mobile nutrition deficiency in the plant is more which will visualize in the hole plant [3, 5].

Immobile plant nutrients do not transfer from one place to other plant in plant. If there is deficiency occurs which will be visualized in the newer leaves on top side of the plant due to mobile nutrients deficiency.

Macronutrients such as N, P, K and Mg are required in large amount, so they are best applied to the soil. The micronutrients are needed in small qualities and can be applied in soil and spray. In this paper, we are going to discuss various image processing technique and algorithms as well as machine learning algorithms help in smart farming [1, 2].

2 Key Technical Issues to Be Addressed

To increase the crop productivity, we want to consider the important parameter required and overcome the excess parameters which not increase the crop productivity but help in the crop losses.

(A) Factors to be consider for increasing the crop productivity

- (I) Plant growth
- (II) Requirement of water and light
- (III) Macro and micronutrients
- (IV) Fertilization requirement and process
- (V) External factors such as birds and pests.

Some of the above factors can control and monitor by different sensors available in the market but some of the parameter requires image processing and machine learning tools. We can take the reading of different sensors and analyze the data to increase the crop productivity.

(B) Nutrient deficiencies causes:

- (I) Over-watering: Due to over-watering, soil nutrients go more deep than the root area which will not absorbed by root and it creates nutrition deficiency. It's create nutrition deficiency. Sometime nutritional deficiency may arise due to deficiency of some other nutrients. Iron is very important nutrition for photosynthesis.
- (II) Under-watering: Due to under-watering, soil nutrients are not movable in the soil and it will create lack of nutrition availability to the plant roots. Finally, plant will face nutrition deficiency although adequate nutrients are available in soil.
- (III) Excess use of nutrient: Nutrients are interdependent means excessive uses of some nutrients will increase the demand of other nutrients. For example, excess of potassium can increase demand of magnesium.
- (IV) pH balance: If pH is not in the recommended range, then it will create nutrient deficiencies. Absorption of nutrients is mostly depending on the soil pH. Good soil pH will give help in soil and nutrient reaction which will create more nutrient abortion facility. Soil pH will changes due to excess/less uses of nutrients. pH affects soil nutrient reaction which will affect some micronutrients.

(C) Challenges and constraints:

Sometime disease and nutrient deficiency symptoms are similar and temporally due to chemical spray and excessive uses of fertilizer on plant. Due to this effect of chemical spray and fertilizer creates some symptoms effects on plants which looks like nutrients deficiency, due to this misinterpretation happens for that proper plant inspection required. Here are some examples:

- (I) Plant disease—Plant diseases and nutrition deficiency look similar and it's very difficult to differentiate between diseases or nutritional deficiency. For correct identification of disease or nutritional deficiency, whole plant scanning is required.

- (II) Chemical spray and fertilizers—Chemical spray to the plant will create some nutritional deficiency or disease symptoms. For correct identification of such symptoms, we will keep record of spray timing, quantity, frequency, etc. and then go for analysis. Most of time, spraying does not cover whole plant so that it will be easy to observe the plant and identification of nutritional deficiency/diseases.

3 Methodology: Detailing Stepwise Activities and Sub-activities

We are going to use support vector machine (SVM) classifier algorithms and then testing which algorithms work better in term of accuracy, speed of operation, memory requirement, scalability accuracy, etc. Here, we are going to discuss only SVM [4].

(A) Image acquisition:

In this step, the sample images are collected, which are required to train the system. Maize crop leaf images are taken by using digital camera and are used for both training and testing the system. The standard jpg format is used to store these images. The RGB colour images of maize crop leaf are captured using smart phones or digital camera. Damage and healthy maize plant leaf images taken from different locations and light intensities.

(B) Pre-processing:

Image pre-processing task involves the image enhancement for that we can use filtering, CLAHE algorithm, etc. In order to achieve high accuracy, the RGB images are converted into 256 grey scale images and additionally applying green index and rescaling the pixels values to create binary images. To increase the contrast using various contrast enhancement techniques like histogram equalization, contrast adjustment etc which is required to increase image recognition accuracy (Fig. 1) [10].

(C) Segmentation:

In image segmentation, the separation of the given image into healthy and unhealthy regions with respect to certain features is done. Clustering is a method by which the large sets of data are grouped into clusters of smaller sets or segments of similar data. Similarly, thresholding based, clustering methods, histograms, compression methods, region growing, etc. are some segmenting techniques used for segmentation.

(D) Feature extraction

Feature extraction as the maize leaf disease consists of several types of disease from image edge, corner, light intensity, colour, shape, etc. Width and length of

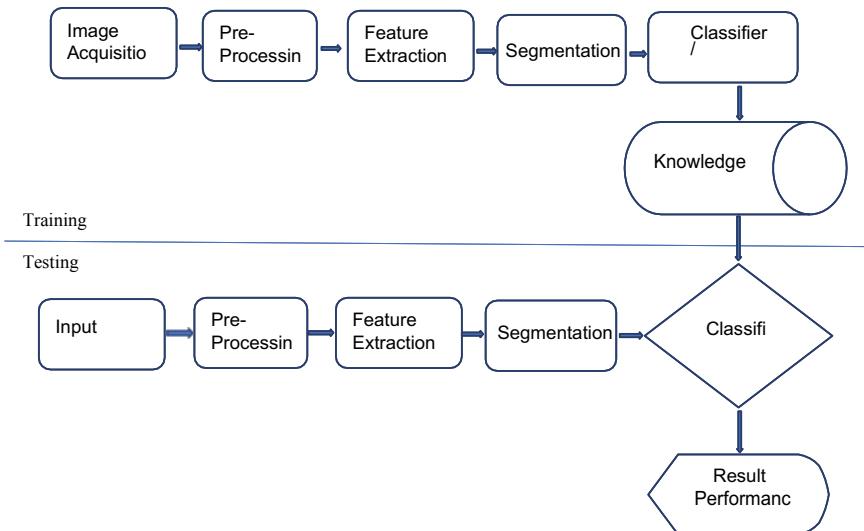


Fig. 1 Implementation flow of the proposed system

the image are significant characteristic to describe. similarly, breadth and height are used to measure the pixel count. Colour feature used to separate the foreground and background of the image so that focus is given on the foreground features. Colour feature is very important to classify the images in two broad classes, foreground and background region. Image edge, corner, shape help in image direction identification so that it will be properly process. Light intensity is used to reduce the error rate of classification.[8] LBP, HOG, SURF, GLCM, MSER, histogram features, Wavelets Canny edge detection, etc. are the different feature extraction methods.

(E) Classification:

Different types of classification features like artificial neural network [ANN], naives Bayes classifier, fuzzy classification, particle swarm optimization algorithm (PSO), membership function, SVM classifier, orthogonal locally discriminant projection algorithms (OLDPA), minimum path evaluation theory, discriminant analysis, AdaBoost algorithm, rule set theory, etc. [6].

ANN uses texture and colour features were extracted from RGB image distribution indices to calculate the region of interest. Naives Bayes classifier works on colour and shape features. Fuzzy classification method works in two steps, image segmentation and number of diseased spots for each spot. PSO algorithm uses histogram equalization method and de-noising using image filter. SVM, naive Bayes, decision tree, KNN, random forest, AdaBoost, neural networks, rule-based classifiers, fuzzy classifiers, etc. are the different classification methods [6].

(F) Performance measures:

Sensitivity, specificity, accuracy, error rate, ROC curve, AUC, F-score, etc. are used to measure performance.

4 Workplan

SVM performs the final classification using multiple kernel function such as linear, polynomial, radial basis, and sigmoid function is the best method to classify leaf diseases. It uses different training sets, that is, the colour, texture and shape feature vectors of each sample are treated as different training sets into three corresponding SVM classifiers.[9,11]

Support vector machine (SVM) classifier is used to classify maize crop leaf. The leaf region is segmented using threshold method. SVM classifier trains using colour, texture and shape feature. SVM classifier classifies in three category based on different extracted feature sets. Classifier categories in low-, mid- and high-level extracted features class. Low-level feature extraction process follows plant pathology. Mid-level classifier used to farther classify the images based on the low-level classifier result. High-level classifier used for error correcting [6, 7] (Fig. 2).

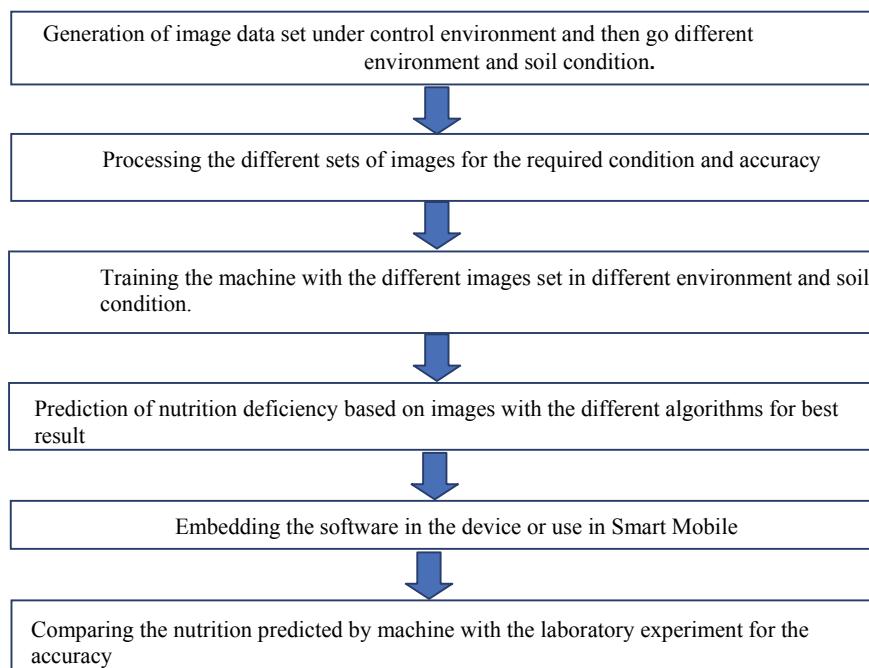


Fig. 2 Working of the proposed system

5 Conclusion and Future Scope

We can identify the nutritional deficiency in the early stage which will give us the requirement of nutrition. We are avoiding unnecessary fertilizer uses which will help us saving money and soil pH. Soil pH is balance, then it will save land preparation cost. Early warning of nutritional deficiency will motivate to use organic fertilizers which will save nation's economy. Machine learning and image processing help to build similar model for different crops. For the larger area, drone-based monitoring system can cover large areas of land. Different crops having different nutritional requirement, soil type, water, light, etc. so that different parameters need to be consider to build model for different crops. Mobile-based instant solution can be made for farmer.

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Single Dark Channel Prior Generalization of Smoggy Image



Anika Saini, Avinash Sharma, and Kamakshi Rautela

Abstract This paper proposes dark channel prior algorithm to remove smog from an image. Smog degrades the quality of outdoor pictures, and image quality has been lost considerably. An important problem is that of the elimination of hazards, which is called dehazing. The turbid material in the atmosphere (e.g., contaminants and droplets), typically degrades images of natural scenes. The decayed pictures lack color fidelity and contrast. The deterioration is spatially dependent, because the volume of dispersion depends on the scene point distance from the camera. In this work, a simple but effective picture is presented before the dark channel which is stripped. The previous dark channel is a kind of outdoor camera data. It is based on a crucial observation. A GUI is created using MATLAB in this paper. Using this GUI, image is encrypted first and then compressed (EtC) using which the thickness of the smog can be measured directly and a high-quality smog-free image can be obtained. The effectiveness of the proposed method is validated through the results obtained by dehazing the images.

Keywords Dark channel prior · Dehazing · EtC · Smoggy image · Soft matting

1 Introduction

Smog is said to be an atmospheric phenomenon where any media or picture is not clear or foggy and because of which it is difficult to extract information and with certainty from the scenes. Smog is one of the main reasons to cause difficulty to many computer vision/graphics applications [1]. The visibility of the scene is compromised as well as the dependability of outdoor surveillance systems is minimized; the

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clearness of the satellite images is reduced; the colors of the pictures got changed and the contrast is decreased, which is an annoying problem. Removal of smog from photographs in computer and computer graphics areas and therefore is a high priority and highly requested topic [2]. Many computer vision/graphic applications problems come from obscurity. In computer vision, the methodology to resolving obscurity or ambiguity can more or less be divided into two structures. The first one is to get hold of more identified variables, e.g., some techniques that are used to remove smog take multiple pictures on the same scene. Sound is easy, but additional images cannot be easily acquired while performing. The second arrangement is to force additional refinement using a number of information or assumptions known in advance, namely some “priors.” This approach is more realistic since only one picture is needed. In this study, the emphasis of this research is on eliminating the single picture smog.

Within this work, an important yet simple preceding dark channel is established to eliminate smog from a single image [3]. A particular aspect of the smog-free photographs that lay outside is the dark channel prior: These photographs are meant to produce patches, and the vast number of patches in such photographs will have pixels that are black in at least one-color range. Shadows, having bright or lot of different colors, different points/lines/angles, etc., or many other factors cause these dark pixels in an image. This prior gives a control that limits or restricts certain behavior for each pixel and thus solves the problem’s ambiguity [4]. The first is found in a practical smog-imaging device, and we can retrieve high-quality smog-free pictures without difficulties. This smog research is not restricted to visibility by machine. For several sensory issues, the human visual system (HVS) faces the intrinsic ambiguities and sense of smog. These ambiguities can be solved by HVS as it has good abilities to solve it. Assured priors should be used by HVS to do so as long recognize by people [5]. In psychology and physiology, the majority of these priors remain inexplicable. This work design quite a few illusionary studies focused on psychology, and the HVS uses the mechanism which is linked to the dark channel prior to distinguish smog as mentioned by it. This corroborates even the validity of the dark canal as a machine vision system, since it is a successful solution to artificial intelligence to mimic human brains.

2 Background

For computer vision and computer graphics, the model commonly used to explain the creation of a smoggy picture is [6–8]:

$$i(y) = K(y)T(y) + U(1 - T(y)) \quad (1)$$

here $y = (l, m)$ which represents the coordinates (l, m) position of pixel in the photograph.



Fig. 1 Smog visualization calculation factors. The transmission map T is seen as $T = 1$ as white and $T = 0$ as black

Figure 1 displays the smog and this figure variable. The smog picture is “ i ”. $i(y)$ is a pixel light 3D RGB matrix. K' is the radiance symbol for the shot. $K(y)$ is a 3D RGB light color vector representing the y point of the image. Unless this illumination was not from smog, it would be the illumination observed by the viewer. And the radiance K is sometimes referred to as a picture without smog. T' is a diagram defined as smog transfer or transparency. $T(y)$ in $[0, 1]$ is a scalar. Intuitively, $T(y) = 0$ is completely smog and blurry, and $T(y) = 1$ is safe from smog and totally visible and $0 < T(y) < 1$ is semi-transparent. U' is the color of the world. It is a 3D RGB vector usually assumed to be spatially constant. It is often considered as “the color of the atmosphere, horizon, or sky” [6–8].

Next deepness is calculated. When a point in location y of a scene has the distance $d(y)$ from the observatory, the depth of the point d is named, the smog transmission T will be deepness physically associated d .

$$T(y) = \exp\left(- \int_0^{d(y)} \gamma(a) da\right) \quad (2)$$

For this case, γ is the atmosphere scattering coefficient and atmosphere’s physical features particle content, scale, form, and concentration are deciding. $\int_0^{d(y)} \dots$ is on a line of the viewer and an act point. Smog degrades images using Eq. (1)

The first cause of degradation is to reduce the visibility due to the direct attenuation. Visibility is defined according to the differentiation of the target as far. Visibility is also defined in the screen view by the image gradient.

$$\nabla i(y) = T(y) \nabla K(y) \quad (3)$$

Here T is shown as standardized in order to disregard T ’s gradient. For T is inside the $[0, 1]$ set. The value is less than K . It reduces the contrast which allows it easier to distinguish the objects.

Simple smog removal methods are based on other priors, which can be numerical, experiential, condensed. The disparity in the number of variables ($3x$) and the undisclosed number ($4x + 3$) in the smog simulation equation is roughly x . Therefore, at least one limitation will be imposed for each pixel.

It must be thought that the T transmission should be viewed as a permanent unrelated to location y :

$$i_C(y) = K_C(y)T + U_C(1 - T) \quad (4)$$

Therefore, transmission T decreases the number of unknowns from x to 1.

The dark subject subtraction introduced in [9] is used to generate a single element. In the remote sensing region where photographs are multi-spectrum (more than three channels), the technique was established previously. Taking one channel C into consideration, a dark source in that channel must be expected to be present. The discrepancy between unknowns and calculations is around the amount of pixel y in a single picture smog elimination. It means that for each pixel a fixed restriction will be enforced. However, with a collection of pixels, conclusions or precedents can be created. Both Tan's [8] approach and Fattal's [7] take tiny local patches into consideration. In increasing region, Tan's presumption of visibility maximization may be added, but is less accurate. The ICA form of Fattal is physically oriented, but used in just a few areas.

3 Methodology

Here for single image smog removal a novel prior—*dark channel prior* is proposed. The foundation of dark channel prior is focused on the figures of outdoor smog-free photos. It has been noticed that certain pixels at least have very low power one-color channel (RGB) in almost all of the surrounding regions where heavens are not protected.

Mathematical Construction

The following is mentioned the statistical definition of the aforementioned remark.

3.1 Dark Pixel

To describe a dark pixel, find some “ δ ” threshold and any pixel in the three RGB channels with an intensity below the threshold value is referred to as dark pixels. Let $K(x)$ be an obscure pixel. Then:

$$K(y) \Leftrightarrow \min_{C \in (r,g,b)} (K_C(y)) \leq \delta \quad (5)$$

Therefore, all $K(x')$ pixels dark pixels also fulfill the following condition:

$$\min_{C \in (r,g,b)} (K_C(y')) \leq \min_{C \in (r,g,b)} (K_C(y)) \quad (6)$$

Here y' signifies other pixel coordinates. An appropriate required requirement shall be met for a patch with at least one dark pixel:

A patch Ω contains at least one dark pixel

$$\Leftrightarrow \min_{x' \in \Omega} (\min_{C \in (r,g,b)} (K_C(x'))) \leq \delta \quad (7)$$

The threshold “ δ ” rate is not specifically addressed, and the inequality is written only as follows:

$$\min_{y' \in \Omega} \left(\min_{C \in (r,g,b)} (K_C(y')) \right) \approx 0 \quad (8)$$

It can be seen that here just have to work with the quantity $\min_{y' \in \Omega} (\min_{C \in (r,g,b)} (K_C(y')))$.

3.2 Dark Channel

Denote $\Omega(x)$ as the amount of the x -oriented surface pixel color.

The dark channel of K is defined, given an image i , as a map that satisfies:

$$K^{\text{dark}}(y) = \min_{y' \in \Omega(y)} \left(\min_{C \in (r,g,b)} K_C(y') \right) \quad (9)$$



Fig. 2 Dark channel computing. **a** An original K photo. **b** It measures the minimum values of (r, g, b) for every pixel. **c** The minimum filter on **(b)** is performed. That is K 's dark screen

Remember that in every pixel is scalar. A minimum of two operators create a dark channel. On every line, the operator is performed. See Fig. 2b for an example. See Fig. 2c, the operator $\min_{y' \in \Omega(y)}$ is a *minimum filter* [10].

It is worth mentioning that the dark channel is a picture service; however, smog-free or smog it may be. The dark channel $i^{\text{dark}}(\mathbf{x})$ of a smog picture can also be determined by:

$$i^{\text{dark}}(y) = \min_{y' \in \Omega(y)} \left(\min_{C \in \{r, g, b\}} i^C(y') \right) \quad (10)$$

In the smog removal, the process “dark channel” will be very useful.

3.3 Definition: Dark Channel Prior

Now the mathematical formula of the dark channel is ready to be described. The bulk of patches will have dark pixels in our observation.

Many pictures which are not sky-covered, most patches $\Omega(x)$ would satisfy outdoor hazard-free images:

$$\min_{C \in \{r, g, b\}} \left(\min_{y' \in \Omega(y)} K^C(y') \right) \approx 0, \quad (11)$$

Simplified:

$$K^{\text{dark}}(y) \approx 0. \quad (12)$$

That is what we call a dark channel observation before.

The core idea of this thesis is the dark channel before. This is an act based on statistics and substrates. Though very simple, we are going to prove that in smog removal, it is very powerful.

3.4 Innovative Algorithm for Single Image Smog Removal

Here it is suggested that a single picture smog algorithm with the dark channel until elimination. We show that the previous dark channel provides an additional limit for each pixel, which gives an approximate transmission value,

and then build a “soft matting” system for finishing the diagram. It is suggested that also a robust methodology on the basis of the previous dark source to approximate the atmosphere light U .



Fig. 3 A foggy, dark channel image

It can be seen the dark streams with smog-free pictures. However, no dark channel is seen in a smog image (but the word “shadow channel” is used). The trigger is the extra air: As the air light is applied, the dark pixels are illuminated from Fig. 3 the first time.

3.5 Transmission Estimation

First, before estimating transmission t , we use a dark channel. Note the equation (13) for foggy imagery:

$$i(y) = K(y)T(y) + U(1 - T(y)) \quad (13)$$

Assume the light U is measured for the atmosphere. In Segment 3, an automated process for estimating U . The analogy Eq. (13) is simplified by U :

$$\frac{i_C(y)}{U_C} = T(y) \frac{K_C(y)}{U_C} + 1 - T(y) \quad (14)$$

Remember that every color channel C is independently normalized. Then calculate the Dark Channel, insert the minimal operators on both sides of Eq. (14)

$$\min_{y' \in \Omega(y)} \frac{\min_C i_C(y')}{C} = \min_{y' \in \Omega(y)} \frac{\min_C T(y') \frac{K_C(y')}{U_C} + 1 - T(y')}{C}$$

where “ \min_C ” is referred to for convenience by “ $\min_{C \in \{r,g,b\}}$ ”.

It is assumed local patch transmission $\Omega(y)$ to be roughly uniform and refer to this transfer value as $T'(y)$. This transmission value is approximately equal to that of local patch.

3.6 Soft Matting

The front dark channel is a pixel mask, but spatial consistency always must be remembered. Denote the simplified map by T . The map is assumed to be T : (i) approximate T 's approximation of propagation by (15);

$$T'(y) = 1 - i'^{\text{dark}}(y), \quad (15)$$

Here $(i)'$ characterizes the stabilized smog image. (ii) has an edge at a stop-over in deepness, and (iii) is otherwise spatially flat. Firstly, the pixel restriction and the other two are questions about space continuity. Because the deepness is unknown, the sharp edges in the smog image i approach the profound discontinuity.

4 Results and Discussions

Here the effects of the process are demonstrated and then compared with numerous previous works in this segment.

4.1 Patch Size

The patch size in the transmission calculation is a crucial parameter in our algorithm. In the one side, with a wider patch made, the dark channel prior is stronger, since a patch becomes more likely to have a dark pixel. In Fig. 4, we will see it: the bigger the area, the darker the screen. So, with a wider patch (14) it is more appropriate. An over-saturated area contributes for the results of smog reduction of dark colors

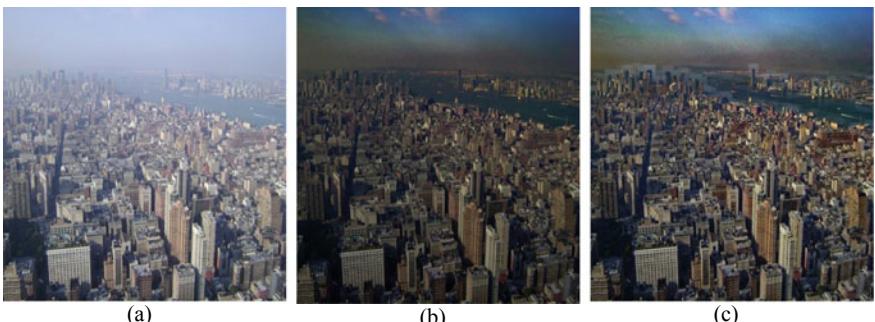


Fig. 4 A 600×400 smog image (a) and the radiance of the restored scene using 3×3 (b) and 15×15 (c) patches correspondingly. The restored scenic lighting is over-saturated with a tiny patch size while the halos for a wide patch size are noticeable

(Fig. 4b). Other than that, it is less reasonable to presume that the propagation is compatible in a system if the system size decreases. Halos that become stronger close to the deep edges (Fig. 4c).

The abrasive dark channel with a patch scale is calculated 15×15 in the method of original dark channel. The fine dark channel must be optimized in order to construct the respective transmitting diagram. The system is challenging to apply in real time during processing with soft matting. In more detailed analysis, the halo effect is caused by the processing with patches. In this paper, it suggested a simple smog removal method, which is a better version of the concept for the dark channel. The dark channel prior is simple but powerful for single image smog removal. While it is a kind of image statistics, it may not work for some particular images. And every channel is handled in the same way. As the color space of the RGB does not allow human vision approximation, the improvements cannot directly reflect the effects on human vision. The color of the artifacts resembles white, and there is no cross-channel area like the shadow or light red is compared broad in the dark channel. In these regions, the restored picture is over-saturated. People are more sensitive to variations in near-white colors, according to human visual features. The over saturation of the effect is conspicuous if these objects have some bright light color. It cannot be overlooked the flaw of the previous.

Because of the exponential growth of the Internet and the growing use of digital technologies, the use of images and video clips has greatly increased. In certain realistic scenarios, such as protected image transmission by an untrustworthy channel provider, image encryption is required before image compression. Encryption mechanisms are used for these cases, and then compression (EtC) systems.

We are concentrating on EtC, even though a compression then encryption (CtE) method is the traditional way of safely transmitting images. We are presenting a new block of scrambling-based EtC systems image encryption which improves protection in relation to traditional schemes. The suggested one requires the use of a reduced block size and a larger number of blocks that maximize both invisibility and protection against multiple attacks compared with traditional systems, for which power against various assaults such as a puzzle and vicious attacks have been debated.

So, to remove smog from an image a GUI is created. In the region of which the scenic deepness is able to remove the hazard in less computational form, and the resulting discontinuous areas, we optimize the transmission map locally, avoiding large computations. Here an image is first encrypted and then compressed. Smog is filtered from an image and then processed with DWT compression (Fig. 5).

DWT or discrete wavelet transform compression technique, the wavelet transformation is applied using a discreet series of wavelet scales and translations that obey those defined rules. This transforms the symbol into a wavelet, which is a major difference from CWT or a continuous wavelet transformation, similarly termed as discrete time continuous wavelet transformation (DT-CWT). In other words, this transformation decomposes the signal into a mutually orthogonal wavelet sequence. For splitting the image into a pixel, DWT is used. DWT is used particularly for lossless image compression in signal and image processing. For lossy compression,

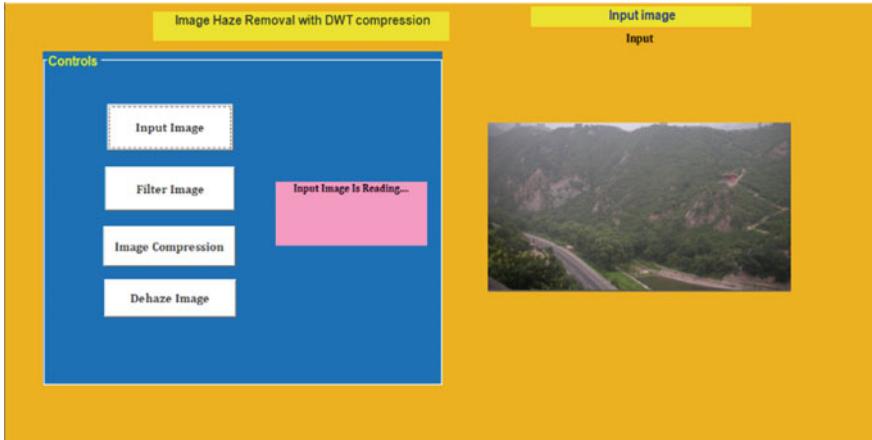


Fig. 5 GUI for removing smog from an image

DWT is also used. The lossless image compression is used mostly for DWT lossless image compression, which also gives good image quality and compression. In lossless compression, the PSNR ratio of the image is also fine.

Many non-sky patches have certain pixels with a very low amplitude and close to zero, at least a single color line. The observer uses the following interpretation of dangerous external pictures. In such a patch, the total size is zero. By using the concept of a dark channel, we can see that K 's intensity of a dark channel is low and appears zero when K is an outdoor smog-free image, except for the light:

$$K^{\text{dark}} \rightarrow 0$$

Figure 6a is the input image that is smoggy, and then (b) is processed image; here minimum of the every pixel (r, g, b) values is calculated, and Fig. 6c shows dark channels of corresponding images; a minimum filter is applied on (b). Figure 6d shows the result, filtered smog-free images.

5 Conclusions

This work helped us study the problem of smog removal and related problems in this thesis. The main contributions of this thesis are summarized below:

This prior is focused on picture figures generated as opposed to the heuristic theories of previous approaches through inherent physical properties (illumination, color, and geometry). The presentation gives a good approximation of the uncertainty for any pixel. In different situations, because of its simplicity, this smog removal algorithm is very efficient. Experiments have shown that our approach is the majority

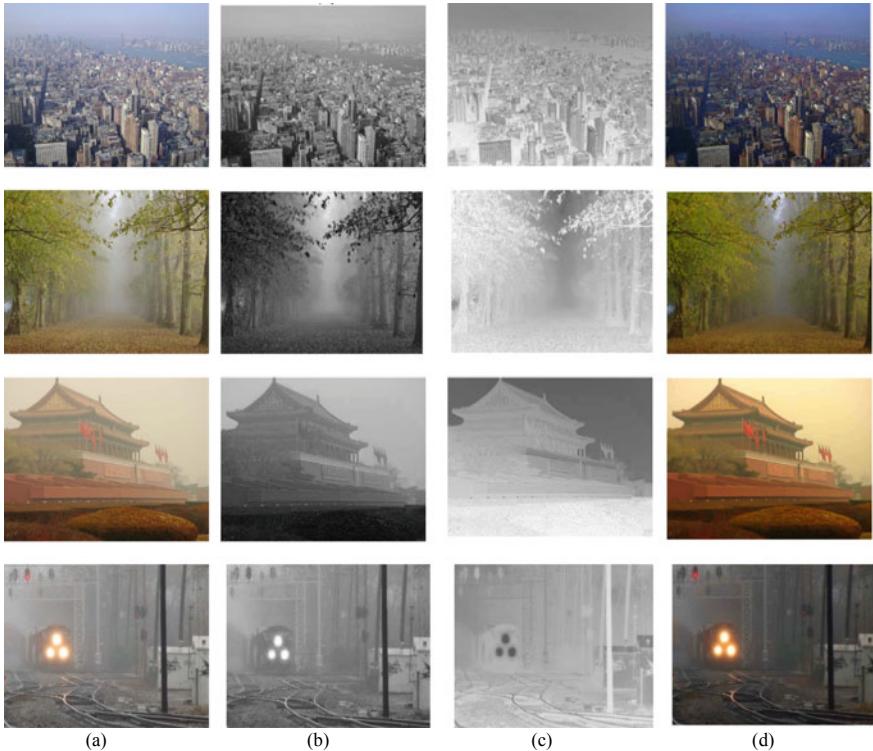


Fig. 6 Smog removal using dark channel prior: **a** Input smoggy images. **b** Processed images. **c** The corresponding dark channels. **d** Smog-free output image

of the previous works. A GUI is created where first an image is encrypted using dark channel and then compressed to remove smog from an image and to get clear image. In the region of which the scenic deepness is able to remove the hazard in less computational form and the resulting discontinuous areas, we optimize the transmission map locally, avoiding large computations. Here an image is first encrypted and then compressed. Smog is filtered from an image and then processed with DWT compression. For splitting the image into a pixel, DWT is used. DWT is used particularly for lossless image compression in signal and image processing. Observing the results, it is clear that dark channel prior works well for removing smog from an image. The well-known dark subject subtraction method, commonly used in multi-spectrum remote sensing systems, is partly inspired in this dark channel before. Spatially homogenous smog is eliminated by adding a constant value that fits the darkest object in the image. This concept is more popular and suggests a new first for dehazing the natural image.

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IoT Technologies Based Fire and Safety Alerting System Using Android Application



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Abstract In recent days, people are not considering fire safety as an important factor. So, the fire system which is implemented in any building is only detection and buzzer based but does not able to notify all the users of this building and for high-level fire hazards, they are not much smart to inform the ambulance and fire officials of the town. However, there is lack of such a smart system, which can interact and notify each user of this building via an Android application. The first symptoms of the fire are the presence of smoke and high temperature. The system which is implanted each and every area of the building will monitor the fire, smoke, and temperature of that particular area using respective sensors and send the data to google Firebase database which is able to receive data from implanted Raspberry Pi-based system and transmit that data to the Android application in real time in order to notify alert to all the users about the status of the fire and hazardous situation with live location of building's area in graphical and text message form, as well as it will also inform the fire services, police, and ambulance. Then, the system will also provide to user with a better safe exit place and will also raise the buzzer sound to alert people manually.

Keywords Raspberry Pi · Flame sensor · Smoke sensor · Android application communication · Firebase database · Internet of things (IoT)

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1 Introduction

In the present scenario, fire safety is quiet underdeveloped when compared to other technology advancements. Through this project, we seek to optimize and improve the current fire safety techniques. As fire safety has not always been the one topic that organizations really emphasize about, contradictory it is one of the most important issues to be taken care of as fires in any place such as hospitals, educational premises (schools and colleges), corporate buildings, shopping malls, and residential condominiums/complexes. [1] can have devastating effects to the people and the place even after the fire has been taken care of. In standard practices, most used devices in this sector are smoke detector and temperature detector which signals the authorities and the people that are faced with this situation on a very early stage, and it does so by using a buzzer and other components to switch on the other safety services. Our project will use this as our base to form a fire alerting system that will not only signal but also give detailed description of the premises which is under fire. By using sensors such as temperature, smoke, and integrated software working on “Pi,” we will also be able to send live information about the temperature and smoke value of the fire taking place in the vicinity of the device and notify every user present there [2]. This information will be sent to the fire department or other services like ambulance and police through IoT, and this helps in being prepared in advanced for the hazard to be faced [2]. The device needs to be connected to the Internet to pass on all the collected information to mobile phones through an app. The devices each will have date and time stamp system with a unique ID for individual devices allowing the authorities to locate the fire place easily in the premises.

2 Literature Survey

The present system requires improvements for better output. The failure rates can be minimized with increase in accuracy [3]. Standard systems that are widely used consists of a single admin that would receive a signal through the detecting device. There was also a camera attached with the system to capture live image of the incident and sends it to the admin. The admin acts as a judge to whether the alarm is to be raised or not, a SMS is also sent by the individual to the fire brigade authorities as well as an E-mail of the image is sent to the user. All the detailed description about the device and its sensors with information regarding the fire is later uploaded on the webpage which can later be updated at any time, and this also helps in viewing the fire data from any place on the globe with the help of Internet. The main issue occurs when the admin is absent due to any unforeseen events leading to the system failure and a high chance for the fire hazard to greatly increase [4]. There was also a minor delay in sending messages because system is sending image to admin and user. The new design helps remove all the related obstacles by sending alerts not only to a

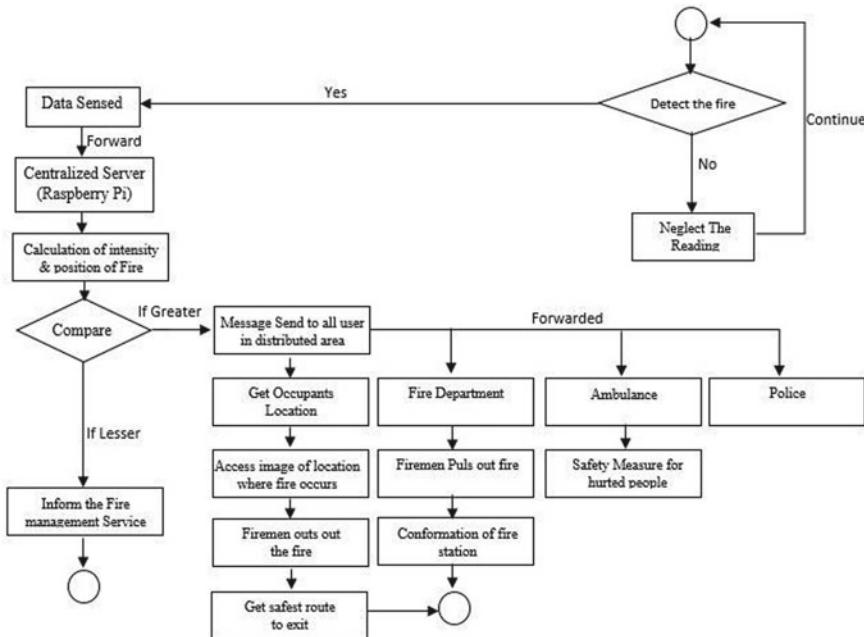


Fig. 1 Proposed system workflow diagram

single individual (admin) but also to all the required authorities and people with live location and not using camera for latency less message transmission [5] (Fig. 1).

3 Proposed System

The working of this system is like the hardware is configured as per area, and it is installed one time in that area and an active internet connection is provided to the Raspberry Pi 3b for working, all the sensors that are flame sensor and smoke sensor (MQ2) are connected with S 3b, and in that particular area, no matter how many users are there they all registered in that system, and there is an Android application communication between user and system, so in case of fire, the user will be notified in Android app with continuous notification, and they are also provided proper escape way to the user, and on the other side, the fire alert notification is sent to the fire brigade and ambulance service, so better steps will be taken for precautions.

4 Methodology

4.1 Raspberry PI 3B

Raspberry Pi is a compact computer. The Raspberry Pi 3 model b is a powerhouse, and this card sized computer has variety of uses. It is simple to use and capable of connecting to any hardware such as monitor, keyboard, and mouse. It features such as small size and easy interface which helps it to be used quickly for real-time use [6]. The specification for this board is 1.2 GHz ARM Cortex-A53 Quad core processor, 1 GB of RAM with 64 Bit CPU, having 4 x USB ports, with 802.11bgn Wireless LAN and Bluetooth 4.1 technology [7].

4.2 Smoke Sensor

A smoke sensor is used to sense the smoke, typically as a detector to detect flame. Mainly, the MQ-2 sensor is used to sense LPG, methane, I-butane, smoke, and many other gases. It can be also used as a gas leakage detector equipment in industries, factories, and educational sectors. The pin configurations are VCC, D0 pin, A0 pin, and ground.

4.3 Flame Sensor

The flame sensor is used to detect flame by capturing infrared wavelengths from fire. It is mainly being used to detect flames. It features detecting infrared light with a wavelength that ranges between 760 and 1100 nm. An infrared flame sensor captures and then it converts data from an analog signal to the digital signal. The pin configurations are VCC, D0 pin, and ground [8].

4.4 Buzzer

If you want to add sounds like beeps, tones, or alerts to your project, you require a piezo buzzer. The buzzer will not require any external oscillation, simply provide a current of voltage between 9 and 15 V DC, and it will make noise [9]. This actuator has two wires attached and also two screw mounting points, so circuit integration can be easily possible. To use, it connects the black cable to the negative pin and the red cable to the positive pin of the voltage source.

4.5 Google Firebase Database

Firebase mainly works as a backend service (BaaS) which started as a start-up and featured a great application development on Google Cloud Platform. It is a real-time database that works on only push method not require any type of request. The system will automatically change data whenever there is a change in the database. It is connected to a Web socket, and it is faster than HTTP. One client changes the data, and all the linked clients get revise data instantly. It provides inbuilt security, authentication, and all other services. So in our system, the Firebase database is mainly connected with Android app, and on the other side, it is connected with Raspberry Pi 3b, so the flow of data is like whenever sensors will sense the data; through Raspberry Pi, the data will be sent to Firebase database, and then, after through Firebase, the data will be sent to the user on their respective Android application. Here is a simple way to connect Raspberry Pi with Firebase, and for the android application, it is automatically imported and configured on just one click.

4.6 Android Application Communication

For android application development, Android Studio IDLE is used. In our application, there are two main pages that are the first login page and the second is the homepage. For login, user need to enter the name and mobile number and there will be automatic authentication process done using google Firebase, it will verify each user by sending OTP so there will be no requirement of signing up for new users, only authentic people with their unique number can only access this application. And there will be no chance of data duplicity. Further, the second page is homepage which shows a profile of the user, and as the prototype is shown in this system four rooms model be built with their specific room numbers, and then, the application is connected to Firebase database, so it can receive data and reflect changes on the homepage by showing a graphical representation of an image, and it will use a green color symbol to show the safe exit path and receives notification continuously to the users [10]. Even if the application is running in the background or even it is closed, the fire alert notifications would be received continuously to all registered users and the logout feature is also available for each user in the application.

5 Result

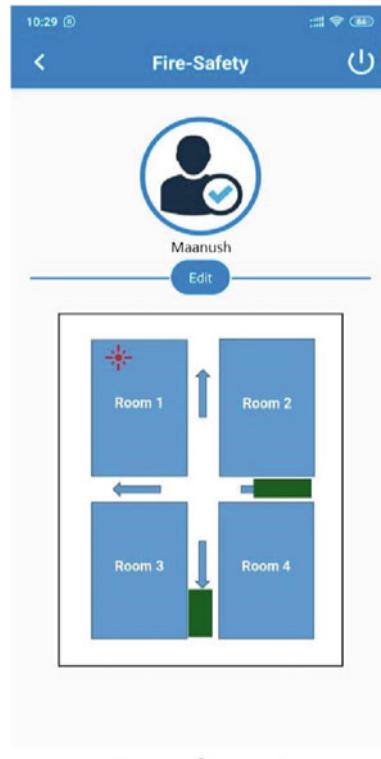
At the initial stage of the system, when it will start booting for the first time, it is by default in “off” state, so the system will show the “off” message on command shell, and the “All Safe” status will be shown to all users. Every sensor having its individual “on” or “off” state. So, the fire or smoke or both detected, the state of sensors will

be changed from “off” to “on” according to their current scenario and respective messages will be sent to all users. And if whatever changes in detection are done, it will show real-time data change in command shell and all the changes of state will be sent with date and time to Firebase database, so further communication will be done as early as possible to take initial safety measures. Whenever the changed state of the sensor receives from Raspberry Pi, it will directly reflect on the main database because Firebase is a real-time database. The attribute data which is received from Raspberry Pi is the date, timestamp, and sensors “on” or “off” state. This database is also linked with an android application, so that the information, which is fetched in real-time by Google firebase will send to all registered users on their Android application, and it will reflect changes on the application homepage.

Whenever fire, smoke, or both are detected in the room, smoke and fire images will pop up in application GUI, respectively, and also green mark is shown for proper safe exit way, also application gives continuous notification (Fig. 2).

On the other hand, the admin Android application where admin needs to sign in using its unique credentials, and it will take to the homepage of the admin application, and it will show the data contains address, building name, and place where fire is detected as shown in Fig. 3.

Fig. 2 Android application GUI



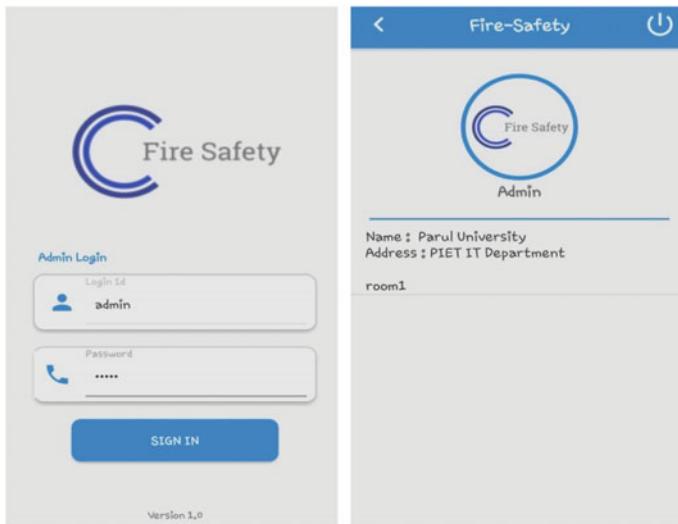


Fig. 3 Admin Android application GUI

6 Conclusion

This paper has proposed a smart fire and safety system that is configured using a Raspberry Pi with a flame sensor, smoke sensor, LEDs, and buzzer in order to sense the fire and communicate to google Firebase to provide real-time information to all the users via android application. The novelties of the proposed work are manifolds. Besides proposing a smart fire safety system, it facilitates (i) real-time communication with all the users via an Android application in order to take priorly fire safety precautions. (ii) Graphical representation using green color paths of the building for fireproof ways of exit. (iii) In the fire situation, the system will automatically inform fire brigade officials and ambulance services to take early steps, so there will be no huge fire loss.

Future work includes find out the sensor's proper working for system otherwise stopped sensor lead to entire system failure, to detect fire intensity and its rate of spreads in a particular duration which can help to priorly analyze the hazards situation of that place to take necessary action before going out of control.

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Effects of Uber and Ola on SVM and Naïve Bayes



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Abstract Twitter is a microblogging site that helps in opinion mining of tweets (reviews) from people [1]. Understanding the reviews from their tweets helps in determining what a business needs to improve on. This paper focuses on the algorithms used that are SVM and Naïve Bayes, their functionality, accuracy, precision and recall value. The effect of the two machine learning algorithms gives us the idea of which algorithm can fetch the best suitable results. To determine this, we use a medium to understand it which is ‘confusion matrix’. The datasets used are ‘Uber’ and ‘Ola’. Uber and Ola have a large number of users who use the cab service regularly. We extract tweets that vary in number and the algorithms check the words which represent sentiments of people’s review. The algorithms then train the data from the tweets to identify which tweets can be categorized as positive, negative and neutral.

Keywords Twitter · Uber · Ola · Machine learning · Confusion matrix · SVM · Naïve bayes

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1 Introduction

Machine learning is a branch of artificial intelligence that is concerned with the construction of models from data and presenting it in an understandable format. Supervised machine learning is called a subfield of machine learning. As computers derive models from labeled training data, it helps in understanding the models properly. Recently, the field of machine learning has seen a rise in the popularity of probabilistic and statistical models. This paper focuses on showing the effects of SVM and Naïve Bayes on our datasets [2]. We gather 3000 tweets from Uber and Ola and we first clean it. The two algorithms have a set of words predefined in the library which it uses to find from the tweets. The words associated are positive, negative or neutral. These algorithms find the words associated with these sentiments and then compare them. It later bifurcates it and does analysis in the form of graphs and diagrams. We check three things here while watching the effects of the two algorithms. The data on which the algorithm is applied is training data. Once for particular datasets in our case for the first 500 tweets, we train the data. Then, we gradually increase the number of tweets, i.e., we next train 1000 tweets and increment it till 3000 tweets. The first 500 trained tweets then are used as trained data, the new datasets or tweets are the testing data, and this testing or training data is compared with the tested or trained data.

These are the following things we watch for in our effects from the algorithms. First, the accuracy, second precision and third recall value. Accuracy defines how accurate is the model selected for the datasets [3]. Precision talks about how perfect or precise are the method or how effective is the algorithm on the datasets. Does it also depend on how the data is like? Does the tweet have multilingual content (in case of India) Is the data clean? Are there stop words? White spaces, etc. Recall value checks whether the accuracy predicted is correct or isn't? Finally, we represent the diagrammatic presentation of accuracies, confusion matrix, formulas and accuracy outputs.

2 Literature Review

Machine learning is very popular which uses computer science and statistics. Machine learning enables computers to understand data and devise new techniques to implement new algorithms. The process of developing algorithms that enable the machine to learn to perform a task in a particular manner is called machine learning [4]. Now, we have a vast variety of methods and techniques in machine learning for various functions. The two machine learning algorithms we have used for our datasets are support vector machine (SVM) and Naive Bayes algorithms. SVM is suited for extreme cases, and it is a frontier that best segregates the two classes (hyperplane/line). SVM can be used in multi-dimensional datasets where data points are referred to as vectors. It is more often used in regression and classification problems.

Naïve Bayes follows a probabilistic approach to solve problems considering different factors [5]. Even Naïve Bayes is used for classification of datasets, for prediction-based problems and review system problems. These algorithms are multi-purpose used and have been used previously to solve a wide variety of problems.

Previously, people have used Twitter sentiment analysis for various datasets, but we have not come across Twitter sentiment analysis for Uber and Ola datasets. The idea behind doing Twitter sentiment analysis for Uber and Ola is the vast amount of datasets available. This will help us understand reviews of customers using the services of the cabs and give insights about the same. Support vector classification aims to understand a computationally efficient way of separating planes and learning how a ‘good’ separating hyperplane differentiates in a high dimensional feature. SVM is considered to be more accurate than Naïve Bayes for different datasets. But in our datasets, Naïve Bayes is more accurate and is helpful for large amounts of datasets [6]. In Naïve Bayes, each variable/function is independent of each other which is why the accuracy increases, unlike SVM which is dependent or related to each other. We focus on three important factors while determining the output’s first accuracy, second precision and third recall value. Accuracy comparison among the two datasets helps us understand the effect of datasets on the two algorithms.

Thus, using Twitter sentiment analysis, we find the best algorithm which gives the best accuracy for our datasets.

3 Methodology

The algorithm considered in this project for classification purpose is SVM and Naïve Bayes:

1. Support Vector Machine Algorithm

Support vector machine (SVM) is a supervised machine learning method and is a binary classifier [7]. As an important example of the kernel method, SVM divides the data into different categories based on the classes with the help of hyperplane as shown in Fig. 2. As a supervised learning method, the algorithm is trained with labeled training data. SVM is known to be robust with a very large number of feature selection and smaller sample sizes which allows learning both simple and highly complex classification models [8].

Take Fig. 1 as it can be observed that two different classes indicating circle and square are used, SVM creates a hyperplane that divides the two classes with the maximum margins.

2. Naïve Bayes Algorithm

The Naïve Bayes algorithm reduces the complexity of Bayes theorem by assuming conditional independence over the training dataset. The principle that is followed by

Fig. 1 Operation of SVM algorithm

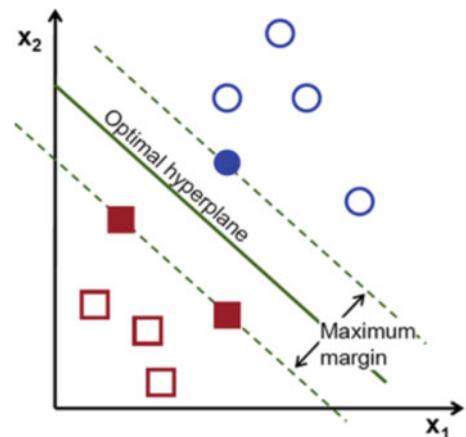


Fig. 2 Bayes theorem

$$P(A|B) = \frac{P(B|A) \cdot P(A)}{P(B)}$$

Probability of B occurring
 given evidence A has already
 occurred Probability of A occurring
 ↓ ↓
 P(A|B) P(B)

Probability of A occurring
 given evidence B has already
 occurred Probability of B occurring

the algorithm is that every pair of features that have been classified is independent of each other. The probability of the feature is considered with the probability of individual feature occurring divided by the probability of the remaining feature [9] that can be seen in Fig. 2.

Below now, the experimental results would be displayed for this project.

4 Experimental Results

The two algorithms used in the paper are support vector machine (SVM) and Naïve Bayes. The algorithm comparison between the two is decided based on the accuracy of both for example: in terms of accuracy if one algorithm gives better values it might be good for the particular datasets [10]. Also, the other factor-dependent is recall and precision. Recall can be calculated on positive and negative also precision can be calculated on positive and negative. Depending on all the values obtained after calculation, the best algorithm can be chosen.

The sentimental analysis obtained from the tweets of Uber and Ola was used to generate the word cloud of the words that were highlighted more compared to the



Fig. 3 Word cloud of Uber

other words used in the text. This gave a brief idea of what kind of a sentimental vocabulary was obtained in various segments of the data. With the help of the word cloud, it was clear what the users wanted specifically related to the company, this is shown in Figs. 3 and 4.

The formula for accuracy, recall and precision is

$$\text{Accuracy} = \frac{a + d}{a + b + c + d}$$

$$\text{Recall (Positive)} = \frac{a}{a+c}; \quad \text{Recall (Negative)} = \frac{d}{b+d}$$

$$\text{Precision (Positive)} = \frac{a}{a+b}; \quad \text{Precision (Negative)} = \frac{d}{a+b}$$

Table 1 shows the confusion matrix, which is the table where accuracy can be calculated based on values obtained in the respective cells.

The overall accuracies of two algorithms on 3000 data are indicated in Table 2.

In Table 2, the overall accuracy of two algorithms on two different datasets is calculated with the help of the confusion matrix. It can be seen that the SVM in both the datasets performed good but in comparison with Naïve Bayes on both the



Fig. 4 Word cloud of Olá

Table 1 Confusion matrix table

	True positive tweets	True negative tweets
Predicted positive tweets	a	b
Predicted negative tweets	c	d

Table 2 Classification of tweets with different datasets

No. of exp.	No. of tweets	SVM (Uber, %)	Naïve Bayes (Uber, %)	SVM (Ola, %)	Naïve Bayes (Ola, %)
1	500	85.23	86.58	67.11	70.47
2	1000	84.95	87.29	68.56	69.57
3	1500	84.60	87.05	69.71	71.49
4	2000	84.47	87.485	70.12	71.45
5	2500	84.25	86.38	71.43	72.36
6	3000	84.87	86.65	73.19	73.64

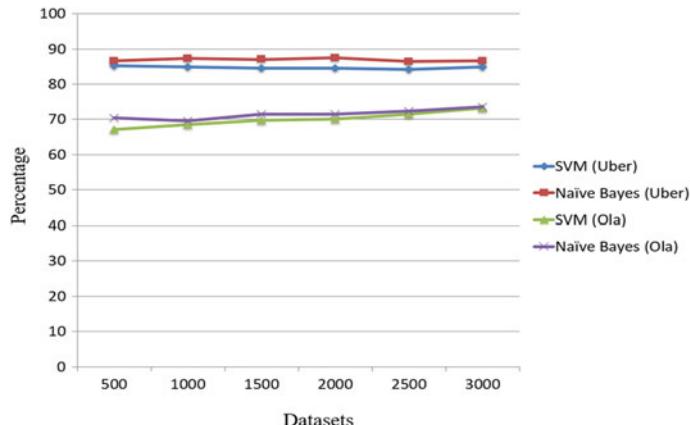


Fig. 5 Diagrammatic presentation of accuracies in the experiment

datasets was not that good, as Naïve Bayes in both datasets outperformed SVM. The graphical representation can be observed in Fig. 5.

Table 3 shows the correct tweets and incorrect tweets of the two datasets which are Uber and Ola on two different algorithms that are SVM and Naïve Bayes.

Table 4 explains the precision comparison of positive tweets for respective datasets as it can be observed that Naïve Bayes performed better with both the datasets.

Table 5 explains the precision comparison of negative tweets for respective datasets as it can be observed that SVM performed better with both the datasets.

Table 6 displays the recall comparison for positive tweets on test datasets and Naïve Bayes performed better in comparison with SVM.

Table 7 displays the recall comparison for negative tweets on test datasets, in this SVM, was giving better accuracy but Naïve Bayes still outperformed for both the datasets.

Table 3 Results of accuracies with the maximum number of tweets

Total number of test	Classifier used	Tweet dataset used	Correct tweets	Incorrect tweets
3000	SVM	Uber	763	136
		Ola	654	245
	Naïve Bayes	Uber	790	109
		Ola	661	238

Table 4 Precision comparison for positive tweets on test datasets

No. of exp.	No. of tweets	SVM (Uber)	Naïve Bayes (Uber)	SVM (Ola)	Naïve Bayes (Ola)
1	3000	0%	100%	0%	100%

Table 5 Precision comparison for negative tweets on test datasets

No. of exp.	No. of tweets	SVM (Uber)	Naïve Bayes (Uber)	SVM (Ola)	Naïve Bayes (Ola)
1	3000	100%	87.00%	100%	73.15%

Table 6 Recall comparison for positive tweets on test datasets

No. of exp.	No. of tweets	SVM (Uber)	Naïve Bayes (Uber)	SVM (Ola)	Naïve Bayes (Ola)
1	3000	0%	16.17%	0%	2.85%

Table 7 Recall comparison for negative tweets on test datasets

No. of exp.	No. of tweets	SVM (Uber)	Naïve Bayes (Uber)	SVM (Ola)	Naïve Bayes (Ola)
1	3000	84.87%	100%	72.27%	100%

5 Conclusion

The study aims to evaluate what effect does the datasets make on the classification algorithm and what accuracy, precision and recall values we get from it. In this paper, we used the two-classification algorithm SVM and Naïve Bayes and as we can see from the above results, Naïve Bayes outperformed in both the datasets with an accuracy of 86.65% in case of Uber and 73.64% in case of Ola. Also, the datasets were increased with the interval of 500 to understand different accuracy, with that the precision of positive and negative tweets was calculated which showed that in case of positive tweets Naïve Bayes was good and in case of negative tweets SVM was good. Similarly, the recall values of positive and negative tweets were calculated with that we saw that in case of positive recall the Naïve Bayes performed well and in case of a negative recall, the Naïve Bayes performed well. The Naïve Bayes fits perfectly with the datasets we used in this project.

6 Future Scope

We understood from the datasets that data correctness is really important. The more accurate the datasets the better the outputs. For example, in this paper, the dataset Uber gave more accurate results because the data (tweets) was clean and understandable. So whichever dataset, we want to do sentiment analysis on should have accurate correct data.

We can improve datasets and help algorithms understand which language is the data (tweet) in and accordingly understand the sentiments more accurately. We can

further have an area or location-based sentiment analysis for a better understanding of customer reviews according to the area they use the services in. SVM is generally a better algorithm, but Naïve Bayes gives more accurate results in our case. If data is cleaned and more precise, we can have better accuracy for SVM as well in the future. Data dependency depends on what data is presented. If the accuracy of the tweets increases, we can try different algorithms and give comparative statistical outputs.

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Analyze Classification Act of Data Mining Schemes



**Omprakash Jaiswal, Pawan Kumar Saini, Shalini,
and Yatendra Mohan Sharma**

Abstract In the current era, the elevated amount of data related to various working field is globally available that utilize by huge research community for fetching an unseen knowledge. Related field study reveals that classification schemes of data mining have highly exploited by investigators for labeling data and to recognize the category/class of fresh entered statistics but with differ operational structure each handy scheme puts fluctuate upshot even evaluates with same data sets. Hence, an assortment of an exclusive classification scheme is still a research challenge of related field. In term to discover and demonstrates suitability/unsuitability of accessible classification scheme, this paper presents a comprehensive assessment among some of the most adopted classification methods in company of few benchmarked datasets access from UCI repository.

Keywords Data mining · Classification · Decision tree · Naïve Bayes · Support vector machine · Multilayer perceptron

1 Introduction

Nowadays, an unavoidable technological development increases the size of digital data in rocket high speed, stored in a variety of globally connected repositories. Worldwide huge investigators exploit these data sets with a number of data mining schemes for attaining hidden knowledge under different working area. However, a number of classification methods are openly accessible but with different structural

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body each one handy algorithm put differ upshots even execute with same data set. Additionally, unique associated issues of every practice affect an act and suitability of selected algorithm that motivates investigators in globe to optimize an action of presented schemes. Recently, the number of published efforts demonstrated the pros and cons of dissimilar classification algorithms in different ways [1–3]. This paper presents an analytical estimation of different but most adopted data mining classification algorithms in direction to discover-related intricacy and aid to naïve investigators for better understand the suitability/unsuitability of each one technique with an motivation of optimization process.

2 Prominent Schemes Exploits for Classification Process

Typically, classification is a supervised learning practice that begins with training of build scheme followed by testing of build model [4]. Description of each offered process is not possible to include in this paper, but a few prominent classification methods in modern time frame are

2.1 *Naive Bayes (NB)*

This scheme belongs to the family of Bayesian theorem, moderately works with real-world state of affairs, in different areas to analyze sentiments, filtering of spam and to build valuable recommendation method [5]. Some rewards and restraints of NB are:

1. Easy to implement and highly efficient to promptly train build model.
2. Desires exceptionally squat amount of training data, memory and CPU power.
3. Incredibly sensitive with format of input data, not fit for missing value datasets.
4. This scheme does not classifies the statistics if that was missing in training set.

2.2 *Decision Tree (DT)*

DT is one other key unit members of supervised learning schemes and can exploit for resolving regression issues along with classification [6–8]. Key constraints of DT are

1. DT does not want normalization and scaling process of exploited statistics.
2. Competently able to handle issues of missing values and easy to clarify.
3. DT structure highly affected with little alteration in exploited data.
4. Intermittently, the estimation of DT maybe more complex against of other methods.

2.3 Support Vector Machine (SVM)

A well-adopted unit of supervised learning schemes that mostly utilize for solving an issues of classification. Key strength and of restraint SVM scheme are

1. Capable to grip nonlinear statistics by exploiting of kernel trick.
2. Mostly utilize to solve classification issues but can be used for regression.
3. This scheme desired extensive amount of system memory.
4. Huge time frame takes in account for model training and hard to interpret.

2.4 Multilayer Perceptron (MLP)

MLP is a variety of feedforward ANN (FF-ANN), build with input, hidden and output layer. Apart to input layers, the nodes exist at each layers recognizes as neuron that exploits nonlinear function. Key strength and restraints of MLP are

1. Highly suitable for regression and mapping process with fault tolerance skill.
2. Perform speedily predictions act in the midst of imperfect knowledge.
3. Training of build model is expensive and time-consuming practice.
4. Inexplicable behavior and huge dependencies on training data.

2.5 Logistic Regression (LR)

This scheme bestows binary classification and is not suitable for prediction of continuous effects. Key merits and demerits of this scheme are

1. Desires low amount of computational resources.
2. Extremely interpretable and have no need for tuning/scaling of input features.
3. Have linearity assumption, not suitable for solving of nonlinear issues.
4. Barely fit for forecasting of discrete functions.

With above-converted schemes, several other classification methods have also rapidly utilized by investigators in various ways [9, 10].

3 Research Methodology

To analyze the classification act of several data mining scheme, five benchmarked datasets (shown in Fig. 1) have taken from the UCI repository. Furthermore, a pre-processing step has carried out for cleaning of data and to attain only most appropriate attributes, considers correlation-based feature selection (CFS) and gain ration (GR) scheme. Figure 1 describes the adopted methodology in a better way.

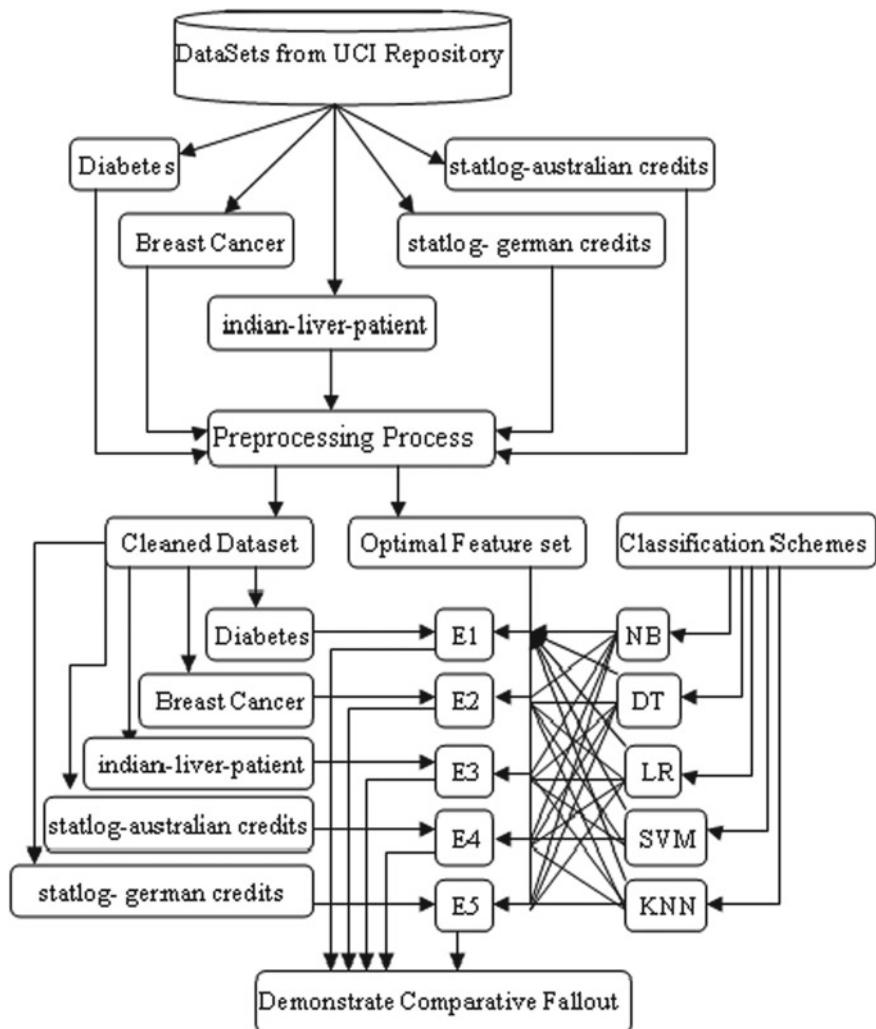


Fig. 1 Research methodology

E1–E5 is the number of experiments, within each experiment every dataset has simulated with all exploited classification scheme. Furthermore, a comparative evaluation fallouts have demonstrated to explain the classification act of each algorithm. The act of each classification algorithm has evaluated with the measuring scales of accuracy, talent to fittingly predict unseen data value. Compute as

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{FP} + \text{TN} + \text{FN}} \quad (1)$$

where true positive (TP), true negative (TN), false positive (FP) and false negative (FN).

4 Experiment and Result Analysis

At initial level diabetes, the dataset has considered for experiment, enclosed 768 instances with 8 attributes. Furthermore, the preprocessing process has considered to remove associated glitches and attain only optimal features with the mechanism of CFS and GR schemes, offered attributes by CFS and GR schemes are depicted in Table 1.

Comparative numbers in Fig. 2 clearly indicate that logistics regression (LR) scheme has attained high classification accuracy in company of feature selected by CFS mechanism. To reconfirm the suitability of this algorithm, one other simulation

Table 1 Attributes of diabetes dataset

Original associated attributes	Attributes suggest by CFS	Attributes suggest by GR
Preg, Plas, Pres, Skin, Insu, Mass, Pedi, Age	Plas, Mass, Pedi, Age	Plas, Mass, Age, Preg

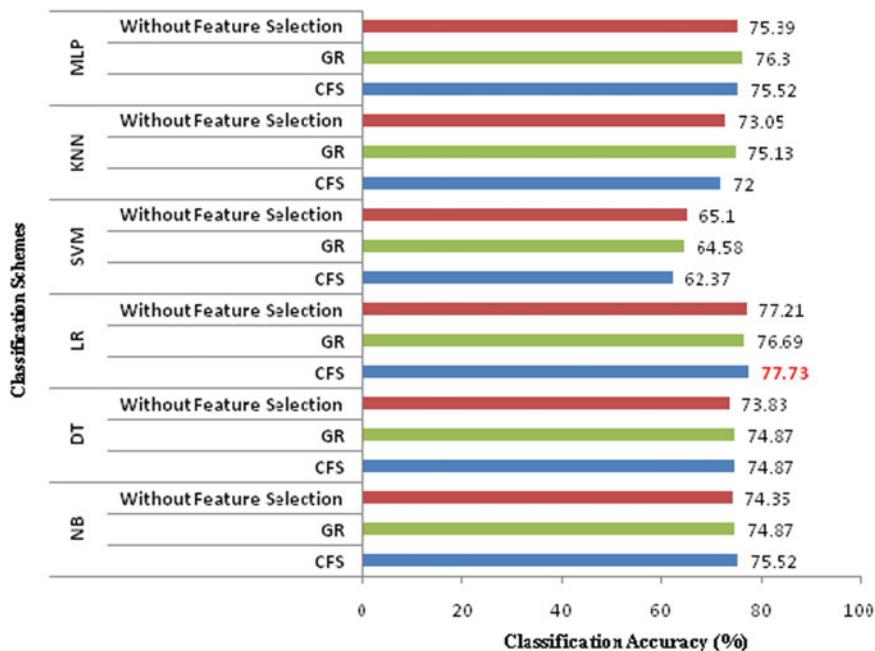


Fig. 2 Accuracy rate of classification scheme over diabetes dataset

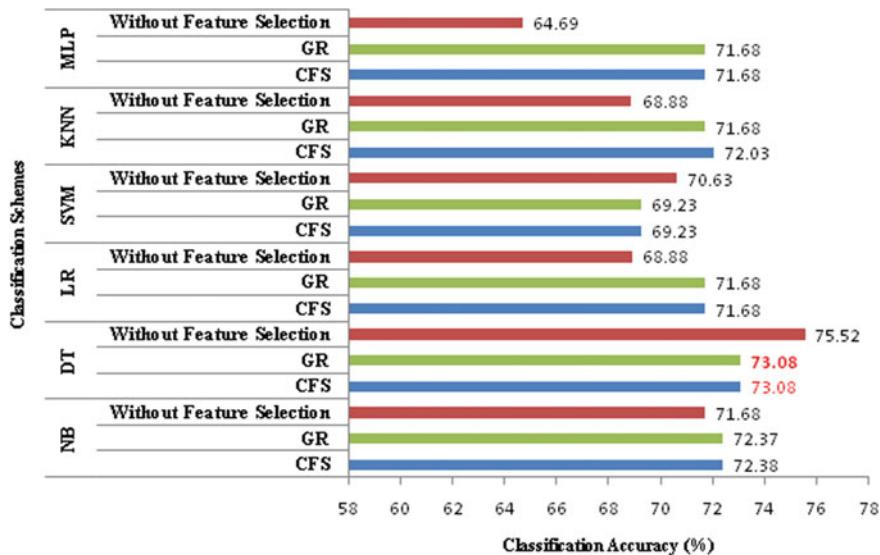


Fig. 3 Accuracy rate of classification scheme over breast cancer dataset

Table 2 Attributes of breast cancer dataset

Original associated attributes	Attributes suggest by CFS	Attributes suggest by GR
Age, menopause, tumor-size, inv-nodes, node-caps, deg-malig, breast, breast-quad, irradiat	Tumor-size, inv-nodes, node-caps, deg-malig, irradiat	Node-caps, inv-nodes, deg-malig, irradiat, tumor-size

work has done with utilization of breast cancer dataset that contained 286 instances and 9 attributes. Figure 3 illustrates the comparative act of classification methods and Table 2 depicts total and suggested attributes of exploited dataset.

As shown in Fig. 3 that over breast cancer dataset classification process, DT has outperformed against of other methods. Additionally, the implemented scheme has outperformed with the selected features of CFS schemes; therefore, in the next evaluation, CFS scheme has exploited for feature selection process with consideration of three Naïve datasets, liver, Australian and German credit dataset. Figure 4 depicts the comparative classification act of exploited scheme.

As depicted in Fig. 4 that for classification act over liver dataset, the SVM method has outperformed but with both of credit datasets LR scheme outperformed. The above experiment fallouts dented that no one single algorithm is fitted for classification of each data set; hence, the selection of an efficient classification and feature selection procedure is always a hard challenge and a trickier dare in front of investigators.

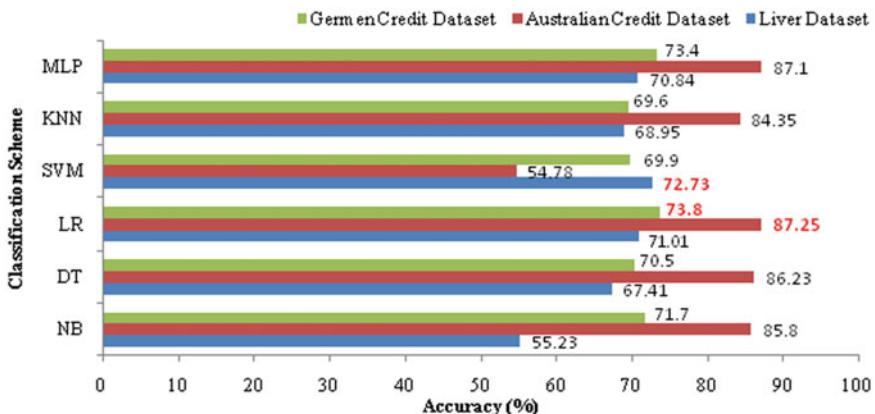


Fig. 4 Accuracy of classification scheme over liver, Australian and German credit dataset

5 Conclusion

This paper analyzes the classification act of NB, DT, LR, SVM, KNN and MLP over five different dataset, accessed from benchmarked repository UCI. CFS and GR schemes have considered for feature selection process. Experimental fallout has denoted that no one standalone algorithm is fitted for each dataset, but DT and SVM scheme has put better accuracy value, however, LR approach shown its efficiency over credit dataset of Australian and Germany. The analyzing effort of this paper evidently shows that still selection and implementation of an efficient classification method is a tricky challenge in front of investigators that can be taken in account by Naïve investigators in further optimization process.

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Detecting Denial-of-Service Attack Using Dendritic Cell Approach



Kaanan Arora and Shilpa Mahajan

Abstract Denial of service (DoS) and distributed denial of service (DDoS) are an attack that aims to hinder the working environment of a legitimate user which is what makes it harmful and threatening. It is mostly implemented by a person who aims to harm the system and denies access to the lawful user from using his/her own device. DoS attacks are quick and quite easy to implement and mainly target networks and online systems. This paper aims to present a study of multiple research and literature in the field of detection of denial-of-service attacks with different approaches, i.e., the attacks in the network by using an algorithm based on dendritic cell in an artificial immune system, algorithm based on Kolmogorov complexity metrics and the DoS attack in a cloud environment, i.e., wireless body area networks (WBAN) while developing an output for a larger database using dendritic cell algorithm and hence develop a detection technique for the attacks. These have classified attacks on the basis of the fact if the legitimate user's premise is being attacked or not. Hence, this comparative review will be useful for the development of robust algorithms for the detection of active or inactive network attacks.

Keywords Denial-of-service attack (DoS) · Dendritic cell algorithm · Intrusion detection system · Wireless body area networks (WBAN) · Distributed denial-of-service attack (DDoS)

1 Introduction

Denial-of-service attacks and distributed denial of service have been known to the computer science field for a great amount of duration now. Denial-of-service attack is one of the most commencing and harmful cyber-attack known. Denial-of-service (DoS) and distributed denial-of-service (DDoS) attacks area, it is one of the varieties of pugnacious and sinister intruding to online servers. They flood the victim node with

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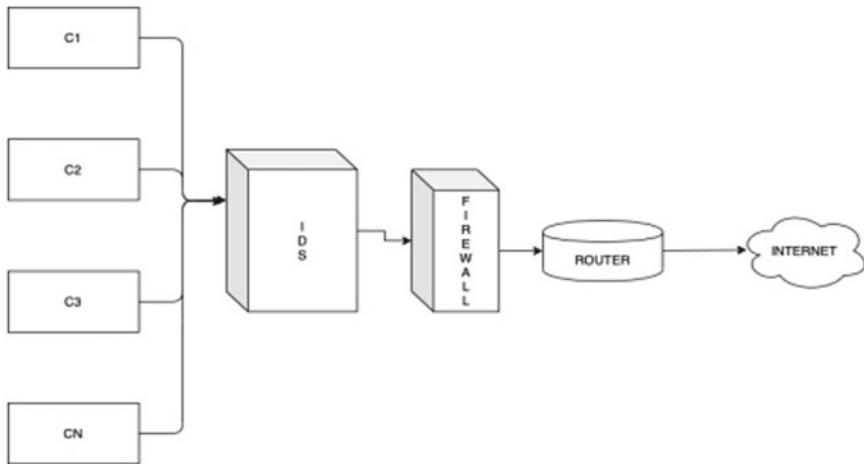


Fig. 1 Flowchart to describe the access of the Internet with computers. Zones of denial of service

a cannonade of malevolent or deformed packets, inflicting the victim node to either slow or even finish off, and hence, deny the services to legitimate users. Therefore, a sensible and economical DoS/DDoS detection technique is required.

Though the secured networks which are designed for user authentication, encoding and firewall systems are equipped to shield corporations and people from cyber attacks, such as DoS, computer hackers endlessly notice ways in which to wreck these systems to attack networks and its interconnected computers [1]. An intrusion detection system (IDS), therefore, becomes a necessity as a further wall for safeguarding systems despite the impediment techniques [2].

The intrusion detection system is a software system that majorly aims to safeguard one's computer system from incoming harmful traffic of attacks and malware like trojans and virus-containing executable files. An attack can be classified into signature-based mostly and anomaly-based by the IDS. The majority holder in the IDS is a signature-based one. Previously multiple algorithmic approaches have been applied for the detection of denial-of-service attacks, and most of these are applied for gathering the signature-based ones but some methods and approaches to find anomaly-based attacks have also been discovered and implemented [3]. This paper aims to take into account certain approaches that have been discovered over time for the finding out denial-of-service attacks (Fig. 1).

2 Review and Comparative Study of Existing Algorithms

Kulkarni et al. describe that the DDoS attack detection can be done by using the algorithm which is based on one of the Kolmogorov complexity theorems. As per its notion, for two string which is random, A and B,

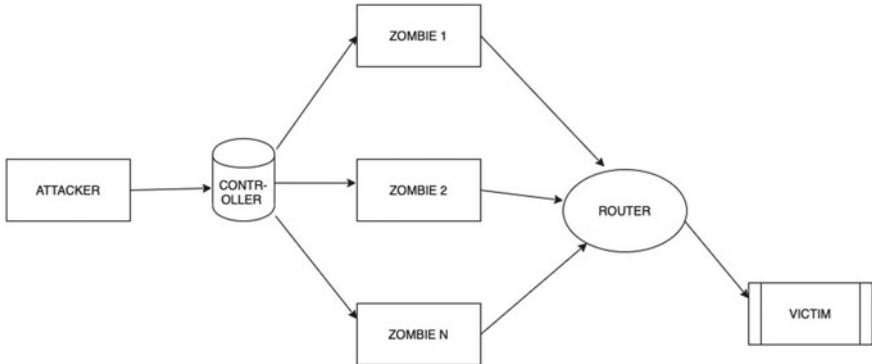


Fig. 2 Interaction of controller for zombie zones of network with respect to the router

$$K(AB) \leq K(A) + K(B) + x,$$

where $K(A)$ and $K(B)$ are the complexities of strings, x is a constant and $K(AB)$ is the joint complexity of the concatenated string [4] (Fig. 2).

When variables are random, it holds equivalence relation. It can also be inferred from this string, when the string are highly correlated, the joint complexity further decreases. Hence, two strings of similar nature, having the same characteristics and also show related patterns. This study can be utilized for generating programs of combined strings [4].

In another study, authors reviewed and identify various attacks associated with cloud security. In this paper, a packet-based confidence filtering approach is devised. This approach uses pattern correlation mining technique in cloud-based environment to detect DDOS attack [5]. The limitation of this approach is a slower as it a large database is managed which affects the processing speed of a cloud server [5]. Another significant and most effective approach is Dendritic cell network algorithm in which consists of three modules data preprocessing, signal extraction module, and DCA module [6]. In the data processing module, the main feature is that they extracted from input network traffic and whose values fluctuate due to the occurrence or non-occurrence of abnormal activity.

3 Way Forward and Analysis

The prevailing studies in the field of denial-of-service attack detection are advanced and well sufficed. The system that we aim to propose shall accommodate all the aspects of the DoS/DDoS attack. The system that we shall propose must incorporate WBAN service management in a DDoS case, and it must also help catch the anomaly-based DoS attack, as the studies in this field have acquired high standards and set up benchmarks, but one thing that this field lacks is the ability of the system to train

itself to modify itself as per the need of the environment and detect the attack and its anomaly aspect. The system that we look forward to will be created with machine learning techniques by training and testing the NSL-KDD dataset to work on the inherent problems and learn to identify signatures and anomalies as well.

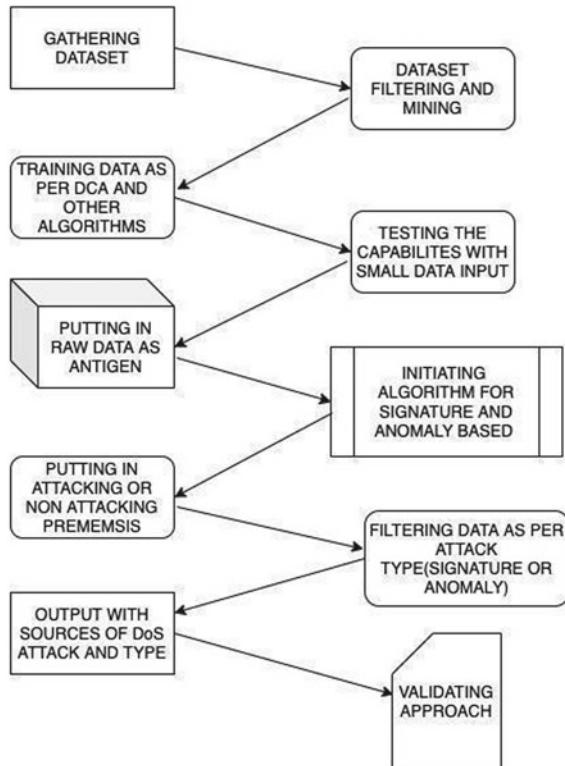
4 The Algorithmic Approach

The dendritic cells are the tiny cells in the human body that processes and works in such a manner as to avoid the diseases caused by an outside entity entering the human body and the body is not compatible to digest, process, or ingest it (Fig. 3).

An antigen is a foreign element that enters the human body through various input paths and binds itself to the body to form harm and destruction. This is where the dendritic cells come to play, and they hold the antigen and eat it off, i.e., nullify its destruction capabilities [7].

In the above studies, various methods and algorithms have been used to detect a denial-of-service attack; we aim to further elaborate the dendritic cell approach as it

Fig. 3 Proposed approach



shall hold on the computer-based antigen, i.e., the form of malware. So till the time, the processing will take place of resolving and figuring out the issue, the malicious code or file that is capable of performing denial-of-service attack will not be further spread into the system.

Pseudocode:

```

set totalcells;
xcount ← 0
Activate and start dendritic cells;
while incoming traffic
    if x then
        increment xcount;
        CI=xcount mod totalcells;
        DC of CI is part of x;
        update DC's x profile;
    end if
    if signal then
        calculate costimulation signal and k function miscellaneous values;
        for all DCs do
            decrement DC's lifespan by value of costimulation signal;
            Increment DC's k value by new value of k function developed;
        if DC's duration of life <= 0 then
            give context value to DC;
            Move DC from calculative area;
            reset DC value;
        end if
        end for
    end if
end while
for each x type do
    calculate MV;
end for

```

Here x is the total and stepwise incrementing antigen count, which is supposed to contribute by telling the algorithm if the incoming category is the one that can create chaos or harm to the human body or in this case the active system. CI is the cell index of the values which is supposed to be calculated by finding a modulus value of the xcount, i.e., the count value of antigens on the total cells available to access. DC is the dendritic cell that is supposed to capture the antigen and encapsulate them till further destruction is approved in this case where DoS attacks are meant to be held and trapped. MV is the mature context antigen value that is meant to be calculated; once the entire data has been processed, this value is to calculate the final results and outputs by taking into consideration various run times and accessibilities.

5 The Dataset

As we are working on a network problem which features like an inherent; most cases in this area of study we have opted for NSL-KDD dataset to access and study further NSL-KDD dataset has many attributes for one to work on and provides a vast prospect to people analyzing it. Also, the number of case records in this dataset is sufficient to speak of the population of attacks, and some of the many attributes are attack type labels, different levels of attacks, continuous or discrete fields, and field names of attack. The NSL-KDD dataset contributes of multiple data files which are well-differentiated like the 20% train set and others based on attributes which makes it efficient to work on for attack detection.

6 Results

In simple words for our implementation, we have considered the body to fight outside antigens, i.e., attacks. We have used the approach of machine learning with python code to train the data and find out conclusive values of defining characteristics. Multiple libraries and training/testing functions have been used to execute this (Figs. 4 and 5).

As we used the time function, the classifier running time is one of the outputs along with prediction time. Accuracy of the model is also evaluated. Precision here is the percentage of our results which are relevant. On the other hand, recall refers to the percentage of total relevant results correctly classified by the algorithm we used.

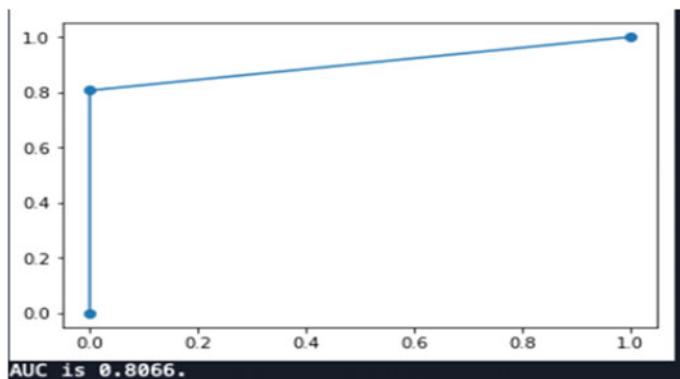


Fig. 4 Screenshot of the output graph and AUC value (output)

```
return self.partial_fit(X, y)
/Users/kaananarora/anaconda3/lib/python3.7/site-packages/sklearn/preprocessing/data.py:323:
DataConversionWarning: Data with input dtype int64, float64 were all converted to float64 by
MinMaxScaler.
    return self.partial_fit(X, y)
Classifier trained in 24.062 seconds
Predicted in 0.562 seconds
Accuracy is 0.8902.
Precision is 1.0.
Recall is 0.8866.
F is 0.893.
```

Fig. 5 Screenshot of values attained for the metrics (output)

7 Conclusion and Future Scope

When sufficient algorithms and approaches are set up with the datasets and inherent data types, it is seen that one can contain these commencing attacks of denial of service as well by classifying the incoming traffic by training and rigorously practicing on the data. As seen, the NSL-KDD dataset has opened up multiple approaches for algorithmic appliances. The DC algorithm is the one that is most suitable for signature-based and anomaly-based attacks as figured by the IDS.

The field of denial-of-service attacks has a great future scope as the phase we are working on is the detection; the other level which is yet to be elaborated is the one to build a sustainable fight against such attacks completely from intruding the field of information technology from all platforms of its practice. Denial of service as an antigen of the human body is dealt with and contained so shall the antigen like attacks, such as DoS and DDoS should be capable of the same containment and further spread. In simple words for our implementation, we have considered the body to fight outside antigens, i.e., attacks.

We have used the approach of machine learning with a python code to train the data and find out conclusive values of defining characteristics. Multiple libraries and training/testing functions have been used to execute this.

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A Novel Combinatorial Approach for the Reduction of Multi-compartmental Model into a Single-Compartment Pyramidal Neuron Model



Akanksha Kaushik, Jyotsna Singh, and Shilpa Mahajan

Abstract The development of compartmental model of neurons includes regulating a deck of parameters to make the model behave like a realistic model. A vast network simulation requires a simplified model of a neuron that reserves the synaptic integrity and passive electronic properties of real cell. Although attuning parameter is a time-consuming and intimidating process, yet it is required to simplify the multiple-compartment model into a single compartment model to carry out large network simulations. Here, we present a combinatorial approach to simplify the two-compartment pyramidal neuron into reduced pyramidal neuron model. To keep a track of the behavior of the reduced model, results from 15 trials were obtained with original parameters both for two compartment model and the reduced model.

Keywords Pyramidal neuron · Compartmental model · Combinatorial approach

1 Introduction and Background

1.1 Pyramidal Neuron

Pyramidal cells or neurons comes under the class of multipolar neurons present in different parts of brain comprising of cerebral cortex, amygdala, and hippocampus [1–3]. The word multipolar neuron means that it is a kind of neuron which contains

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one axon and many dendrites licensing the unification of a great deal of information signals from other neurons of different parts of brain.

What distinguishes pyramidal neuron for other types of neurons, is its two-compartment architecture: one is Soma and other one is basal and apical dendrite trees. Dendrites are the very fine tentacles attached to the neuron, which is also called as the origin of the neuron. When a number of dendrites are attached to a single unit then that is called as Soma.

Soma: One of the remarkable features of pyramidal neuron is its cone/pyramidal shaped soma, and other features are single axon, multiple basal dendrites, large apical dendrite, and the existence of dendritic spines.

Dendrites: Dendrites are commonly called as the input area of the neurons and are highly branched. The feature of branching lets the neuron to send and receive signals to-and-from other neurons [4–7].

This type of nerve cell is found to be robust in information processing (its transmission and receiving), effectively transforming an input signal into a distinct pattern in the form of action potential output. In general, action potential arises from axon initial segment (AIS). As apical dendrites have spatial arrangement, it has to distribute input signals to the regions of action potential initiation. Each dendrite not only receives and transmits information signal to axon, but it is also principal signaling unit for amalgamating synaptic input [8–10].

Dendrites of pyramidal cells bank on its inherent nonlinearities which includes complex morphology and voltage-gated channels for integrating synaptic signals. The most common gated-channel of apical dendrite is voltage-dependent calcium channel. The presence of calcium channel makes dendrite to operate in either two-stage integration manner or global mode. Although, dendrite does not contain Na^+ and K^+ ion channels for generation of action potential (as done in axon), yet it is significant for information transmission because of presence of calcium-dependent ion channels.

In computational study, research have been done on two compartment model, i.e., two separate equations for Soma and Dendrite, respectively, are used. In our work, we have proposed a reduced pyramidal neuron equation which generates the same result as a two-compartment model generates (Table 1).

2 Methodology

2.1 Conductance-Based Neuron Model

In this paper, we have formulated a computational model-based reduced pyramidal neuron equation based on formalism used in Hodgkin–Huxley model. Like other neurons, pyramidal neurons too have a number of voltage-gated channels. In pyramidal neuron, there are a plenty of K^+ , Na^+ , Ca^{2+} channels in dendrites, and soma has

Table 1 A succinct review of the related work is presented in this table

Paper	Year	Author(s)	Technique used	Result/conclusion	Gap(s) identified
[11]	1993	Bush et al.	CABLE Simulator running on MIPS Magnum 3000/33	The layer-5 pyramidal cells are reduced to layer-2 pyramidal cells model	The reduced model cannot be used to explore the grouping of synaptic inputs individually
[12]	1999	Migliore et al.	Compartmental model of CA1 hippocampal pyramidal neuron elucidate change in modulation behavior	The A-type transient K ⁺ conductance can regulate the local interplay between synaptic input and backpropagating action potential	In this paper, it is shown that only transient K ⁺ conductance plays a key role in regulation of interplay between synaptic input and backpropagation action potential
[13]	2001	Graham P.	A comparison-based model between pattern recognition ability and artificial neural network of the cell in the presence and absence of noise	In this paper, it has been presented that despite, enumerable of sources noise, a pyramidal cell can easily recognize temporarily presented input patterns. This means that a pyramidal cell can act as associative memory device, operating at 40 Hz gamma frequency to recall stored patterns	The model presented here worked well with a smaller number of noise patterns stored in the cell but when a number of patterns is stored, the noise from the other patterns stored in the cell came to distract the recognition process
[14]	2003	Saraga et al.	Multi-compartment models of hippocampal OLM interneurons using channel kinetics, submissive properties, and densities	Initiation of a spike depends amount of input, location and innate properties of interneuron	The channel conductance densities were measured for OLM interneuron but Na ⁺ inactivation and its voltage dependence with time were not measured

(continued)

Table 1 (continued)

Paper	Year	Author(s)	Technique used	Result/conclusion	Gap(s) identified
[15]	2008	Royeck et al.	Biological techniques like mutation in mice, voltage clamp recordings, and computational approaches	In the mutated mice, which were lacking Nav 1.6, a depolarization shift was observed	In this paper, it was not explained the importance of Nav 1.6 in restraining neuronal excitability
[16]	2009	Hu et al.	Patch clamp-based experiment was conducted to examine the distribution and biological properties of sodium channel from giant axon patches of rat prefrontal cortex	The axonal and somatic recordings from voltage clamp experiment revealed that distal Nav 1.6 assists for institution of action potential and proximal Nav 1.2 assists its backpropagation to soma	The main focus was only on sodium concentration and all other concentrations were unchanged. If we consider the heterogeneity in the model biological properties of sodium channel may not depend only on its concentration value
[17]	2011	Casale et al.	A high-resolution temporal and spatial voltage-based dye imaging of mouse dorsal lateral geniculate nucleus was used to evaluate the attributes of dendritic voltage deviations ion response to K/Na spike generation	Experimental results show that action potential always initiates in proximal dendrites i.e. soma in response to the external current injection and rapid backpropagation takes place in dendrites	The action potential propagation in dendrite does not support the assumption that dendrites of thalamic neurons operates in two different regions: one global and one local
[18]	2012	Bahl et al.	A genetic algorithm-based evolutionary model was used to reduce the two-compartment model into a single compartment model	A three-stage approach that automatically builds a reduced model of five-layer pyramidal cell which nearly resembles the experimental data	In this paper, only calcium dynamics are considered for the reduction process of pyramidal neuron

(continued)

Table 1 (continued)

Paper	Year	Author(s)	Technique used	Result/conclusion	Gap(s) identified
[19]	2013	Ferguson et al.	A mathematical model of rapid spiking Parvalbumin positive (PV+) interneuron networks was developed to obtain understanding whether PV+ interneurons are capable of contributing directly to high frequency oscillations in Hippocampus	The simulation results estimate that the CA1 swift-firing PV+ interneurons can yield high frequency rhythms, but only if excitatory synaptic drive is proportionately high and inhibitory PV-PV synaptic conductance strengths are comparatively low	In this model, gap junction interconnection is not included
[20]	2013	Lewin et al.	A computational modeling technique of CA1 pyramidal neuron which narrates for ionic operations important to keep potassium and chloride grades in CA1 pyramidal neurons	The results indicate that the prime effect of reduction in KCC2 activity in pyramidal neuron increases in chloride collection and resultant increase in GABA depolarization	The results in this model did not account for the offering of potassium transients present outside the membrane in assisting network synchrony
[21]	2017	Yi et al.	A two-compartment conductance-based model to check the how calcium movement in apical dendrites engage in initiation of action potential	The reduced two-compartment model developed in this paper is able to explain the typical facts of pyramidal neuron which was used in understanding the circuits relevance to cortical computation	The current study only focuses upon the significance of calcium spike of apical dendrites which influencing the firing pattern of two-compartment neuron

some other channels. Both the compartments have their associated currents which helps in generating spike or action potential. The soma component contains I_{Na} and I_K [22] whereas dendrite component contains I_{AHP} . Both Soma and dendrites contain high threshold L-type current I_{Ca} and leak current I_L . Moreover, both the compartments have two additional currents, i.e., transient A-type potassium current I_A and large conductance calcium-based potassium current I_{CT} [23]. All these ionic currents

maintain the network dynamics. The complication of two compartment model is that it becomes unsuitable to do the analysis of the model as it contains a number of dynamical variables in a repeated fashion. Therefore, we aimed to reduced, or rather combine a few ionic currents and concurrently keeping in view the neuronal dynamics remained unaffected. Therefore, the reduced pyramidal neuronal model is a single compartment model consisting of I_{Na} , I_{K} , I_{L} , I_{Ca} , I_{A} , I_{AHP} , I_{CT} .

The reduced pyramidal neuron membrane potential dynamics are modeled as follows:

$$\dot{V}_{\text{pyr}} = I - I_{\text{Na}} - I_{\text{K}} - I_{\text{L}} - I_{\text{Ca}} - I_{\text{A}} - I_{\text{AHP}} - I_{\text{CT}} \quad (1)$$

In this proposed methodology, all ion channels are modeled according to the formula used in Hodgkin–Huxley model [24]. Therefore, dynamics of gating variables is a that follows first-order kinetics,

$$\dot{a} = \emptyset_a [\alpha_a(1 - a) - \beta_a a] = \emptyset_a [a_\infty - a]/\tau_a \quad (2)$$

The aim of the equation curtailing is to lessen the number of dynamical variables but not to considerably changing the analytical properties.

3 Results

To validate that the reduction in model parameters did not change the neuronal dynamics, results from trials were obtained with actual parameters both for two compartment model and the reduced model.

The results for reduced pyramidal neuron model are shown in Figs. 1 and 2.

4 Conclusion and Future Work

To conclude, we have shown that reduced equation does not affect the statistical effectiveness of the neuron and in-turn reduces the complexity of analyzing the dynamical variables. The reduced one-compartment model consists of nine dynamical variables, whereas the two-compartment model consists of 14 dynamical variables in repetition. This reduced pyramidal neuron equation can be used further, to investigate the problems or diseases associated with brain because as discussed above, pyramidal neurons are very significant in information transfer and are also in large number. It is also one of the neurons which is strongly affected by Alzheimer and Parkinson disease. Furthermore, by performing supplementary approximations, the effective variables in one-compartment model of pyramidal neuron can be reduced, which can be the topic of further research.

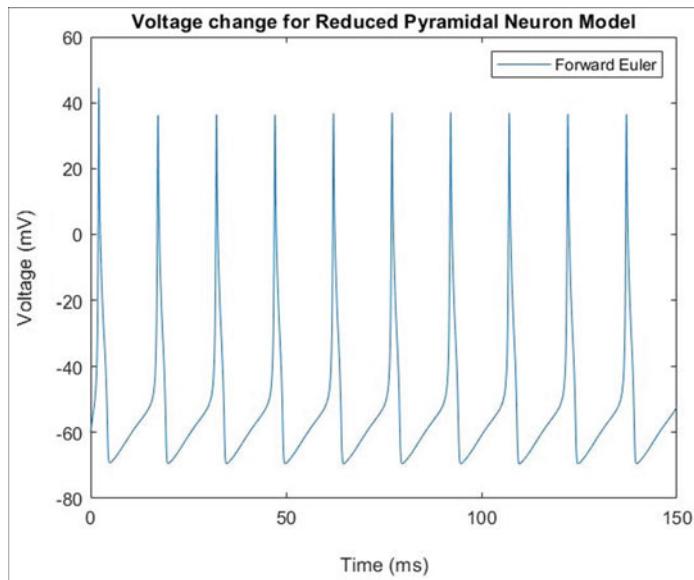


Fig. 1 Time versus voltage graph

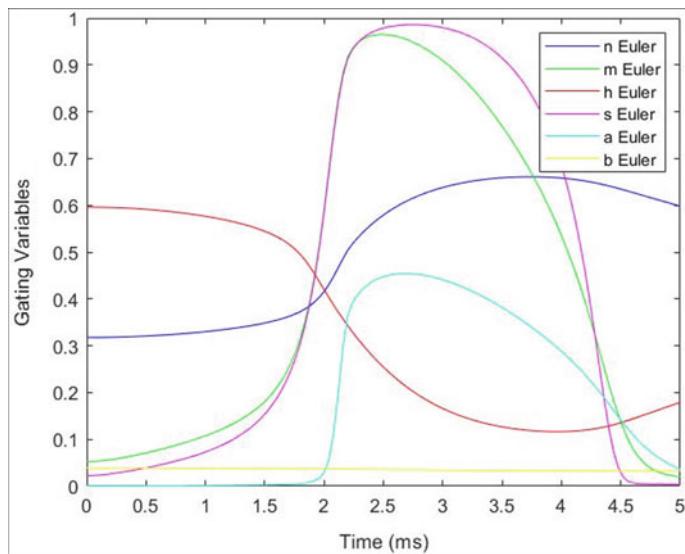


Fig. 2 Time versus gating variables

5 Discussion and Comparison to Existing Model

In our study, we have used a Brute-force approach that will generate precise model of two-compartmental pyramidal neuron with simplified structural features. The objective is to create a model equation with minimal number of compartments and at the same time, keeping current computational limits and simulation of large and realistic model. The reduced model for pyramidal cell presented here fits good to the full model and is preferable for carrying out lager network simulations.

Our model resembles the concept used in Bahl et al. [18] in which a machine learning-based three-stage approach, i.e., genetic algorithm, was used to reduce the five-layer pyramidal neuron. In this paper, we have used a combinatorial approach that will compile all ion channels in one equation thereby decreasing a two-compartmental model into single compartment model, and at the same time maintaining the neuronal dynamics unchanged.

For carrying out simulation on complete network, the equation presented in this paper alone cannot be used because every neuron is connected to every other neuron via synapses. Therefore, introduction to excitatory post-synaptic (EPSP) or inhibitory post-synaptic (IPSP) current is required.

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Smart Dine-in System—Automated Food Service



Manas Chopra, Mansha Chandna, Mayank Jain, Mohit Kalra, and Mehak Khurana

Abstract Nowadays, people look for a system that satisfies their needs in a comprehensive way. In restaurants, for traditional food-ordering system, a waiter or worker records the order placed by the customer which are prepared in the kitchen and bill is generated. This is time-consuming and can also result in human errors like shuffling of orders and servicing errors. The objective of this novel system is to automate the restaurant system and increase the quality of service by **designing a grid layout** track for food-serving trolleys (along the ceiling), which deliver the food ordered to the customer to his table. This system is feasible, efficient, easy to use and can give a better quality of service as compared to other existing systems.

Keywords Smart dine-in · Shortest path algorithm · Internet of Things · RFID · Arduino Mega

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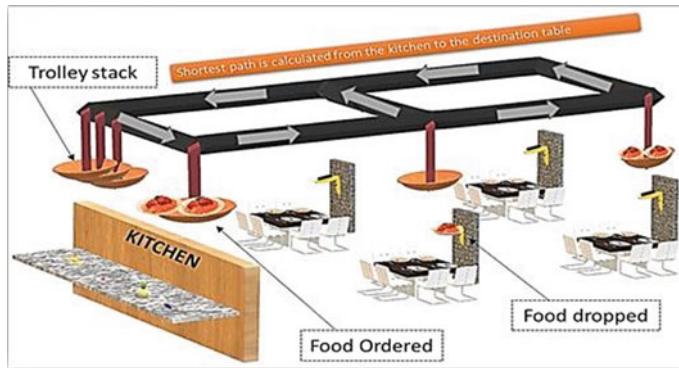


Fig. 1 Smart dine-in system architecture

1 Introduction

The growth in technology has hugely affected the marketing proceedings. The restaurants can be enhanced by the adoption of digital systems. The rivalry between the restaurant businesses has also intensified due to advancements in food-ordering systems.

The proposed project aims to automatize the food ordering and billing system in a restaurant and enhance the dining affair of consumers, focusing on the design and application of the smart dine-in system with real-time opinion of the consumer. The customer will place an order through a Web application or an android/iOS application [1]. The food will be prepared by the chef, and a waiter will place it on the service trolley with order number added to the trolley which will automatically go and deliver the food to the ordering table.

In existing ordering system, sometimes the consumer is not satisfied by the service. It can be so due to reasons such as delayed food service, poor management in rush hours, waiting too long [2], degraded food quality in rush hours and many a time wrong delivery of food. The system developed covers these areas related to the smart dining system to make customers satisfied and increase the quality of service using the principle of first order, first served (Fig. 1).

2 Problem Statement

The existing dine-in system is a complete manual procedure that requires paper and pen, waiters and additional staff. The consumer waits for the waiter to note down the order, and then he/she takes the order to the kitchen, updates it in the system's database and further produces the respective bill. Although this methodology is easy, it is not error-free. It is often difficult to elucidate the waiter's handwriting too.

To overcome these limitations, systems are making advancements to automatize the dine-in procedure. Using the smart dine-in system, the ordering and the food-service system can be made more effective, faster which assists the management to reduce manual errors and improves the business efficiently.

3 Technologies Used

3.1 *Arduino Mega*

Arduino Mega, a non-proprietary computing technology is built over an input/output board and a programming interface. It can be connected to software on your computer or used as a stand-alone interactive object. The Arduino Mega 2560 is a microcontroller board which is built over the ATmega2560. It has 54 digital I/O pins (15 are for PWM outputs), 4 UARTs, a 16 MHz crystal oscillator, 16 analog inputs (hardware serial ports), a power jack, an ICSP header, a USB connection and a reset button. It supports the microcontroller; power it with an AC-DC adapter, battery or connect it to a computer with a USB wire [8].

3.2 *Radio Frequency Identification (RFID)*

It uses a micro-processing chip and an antenna in a tag/label which transmits already saved data as soon as subjected to radio waves of the right frequency. The chip carries up to 2000 bytes of data. The RFID device is scanned to get the identifying information just like a magnetic stripe or a bar code. Many software and hardware components or devices are required to open the door when somebody with correct authorizations shows their RFID card to the reader [9].

3.3 *Weight Sensors*

It is a kind of sensor otherwise a transducer. The working principle depends on the conversion of a load into electronic signals which can be a drop or increase in voltage. It plays a crucial role in ensuring high-precision weighing and offer the highest levels of linearity, repeatability and speed. Weight sensors are customized according to the needs of machine and equipment manufacturers for simple electrical and mechanical integration [10].

3.4 Wi-Fi Module

It is a component that handles the communication between the present wireless devices which are connected to it. It modulates the radio waves; then pass the data to the next component in the router. The ESP8266 Wi-Fi module is a self-contained SOC with TCP/IP protocol stack that gives any microcontroller access to a specific Wi-Fi network. It is capable of either offloading all Wi-Fi networking functions from another application processor or hosting an application. In a medium or large restaurant, it is important to use the Wi-Fi module instead of Bluetooth module as in a large area, Bluetooth will not work [11].

3.5 Linear Actuator

These move in a straight line, in distinction to the circular motion of a traditional electric motor. These are used in industrial machinery and in computer devices such as printers and disk drives, in valves, dampers, mobile devices and in areas where straight motion is required. Hydraulic/pneumatic cylinders which are inherited in a linear actuator produce linear motion [12].

3.6 Stepper Motor

It is a brushless DC electric motor that splits a full rotation into several subsequent similar steps. The motor's position can be then directed to move and hold at one of these steps without any position sensor for feedback, as long as the motor is carefully sized to the application with respect to torque and speed. The IC used with a stepper motor is L293D. The L293D is a 16-pin motor driver IC. A single L293D IC is capable of running two DC motors at the simultaneously; also, the direction of these two motors can be controlled independently [13].

3.7 DC Motor

It is a class of rotatory electrical motors that convert DC electrical energy to mechanical energy. It relies on the forces generated by magnetic fields. L293D IC is a motor driver IC that allows the DC motor to move in any direction. It has 16 pins which control a set of two DC motors together omnidirectionally [14].

Table 1 Smart dine-in systems other available models

	Smart dine-in system	Other available models
1	The model supports two types of movements—going down and going right across the grid network to reach to the destination table	As per our research, models available in the market have either unidirectional movement or spiral movement of the trolley
2	Grid model—the trolley can move on the grid track and reach any table in the restaurant	Unidirectional model—it is not a grid model. The trolley has dedicated tracks to move in different directions And all the tracks are set up along the walls; hence, all the space in the middle would be wasted
3	Grid model—the trolley network will be set across all the tables in such a way that every table in the restaurant will be served with least change in positioning of tables	Spiral model- This is not a grid model. The trolley would come in a spiral/circular way, and this system is placed in the center of the table which can hamper the interaction and ongoing talks between the people
4	More efficient	Less efficient
5	Seating capacity remains the same	Seating capacity would be compromised

4 Comparison with Existing Systems

There are many existing models that automate the restaurant service, but they come with their drawbacks and hence cannot be used to deliver food in a medium or large restaurant efficiently without modifying the already existing table layout. On the other hand, this smart dine-in system has emerged out to be the best of all existing models in the market, occupying the minimal space and maximizing the seating capacity in restaurants as this system does not require to alter the existing table layout.

There are mainly two types of models:

1. The trolleys move along one path only, and the tables are placed along the walls. This is a major drawback for medium or large restaurants as they have a lot of open spaces, which cannot be utilized with such kind of model [7].
2. In the other type of model, the trolleys move in a spiral or circular manner, which is placed in the center of a circular table and the trolleys deliver food using face recognition. Such a model will not be successful in India because not all the seated members will be able to interact with each other; only the adjacent members will be able to do so (Table 1).

5 Proposed System

To overcome the drawback of the existing system, we have developed the smart dine-in system. The architectural design of the proposed system is shown in Fig. 2.

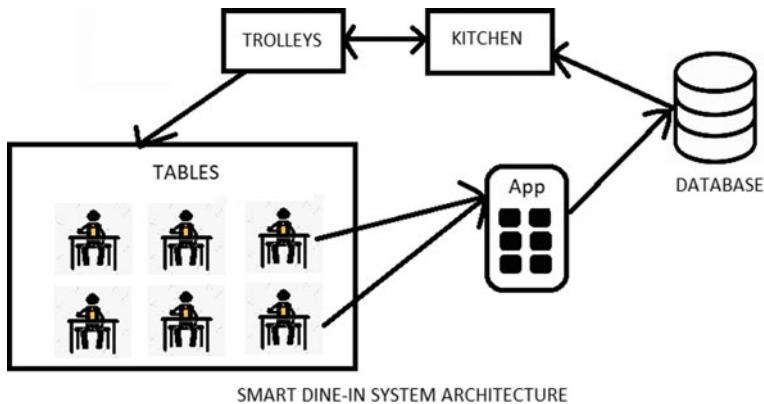


Fig. 2 Working of the system

Figure 2 shows the architecture of the complete system, wherein the tables depict the restaurant and customers visiting the restaurant. They are connected to the system via the developed application “Order Food,” the application is connected to a common database. The chef prepares the order, and the servants place the prepared order into the trolleys, add the destination table number to the trolley, then the trolley delivers the food to the destination table and returns back to kitchen. Some of the advantages of the proposed system are:

- i. Increased quality of service even during rush hours.
- ii. Fast ordering and paying.
- iii. The automated system is more precise and better when compared to traditional and conventional ways.
- iv. Reduces human labor cost.
- v. Collision avoidance between trolleys using UV sensors.
- vi. There are no battery issues for the trolleys, copper sheets can be used along the grid track, and the tire of the trolleys can be made up of carbon fiber, which will provide a continuous AC supply to the trolley without any wiring problem.
- vii. The number of tables are variable and can easily be added or removed.
- viii. The system supports different sizes of customer tables placed at different distances from each other.

6 Method

The system consists of various modules integrated to bring out the best of the automated food ordering and delivering systems. This system requires a Web application/android/IOS [3] mobile application with ease of access and food-ordering system, a properly organized and managed database designed. In addition, it requires trolleys that will move along the path installed along the ceiling of the restaurant.

There is another basic application designed for the waiters that will keep the food on the trolley from kitchen and give order number as an input to the trolley.

The whole system will be interconnected remotely using Wi-Fi. The system supports various payment.

methods, providing the best service and minimal effort by the customers. The stepwise methodology is discussed below [4].

Step 1: On entering, customer will install a restaurant food ordering app or just open the Web app in a browser.

Step 2: The app will be used to scan the table number on the table; after that, the customer will be able to place the order and make payment using any of the payment methods (cards, UPI, net banking, etc.) [6].

Step 3: The order is confirmed and displayed to the chefs in the kitchen.

Step 4: As soon as the food is prepared, it is placed on the trolley by the attendant.

Step 5: Then the attendant will enter the order number through another application for that trolley, and the trolley will follow the shortest path to the destination table. The trolley recognizes the destination table using an RFID scanner placed on each trolley. There are RFID tags [5] placed on the ceiling just above the tables, and all the table numbers and tag numbers are stored in the database which will be used by trolley to map the table numbers with tag numbers and order number.

Step 6: The trolley will read the RFID tag containing the destination table number and will drop the food on the tray.

The trays are attached on a pillar on each table. The tray has weight sensors on it, and it will bring the food down to table level slowly. The tray will go back up once the food is picked which will be identified through weight sensors.

7 Shortest Path Calculation

The shortest path from the kitchen to the specified table, which the trolley will take to deliver the food is calculated using the depth-first search algorithm (DFS). The algorithm starts at the root node and explores as far as possible along each branch before backtracking to calculate the shortest possible path.

In Fig. 3, the path is depicted in green.

8 Results

The system is a full-fledged implementation of hardware and software for increasing the quality of service at restaurants. It will help to avoid unnecessary waiting in queues for ordering and billing. Making payments will become faster and easier with security intact.

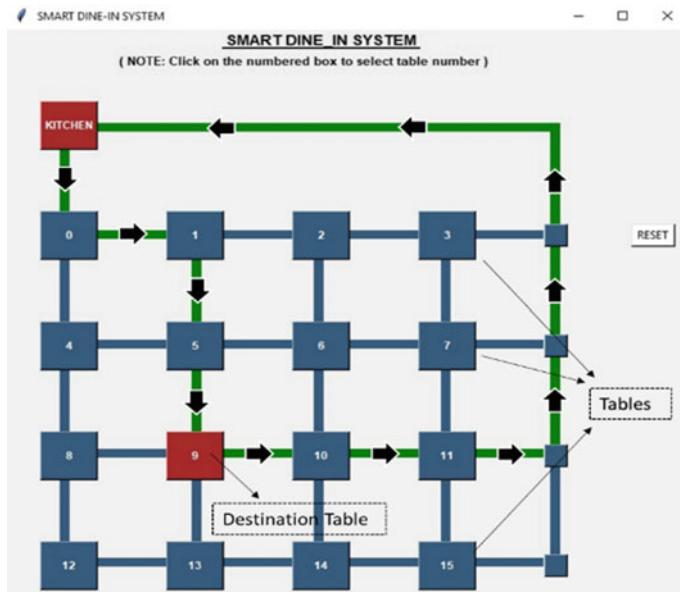


Fig. 3 Calculation of shortest path using DFS

Also, the installation of such a system will increase the popularity of the restaurant, and it will result in boosting up of the sales too. A prototype of the trolley of the system explained above has been implemented by using various hardware components and sensors.

The underlying picture shows a basic example of the architecture and working of the trolley. The design needs to be refined and the working will become better if more reliable sensors and other pieces of equipment are used in the model. The model shows the movement and the functioning of the trolley, it operates on batteries and has breadboard, various ICs and Arduino board connected on the top. It can turn at 90 degrees on the spot. It follows the designated path and moves forward as well as backward (Fig. 4).

9 Conclusion and Future Scope

We conclude that the system combines hardware and software for increasing the quality of service at restaurants. This helps to avoid unnecessary waiting in queues for ordering and billing while making payments faster and easier with guaranteed security. With its successful implementation, it can completely change the manner in which the current dining market functions and pave way for more such advancements.

Although this system is better than the unidirectional and spiral systems out there, it has its own limitations. Some of those are as follows:

Fig. 4 Trolley for food delivery



- Voltage supply issues with DC motors may arise.
- Configuration problems with the Bluetooth module.
- The high cost of hardware equipment can hamper the completion of the model.
- After successful implementation in a restaurant, it may reduce opportunities for employment.

Future enhancements include minimizing the size of the trolley by using 3D printing techniques to create the exact and compact parts. The trolley weight distribution among the wheels can be managed.

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A Comparison of Various Data Mining Algorithms to Distinguish Mammogram Calcification Using Computer-Aided Testing Tools



Chaitali Bhowmik, G. S. Pradeep Ghantasala, and Reddy AnuRadha

Abstract Several computer-aided testing tools have been developed more than ever in breast cancer research to minimize misdiagnosis. In this paper, a data mining method has been discussed that could help oncologists identify and detect breast cancer. Including microcalcifications, masses, and even regular findings from tissue was used as a stable database of 410 images. Two extraction techniques have been applied, particularly the unit for gray standard and length of the gray level unit. Many data mining classifications were also used for classification purposes. The findings were shown to be very favorable (roughly 70%) in terms of mammogram separation and BI-RADS® scale (>75%) with acceptable reliability and functional precision. The classification of random forest was the best predictive method to distinguish microcalcification with excellent performance.

Keywords Microcalcification · Data mining · Classifier · KNN · Random forest · SVM

1 Introduction

Although it is not the worst, breast cancer has a high incidence and a high death rate in public health, particularly in women. It is calculated in a recent survey that around 350,000 breast cancer cases are reported among about 0.75 billion inhabitant women in India, and approximately, 1,800,000 women will be affected by early 2020. In another study in Portugal, it is estimated that about 4500 new breast cancer cases

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are reported among 5 million inhabitant women per year, and approximately, 1500 women die of that disease each year, which represents four case studies daily based on figures from the “Liga Portuguesa Contra o Cancro.” Through 2025, the same study estimates 19.3 million new cases of cancer, with the most significant increase in the number of breast cancers [1]. Early diagnosis and patient surveillance systems are necessary to combat this trend, as well as provide better and more accessible health-care. Our study’s main aim was to develop a toolkit for the detection of breast cancer employing data mining techniques. The intention was to create a decision-making system that could be exploited by experts or by students to define the concept through learning tools accurately. It could increase diagnostic and clinical efficiency, have been used to assess patterns in diseases, and are essential for new clinicians’ training. The use of classification methods was then tested to determine the characteristics and graders are more effective in defining mammogram properties.

2 Breast Cancer

Breast cancer is an untreated disorder of the breast cells when there is a pattern of DNA error. Around 95% of these tumors are epithelial in the breast, as well as carcinomas [2]. Approximately, 80% (DCIS) and 20% (LCIS) of the mammalian pipeline usually are found [3, 4] in turn. Two causes lead to better breast cancer survival rates: first, early mammogram diagnosis, and secondly, improvements of systemic adjuvant therapy like chemotherapy and hormonal therapy.

2.1 Types of Breast Cancer

Cancer is not all synonymous within the breast. We separate between blisters and fibroids that create and go absent over a certain period or intraductal papilloma that are sporadic developments that seem hazardous. The level of introduction can be distinguished. Masses have recommended that carcinoma could be cancer, a term used to portray cancer, which begins within the cover of the organ, just like the breast (epithelial cells). However, the biopsy is continuously vital for fatalities’ conclusion, both by sores (non-cancerous packs filled with liquid) and by fibroadenomas (muscular non-cancerous tumors). In calcification, on the other hand, small levels of calcium deposits can occur individually or in clusters of calcium minerals [5] in breast tissue.

2.2 Arrangement Criteria

International standards have been developed for the accuracy of data collection and processing from various sources [6].

The research titled “Breasted Imaging System and Database System” is the American College of Radiology [7], which presents a mammographic standardization framework opinions which include the vocabulary lexicons, a medical report structure, a classification, and a coding system. A standardized breast imaging monitoring approach that does not suppose the BI-RADS® recommends individual case management decisions. Level 1 is the standard lesion-free ammoniums; Level 2 and 3 are the brains, and Grade BI-RADS is the need for initial supervision; Level 4 and Level 4 are the suspicious anomalies chance of malignancy ranges between 20 and 75%; the final is BI-RADS 6. The criteria are provided in this BI-RADS® guidance, Level 3 is the partial or insufficient assessment of standards 1. According to an investigation by the most crucial impact factor for the mammographic vulnerability was Boyd [7] and subsequently published in several more studies [8]. The studies were mainly conducted based on breast tissue exposure as an appropriate measure of the incidence of breast cancer. Different classification schemes have been established over the years [9]; the 2003 ACR has been introduced, the world's four most commonly used types of mammographic density [10].

1. Lipomatous mainly (<25% of glandular tissue);
2. Density of the granule in fiber (25–50%);
3. Extremely dense breast (51–75%).

3 The Techniques

The main advantage of data mining is that a variety of practical guidelines can be drawn up to differentiate between several suspected risks [11] distinguish by identifying every similar dataset within one class. The use of classification methods was tested to determine which characteristics and classifications work best in mammogram detection.

Data definition photographs were taken from the InBreast [12], which had been built by a group of institutions at the University of Porto and which, with the author's permission, were available to the public. The dataset contains a total of 410 images (115 cases), 90 of them are of (four pictures per case), two breast-affected women, and 25 of them are of (two views per case) one breast-affected women. The set also includes certain kinds of data, such as weights, calcifications, distortions, and asymmetry identified by experts. The usable mammograms were preprocessed into the MATLAB® and glued to prevent specifics that were essential for the following steps. The picture similarity key factor was used for the Gaussian filter [13–15]. The RAI portion and image translations in 4-bit were followed as necessary for a second feature extraction procedure. The first method of collecting characteristics was then used. A total of 410 photographs were made, with several injuries to a single mammogram, some resulting in a total of 439 characters.

3.1 Features Extraction

Feature extraction is a crucial consideration when the decision support system is implemented. Breast tissue is thus, therefore, classified through its capacity to recognize and manage disease and damage variations [16]. The main characteristics are distinguished. Thus, texture has been chosen (Fig. 1).

In these methods, two of the MATLAB® functions based on the matrix were used: GL CM GLRLM and GLMR (gray level run length matrix) co-occurring (GRLM). First of all, the first is the statistical texture test to look at the spatial relationship between image pixels; the second is the computerization of the number of rows with different angle gray rates [16–18]. The second technique is based on the first approach. Two times in the same image, Table 1, each function extract of the arrays, as mentioned earlier, was removed from the first ROI values of an injury discovery, for example, SRE L and one second for a clean/regular ROI as for SRE N.

Fig. 1 MATLAB collection of the mammogram area of interest

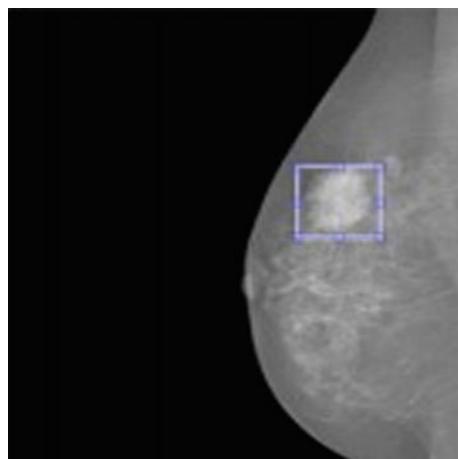


Table 1 Extracted features

GLCM	GLRLM
Contrast; Correlation; Energy; Homogeneity	Short run emphasis (SRE); Long run emphasis (LRE); Gray level non-uniformity (GLN); Run length non-uniformity (RLN); Run percentage (RP); Low Gray Level Run Emphasis (LGRE); High Gray Level Run Emphasis (HGRE)

3.2 Types of Identification

Many classification techniques, including J48 choice tree, Gullible Bayes, and Arbitrary Forestry, the closest supporting vector machine in the area, were used. The different classification methods have been chosen for the accuracy of other datasets and the lack of results in the use of the IN breast software. The application of these various approaches, which were comparable to related studies [15, 19] and used in other databases [20], was used to clarify the most effective classifier on a case-by-case basis. To order to implement these approaches, we use WEKA®. The most advantage of information mining is the plausibility to set up a set of reasonable recommendations to identify a variety of potential risks [11] as a BI-RADS script for each event, with GLRLM outputs listed. The second classification includes the classification of the breast density of the radiologist and the GLCM, which we call BRD (without a selection of ROI). Finally, the latter was generated for each mentioned picture finding (characteristic file) link the finding type (mass, microcalcification, or healthy tissue) to the GLRLM.

4 Outcomes and Discussion

In terms of some measures, they were compared, and the results analyzed. The under curve field (AUC) is a way of selecting the correct models, regardless of expense and class allocation. The scientists must draw the ideally suited AUC profiles and know that the solution is more effective if the AUC value is equal to the one. The first refers to the study's capacity to accurately diagnose a disease, and the second criterion relates to a particular characteristic that represents a proportion of the harmful components. Positive anticipated esteem (PPV) was moreover given to each classifier. International precision was identified and evaluated according to the global success ratio of each sort to discover both the most excellent pointer and the leading strategy for determining breast cancer.

First scenario: In the first case, the GLRL Multiple Features are linked to the BI-RADS® grouping (Table 2).

We found that the results for each classification were excellent during our analysis, but the random forest was the better predictor process for this classification. This distinction allows us to reach PPV values of around 76.0% both for healthy and malignant tests, resulting in a success rate, the reliability and the accuracy of this process for both the success rate and the AUC (0.831) (around 0.78 and 0.76). The tests of this example demonstrate that the Naive Bayes and SVM-SMO have poor mean values for all variables. We inferred from this study that there is a significant drawback in terms of their five-class BI-RADS® estimation. Therefore, according to some conclusions from our studies, we have adopted a method to split BI-RADS® classes into benign and malignant to avoid inconsistent weight for each category.

Table 2 BI-RADS® sub-set GLRLM results

Classifier	BI-RADS®	PPV	AUC	Sensitivity	Specificity	Global accuracy (%)
Naive Bayes	Benign	0.205	0.436	0.538	0.532	53.3
	Malign tint	0.837	0.436	0.532	0.538	
SVM-SMO	Benign	0.05	0.508	0.571	0.523	52.5
	Malignant	0.965	0.508	0.523	0.571	
k-NN	Benign	0.657	0.789	0.724	0.707	71.4
	Malignant	0.767	0.789	0.707	0.723	
J48	Benign	0.427	0.604	0.634	0.592	60.6
	Malignant	0.771	0.604	0.592	0.633	
Random forest	Benign	0.757	0.831	757	0.775	76.7
	Malignant	0.775	0.831	0.775	0.757	

Second scenario: The second scenario evaluated was based on BRD-related elimination of GLCM functionality, as per ACR.

When we compared our results with Fonseca [20], which employs the same database, we found that KNN and SVM are the same; the findings in our 1 and 2 classes are the lowest in the total hit rate range, according to the fatty tissue (about 55%). In contrast with previous work [20], we have achieved the highest random forest results, as the precision of fatty and dense tissues was approximately 52.0%. In comparison, the result was better, and the accuracy was 58.7%. Using GLCM, the outcome of the class prediction was very different, perhaps because of the difference of initial data in every class and the differences with the adjacent courses 1–2, 2–3 up to now. The result of this prediction is quite different. Density shifts were found to be the highest in this case. The better form, PPV and vulnerability for random forest variability ranged, depending on class, between 72.5% to BRD 1 and 11.5% to BRD 4. The differences between the attributes or the scale of each category in the database will clarify this (Table 3).

Third scenario: The last scenario analyzed was based on the type of results observed in individual cases. Such tests were split into three sub-sets (3a, 3b, and 3c), to find the best form of a prediction. The first is that the datasets (mass, micro, and regular) have historically been classified. The second part includes only a form of general approach showing a lesion in the tissues, regardless of its nature. A general approach is part of the last section.

Our tests show that healthy tissues for all classifiers show 100% of correctly classified cases in the percentage of correctly classified instances concerning the differences between the bulk, microcalcifications, and healthy tissue by examining the findings of subgroup 3a (Table 4). Because of that, the overall efficiency was poor, and the best results were achieved with 76.9% precision in the classifications of SVM-SMO and J48, such as Naive Bayes or random forest. Although the last two approximations showed increased global efficiency by analyzing each class's

Table 3 GLCM results of BrD results

Classifier	BrD by ACR	PPV	AUC	Sensitivity	Specificity	Global accuracy (%)
Naive Bayes	1	0.592	0.725	0.534	0.791	34.5
	2	0.206	0.480	0.276	0.615	
	3	0.165	0.596	0.250	0.753	
	4	0.538	0.750	0.182	0.959	
SVM-SMO	1	0.633	0.782	0.679	0.828	49.7
	2	0.817	0.594	0.418	0.786	
	3	0.000	0.666	0.000	0.753	
	4	0.000	0.500	0.000	0.929	
k-NN	1	0.792	0.820	0.638	0.886	54.9
	2	0.557	0.647	0.514	0.743	
	3	0.636	0.712	0.500	0.808	
	4	0.038	0.651	0.091	0.930	
J48	1	0.625	0.784	0.658	0.823	51.6
	2	0.557	0.655	0.507	0.741	
	3	0.429	0.722	0.429	0.812	
	4	0.115	0.612	0.158	0.934	
Random forest	1	0.725	0.829	0.690	0.864	58.7
	2	0.603	0.715	0.556	0.770	
	3	0.516	0.785	0.553	0.844	
	4	0.115	0.704	0.200	0.935	

findings individually, neither has accurately categorized masses nor reached 100.0% PPV for microcalcifications. KNN classified each category with 70.8% accuracy, despite not promising mass results (PPV = 0.228 and sensitivity = 0.315).

When analyzing Table 5, we should understand that all the rates tested no classifier seems to be the highest. Regardless and because of PPV, J48 and SVM-SMO obtained the best performance for the identification of the micros. Still, the results were the worst precisely for public detection of other casualties. Naive Bayes was therefore considered the best-comparing average and optimal values for mass separation. Simultaneously, random forest is perceived to be the best for global precision, providing the best results in the classification of microcalcifications. The final sub-set (3c) was a general approach, which means that the tissue has a lesion independent of its structure. From the results, we found that every particular process obtained the highest prediction value (100% of each field). It helps us to ensure that our system separates every injury from healthy tissues. The last scenario showed exciting results because the weights were smaller (267 micro and 101 weights), which were reinforced by global percentage accuracy values, 59.0% by sub-set 3a, and some 50.0% by sub-set 3b. It is an exciting area for future research though not the optimal world proportion.

Table 4 3a sub-set results (division of mass, micro, and normal tissue)

Classifier	Subclass	PPV	AUC	Sensitivity	Specificity	Global accuracy (%)
Naive Bayes	Mass	0.911	0.700	0.348	0.949	58.7
	Micro	0.356	0.774	0.913	0.487	
	Normal	1.000	1.000	1.000	1.000	
SVM-SMO	Mass	0.000	0.605	0.000	0.770	76.9
	Micro	1.000	0.705	0.726	1.000	
	Normal	1.000	1.000	1.000	1.000	
k-NN	Mass	0.228	0.636	0.315	0.787	70.8
	Micro	0.813	0.737	0.736	0.653	
	Normal	1.000	1.000	1.000	1.000	
J48	Mass	0.000	0.636	0.000	0.770	76.9
	Micro	1.000	0.703	0.726	1.000	
	Normal	1.000	1.000	1.000	1.000	
Random forest	Mass	0.257	0.628	0.280	0.783	67.6
	Micro	0.749	0.729	0.727	0.591	
	Normal	1.000	1.000	1.000	1.000	

Table 5 3b subgroup results (division of microcalcification)

Classifier	Subclass	PPV	AUC	Sensitivity	Specificity	Global accuracy (%)
Naive Bayes	Micro	0.352	0.630	0.879	0.337	49.5
	No micro	0.871	0.630	0.337	0.879	
SVM-SMO	Micro	1.000	0.500	0.000	–	72.5
	No micro	0.000	0.500	0.726	0.725	
k-NN	Micro	0.798	0.573	0.727	0.280	63.8
	No micro	0.208	0.573	0.280	0.727	
J48	Micro	1.000	0.492	0.726	–	72.5
	No micro	0.000	0.492	0.000	0.671	
Random forest	Micro	0.798	0.577	0.753	0.752	66.3
	No micro	0.307	0.577	0.365	0.365	

5 Conclusion

With the findings, we ensure the successful implementation of the procedure for mammograms to detect cancer through the utilization of mischance classifiers (BI-RADS®) and breast thickness (BrD). A few later works utilized the InBreast database [19] to classify fatty/dense tissues even when used for other classification methods for malignancy. The study of Carneiro et al. applied K-means to specific characteristics of Haralick and demonstrated a precision of 85% to classify density groups.

A way of determining density groups is by comparing these results with the results we have obtained. The disparity between values can be explained by various pre-processing techniques compared with obtained results with a closed environment for accuracy. We expected to apply the demonstrated proposal in this investigation to other information sets in arrange to understand better how strong global accuracy values can be. One can also change the methods used at the level of the image pre-processing and utilize GLRLM removal functionality to prevent errors. Other software packages can be used, as it is crucial to speed up and perform better treatment, for example, by using a language such as C++ while taking into consideration the reciprocal asymmetry and temporal distortion.

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An Effective Technique of Protocol-Aware Network Traffic Classification for Performance Enhancement of SDN



Chaitali Bhowmik and Tirthankar Gayen

Abstract Software Defined Network (SDN) decouples control and sending capacities, empowering system control to turn out to be straightforwardly a programmable network and the fundamental framework that is disconnected from various applications programs and system services. Traffic classification in SDN is very crucial as the unique feature of SDN can be exploited for better traffic management, flow control, security, reliability and overall performance of the network. Classifying network traffic using Machine Learning (ML) algorithms helps in better decision making for monitoring security loopholes of a network. In this paper a protocol aware traffic classification framework which is able to classify the network traffic based on different flow features has been proposed. This framework not only helps in identifying different protocols but also transitively helps in identifying benign and anomalous traffic in a network which enhances the performance of a network by minimizing the interprotocol communication time. Various supervised machine learning algorithms have been used to predict the protocol from network traffic and the results have been compared to identify an effective technique for classification of network traffic.

Keywords Software defined network · Machine learning · Supervised learning · Traffic classification

1 Introduction

Software Defined Network is architecture for networking which is different from traditional networking system. Before the invention of SDN the network constituted of switches which acted as the decision making as well as the forwarding device. But

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in SDN this has been changed. Different components of the SDN architecture constitutes of application layer, the control layer and the infrastructure layer which basically contains SDN application, SDN controllers and SDN switches those are actually the data plane devices. Open Flow protocol which is a communication protocol on top of TCP is used in SDN. The SDN southbound interface helps to communicate between control layer and infrastructure layer. The northbound interface is used to communicate between the control layer and application layer. The use of this new paradigm has enabled the traffic engineering to be done with less time and CPU resources.

2 Traffic Classification

The network traffic classification can be done using various methods such as (1) Port based, (2) Payload based and (3) Machine learning based methods [1]. **Port based:** this method is dependent on the principal that the well known applications run on fixed port numbers. In this method we can identify an application from the port number it is using. Though this is the easiest and fastest method for identifying network traffic application but the problem with this method is nowadays most of the applications use dynamic port numbers which has stopped the use of port based methods for traffic classifications. **Payload based:** these methods can be categorized in two types such as Deep Packet Inspection (DPI) and L3/L4 AccessList depending on processing method used. Here the payload of a data packet is analyzed using signature based methods to get the idea of the incoming traffic. Though this technique provides a good accuracy but it is very much resource consuming and hampers users privacy. **Machine Learning based:** these techniques exploit different machine learning algorithms such as Supervised, Unsupervised, Semisupervised and Reinforcement learning. Though the accuracy of these techniques may be less than DPI but they are usually less resource consuming, able to predict encrypted traffic and computationally less expensive. So the motive is to use them for traffic classification. Many researchers have studied these methods of classifications but in this paper a new type of classification have been proposed which is on the basis of protocols. The traffic is classified as per the underlying protocol which is used by different applications or data packets. With the blast of internet applications and network traffic there are huge number of complex protocols, topologies and network environments in use which increases the time to interact between different protocols. With the identification of proper protocol the interprotocol communication time can be minimized which will benefit in enhanced network performance by minimizing the processing delay. Using the proposed technique it is possible to identify the protocols with an acceptable accuracy rate that could be used to analyze the network traffic within a small period of time. The contributions of importance of this paper are

1. A real time protocol aware traffic classification technique has been proposed which can be applied for networks with an acceptable accuracy.

2. The result obtained from different machine learning algorithms have been compared to show the appropriateness/applicability of these algorithms in traffic classification.
3. A new category of traffic classification is introduced that has been tested on real life data.

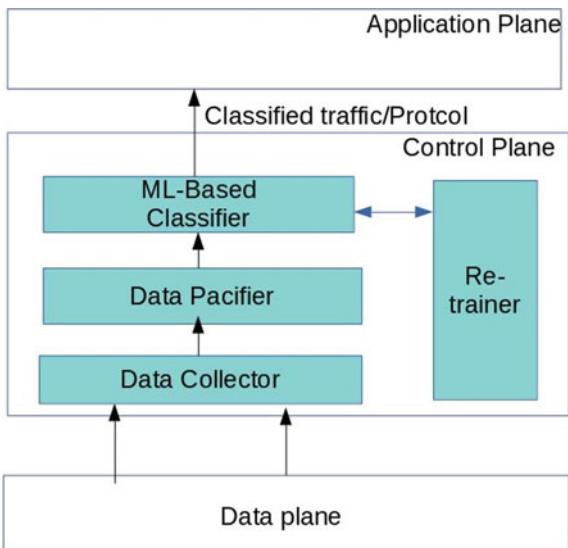
3 Related Work

Traffic classification that is used for fine grained network management is required for various operations like routing, anomaly detection, resource allocation, security and enhancing the performance of the networks. Earlier only port based methods were used followed by payload based methods. But ML based methods have drawn the attention because of its less resource requirement. Many authors have used ML with DPI to get a good trade-off between accuracy and complexity. Li and Li [2] used DPI and ML together as a multiclassifier for application layer traffic classification. Da Silva [3] used Genetic Algorithm and SVM for selection of suitable flow features for traffic classification. Chen and Zheng [4] proposed a ML based routing pre-plan architecture for enterprise network using flow feature extraction and path selection by exploiting the distributed architecture of SDN. Xiao et al. [5] used Decision Tree to identify backbone or elephant flow with low cost in Data Centre Network. Wang et al. [6] designed a framework for QoS aware traffic classification using Semisupervised algorithm. Amaral et al. [7] described a simple architecture for data collection and traffic classification in an enterprise network. Santos Da Silva et al. [8] proposed Atlantic which is used in campus network for anomaly traffic detection, classification and mitigation. Yu et al. [9] also proposed a QoS aware traffic classification which is based on ML and DPI. Lyu and Lu [10] shown how to do media traffic classification using Deep learning techniques. Sawabe et al. [11] in their paper identified different Smartphone applications using encrypted traffic analysis. Most researchers have done the traffic classification on the basis of QoS, flow or application traffic. In this paper the new approach of traffic classification on the basis of protocol using ML have been discussed. The prediction of protocol is useful in minimizing interprotocol communication time which enhances the network performance by minimizing the processing delay of the network.

4 The Proposed Protocol-Aware Traffic Classification Framework

The proposed framework is divided into four different modules. These are (a) a data collector, (b) data pacifier, (c) ML based traffic classifier and (d) an optional re-trainer. An overview of the framework is shown in Fig. 1. The modules are placed in the control plane because of the global knowledge of the controller.

Fig. 1 Protocol aware classification framework



- (a) The data plane elements (Open Flow switches) collect the overall network traffic. These collected flows are then sent to the control plane where the data collector takes these data as input. The network flow data contain different features like packet characteristics such as length of packet, Data flow time characteristics such as inter-arrival time of data flow, characteristics related to protocol such as packet source port and destination port number and random information like hurst parameter.
- (b) The collected packets are then sent to the data pacifier which will search for any irrelevant, redundant and erroneous data in the collected flow and modify them accordingly. The modified data will be restructured or pacified to a uniform and simple form so that those data will be fit for applying to the machine learning model.
- (c) The pacified data is given as input to the ML based traffic classifier. It works on labelled data using SVM and classifies the network flow as per different protocols used during the training time.
- (d) The ReTrainer is an optional module. ML based models sometimes are not able to classify the incoming flow data accurately as they lack proper training data to identify new dataset. That is why one needs to re train those models after some specific time interval. The result of the classifier is checked with the estimated accuracy to identify if the model is giving proper result or not. If it deviates then the ReTrainer is used.

4.1 *ReTrainer Technique*

The ReTrainer works on the following steps:

1. Handling the missing values such as removing null values, calculating mean, median, mode of features of new dataset are performed as AutoML cannot work with missing values.
2. Appending new dataset to the existing dataset.
3. Applying Auto-Sklearn, an AutoML tool [12] on the merged dataset. AutoML will set the required hyper parameters and check for different ML algorithms as suitable.

In accordance with Feurer et al. [12] the retraining of machine learning models can be done automatically using AutoML tool. Their introduced Auto-Sklearn is based upon meta learning and ensemble building along with Bayesian Optimization.

4.2 *Proposed Technique*

The steps of the proposed technique for the protocol aware traffic classification are enumerated as follows:

1. Collect Data set by Data Collector from Data plane.
2. Send collected packets to Data Pacifier.
3. Search for any irrelevant, redundant and erroneous data in the collected flow.
4. If error found then remove the erroneous data from the dataset.
5. The modified data will be restructured so that those data will be fit for applying to the traffic classifier.
6. The pacified data is given as input to the SVM based traffic classifier.
7. The Traffic Classifier classifies the network flow as per different protocols used during the training time using SVM.
8. If Traffic Classifier is able to classify the traffic then generate classified traffic.

Else if the classifier is not able to classify the traffic due to lack of proper training dataset, and then use ReTrainer.

5 Experiment and Result

1. Data Collection: For collection of real-life network flow data a packet sniffing tool Wireshark is used. Collected data is stored in.csv format. Some of the considered features are length, timestamps, inter-arrival time of the packets, the MAC and IP source and destination addresses, the duration of flow, the byte count and the packet count of the connection. Selection of features for classification is very

Table 1 Functions used

Functions	Description
drop()	To delete any row or column (specifically)
drop_duplicates()	To delete duplicate data from dataset
isnull()	To check missing data (NaN)
dropna()	To delete null values

important as the accuracy of the classifier depends on the features selected. The selection of advanced features can be found from [13].

2. Data Pacification: In this module initially all the erroneous entries have been resolved from the dataset. The process of data pacification involves eradication of duplicate data, inaccurate data, wrongly formatted data and extra spaces. For performing the above task a few Python functions which are present in Pandas library have been used. Table 1 contains the details of some of these used functions.

Till now, mostly all the inaccurate record have been excluded from the dataset. But Dataset still have some of the columns which contain categorical values. Feeding categorical data in ML models make their performance worst, so Encoding is used to convert categorical data into supported form. The encoding helps in using categorical data in various estimation models. It uses only 1 and 0 to show all of the required information on group membership.

3. Model training and testing: The captured real life network flow data from a campus network is divided into training and testing dataset in the ratio of 8:2. The training dataset is being fitted to the 5 different traffic classifiers separately. Remaining 20% test data is kept aside so that to test the classifier later after training. 10 fold cross validation which is a standard for applied machine learning has been used. Here the dataset is shuffled and is divided into 10 groups. Then each model is trained with any 8 groups of data and tested with remaining 2 groups of data. The same applies for all ML algorithms of consideration. This is done for resampling of data with low bias.

6 Discussion

For the performance evaluation of the classifier four performance metrics which are (a) Recall, (b) Precision, (c) F1-Score and (d) Accuracy have been calculated. Among these, Accuracy is the main metric that has been used for comparing different ML classifiers. Here it has been checked that the predicted protocols using different ML classifiers are correct or not. For this initially a confusion matrix has been created. It works on four important terms which are as follows:

- True Positive: The classifier predicts YES and the actual output is also YES.
- True Negative: The classifier predicts NO and the actual output is also NO.

- False Positive: The classifier predicts YES and the actual output is NO.
- False Negative: The classifier predicts NO and the actual output is YES.

Next the confusion matrix is used for calculation of other metrics.

(a) Precision for any protocol “ i ” is calculated as:

$$\text{Precision}_i = \frac{M_{ii}}{\sum_j M_{ji}}$$

Here M is the confusion matrix and i and j are the rows and columns of M .

The precision of Naive Bayes, KNN, Random forest and SVM for a few protocols are shown in Table 2.

(b) Recall for any protocol “ i ” is calculated as:

$$\text{Recall}_i = \frac{M_{ii}}{\sum_j M_{ij}}$$

The obtained recall values of the four ML classifiers are specified in Table 3.

(c) F1-Score can be measured on the basis of Precision and Recall. It is calculated as follows:

$$\text{F1-Score} = 2 \times \frac{1}{\frac{1}{\text{Precision}} + \frac{1}{\text{Recall}}}$$

Larger F1-Score signifies better performance of the classifier.

(d) The accuracy is calculated as:

Table 2 Classifier precision

Protocols	Naive Bayes	KNN	Random forest	Support vector
DHCP	0.238	1	1	1
NBNS	0.143	1	1	1
SMB2	0.765	0.974	0.974	0.974
SSDP	0.839	0.875	1	1
TCP	0.682	0.977	0.955	1

Table 3 Classifier recall

Protocols	Naive Bayes	KNN	Random forest	Support vector
DHCP	0.588	0.97	1	1
NBNS	1	1	1	1
SMB2	0.342	0.988	1	1
SSDP	0.413	0.985	1	1
TCP	0.714	1	1	1

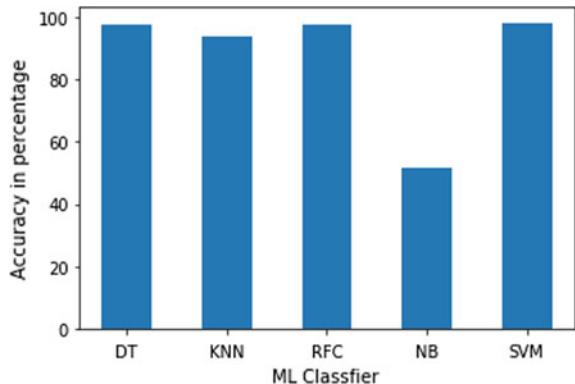
Table 4 Accuracy value

ML algorithm	Accuracy
Decision tree (DT)	97.7401
KNN	93.7853
Random forest classifier (RFC)	97.7401
Naive Bayes (NB)	51.4124
SVM	98.3050

$$\text{Accuracy} = \frac{\sum M_{ii}}{\sum_i \sum_j M_{ij}}$$

It is basically the average values of the elements in the main diagonal of the confusion matrix. The higher the accuracy, the higher is the performance of the classifier.

It can be observed that Decision tree and Random Forest are showing the same accuracy as the collected labelled flow data is of small size. For larger dataset these algorithms work better. The accuracy for each of the algorithms is shown in Table 4. The lowest accurate algorithm is Naive Bayes with approximately 51% accuracy. SVM is the best suited algorithm with an accuracy of approximately 98%. So SVM based classifier could be used to implement our proposed framework. The problem with supervised machine learning classifiers are that they require highly labelled dataset which is not always available in a network. But in campus networks it is feasible to use supervised algorithms as capturing labelled flow data is comparatively easy. In Fig. 2 the accuracy of Naive Bayes, Decision Tree, KNN, Random Forest and SVM classifiers have been shown with the help of a bar graph.

Fig. 2 Accuracy of ML classifier

7 Conclusion

Traffic Classification in SDN can be exploited for better traffic management, flow control, reliability and overall performance of the network. In this paper an effective technique of Protocol-aware traffic classification has been proposed which can work for campus or enterprise network. The proposed traffic classifier has shown good accuracy for different machine learning algorithms on real life campus network traffic. Coming to the Machine Learning algorithms, SVM has best accuracy whereas Naïve Bayes has shown least accuracy. Auto-Sklearn [12] on the other side performed better than Auto-Weka [14] while applied for same datasets making it suitable for implementing ReTrainer. From this study it can be inferred that ML based traffic classifiers are demonstrating good performance while coming to traffic classification for identifying network protocol. With the help of protocol prediction there will be an enhancement in the overall performance of a network by minimizing the interprotocol communication latency thus by minimizing the processing delay. Addition of more flow features to the classifier can make the framework more robust, reliable and effective for deployment in Data Center Network.

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An Advanced Cognitive Approach for Heart Disease Prediction Based on Machine Learning and Internet of Medical Things (IoMT)



Warish D. Patel, Brijesh Vala, and Himal Parekh

Abstract The motion has been discovered life points altogether and in particularly in advancement, yet patients, regardless of everything combat in getting the thought and creating assist they with requiring to the ever-growing price of restorative administration businesses and consequently the extending wide variety of consistent diseases patients. The correct surprise within the field of the Internet of Things makes all elements interconnected. Here, an IoT- and MQTT-based machine learning version is deduced for heart status conjecture shape to be able to collect essential facts from the bodily frame the use of IoT devices (sensors) and pass those data to the cloud in which the info are taken care of. MQTT is an apparent illuminating show wherein you will disperse and attain messages as a client, which is right for device-to-gadget or IoT world. Simulated intelligence (ML) has been exhibited to be practical in supporting with selecting selections and conjectures from the considerable degree of know-how conveyed by the restorative hospitals. A solution gives a choice for coronary ailment immediately also. The path of action seems, with the aid of all accounts, to be empowering when it is gotten along facet medical profile facts, higher selections are often made, and forewarning of emergency are frequently perfect, which may assist with saving lives. A story technique is deliberate to seem at the shape the extent that various execution estimations like exactness, affectability, and disposition within the choice for cardiovascular disease.

Keywords Smart healthcare · Cognitive IoT · ECG · HSLM · Machine learning · Heart disease prediction · IoMT · CVD

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1 Introduction

Cardiovascular disease (CVD) is creating the reason behind mortality these days wherever in the course of the globe. As seemed through unequivocal reviews wiped out 2014, it has been determined that the critical motive force of demise has moved to non-transferable torment from transmittable turmoil, which is not kidding in a sense considering the manner that non-transmittable infection like cardiovascular ailment is that the maximum dangerous clarification of death bearing the estimations of 17% alone [1]. We delineate a model which could mechanize the entire undertaking of expertise combination and transferring the information with the assistance of IoT gadgets and sensors to an application jogging a machine learning figuring at the cloud, that may through then pick the result issue to the know-how assets assembled from unique IoT instruments and sensors related to the affected person or client end ceaselessly. PC-based know-how (ML) estimation has capabilities a unique impact in the dynamic system on any occasion, coordinating an extraordinary diploma of information [2]. IoT-based device will take all the vital sensitive and personal statistics from the body, as an example, heart rate, ECG, and temperature so ahead with the help of our machine learning estimation will verify the result and provide the overall coronary heart disease of the patient. It is going to reinforce people to find a few arrangements regarding their again and forth development coronary heart disorder besides destiny want for any coronary disorder are going to be vital to shape the critical preventive steps at the right time.

The machine will constantly display and make specific reports of the affected person. The device will process diverse activities of understanding and concentrates the expertise through probabilistic appraisal as displayed via the proposed selection model. A sifted via added sharp IoT structure for coronary heart arrangement from the satisfactory want is formed. A uniform prospering assisted structure with ECG, heartbeat, and temperature for patients is ensured about as a stand-out software for envisioning heart grouping from the satisfactory. An MQTT mapped out between the numerous sensors and PC for extra information overseeing is arranged. The information is negative down employing a sign birthday celebration and AI structure to gauge the hankering accuracy. Cloud, almost as IoT primarily based ailment affirmation version, has ended toward the screen, envision and observe the coronary illness.

Major problem for human institutions and relative IoT packages where it is predominant to induce achieves industrious [3]. Primarily, cloud-based computational version is required to expire accommodating associations and other dormancy fragile effects with low reaction time, least essentialness use, and high exactness.

An objective in the back of this approach is to screen numerous patients for diminished government managed savings costs, and remedy time is that the attitude of destiny human association affiliations. To screen the patient thriving nuances every and every 2d and update the nuances to Server or Cloud by techniques for a pushed Internet of Things (IoT). Regulators or different separate people can unexpectedly view or display screen this situation of patients without a made sure about activities.

To reap raised degree of precision and occasional inaction. Conjecture of coronary disorder situation to the present circumstance.

At this time have delivered Hierarchical Supervised Learning Methodology (H-S-L-M). It will have an unmistakable leveled technique of various directed AI estimations. Strangely, the HSLM gadget makes use of all functions without any obstacles to feature affirmation. The flavor wondering will have want for all parameters and essential parameters moreover.

2 Related Work

The paper [1] considers the most used tendencies open for the balanced BP checking trust oscillometric framework and photoplethysmographic (PPG). It is at five-layer structure dependably will not expose the IoMT-based looking systems in the course of which each layer is for diverse clarification and things. The five layers defined are physical part, data local elaboration, data transmission, data central elaboration, and data distribution service. Savvy devices reliant on oscillometric structures are clarified and remoted, and their evaluation of precision and enduring quality. The units reliant on oscillometric techniques are electronic vital sign monitor, QardioA structure, OMRON HeartGuide from which OMRON HeartGuide is the most sturdy and cautious. The device's concern to photoplethysmographic (PPG) is IBP Auralife, Pioneer IoT, Asus VivoWatch BP.

The maker has analyzed in paper [2], the disparity in beat is primary to peer for each heart's prospering and its working. Along these lines, this paper proposes IoT cloud-based heart rate variability (HRV) looking machine. It courses of action of an ECG sensor-related with a coffee energy microcontroller, and this microcontroller is interfaced with Wi-Fi for far-flung transmission of understanding. The consistent heartbeat regards are spouted to PubNub IoT web interface, and consequently, the characteristics from this interface are often persistently reviewed the usage of the freeboard.Io dashboard. The makers use AD8232, which may be a joined single-lead ECG the front from analog devices wired to MSP430F5529, which may be an ultra-low electricity 16-piece microcontroller unit (MCU). This microcontroller is interfaced with the CC3100 Wi-Fi supporter pack. They furthermore make gain themselves with Energia that is an open-source empowered advancement condition (IDE) deliberating wiring and Arduino structure for programming of launchpad, PubNub for data spouting, and Freeboard.Io for IoT statistics observation arrange. The among beat-interval (IBI) and the heartbeat were obliged through immersing for the reason that a prolonged time again settled edge, primarily based shape and shortened moving every day based on regular QRS zone device.

In [4], facts processing used with the human association's department has offered an upward push to progressed clinical alternatives on the brink of power time of sufferers. In any case, picking the foremost legitimate information burrowing structure for the unequivocal clinical difficulty is that the standard challenge since precision is that the central difficulty. This paper discusses different facts processing techniques with their want, focal centers, imprisonments, and application regions.

This paper [3] inspects the proposed framework to bring together eight parameters from the physical body that are diagnosed with the guts utilizing IoT instruments to assume and stop clear, wonderful cardiovascular sicknesses. The makers use Arduino Uno, cholesterol detector, pulse sensor, essential sign cuff, and glucose meter. They want proposed to apply a microcontroller unit (MCU). The MCU is going to be related to the vital equipment sensors and modules.

This paper develops a solution wherein patients can utilize wearable sensors, which will provide a wager and frightening of their coronary illness conditions. The device creates an effect of being attractive when it is gotten along aspect recovering profile statistics, and better choices are regularly made, and frightening of crisis are often promising, which may assist with sparing lives. We use information amassed from slightly any people to choose our assessment and selection version. The makers use sensors immediately BioHarness three.zero, which made via Zephyr technology. This sensor joins three bits: chest lash, shoulder tie, and consequently the vital module Java orchestrate, standard expansion eight improvement pack. The path of motion knickknacks interweaves approach version and facts assessment process.

This paper [5] splits down shape up a wearable cardiorespiratory watching contraption that might display and show four parameters progressively all at the same time as on a telephone display or on a PC screen. A version framework to evaluate beat, breath rate, edges slender oxygen drenching (SpO_2), and the temperature is formed. The producers use LM35 temperature sensor, SpO_2 sensor, pulse sensor, PPG sensor, Arduino Uno. Consistent checking of those physiological parameters can help in viably seeing more than one cardiovascular, neurological, or maybe pulmonological infections at a beginning period. This flourishing watching shape will comprise a frame sensor mapped out with signal overseeing and facts transmission modules through which the accumulated facts are often transmitted remotely with the aid of procedures for Internet.

3 Proposed Methodology

The mechanical assembly incorporates various sensors like ECG, heartbeat, and temperature with NodeMCU throughout a breadboard with the help of jumper wires. The sensors accumulate records from the patient's frame and ship it to data collector. The info are frequently visible with time stamp over there direct in Thonny or CMD of Raspberry Pi. Inside the give up of the day, MQTT sends the gathered statistics to Firebase Live cloud. This is regularly our electronic propelling DB from firebase. We might want to log into the use of our Google account. The substance that we have

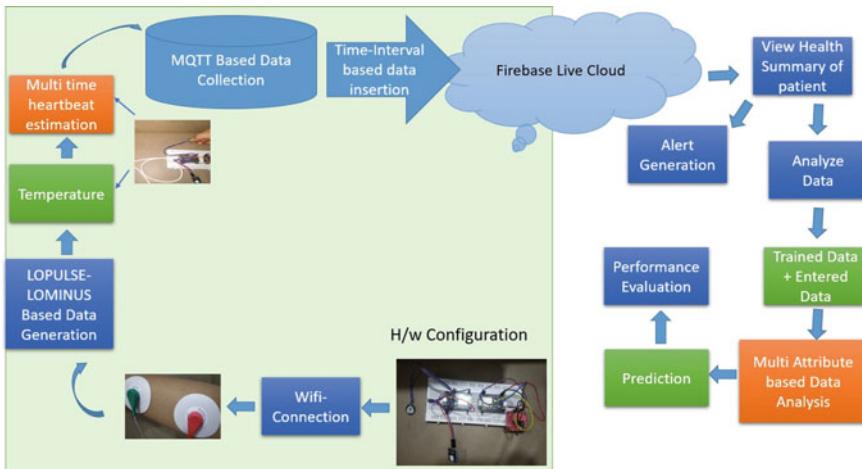


Fig. 1 Proposed framework

got moved to Realtime DB moves all of the substance of CSV records, that's all the information got from sensors into this database. If we grow every zone that are ECG, temperature, and pulse, we will see amassed facts from sensors. The information which is not obliged run the patients of these facts or near ones of them are incited with a cause message with the target that they will make preventive advances. The information is explored and looked after out by using an AI module with the assist of hybrid supervised learning methodology (HSLM), and conjecture are going to be finished ward upon estimation that patient has or may have coronary trouble or not. Future determine is in like way made available. The presentation will in like way be evaluated on unequivocal estimations (Fig. 1).

- **Step-1: Hardware Configuration:**

Connections between hardware:

1. NodeMCU. 2. Raspberry Pi. 3. Heartbeat sensor. 4. ECG sensor. 5. DHT11.

Procedure:

1. Initialization of ports.
Raspberry Pi port 1883 for MQTT server configuration with default ID password.
2. The connection between NodeMCU Wi-Fi with Raspberry Pi to send data using the MQTT server.
3. Raspberry Pi connected to live cloud through the Internet.

- **Step-2: Data Generation:**

1. Pulse sensor:

- Analog sensor.
- Connected to A0 pin of NodeMCU.

- Continuous analysis of heartbeats based on the previous beats.
 - Generation of ID–value pair to send data to NodeMCU to Raspberry Pi.
 - Data upload-periodic interval of 15 s.
2. ECG sensor:
- Analog sensor connected to A0 pin of another NodeMCU.
 - Three electrodes are connected to body parts.
 - LO + AND LO-PIN of ECG are connected to D0 and D1 pin of NodeMCU.
 - Wi-Fi establishment.
 - Continuous ECG values are combined in json character array.
 - ID-array payload upload to Raspberry Pi NodeMCU.
3. Temperature Sensor:
- Digital sensor, D2 pin of NodeMCU, identifying temperature and humidity values.
 - ID-temp string generation and data upload after every 15 s.
- **Step-3: Data Upload To Live Cloud:**
 1. Data collection through the configuration of:
 - Username, Password, Broker, Port, client_name, Topic.
 2. Cloud initialization through Json which has credentials.
 3. CSV generation.
 4. CSV upload for data storage for further ML-based analysis.
 5. Live cloud visualization of ID-sensor value pair.
 6. ID-sensor value data upload after every 15 min.
 - **Step-4: Machine Learning—Hybrid Supervised Learning Methodology (HSLM):**
 - Importing live dataset.
 - Factor variables.
 - Partition data in three phases:

train 70%, test 30%, -train 80%, test 20%, -train 90%, test 10%.

 - Process for every attribute—all variables.
 - Binomial logistic regression for the training dataset.
 - Confusion matrix for training data.
 - Calculating miss classification error for training data and accuracy.
 - Confusion matrix for test data and calculating error and accuracy (Table 1).
 - User input for all attributes for testing.
 - Based on user input, predict the possibilities of having heart disease.
 - Process for significant attributes: age + alcohol + obesity + beat + temp.
 - Again, do the same process for significant values.

Table 1 Confusion matrix

		Predicted class	
		C1	C2
Predicted class	C1	True positives	False negatives
	C2	False positives	True negatives

- Recursive partitioning and regression tree for data.
- Predict the values and create a confusion matrix based on the tree.

ROC Curve for Performance Evaluation

The receiver operational characteristic (ROC) plot could be the most well-liked live for evaluating classifier performance. The mythical monster plot is predicated on two necessary analysis measures—specificity and sensitivity. Specificity could be a performance life of the negative half, and sensitivity could be a performance life of the positive half. The bulk of machine learning models turns out some quite scores additionally to foreseen labels.

4 Results and Discussion

As confirmed up in Fig. 2, we have associated PC with Wi-Fi. Additionally, connect the information interface with the Raspberry Pi and associate this with PC's USB. Once Raspberry Pi is viably implanted, interface Raspberry Pi through VNC viewer.

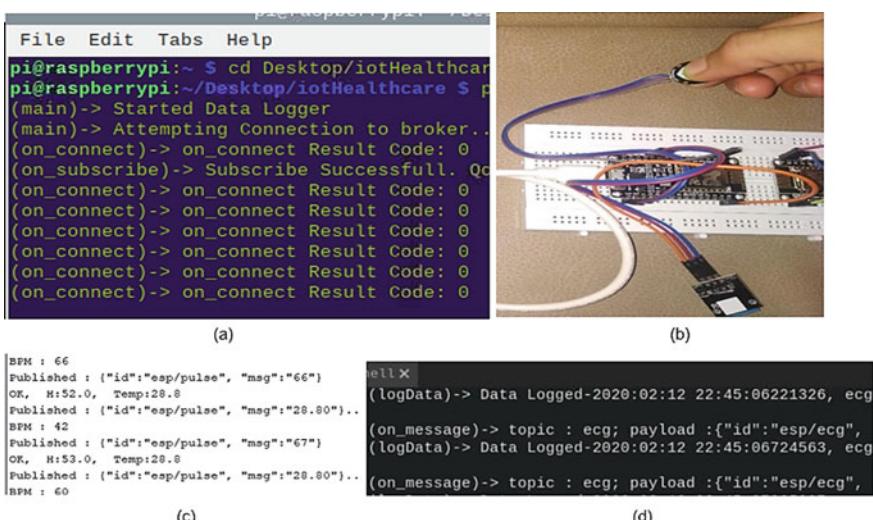


Fig. 2 **a** Data collector; **b** hardware connection; **c** live feed of data; **d** log data generation

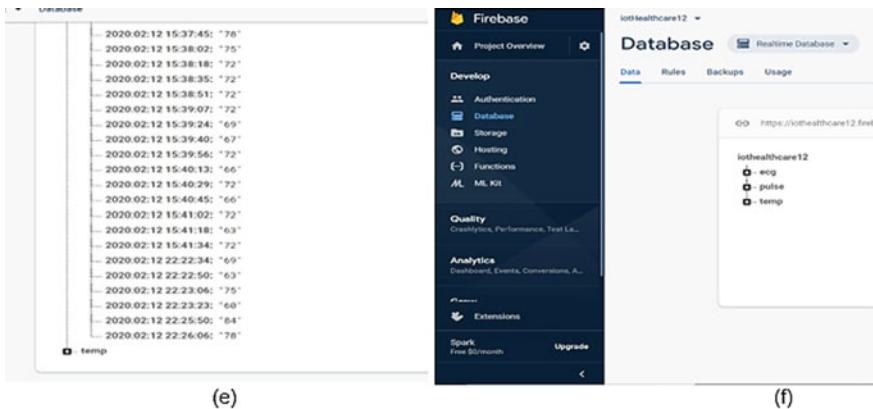


Fig. 3 **a** Heartbeat database; **b** data storage in firebase

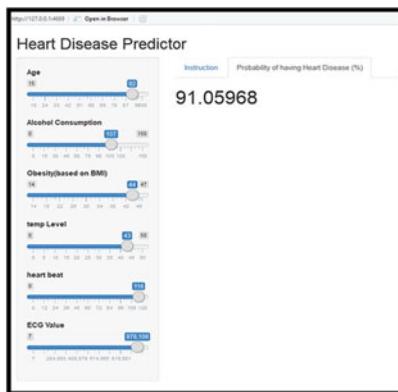


Fig. 4 Heart disease prediction and comparison with existing methods

Execution of DataCollector.Py has been accomplished and making compelling affiliation (the resulting code are going to be exhibited 0 thinking about the way that until now we've no longer related any sensors). By then, we've related each sensor, which is ECG, pulse, and DHT, with NodeMCU at some stage in a breadboard with the assist of jumper wires. The info are going to be taken care of to the fireside base database at a 5-min interval (Figs. 3, 4, 5, 6, and 7).

5 Conclusion

Sensor advances are often applied successfully in healthcare sector. Especially, with infinite coronary disorder patients, because it facilitates with saving lives via brief

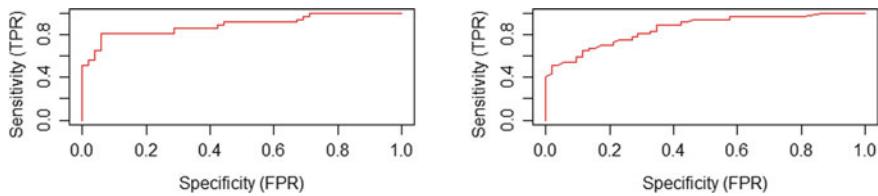


Fig. 5 Specificity and sensitivity for performance analysis

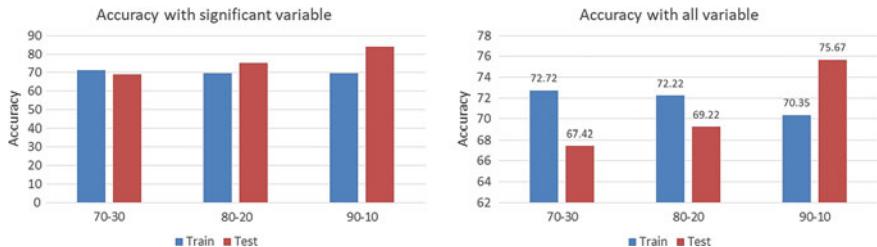


Fig. 6 Accuracy with all and significant variables

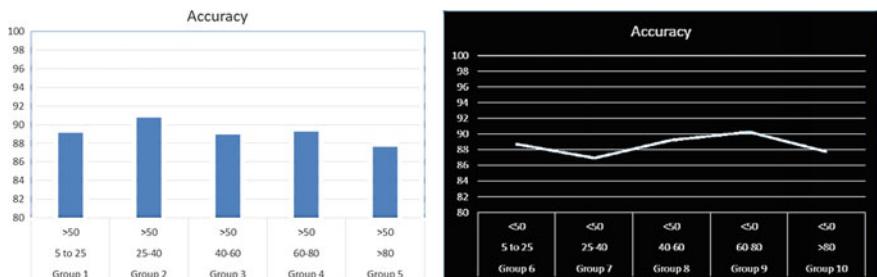


Fig. 7 Accuracy with all groups

mediation and decline viable life mishap to the half. Primarily if these headways are utilized in calm, far-flung checking structures, three partner bits can benefit from the aid of this assessment.

Additionally, at an equivalent time, the machine alerts experts about any odd results. As needs are this kind of computerization may lessen the last part of the most process on experts. Finally, its alternatives to doctors. In which, the hospitals can arrange their social protection systems with this shape to provide home thought organizations. Here, an embedded IoT structure to screen heart abnormality and destiny coronary heart dream the use of go breed AI count. Different sensor systems will not apprehend the critical signals also indications of the patient. The data assembled will not be going to envision the guts status of the patient. Future work will include AI module to be realized with accumulated data, coronary sickness desire, execution evaluation, UI the use of Shiny R all through which we got 87%

accuracy that's moderately excessive than other existing procedures. In the future, we can include more sensors like GPS sensors to be composed with proposed.

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Effective Decision Support Scheme Using Hybrid Supervised Machine Learning Procedure



Yatendra Mohan Sharma, Pawan Kumar Saini, Shalini, and Neelam Sharma

Abstract Nowadays, under different operational fields, huge experts rapidly consume dissimilar prophesy schemes for amplifying the quality and reliability of their working actions. An associated literature converse a variety of characteristics and limitations of accessible schemes with an affirmation that still each and every obtainable method is lacking to attain an elevated efficiency, and for that reason, field has a high scope of further research. To crush an insufficiency of traditional and a number of current offered methods, a novel efficient counsel scheme is converse in this paper. To improve an excellence of decision with steadfastness proposed approach vigorously analyze exploited statistics with Hidden Markov Model (HMM), Artificial Neural Network (ANN), Support Vector Machine (SVM), and a form of Decision Tree J48 in company of two different feature assortment procedures correlation-based feature selection (CFS) and gain ratio (GR), and dynamically build a hybrid scheme by utilizing the features of best fitted algorithms in a layered form. Each and every testing phase result has expresses an appropriateness of proposed approach over traditional as well as other obtainable methods.

Keywords Supervised/unsupervised machine learning techniques · Hidden Markov Model · Artificial Neural Network

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1 Introduction

In recent times, under dissimilar working ground much of counsel schemes are rapidly consumed by huge professionals that directly or indirectly play a key role in improving an excellence of working decisions. However, huge refined tools are available in current scenario that aid the professionals of different working fields but associated limitation of each and every offered methods has amplified the fears. Each and every tool requires and utilizes vast volume of data to bring an output at which it user can make an optimal verdict but most of studied models are not suitable for examines the statistics with unstable data sets, model face hitch, and be unsuccessful to provide an efficient outcome for support or build an admirable decision. The current associated literature depicts various rewards of accessible schemes with evidence that still no one standalone counsel scheme is skilled to aid professionals under different working style [1–3]. Therefore, design and implementation field of an efficient counsel scheme are open for research. Additionally, the published efforts affirm that utilization of data mining method into building procedure of counseling scheme is one of the most finest practice. Hence, in this incorporated work, a naïve counsel scheme has discussed that enthusiastically analyze an act of different data mining method over bunch of statistics and vigorously build a layered model to improve the QOS of working resolution.

2 Related Work

In modern era, a vast number of algorithms are in a trouble free accessible mode for enhancing an act of decision support system. The illustration of each and every handy algorithm is not possible to depict in this paper, and description has restricted over the four methods, i.e., Hidden Markov Model (HMM), Artificial Neural Network (ANN), Support Vector Machine (SVM), and a form of Decision Tree J48. With unique benefits of HMM scheme, much of investigators has implement it under various offered techniques [4–6]. In simple term, HMM scheme can be deliberate as a simplest active Bayesian network that identifies unobserved states through Markov procedure. The first exploitation of this model was done for speech recognition but with extreme wealthy mathematical formation, it exploits to aid in different fields like recognition of patterns/handwriting and gestures, tagging of part-of-speech, partial discharges, and bioinformatics. As like HMM, the SVM practice has also rapidly attain huge fame of investigators under different working streams [7–9]. Published efforts elaborated that SVM scheme offer higher accuracy in front of other traditional methods [10–12]. A good amount of investigators demonstrates the advantages and restrictions of ANN-based decision support algorithms [13–15]. With illustrating the advantages of ANN-based schemes, a few efforts have demonstrated the unique associated restriction of this methods that highly affect an efficiency of ANN-based

algorithms [16, 17]. A different group of investigators has demonstrated an effectiveness of J48-based efforts for improving an act of decision support system [18–20]. Associated literature of counsel scheme evidently elaborates that most of the obtainable methods are dependent on the process of supervised learning scheme, and with unique restraint of these algorithms, the build models based on these methods has struggles in real-world scenarios.

3 Problem Statement and Proposed Approach

Related published efforts demonstrate that no one sole classification method is proficient to maintain its acts with alteration of statistics. Additionally, each accessible effort have several issues like inflexibility, takes huge time slot for model building, and fabricates huge wrong mark data. Such issues are highly responsible for failure of existing algorithms. In direction to fabricate an extreme talented counsel scheme, the proposed practice put high concentration on animatedly discovery of the pair of best forecasting and feature selection procedures over exploiting statistics. Figure 1 explains the working methodology of proposed approach.

As symbolize in above figure, subsequent to gather different data set from UCI data pool, the proposed approach robotically analyze classification act of four-well recognized processes, HMM, ANN, SVM, and J48 with an association of feature shrinking procedure CFS and gain ration technique. Furthermore, approach animadly construct a layered procedure by linking the discovered pair of finest forecasting schemes into a linear mode in which mistakenly forecasted data of first approach reconsider with another employed technique. At last, each and every experimental

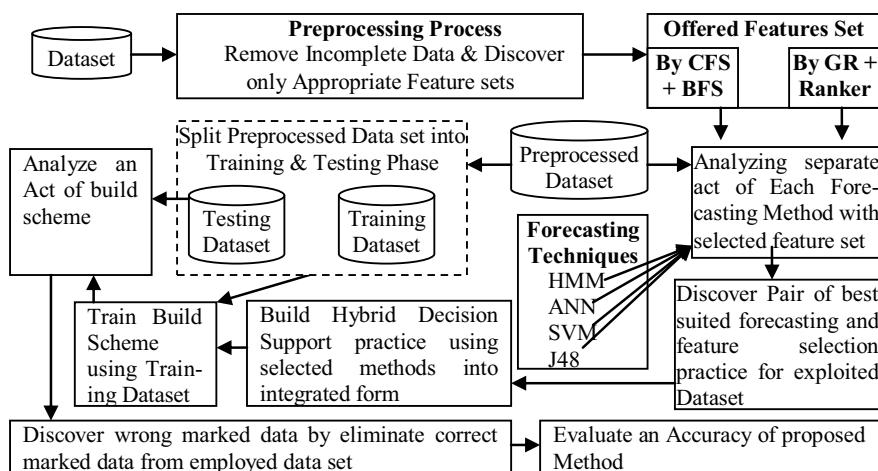


Fig. 1 Proposed method

results of proposed approach have compared with an act of traditional and recent offered methods to illustrate the supremacy of build mechanism. Comparative evaluation denotes that adopted process significantly enhances forecasting accuracy in comparison of other offered techniques.

4 Result Analysis

To elaborate an act and effectiveness of proposed approach, attained accuracy has considered as key parameters, calculated by following equation

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{TN} + \text{FP} + \text{FN}} \quad (1)$$

where

- True Positive (TP):** Against of class type the sum of fittingly forecasted data.
- True Negative (TN):** Without raise an alarm examined record get it correct place.
- False Positive (FP):** A state of affairs that statistics has not links to its fitted class.
- False Negative (FN):** Facts of class estimated as an element of a different class.

In order to observe real act and dominance of designed counsel scheme in comparison of other accessible methods, a number of experiments has carried out with diverse set of statistics, taken from one of the most popular open access data library UCI. To analyze an act of intended approach in front of current offered methods, the statistics of diabetes have taken in account as was employed by Sneha [21], accessed from the UCI that holds the record of 768 persons. The authors of published work proposed a modified approach with the naïve version of SVM, random forest, Naïve Bayes, Decision Tree, and KNN algorithm and stated that they attained 82.30% accuracy with the modified NB algorithm. Figure 2 depicts the comparative analysis among Sneha [21] scheme and our proposed model.

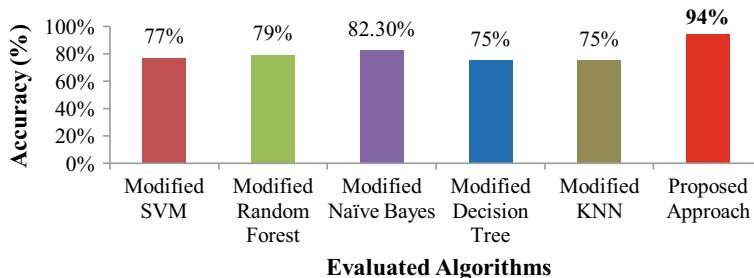


Fig. 2 Proposed approach versus N. Sneha modified algorithm over diabetes dataset [21]

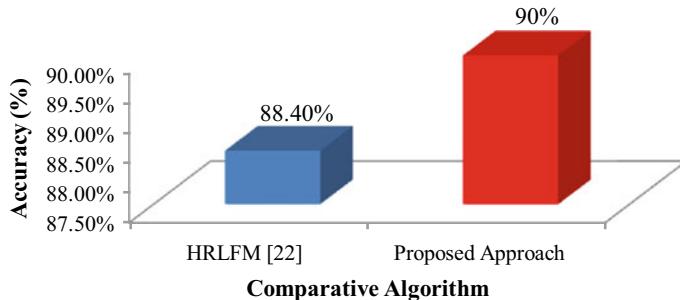


Fig. 3 Proposed and Senthil Kumar Mohan algorithm over heart diseases dataset [22]

The comparative figures depicted in above graph evidently explain the significance of proposed approach but to confirm the suitability of intended algorithm, a separate experiment has carried out with a dissimilar set of data, and heart diseases dataset has considered this time as exploited by Mohan et al. [22] that consist 270 patients records with 14 features set. The published efforts illustrated that their offered method has attain 88.4% accuracy in comparison of other obtainable schemes. The comparative fallouts with same statistics have illustrated in Fig. 3 that denote an intended approach of this paper has attain high accuracy in comparison of Mohan et al. [22] and other recent obtainable algorithms.

The above comparative figures in graph evidently explain the significance of proposed approach in comparison of other classical as well as recent offered methods. Additionally, the healthier fallouts of intended approach exemplify the affectivity of the mechanism that has adopted at the build time of proposed process.

5 Conclusion

This paper proposed a fresh proficient decision support scheme that auto analyze an act of four different algorithms, Hidden Markov Model (HMM), Support Vector Machine(SVM), Artificial Neural Network(ANN), and a form of Decision Tree (J48) over exploited dataset in term to recognize the pair of best suited methods. Furthermore, the build practice utilize discovered methods into an integrated form, utilize methods into a liner mode with company of feature assortment process correlation-based feature selection with best first search and gain ratio with ranker method. A number of simulations have carried out to demonstrate an efficiency of proposed approach. Each and every comparative fallout has indicates the efficiency and acceptability of introduced approach. However, assessment results evidently point out the competence of proposed algorithm over an accessible and some of modern approaches in terms of attained high accuracy but as like to other obtainable process, the proposed model has also associate some unique restraints that can be improve with

future work. A future work can be done in a track to construct a finest self-motivated process with inclusion of other methods in a well-organized way.

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Hybrid Secure Data Transfer Scheme Using Cryptography and Steganography



Rashmi Shree and Dinesh Swami

Abstract This paper offers a naïve data security method using cryptography and image steganography schemes. The ciphertext message image is treated as secret image of steganographic encoding. In this proposed steganographic encoding scheme, both the secret image and cover image are blended together using the mixing operation that results as stego-image. Use of cryptography scheme embeds excellent security in the steganography scheme and also offers two level of security, whenever required. The strength of the proposed hybrid data hiding scheme is tested on different parameters that are shown in result part of the paper.

Keywords Cryptography · Steganography · Information security

1 Introduction

The steganography is a method of conceal writing and used to covert communication. Confidential information demands secure communication resulting to build superior's steganography algorithm, because steganography is much powerful technique for secure communication [1]. It is a branch of Information system security for data protection. Information system security can be classified into three types, i.e., cryptography, steganography and watermarking. Cryptography scheme is widely accepted routine for securing digital information, it encrypt statistics in a way that only authenticate recipients of that information can understand that after applying decryption process with supplied key. Advanced cryptography techniques ensure an information being transmitted but not been modified while in transit [2]. Implementation of cryptographic techniques or algorithm needed for a particular security service is called as cryptosystem, commonly used for achieving confidentiality [3, 4] (Fig. 1).

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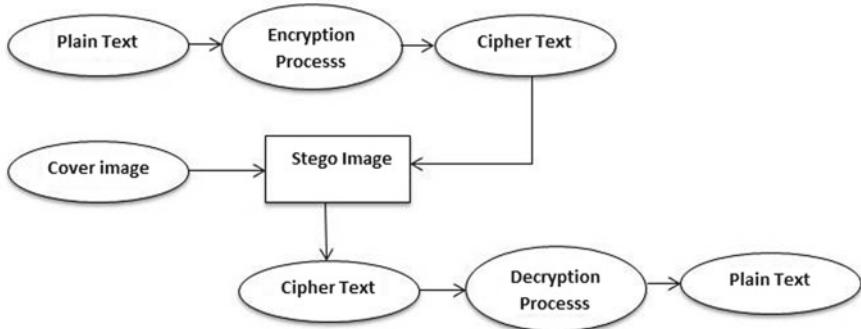


Fig. 1 Steganography and cryptography

Steganography schemes hide important information within an ordinary file to enhance security of transits data. Common types of steganography schemes are text and image steganography, where other text or images have been utilized as cover media. Form the starting age, huge research community has utilized this scheme in direction to improve security of important information [5–11]. There are some key properties that must be considered while generating a stego-file such as embedding capacity, imperceptibility and robustness. Similar to steganography, watermarking is also a data hiding technique, but goals of the two processes are different. Secret messages that are hidden in this process are related and similar to the content in carrier digital signal; however, in steganography, content of the secret message and true carrier file has no relation. In this technique, information is embedded directly into the carrier signal, making slight variation in the pixels; the variations are so finely drawn that it is not identified by any individual eye. These days watermarking is used in the areas such as protecting copyright, protecting copying digital media, fingerprinting, authenticating image, etc.

2 Proposed Work

Build scheme utilizes cryptography and image steganography in a naïve joint form. Initially, build approach encodes plaintext into cipher message and then creates an image of secret message, generates image from ciphertext message. Further approach hides existence of generated image into a selected cover image and forwards that stego-image to its recipient. Figures 2 and 3 show the data hiding and extraction process, respectively.

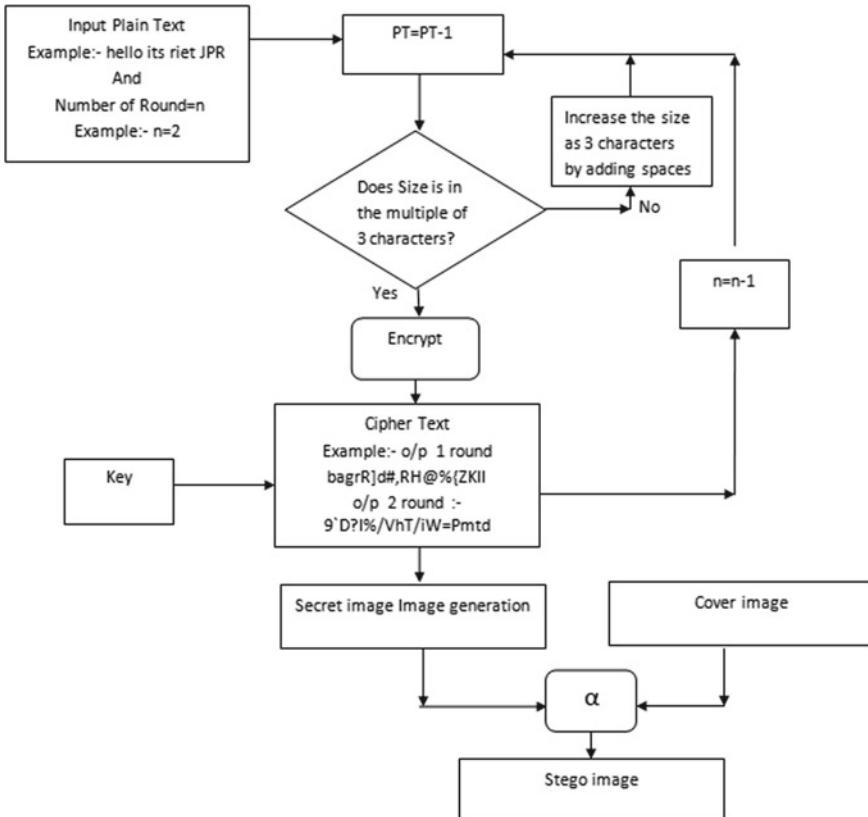


Fig. 2 Block diagram for cryptographic encryption and steganography system

3 Results and Analysis

The performance of proposed method is experienced at the different standard parameters of performance quantity. The technique uses cryptography with variable size of message; the block size of the message is $3 \times S$; here S is very from 1 to n , and minimum message size is 3 characters. Before applying the technique, first the message is resized according to this $3 \times S$, because the encryption process of technique uses 3×3 key size. The overall results from the starting step to the final step (extracted image) are shown in Figs. 4 and 5 for the different cover and the secret message.

The obtained image quality has been tested on different parameters. The quality measurement parameters are as follows:

- **PSNR:** it stands for peak signal-to-noise ratio. It is the measurement of signals noisy and original. $PSNR = 10 \log \frac{I^2}{M}$ DB, I represents the maximum intensity

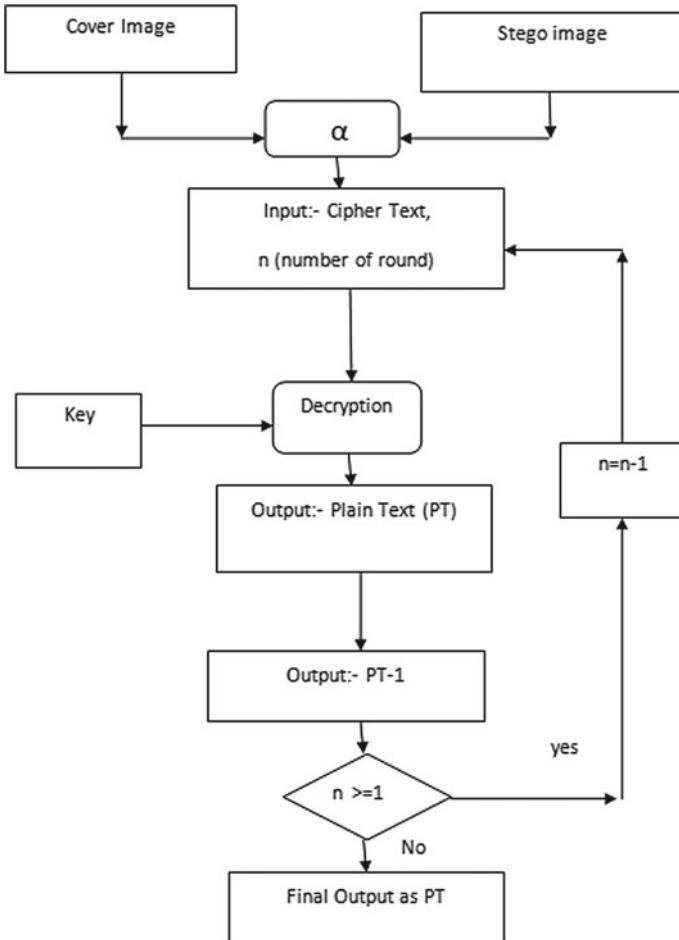


Fig. 3 Block diagram for data extraction and cryptographic decryption

value and M represents the error related to mean square. Table 1 shows the obtained results of PSNR of proposed and existing technique.

- **MSE:** MSE stands for mean squared error $MSE = \frac{1}{X*Y} \sum_{j=1}^X \sum_{k=1}^Y (a_{j,k} - a'_{j,k})^2$ where $a_{j,k}$ and $a'_{j,k}$ represents pixel value at the row number j and column number k of images a and a' respectively, and X and Y are the dimensions of image a and a' . Table 2 shows the obtained results of MSE of proposed and existing technique.
- **NCC:** It stands for normalized cross-correlation; formula for NCC is $NCC = \sum_{j=1}^X \sum_{k=1}^Y a_{j,k} \cdot a'_{j,k} / \sum_{j=1}^X \sum_{k=1}^Y a_{j,k}^2$. Results for NCC and judgment of the proposed procedure at AD (average difference), SC (structural contents) and MD (maximum difference) are shown in Table 3.

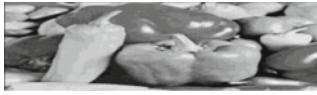
hello its riet JPR	bagrR]d#,RH@%{ZKII
(a). Plain Text message	(b). Cipher text message after round1
bagrR]d#,R H@%{ZKII	
(c). Secret image showing the encrypted message	(d). Cover image
	bagrR]d#,R H@%{ZKII
(e). Stego image	(f). Extracted image
bagrR]d#,RH@%{ZKII	hello its riet JPR
(g). Cipher text message at receiver end	(h). Plain text message

Fig. 4 Obtained results for cover image (Peppers.Tiff) and secret message (hello its Riet JPR)

hello RIET RASHMI Here	kv9{g/x7b,lb`Vx&O3b6V5hs
(a). Plain Text message	(b). Cipher text message after round-1
kv9 {g/x7b,lb`V X&O3b6V5hs	
(c). Secret image showing the encrypted message	(d). Cover image
	kv9 {g/x7b,lb`V X&O3b6V5hs
(e). Stego image	(f). Extracted image
kv9{g/x7b,lb`Vx&O3b6V5hs	hello RIET RASHMI Here
(g). Cipher text message at receiver end	(h). Plain text message

Fig. 5 Obtained results (Lenna.Tiff) and secret message (hello Riet Rashmi here)**Table 1** Comparative PSNR value

Cover image	Proposed technique	Existing technique [16]
Lenna	60.7094	55.4015
Baboon	60.7094	55.4189
Home	60.7094	55.4771
Girl	60.7094	55.3071
Clock	60.7094	55.3331
Cameraman	60.7094	55.4602
Average PSNR	60.7094	55.3997

Table 2 Comparative MSE value

Cover image	Proposed technique	Existing technique [12]
Lenna	0.0552	0.1875
Baboon	0.0552	0.1867
Home	0.0552	0.1842
Girl	0.0552	0.1916
Clock	0.0552	0.1904
Cameraman	0.0552	0.1850
Average MSE	0.0552	0.1876

Table 3 Judgment of the proposed procedure at AD, SC and MD

Cover image	NCC	AD	SC	MD
Lenna	0.9985	-0.2259	0.9968	0
Baboon	0.9982	-0.2259	0.9963	0
Home	0.9986	-0.2259	0.9972	0
Girl	0.9989	-0.2259	0.9979	0
Clock	0.9976	-0.2259	0.9953	0
Cameraman	0.9985	-0.2259	0.9970	0

4 Conclusion

This paper offered a improved data security mechanism by incorporating cryptography and steganography into a naïve joint form. It can be clearly seen from the results that proposed approach has offered 8.8% improvement in the picture quality of stego-image as compared to the previously existing work. So here it can be concluded that the proposed technique provides excellent quality of stego-image as well as the extracted secret image. Additionally, proposed method efficiently produced competent fallouts with less MSE (average MSE = 0.0552), and better results of NCC, SC and MD for girl image among all the images, as shown in result section. The future work will focus on the more advanced hybrid steganography techniques and other kinds of cryptography techniques. The future works will also focus to use this technique in some specific application like banking sector for secure password sharing, etc.

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Robotic Waiters: Detecting Table to Serve Using RFID Tags



Neelima Mishra, Dinesh Goyal, Ashish Dutt Sharma, and Amit Kumar Gupta

Abstract Robots are now providing services in the field of hospitality in China and Japan. They are using a guided path to navigate and serve the food to the table, from where the order comes. Detecting and stop toward correct table is one of the most important factors during serving by robots. Some time it happens when robots do stop at a little distance from the table to be serve or it can also possible that robot detects wrong table. In this research paper, researchers are discussing the present issues exist in current table detecting technique in existing robots and also proposing the solution to detect the correct table using RFID tags.

Keywords RFID tags · Robots · Table detection · Autonomous machines

1 Introduction

Robots in China and Japan are very famous in field of serving in restaurants as autonomous waiters. These autonomous machines do carry the tray of delicious food and reach the destination table to which that order has to be served. The reason researchers are using the term autonomous machine in spite of robotic waiter because

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Fig. 1 **a** Zhang [1] **b** Parsons [2]: picking of ordered food by customers

there is a thing that is lacking in giving the real experience of serving as human waiter provides, that is serving on table and the most important is serving on right table. Researchers find it an issue because the customers of restaurants and hotels do come there for chilling or for any official meeting, at that moment picking the tray from robot by customer is seems like an interrupt for them in between their talks.

In China, the robots are line follower, and they use the count of rotation of wheel to reach the destination table. Sometimes it stops before or after the table in that case placing of tray on table goes wrong, may be robot release the tray and food split on floor. But this feature of serving food on table is not there (Fig. 1).

Picking food dishes from tray from robot waiter is convenient manner to serve food, but it neither fulfill the definition of robot (i.e., a machine that behave as same as any living species) nor give the wonderful experience to customer where waiter do serve dishes on table. The aim of researchers is to provide the solution where robot waiter not only reaches the table autonomously but also serves the tray of food dishes on customer table. The only problem in serving tray on table is to identify the correct table; otherwise, it creates chaos in restaurant and hotels.

1.1 Present Issues

- The magnetic path drawn on the floor to be followed by robots is always at a little distance from the table (as shown in above images also).
- Detection of table is done by count of encoder motor in line following technique. This may sometimes misguide the robot, and it can stop at any position (near or far) of table.
- In some of the Chinese restaurants, customers have to tap on the head of the robot to stop it to pick the ordered food.
- This may be inconvenient for customers because it never gives a good experience of hospitality provided by restaurants and hotels.

1.2 Solution of Detecting Correct Table

Researchers had suggested a solution in detecting correct table to serve food on table and increase the good experience of customers. Using RFID tag is the wonderful solution in detecting correct table and helps robot to be close enough to the table to serve properly without creating any chaos.

Full form of RFID is radio frequency identification. It is a small gadget that contains the combination of a chip and antenna. RFID [3–5] is used for automatic data capture allowing contact less identification of objects using radio frequency. The main purpose of this electronic gadget is to identify an object (living or non-living) wirelessly by transmitting a serial number that is unique for each and every tag (that means each RFID tag is having a unique serial number which is identified by reading it using RFID reader in a particular range of electromagnetic field).

Structure of RFID:

In RFID, there are mainly two hardware devices, first is the RFID tag or transponder and second is RFID reader. Tag is attached on an object which is to be scanned and reader can be any read/write device that is used to communicate with RFID tag.

As shown in Fig. 2, when RFID tag enters in a read area, the data is captured by reader. This captured data by reader is transferred to PC/workstation through standard interfaces for storage or any other action.

- Here antenna does release radio signals that activate the RFID tag and able to read/write data on it.
- Reader also releases radio signals (the range of signals can be from 1 in. to 100 ft). When a RFID tag comes in contact of electromagnetic area, it discovers the activation signal of reader.
- The data was in encoded form—the IC (Integrated circuit) of RFID tag, that is then decoded by reader and this is how the data passes to PC/workstation for processing.

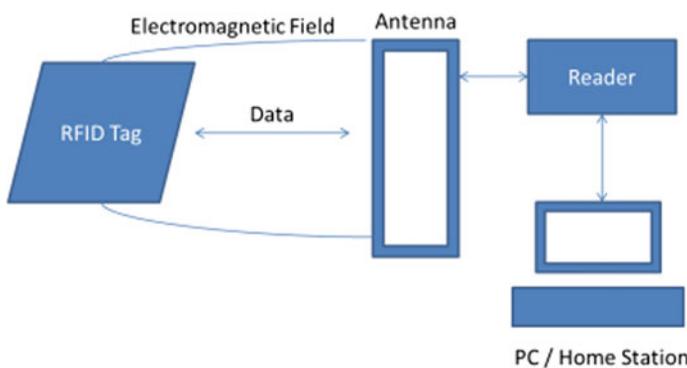
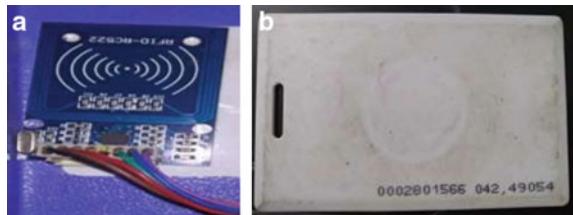


Fig. 2 Structure of RFID

Fig. 3 **a** RFID reader circuit on robot, **b** RFID tag



The objective of RFID is to let the data transmit from an object that is RFID tag and then read by the RFID reader to further process as per application.

2 Hardware of RFID Tag and RFID Reader

See Fig. 3.

3 Process of Table Detection Using RFID

As discussed in above topics that RFID seems the great solution to detect the right table to serve on that because of the feature of detecting object by the unique serial number on tag that is attached on the object. The reason of detecting correct table is to release the tray loaded with delicious food on the correct table properly.

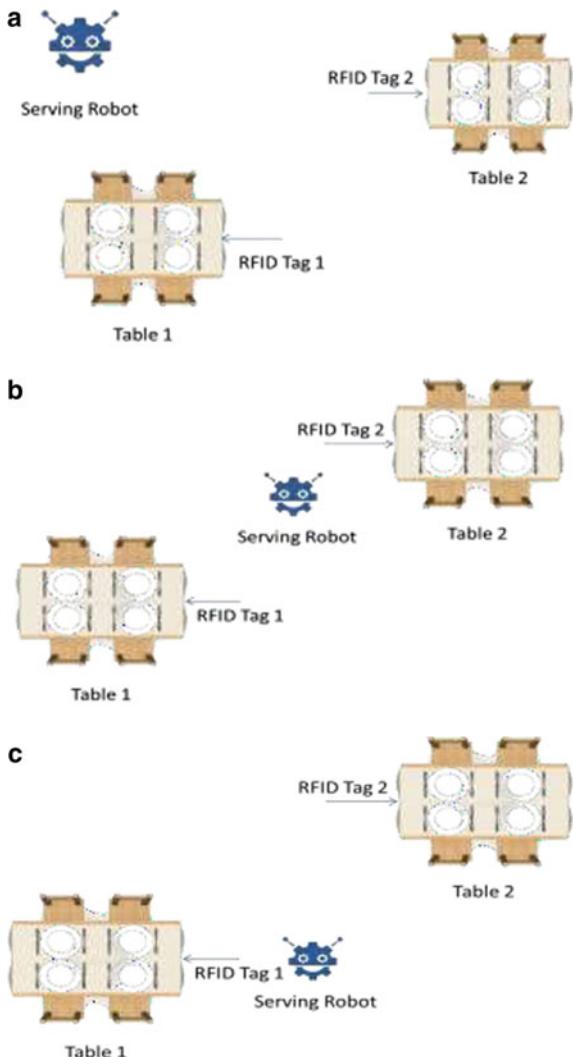
Three main components of RFID are:

1. **RFID tag (Transmitter/Responder):** Tag is used to identify an object (on which it is attached). It consists of microchip that is then connected to an antenna. Each tag has unique serial number or unique ID (identification number) and memory that is capable in storing data like type of product, detail of manufacturing, etc.
2. **The reader (Transmitters/Receivers):** Reader establishes the communication with RFID tag using radio waves. The most thing in this is there is no need to place the tag visible to the reader; the reader can read the tag either it is out of line-of-sight to read and write data on it.
3. **Application layer (Middleware):** In this data is connected to application system for processing.

In this research, RFID tags are attached on each table and at the time of mapping process of serving robot, the robot reads all the tags and sends it to server. In this process, robot reads two parameter to detect the table, first is the (x, y) coordinate of table and the unique number of RFID tag that is attached on that table. These two parameters help robot to detect the correct table.

Step 1 The service employee at kitchen side places the tray of order on robot and gives the command to serve in form of table number to robot (Fig. 4).

Fig. 4 **a** Command given (table number) to robot, **b** navigating to the destination, **c** reading RFID tag and serving on table



Step 2 At the time of mapping of serving robot, it had already stored the location of each and every table.

$$\text{Location of Table} = (x, y \text{ coordinate}, \text{RFID's uniqueID}).$$

These two parameters help robot to identify the correct table that is given in command to serve. Using these parameters, it starts navigating through the shortest path toward the table. Let in following diagram the employee of hotel gives “Table 1” as a command to serve, then serving robot takes the location of “Table 1” from server and move toward it.

Step 3 Then after reaching the exact location provided (i.e., Table 1 in this example), robot reads the RFID unique ID and match the parameters. After confirming the table, it releases the tray on that. In this process of releasing tray, the distance between robot and table is approx. 10 cm.

4 Conclusion

The existing serving robots in China and Japan are line follower machines, and it uses the technique of counting encoder motor rotation to stop at the destination table, but there is no such process to identify either the table is correct or not. As discussed in this paper, researcher's aim is to improve the good experience of customers in restaurants during the serve by robots. Researchers proposed a technique of detecting table using RFID tags, which helps the robot to detect and do serve on the correct table.

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Design Process and Stress Analysis of Spine in Humanoid Serving Robot to Provide Proper Balancing and Load Bearing Capabilities



Neelima Mishra, Dinesh Goyal, and Ashish Dutt Sharma

Abstract Designing a robot that looks like human always gives the better experience in human–robot interaction. It is an important part along with the technology use in it because majorly public got attract toward robot just because of the design or in other words design is the first impression of robot. But with attraction, it is also important that design of robot body should not have any play during navigation and turns while serving. In this paper, researchers are discussing the designing process of serving robot and proposing the spine in robot. This spine basically affects two major factors in robot; they are, load bearing and balance.

Keywords Serving robot · Mechanical design · Inventor · 3D printing · Spine · Humanoid robot

1 Introduction

Earlier, only industries are using robots in factories in the form of robotic arm or conveyor system; their focus is on application of robot in spite of appearance as they look like an automated machines only. But with the change in time, robots are providing the services to human in the social environment also. In the form of interactive robots, it provides services in the hospitality sectors and also assisting elders and especially disabled persons [1, 2]. To share the workplace with human,

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the robot should be of good appearance, lightweight and intelligent (various sensors are used for intelligence).

The replication of robot with human always fascinates the researchers, making a humanoid body of robot with integrating sensors to provide sensing abilities to robot as same like human have, like camera is used for vision in robot as like human have eyes, etc. Like sensing abilities, humans have a spine, which provide balance to the body while walking and holding any load. Using this idea of balancing by human body, researchers are proposing a spine in serving robot. As robots in restaurants need to bear a load of dishes and have to navigate in many directions, spine will help in balancing it properly.

In this research paper, researchers describe the process of designing robot that includes the software designing on simulator and then 3D printing of parts. Then, the complete designing of spine proposed is described with the analysis of load capability also discussed.

2 Related Work

The mechanical design and control strategies for the humanoid robot (named ARMAR) was discussed that can work in any dynamic environment autonomously and can also interact with human [3]. In this paper, a closed form solution of the inverse kinematics of the redundant arm of the robot is provided, and an approach to transfer the human arm movements of typical manipulation tasks to the humanoid robot ARMAR is also proposed. Authors developed the single arm motion planner on the simulator first and then test that on the real robot then. Then, for coordinated motion, they developed a dual-arm motion planner that considered the closed kinematic chain of both arm and object.

They compared the robot of science fiction movies and real robots [4]. They discussed that as robots in science fiction movies can do anything that is impossible for human, but in real robot has limitations in capabilities. The authors discussed the history of humanoid robots, and by taking reference they also discussed the future possibilities for various applications. The main point to note in this paper is appearance and working of robot are varying from application to application.

They described that combining humanoid body with mobility using wheels is very much discussed in many papers [5]. Authors show the survey of some of the humanoid robots that have appearance of human-like body at upper part, and the wheeled platform is used below for navigation. Authors discussed and compared the body parts among similar but different humanoid robots.

In this paper, authors proposed a humanoid robot and they name that Vizzy [6]. It looks like human from the upper body part and having many features like easy mobility, grasping capability, movement of head, eyes and arms. Authors facilitate the Vizzy with these features to improve the acceptance of robot among humans. And the lower body part of Vizzy is a wheel base system (as like car) that is used

Fig. 1 Spine in robot designed on Autodesk Inventor



for mobility. Authors described the requirements, design and construction of Vizzy in their research work.

Authors discussed the past, present and future of humanoid robots in this research paper [7]. They showed that in present scenario, researchers try to develop the humanoid robot as same as human, not only in appearance but also in working like hand, head and eye movement, interaction capability, etc. to understand the depth of designing and development of humanoid robot, and authors surveyed many humanoid robots and understand the working in different time aspects.

3 Process of Designing

3.1 Design on Autodesk Inventor

Autodesk Inventor [8] is used by researchers for designing the 3D models of parts of robot. It helps in visualizing the parts looks like, and assembling of parts is also possible on the same.

It helps the researchers to test the dimensions given either correct or not. Designer can choose the material used for the part which helps in simulating the stress analysis also. For example, researchers choose stainless steel material for the designing of spine and check the sustainability of spine by providing load on it on simulator (will discuss in next section) (Fig. 1).

3.2 3D Printing of Body Parts

To bring the designed part into a form of 3D prototype model, 3D printing is the best process. The software used in 3D printing prints the part into layers which is quite strong and light in weight and also of the same dimension given in the software. With the help of 3D printing of parts, researchers can make the prototype of actual design and can assemble the parts into a full body of robot to confirm the correctness of dimensions also.

4 Spine in Robot

Researchers are proposing spine in robot to provide the balance and load bearing capability in it. It supports the robot body while navigation as same as spine in a human body. For balancing, it is required to centralize the complete load; for that, the design of spine is having two fixtures: One is linked with head, and another is linked with the base of robot that are vertically on the same scale. In the stress analysis process, load of 200 N is provided on the fixture linked with head and test the stress and displacement on simulator (Fig. 2).

The proposed spine in robot is first designed on Autodesk Inventor, and the stress is analyzed to check the load bearing capability on spine and the results are as below.

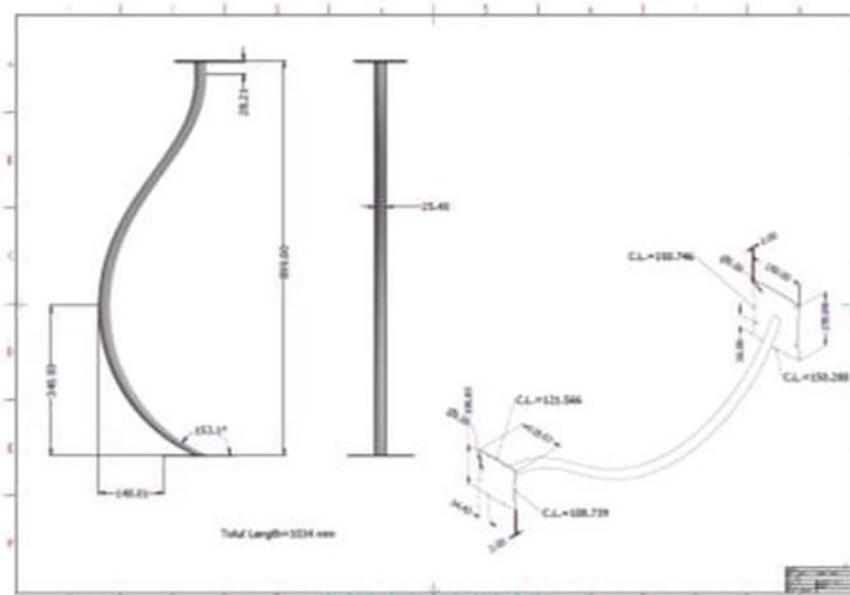


Fig. 2 Drafting of spine on Autodesk Inventor

Table 1 Unit system used

Unit system	SI (MKS)
Length/displacement	mm
Temperature	K
Angular velocity	rad/s
Pressure/stress	N/m ²

4.1 Units Used in Stress Analysis

See Table 1.

4.2 Loads and Fixtures

While navigation, the load carried by robot can unbalance it and in result, the carried item may fall down. So in overcoming from this issue, the proposed spine will help to keep the balanced movement of robot and also help in avoiding jerk and play comes during navigation. The spine had two fixtures on both sides—one is on the neck of robot body and the other end of fixture is at the base. Here, the force of 200 N is applied on first fixture that is on the neck side and test the simulation for the same. Basically, the upper part of the body does carry the load and the complete navigation of robot is depending on the base of robot with the help of the motors and wheels. Then at the time when either robot starts the movement or stops, the motion of upper body and base of robot is separate (and this is the reason of unbalancing). The spine in robot helps in transferring the complete weight to the base of robot and this will balance the movement of robot.

Table 2 Details of fixture 1

Fixture name	Fixture image	Fixture details		
Fixed-1		Entities: 1 face(s) Type: fixed geometry		
Resultant forces				
Components	X	Y	Z	Resultant
Reaction force (N)	-200.027	0.0318586	0.00779906	200.027
	0	0	0	0

Table 3 Applying force of 200 N [reaction moment (Nm)]

Load name	Load image	Load details
Force-2		Entities: 1 face(s) Type: apply normal force Value: 200 N

In Table 2, the name fixed 1 is given to the first fixture (i.e., fixed by the neck of robot body), and a force of 200 N is applied on it to test the bearing capability of spine (refer Table 3). This test of up to 200 N shows no deformation in spine that means the bearing capability of spine is 200 N.

4.3 Study Results

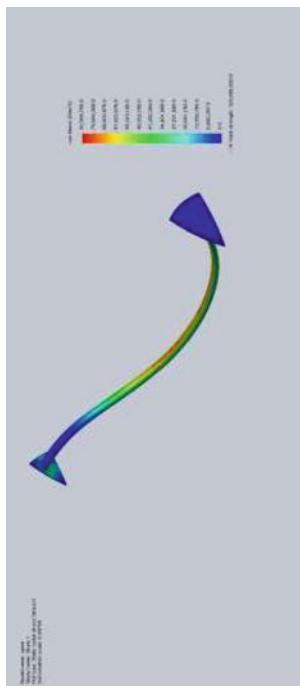
Tables 4 and 5 are the results of bearing capability of spine in robot tested and simulated on the Autodesk Inventor.

5 Conclusion

In this research paper, researchers discussed the designing process they used to design the body parts of robot on Autodesk Inventor and 3D printing for the prototyping of parts. The main aim of this research is to propose the spine in robot to support the complete body while navigation by providing balance and load bearing capability. They show the drafting of spine done on Autodesk Inventor software and then test the stress and displacement on spine at 200 N load on it. Resultant, the minimum and maximum of stress and displacement occur which is present in the study result above.

Table 4 Study of displacement of spine

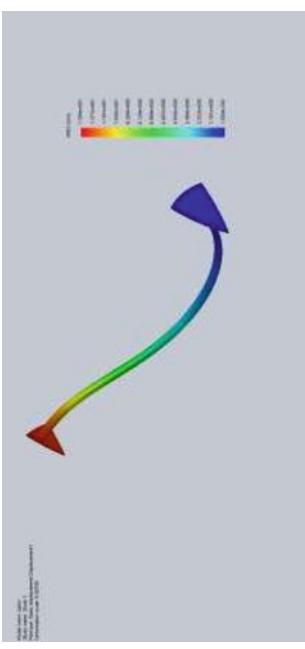
Name	Type	Min	Max
Stress 1	VON: von Mises stress	0 N/m ² Node: 5497	8.25648e+007 N/m ² node: 657



spine-Study 1-Stress-Stress1

Table 5 Study of displacement of spine

Name	Type	Min.	Max.
Displacement1	URES; resultant displacement	0 mm Node: 5	13.9356 mm Node: 876



spine-Study 1-Displacement-Displacement1

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Evaluation of Geotagging Twitter Data Using Sentiment Analysis During COVID-19



V. Ajantha Devi and Anand Nayyar

Abstract Late advances in innovation have empowered individuals to add area data to informal communities' geolocations where individuals share their correspondence and whereabouts in their day by day lives, yet in addition during anomalous circumstances, for example, emergency occasions. Be that as it may, since the volume of the information surpasses the limits of human logical capacities, it is nearly inconceivable to play out a direct subjective investigation of the information. The emerging field of visual investigation has been acquainted with tackle such difficulties by integrating the methodologies from factual information examination and human computer into exceptionally intelligent visual situations. The researcher extracts valuable hidden data from the huge volume of unstructured social media data and model the extracted information for visualizing meaningful information along with user-centered interactive interfaces. This paper proposes sentiment analytics of geo-tagged for anomalous social movement during COVID-19 by incorporating a novel classification technique and by a visual analytics approach for forecasting the overall flow of human crowds.

Keywords Sentiment analysis · Twitter · Geotagging · Social sensing · Machine learning

1 Introduction

The coronavirus disease of 2019, known as COVID-19, is a quickly spreading illness. The COVID-19 is currently viewed as a pandemic that has influenced nations in completely occupied continent. Since the primary instances of COVID-19 announced in Wuhan, China, in December 2019, the quantity of fatalities worldwide

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has expanded quickly. Because of its high contamination and passing rate, governments have executed a wide scope of strategies planned for relieving the spread of this infection and its effect. Such activities started with the Chinese government request to isolate Wuhan on January 23, 2020, to, most as of late, different nations proclaiming highly sensitive situation and executing exacting isolate and social separating estimations (e.g., US, Italy, Argentina, Spain).

Most government pioneers have actualized measures to boost, and sometimes uphold, “social distancing” to decrease the spread of COVID-19. These measures have brought about the dropped amusement occasions, terminations of schools and universities, and organizations diminishing long periods of activity, actualize working from home, or close through and through. There is no uncertainty the pandemic and the measures set up to relieve it have and will keep on definitely sway the lives of millions. As this pandemic and the reactions to it are uncommon, be that as it may, we are probably going to be shocked by how individuals react.

Since the beginning times of the sickness, individuals have communicated their assessment and shared data, just as deception, about it by means of Internet-based life stages, for example, Twitter. As COVID-19 spreads to different nations and governments attempt to relieve its effect by actualizing countermeasures, individuals have additionally utilized Internet-based life stages to communicate their feeling about the measures themselves, the pioneers executing them, and the manners in which their lives are evolving. The utilization of Web-based life, for example, Twitter, as stages to communicate suppositions and offer data about COVID-19, will just keep on developing, exactly in view of the “social removing” measures set up to moderate it.

2 Proposed Methodology

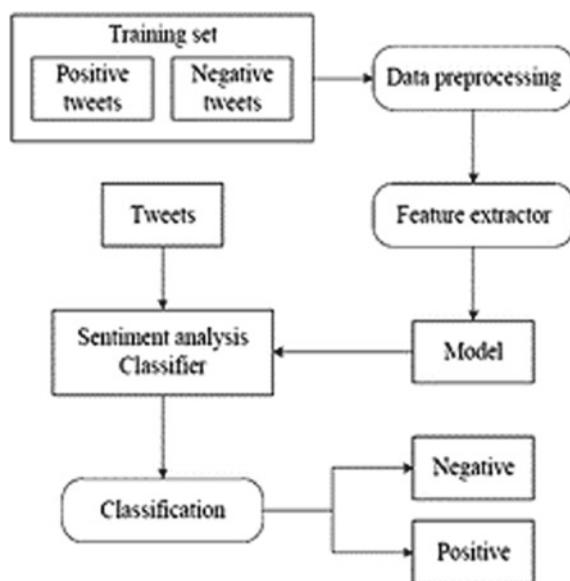
Initially, the gathered Twitter information is pre-processed for information cleaning [1]. The significant features are separated from the pre-processed clean content, applying any of the feature selection techniques as shown in Fig. 1.

The segmented information is physically marked as positive, negative and neutral tweets to set up a training set. At last, the extracted features [2] and the marked training set are given as a contribution to the fabricated classifier to characterize and the rest of the information for test set. Especially the diseases affect people’s family life, business life and all kinds of social life. COVID is the most dangerous problem affecting people in recent period.

2.1 Data Resources

Decision of data resource leads the sentiment analysis [3–5] expect a tremendous activity. Web-based social networking stages as the information sources [6, 7] are

Fig. 1 Workflow of feature extraction of sentimental analysis



widely classified as micro-blogging sites, blogs and review Web site. Micro-blogging (Twitter) has increased high notoriety because of its restricted quality of the substance and publically accessibility of information, which utilize Twitter as the information hotspot for notion investigation.

Twitter Studies

According to the ongoing work, the examinations complete on Twitter information are in the area of marketing, governmental issues, health care, promoting market, sports and so forth. Furthermore, Twitter has been casted a ballot as the most encouraging hotspot for the investigations, for example, network or impact recognition, theme revelation, market and business expectations, proposal frameworks and tweet order.

Tweets

The message posted on Twitter which is restricted to 140 characters. Tweets are commonly made out of: content, joins, emojis and pictures. A 6 s video is even included as a tweet segment. In view of these parts, the mining is applied to arrange content, joins, pictures, emoticon or emojis and even recordings. The tweets contain three documentations including hashtags (#), retweets (RT) and record Id (@).

Dataset Description

The dataset presented is being continuously collected [8] using the Twitter API. The dataset presented here (v1) covers March 30, 2020–April 26, 2020 and contains 6,468,526 tweets. The keywords used for search tweets are: *virus*, *coronavirus*, *ncov19* and *ncov2019* since 30 March, and *COVID-19* since April 2020.

Timestamp	Recently Captured (Showing 5/Approx. 125)
1587926091132	RT @emcormar: Hi everyone! Because of covid, my work opportunities have been delayed and I'm in a tight spot financially - any commission r...
1587926091130	RT @ByronYork: New York State imposes policy requiring nursing homes to admit patients with coronavirus. Can't 'discriminate' on basis of v...
1587926091127	RT @so_radhikal: This is the first in a series of posts on gender and COVID19, which will explore the various gendered constructions and im...
1587926091102	RT @SAfmnews: The SA Communist Party has welcomed the arrival of a Cuban Internationalist Medical Brigade to South Africa to assist in gove...
1587926091087	RT @NangamsoKoza: This is commendable, Premier. Please look into the situation of nurses without PPE at Frontier Hospital. They were on str...

Fig. 2 Tweets on April 26, 2020 regarding coronavirus

The average daily number of tweets collected on dataset *v1* was 208,662.1 ($SD = 100,448.7$, $Mdn = 243,087$). The number of tweets collected increased every month from 724,877 in March, 3,084,729 in April.

2.2 Data Preprocessing

The gathered information is raw tweet data. So as to apply classifier [2], it is fundamental to pre-process or clean the raw data. The preprocessing task includes uniform packaging, evacuation of hashtags and other Twitter documentations (#, @, RT), emojis, URLs which is important to expel non-letter information and images, stop words (are, is, am and so on), decompression of slang words and pressure of lengthened words for Daddyyyyyy as Daddy (Fig. 2).

2.3 Feature Extraction

The pre-processed dataset has different discrete properties. In highlight extraction techniques [2, 6], which are classified as various viewpoints, for example, descriptive words, action words which are recognized as positive or negative to identify the extremity of the entire sentence. Followings are the broadly utilized feature extraction [2] strategies which highlights signify individual and particular words and their event tallies.

- Negative phrases: The negativity words can change the importance or direction of the feeling. So it is clear to take negative word in account.
- Parts Of Speech (POS): Finding things, action words, descriptors and so on as they are huge measures of sentiments.

2.4 Sentiment Classification Techniques

Information-based procedure is additionally called lexicon-based method. The dictionary put together procedure centers with respect to inferring the feeling-based vocabularies from the content and afterward recognizing the extremity of those dictionaries. Dictionaries are the assortment of known and precompiled notion terms. This methodology is additionally grouped into dictionary-based methodology and corpus-based methodology. In the dictionary-based methodology, the feeling focused words [6–10], and afterward look at the word reference are discovered to gather their equivalents and antonyms. Though in the corpus-based methodology, a rundown of feeling words and afterward dependent are made on their setting explicit directions, extra-related sentiment words [9] in an immense corpus are located. To lead vocabulary approach, a paltry arrangement of words portraying suppositions is gathered physically with their referred to directions as a mean of preprocessing task. The set is then developed step by step via looking in the recognized and broadly utilized vocabulary word reference instrument (Fig. 3).

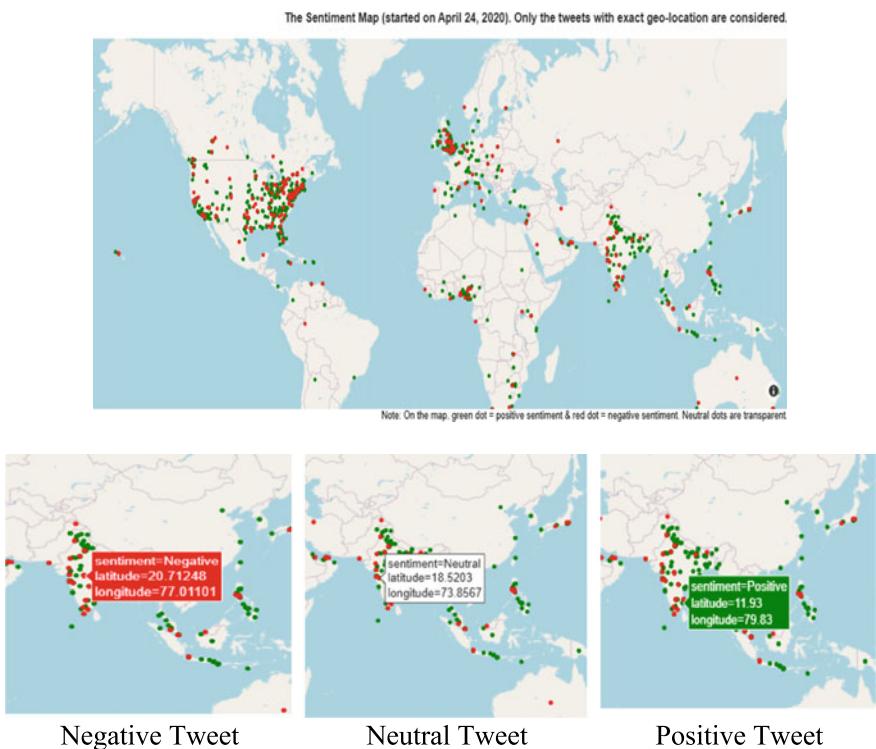


Fig. 3 Tweet map on April 26, 2020

2.5 Visualization

Visualization [11] gives a viable method for information investigation and information portrayal. This area presents some representation strategies for fleeting, spatial and literary examples, which are reasonable for showing our systematic outcomes.

Time is an important property of geo-tagged social media information. Outlines, for example, stacked charts and bar outlines, are a decent regular technique for envisioning straight time. A clock-like time hub could be embraced to underscore the cyclic character of time. Shading or association is commonly reasonable for the translation of the overall time of geo-tagged social media information, though the hub-based plan could be utilized to introduce supreme time (Figs. 4 and 5).

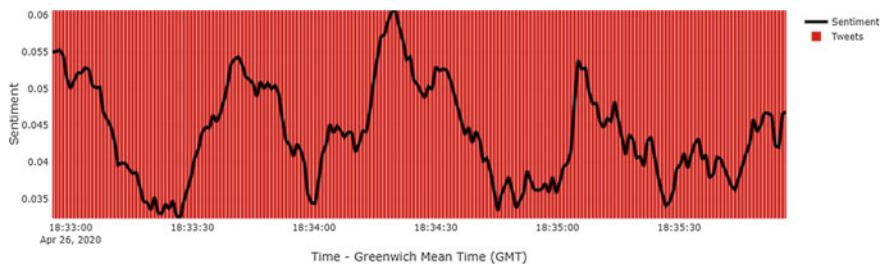


Fig. 4 Sentimental analysis of latest 10,000 tweets

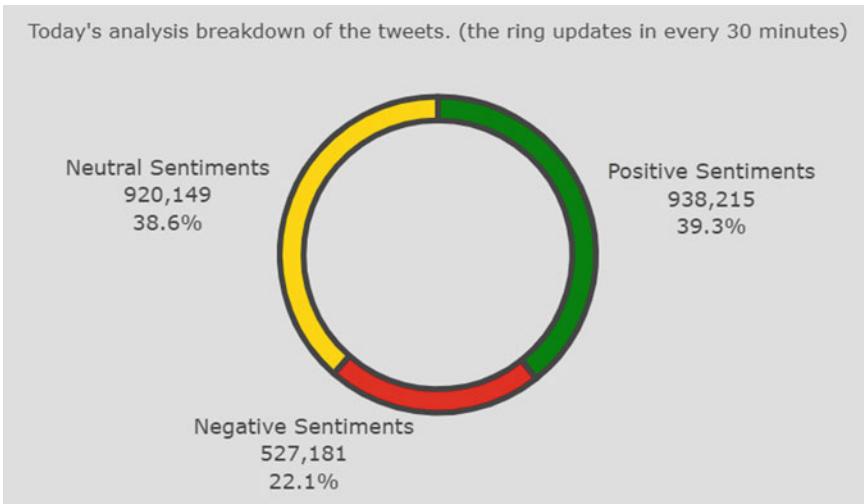


Fig. 5 Sentimental analysis breakdown of the tweets

3 Geo-tagged Analysis for Detector

A client has an alternative to make their area open through a cell phone in the event that they wish to, or give area subtleties in their profile page. The area field is applicable to our exploration since it causes us in following the current/default area of a client. Geolocation codes are appended to the message in an area empowered portable post. Such geo-labeled substance will improve the accessibility and precision of the geographic information attached to COVID or coronavirus related Twitter API posts. For all different purposes, we accept the area quality inside the profile page to be his/her current location and pass it as a contribution to Google's area-based Web administrations to get geo-area codes (i.e., scope and longitude) alongside the nation, state, city with a specific precision scale.

4 Conclusion

In summary, this research paper presents a nonexclusive structure for examining the effects of social events from geo-tagged social media. Following a conversation of the important information preprocessing, an occasion-related data extraction technique joining AI and hashtags is received to remove unlabeled occasion related data from the first dataset. Social sentiment analysis [3, 4] and social supposition mining are then used to investigate the open's comprehension of and sentiments about the occasion COVID-19. The data visualization [11] has been given subsequent to estimating sentiment analysis on the data. The data curated on Twitter are based on two determined hashtag keywords, which are ("COVID-19, coronavirus") and the user can be detected by using geotagging enforcing "social distancing."

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A Comparative Analysis on Offline Signature Verification System Using Deep Convolutional Neural Network



Deepak Moud, Pooja Sharma, and Rahul Chandra Kushwaha

Abstract The objective of offline signature verification is to identify that the signature is produced by the legitimate user (genuine) or produced by imitator (Forged). This is a challenging task because of static (offline) scenario that uses scanned images of signatures. Offline signature verification and identification is concerned with behavioural biometrics and has fetched significant research attention over the last thirty years. The problem still persists and open for researcher because of need of improvement in accuracy and high variations of signature of same user. Identifying features which can best discriminate and classify signature as genuine or forged is needed. Many studies have taken place in literature which exploited hand-crafted features for task. No feature extractor is found satisfactory in terms of performance. Under this study, we have used pertained convolutional neural network to extract features and classical machine learning algorithm as classifier. This paper compares performance of models for particular dataset.

Keywords Convolution neural network · Offline signature verification · Hand-crafted features · Pertained neural network

1 Introduction

The objective of biometrics technology is to identify a person based on biological or behavioural characters. In physiological attribute, the identification and verification take place on the basis of biometric measurement like thumb impression, face, retina

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scan, etc. The behavioural characteristics are speech and the signature. The objective of offline signature verification is to inspect the genuinely of the signer that he/she is the same who claim to be the signer. It is to categorize signatures under investigation valid or forged. Handwritten initials are key attribute of behavioural feature to verify ones identity in administrative, legal and financial sector. As people are acquainted with the use of signature that is why this process is widely accepted and used for verification. Three types of forgeries are (1) random (2) casual (3) skilled (simulated). Random forgeries—the imitator does not have knowledge about the real user and do owns signature instead. In simple or casual forgeries, the forger knows the name of real user but does not have idea about his/her signature. In this situation, forger signs with his complete name or partial name. In skilled or simulated forgeries, the forger knows both name and signature and imitates signature of user, such manipulation has higher likeness and tough to catch. Offline signature verification system is static. Offline signature is a digital image captured through scanning of signature after signature is produced by user on paper or document. It is also difficult to identify best feature extractor that can classify genuine sign and simulated forged signature because same person may make different signature for verification task. To overcome need of good features extractor and to improve accuracy, convolution neural network has been used by many researchers in literature. It has also been identified that convolutional neural network can be used to extract features and then machine learning model can be deployed as classifier.

2 Literature Review

Research on offline signature verification has been incepted from year 1970. Many researchers have started working in this field since then. Initially the emphasis was on extracting features from signature images then using these features as input to classifier for the classification. Plamondon and Lorette [3] have written article in 1989; in this article, authors have reviewed and consolidated all the work done from 1989 to 1993 in the area of automatic signature verification. D. Impedovo and G. Pirlo presented the survey in automatic signature verification. This study includes experimental results of all research work done till 2008. It also shows way forward to new researcher in this field. Paper contains a rich repository of 300 research contributions [4]. Hafemann et al. [2] have surveyed recent work in field of signature verification and provided insight of future advancements and future direction. Authors have given detail of hand-crafted feature descriptors used by many researcher and compared their results [5]. In last few years, researchers have investigated many hand-crafted feature descriptors like geometric descriptors. Nagel and Rosenfeld [6] have written paper on freehand forgeries on cheques of bank. They have used geometrical features: ratio of size and slant [6]. Justino has considered signature verification with different forgery in an HMM framework. Authors have shown encouraging results in simulated manipulation using simple static and pseudodinamic feature [7].

Luiz S. Oliveira, Edson Justino, Cinthia Freitas and Robert Sabourin have proposed techniques used in forensic document inspectors to identify handwriting. Graphometric features: pixel density, pixel proportion, progression, and slant were used [8]. Directional-based descriptors, such as PDF, were calculated from the gradient of outline of image using grid. Local shape descriptor pyramid histogram of oriented gradients (PHOGs) has also been used for signature verification [9]. Malik et al. [10] have implemented speeded up robust features (SURF) that are used to retrieve interest points in digital images. Ruiz-del Solar et al. [11] have explored scale-invariant feature transform (SIFT) technique through which local interest points are fetched from input image and reference image. Yilmaz and Yanikoglu [12] have used texture descriptors, such as local binary patterns (LBP). Hu and Chen [13] have experimented three pseudodynamic parameter based on gray-level image: local binary pattern (LBP), gray-level co-occurrence matrix (GLCM) and histogram of oriented gradients (HOG). The verification was done using writer-dependent support vector machines (SVMs) and global real AdaBoost method [13]. Pre-processing is indeed necessary in all application of image processing, and it is mainly due to noise introduced while images are captured. In signature verification system also, variations may come due to thickness of pen, size, and rotation. Pre-processing is used to retrieve image from complex background then noise is removed and size is normalized. Major pre-processing methods for signature verification system are input size of each signature must be same for convolution neural network, removal of background, centring of image and resizing take place in pre-processing steps [2].

Many experiments have been done in past to obtain features directly from data using convolution neural network (CNN). Bernardete Ribeiro, Ivo Gonçalves, Sérgio Santos and Alexander Kovacec have used massive parallel distributed network (NN) which was successful to obtain complex representation of signature. They experimented with neural network on GPDS data set. Research was able to fetch layerwise high-level presentation of signature with help of three layers with 100 units each. Out of three layers, one layer was input layer and two layers were internal layer. Two steps hybrid model was also developed to lower down misclassification rate. No classification took place in this research [14]. Khalajzadeh et al. [15] proposed convolutional neural network that classifies signature without prior knowledge of feature base. In this experiment, multi-layer perceptron was used for classification task. The experiment was performed on Persian signatures gathered from 22 people. CNN was implemented as feature descriptor and multi-layer perceptron (MLP) was for classification. Total 176 sign from 22 persons were used in training [15]. Soleimani et al. [16] prepared a solution using deep multitask metric learning (DMML). Author has calculated distance metric between pair of signature. The test was conducted on UTSig, MCYT-75, GPDSsynthetic and GPDS960 GraySignatures data set with HOG and DRT features [16]. Luiz G. Hafemann, Robert Sabourin and Luiz S. Oliveira have explored four CNN architectures to obtain classification improvement on the GPDS data set. The methodology was to get feature representation for classifier to verify signature using writer-independent CNN and then resultant features were practised to train writer-dependent binary classifier to categorize signature as fake or valid. The experiment was taken on GPDS-960 data set. The data contain signature of 881

persons. 24 true signature and 30 invalid (forged) sign were collected from each user. The data set was further divided into four parts for training and testing of CNN and SVM classifier [17]. G. Hafemann, R. Sabourin and L. S. Oliveira addressed two difficulties of signature verification system (SVS): (1) 7% error in classification and (2) finding best feature for classification. To overcome both problems, new approach has been devised which includes samples of skilled forgery to be included in learning of features. Authors have trained writer-independent convolutional neural network with genuine as well as skill forged signature and then writer-dependent SVM classifier is trained using these features to discriminate between signatures. Experiment was conducted on four popular data set: GPDS, MCYT, CEDAR and Brazilian PUC-PR data sets. GDPS data set is divided into learning set and verification for CNN and learning set is used in CNN for learning features and then verification set along with learnt features used to train SVM classifier [18]. Hafemann et al. [18] have also proposed variation of previous paper, and in this paper, they have used writer-independent convolution neural network for representing and extracting features of signature image and then support vector machine of writer-independent (WI) network combined with dichotomy transformation used for classification. Dichotomy converts multiple class classifications into two-class classifier. The experiment took place on GDPS and Brazilian PUC-PR data sets. The data set was divided into four parts; two sets were used in writer-independent CNN for feature extraction and two for writer-independent SVM classifier [19]. Ekerek et al. [20] have experimented with two convolution neural network for signature verification. Authors have used two separate network: (1) writer-dependent (WD) and (2) writer-independent (WI) and trained them separately for the task. Experiment was done using publically available GPDS synthetic signature data set. WD model was trained with 30 (15 genuine + 15 forged) signatures from the pool of 54 signatures and remaining 24 samples were used for testing. Similarly, for WI model 300 (150 genuine + 150 Forged), sample from the pool of 540 samples (240 genuine + 300 Forged) were used in training and remaining 240 were used in testing [20].

3 Problem Statement

Identifying and designing feature extractor for signature verification are difficult tasks because it is hard to understand that what characteristics best define signature. Many researchers have made efforts to find features descriptors such as geometric features, graphometric features, directional features, mathematical transformations, extended shadow code, texture features and interest point matching that could represent signature and can also be used to distinguish between genuine or fraudulent signature. So far no handcrafted feature extractor has emerged as best suitable for verification task in literature in terms of accuracy. If experiment results are compared then best published result is equal error rate (EER) 7% in literature on GDPS data set [1]. To improve the efficiency and accuracy of system and to obtain feature representation, scanned image of signature should be used directly instead of handcrafted

features. Scanned image of signature becomes the input to convolutional neural network (CNN) which categorize signature as valid or fake.

4 Methodologies

The objective is to identify an offline handwritten signature verification system capable of differentiating between the genuine and forged signatures based on features extracted using pre-trained CNN and machine learning Classifier. We have used deep learning models that are made available alongside pre-trained weights. These models are used for prediction, feature extraction and fine-tuning. We have used following models for image classification with weights trained on ImageNet:

- VGG16
- VGG19
- ResNetV2
- InceptionV3
- DenseNet
- NASNet

These models were used to extract features of signature images. Features of pre-trained models were used and top dense layers were removed and replaced by one hidden layer with 128 nodes and classification layer with 64 nodes. Pre-trained weights were not retrained for data set only last three layers were trained. Features were extracted from classification layer of convolutional neural networks and then these features were fed into machine learning classifiers for final classification whether the signature is genuine or forged. We have used support vector machine, kernel support vector machine, random forest classifier, decision tree classifier, Naïve Bayes classifier, K-nearest neighbour classifier, logistic classifier and neural network.

Algorithm for Signature Verification

The steps of the algorithm are outlined here:

- Step 1 Acquire the signatures.
- Step 2 Perform pre-processing on the signature.
- Step 3 Extract the features using the trained CNN.
- Step 4 Train the machine learning classifier using the extracted features.
- Step 5 Compare accuracies of each classifier.

Database

We have used the database consisting of data from 70 individuals: 24 genuine signatures for each individual, plus 12 forgeries of his/her signature. PNG images are used total 2112 signature images were used in training and 544 images were used it validation set.

5 Results and Discussion

We have extracted features from classification layer of convolutional neural network, and then machine learning models were used so following results were observed during experimentation.

This experiment was conducted to compare accuracy of various machine learning classifiers. The features extracted from classification layer of VGG16 CNN and these features were fed into classifier and following accuracies were found. The best accuracy was found in K-nearest neighbour classifier with 90.6% accuracy. Second best model was random forest classifier with 90.25% accuracy.

Pertained convolutional neural network: VGG16

Name of classifier	Accuracy
Support vector machine	89.52
Kernel support vector machine	89.15
Random forest	90.25
Decision tree	87.5
Naïve Bayes	88.05
<i>K</i> -nearest number	90.6
Logistic classification	89.33
Neural network	84.37

This experiment was conducted using features extracted from VGG19 CNN and following accuracies were found. The best classifier for given dataset was support vector machine with 83.45% and second best was *K*-nearest neighbour classifier with 82.35% accuracy.

Pertained convolutional neural network: VGG19

Name of classifier	Accuracy
Support vector machine	83.45
Kernel support vector machine	81.98
Random forest	81.68
Decision tree	77.57
Naïve Bayes	79.59
<i>K</i> -nearest number	82.35
Logistic classification	81.98
Neural network	80.51

This experiment was conducted using features extracted from Resnet CNN and following accuracies were found. The best classifier for given data set was neural network with 60.84% and second best classifier was Kernal support vector machine classifier with 60.11% accuracy.

Pertained convolutional neural network: Resnet

Name of classifier	Accuracy
Support vector machine	56.25
Kernel support vector machine	60.11
Random forest	54.04
Decision tree	50.36
Naïve Bayes	54.96
K-nearest number	54.04
Logistic classification	57.53
Neural network	60.84

This experiment was conducted using features extracted from Inception ResnetV2 CNN and following accuracies were found. The best classifier for given data set was random forest with 50.36% and second best classifier was support vector machine classifier with 50.30% accuracy.

Pertained convolutional neural network: inception ResnetV2

Name of classifier	Accuracy
Support vector machine	50.30
Kernel support vector machine	50.18
Random forest	50.36
Decision tree	50.18
Naïve Bayes	49.08
K-nearest number	49.26
Logistic classification	50.18
Neural network	50.18

This experiment was conducted using features extracted from Nasnet CNN and following accuracies were found.

Pertained convolutional neural network: Nasnet

Name of classifier	Accuracy
Support vector machine	50.73
Kernel support vector machine	50.73
Random forest	50.73

(continued)

(continued)

Pertained convolutional neural network: Nasnet	
Name of classifier	Accuracy
Decision tree	50.73
Naïve Bayes	49.44
K-nearest number	50.73
Logistic classification	50.73
Neural network	50.73

This experiment was conducted using features extracted from Densenet CNN and following accuracies were found. The best classifier for given data set was Naïve Bayes classifier with 58.41% and second best classifier was kernal support vector machine classifier with 57.90% accuracy.

Pertained convolutional neural network: Densenet	
Name of classifier	Accuracy
Support vector machine	57.72
Kernel support vector machine	57.90
Random forest	51.47
Decision tree	51.28
Naïve Bayes	58.41
K-nearest number	52.02
Logistic classification	57.35
Neural network	52.38

6 Conclusion

These experimentations were done to identify best models for image classification with weights trained on Image Net for signature verification. All experiments were done on specific data set with same number of epochs. It has been observed that VGG16 pertained model for image classification with weights trained on Image Net has been best among all models. The features of signature extracted from VGG16 yielded best result in terms of accuracy. The best accuracy was found 90.6% with VGG16 model. Many classifiers have been tested and *K*-nearest neighbour classifier has been found best for specific data set. The second best classifier was random forest classifier with 90.25% accuracy which was trained on features extracted from VGG16.

Future Scope Signature verification is still open for research with scope of accuracy improvement. Combination of online and offline features could be way out. Pre-trained CNN can increase accuracy.

Experiments can be performed on public data set with more number of images and with more number of epochs.

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Synthesis of Game Refinement Theory for Cricket



Manish Mathuria, Supriya Bhutani, and Rishi Dutt Shukla

Abstract Today, gaming is on its highest peak as compared to other forms of entertainment. Game refinement theory is applied to make some modifications or to add new refinements to make games more interesting as well as to make them more popular. In aspects of cricket, this research is to analyze its important factors. However, we know that it is very much popular in Asian countries. To analyze its popularity and its gaming approach, some game refinement techniques were used. To get best effect of game refinement, two teams were selected for a game of ten overs. To do so, game refinement equations for score limit games are analyzed and new elements were added to produce the new proposed model for cricket. Match data is synthesized and the graphical result output is drawn. As the result that was achieved after applying new proposed model of score limit games, it proved that popularity of cricket depends on the popularity of high score games. The conclusion of this research is that the game refinement theory can be applied on cricket to make it more popular.

Keywords Gaming theory · Game refinement · Cricket · Score limit games

1 Introduction

Cricket is a bat and ball game played between two teams of eleven players on a field at the center of which is a 20 m (22-yard) pitch with a wicket at each end, each comprising two bails balanced on three stumps. The batting side scores runs by

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striking the ball bowled at the wicket with the bat, while the bowling and fielding side tries to prevent this and dismiss each player (so they are “out”). Means of dismissal include being bowled, when the ball hits the stumps and dislodges the bails, and by the fielding side catching the ball after it is hit by the bat, but before it hits the ground [1].

Game theory is basically the strategic information between the players. Game refinement theory is another game theory focusing on the attractiveness and sophistication of games. The foundation of this was given by Iida. A measure of game refinement was proposed on the concept of information of game outcome uncertainty [2, 3].

2 Methodology

“Game Progress” means two things in cricket:

- One is game speed or we can say the scoring rate (in terms of runs per ball) of first team who starts batting.
- The second is game information progress with bowling (in terms of Wickets and runs per over) which is derived from the game outcome.

Game information progress represents the degree of uncertainty in a game’s results in time or by its steps. The game information progress will be decided by runs per over. Yet we do not know about the physics of the information in the brain, but that the acceleration of information progress is likely be the result of forces and laws of physics (Table 1).

Table 1 Cricket match analysis for a ten-over match

Target score = 110		Run rate required (RRR) = 110/10 = 11		
Over	Runs (score)	Difference	Run rate required (RRR)	Risk of failure (ROF)
1	5	$11 - 5 = 6$	$105/9 = 11.6$	$0.6 * 100/11 = 5.4\%$
2	10	$11.6 - 10 = 1.6$	$95/8 = 11.8$	$0.2 * 100/11.6 = 8.2\%$
3	2	$11.8 - 2 = 9.8$	$93/7 = 13.28$	$1.48 * 100/11.8 = 12.5\%$
4	15	$13.28 - 15 = -1.72$	$78/6 = 13$	$-0.28 * 100/13.28 = -2.10\%$
5	10	$13 - 10 = 3$	$68/5 = 13.6$	$0.6 * 100/13 = 4.61\%$

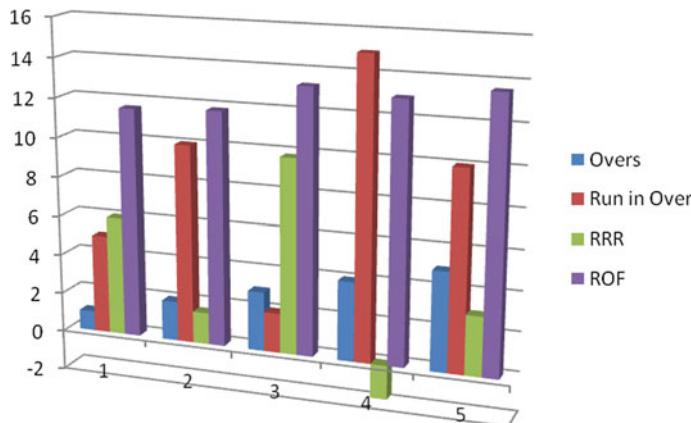


Fig. 1 Representation of four factors of cricket in the bar chart

3 Result and Discussion

The game is played for ten overs where Team-A decided to bat first and made score of 110. This score is a target score for Team-B. Now Team-B will do batting and Team-A will do fielding. This process gives us records for analysis. Here, in the given table, we have taken five overs for growth and run rate representation purpose. Before starting of the batting, Team-B calculates the run rate required (RRR) to win the match, i.e., target score divided by total given overs to play.

- In the given table, we have $110/10 = 11$, i.e., at least 11 runs per over is required to win the match. Similarly, we have taken the analysis of each over, where in the first over, Team-B made 5 runs. But we have the target to make 11 runs in every over, so, we will calculate the difference, i.e., $11 - 5 = 6$. Now, for second over point of view, we have extra load of 6 runs to cover. That is why, we have again calculated the RRR for second over, i.e., $105/6 = 11.6$. Similarly, all the five overs were analyzed.
- The fifth column of the table represents the risk of failure (ROF) which is calculated to on the basis of score per over compare to target score in terms of difference of $RRR' - RRR$, whereas percentage is calculated like for first over percentage of ROF is $11.6 - 11 = 0.6$ and $0.6 * 100/11 = 5.4\%$ (Fig. 1).

4 Conclusion

The purpose of Game Refinement Analysis to get meaningful outcome where as one can measure the Game Interest. On the basis of the game interest rate, the new refinement can be proposed to make it more interesting. Cricket is very interesting game because of dynamic target score, it has maximum number of possibilities of

winning or losing the game. Different factors are need to be analyzed to make possible refinement in the cricket. In this research paper, we have targeted to RRR, i.e., run rate required to win the make, on the basis of that is ROF, i.e., risk of failure was calculated for different overs. This ROF helped batting team to take dynamic decisions on the real time which depends on the availability of overs as well as batsman to play. The overall conclusion of the research is that cricket is really interesting game because of its dynamic diversity. RRR and ROF are really very helpful to predict winning and losing condition at any instance of the match. Further many other factors can be analyzed.

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An Efficient Customized Round Robin Algorithm for CPU Scheduling



Priyanka Sharma and Yatendra Mohan Sharma

Abstract In modern era, to optimize an act of handy system, huge efforts are rapidly propose by research community, huge efforts have published in recent time frame with an amendments in various accessible algorithm of task scheduling process. Due to unique personality, massive amount of investigators opt an algorithm of round robin (RR) for optimization of scheduling act. However, each approach put contribution in an optimization of system act but with unique associated issues of every algorithm, the field is still open for further research. In this paper, a naïve task scheduling approach based on optimization of RR scheme has discussed. The proposed approach effectively boost an exploitation of CPU with energetically set up an effective quantum time span. Experimental results have demonstrates the worth of proposed algorithm in front of traditional RR and its recent optimized editions.

Keywords CPU scheduling · Round robin algorithm · Quantum time · Average turnaround · Waiting time

1 Introduction

Scheduling is a system resource distributing process straightforwardly affects an act of working machine; thus, design and employment of an effectual scheduling practice are the hottest research fields [1]. Scheduling activity is observed by system scheduler to make a decision on next process, which next jobs will access the system resources. There are three separate schedulers are mark by OS, Fig. 1 has demonstrated the type of schedulers and process transition state during scheduling process.

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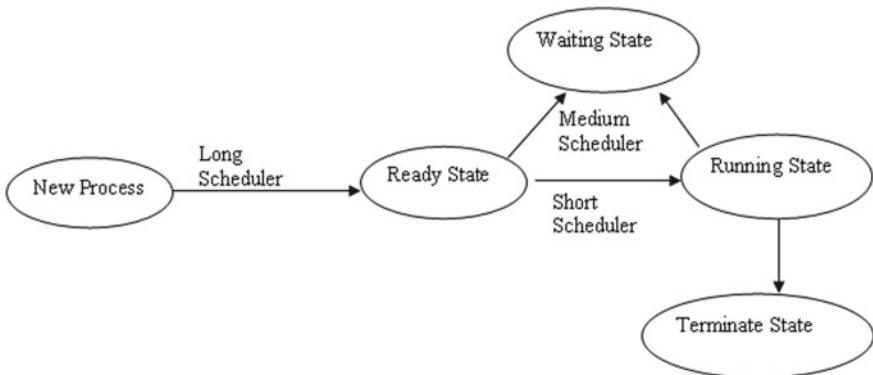


Fig. 1 Scheduler and state of process transitions

- **Long Tenure Scheduler:** It opts new admitted process of system and executed them in an order that a process with low burst time has executed first.
- **Short Tenure Scheduler:** Furthermore can articulate as scheduler (CPU scheduler) goes for a process execution from employed ready queue, allocate process to CPU.
- **Medium Tenure scheduler:** It works for swap process from one to another state usually employ once a process has suspended or resumed.

Related literature of scheduling designated a good amount of investigators utilizes such process in different ways for enhancing an act of employed digital devices but with unique associated restraints, every algorithm has struggled to maintain its competence in real state of affairs. To overcome an issue of task scheduling process and to improve an act of employed machine, a naïve method has discussed in this paper. The projected approach has built with the optimized version of one of the most adopted process scheduling method known as round robin (RR), put an attention of sighting the optimum length of time quantum.

2 Round Robin (RR) Scheduling Procedure

Among several accessible task scheduling methods, a lot amount of investigators has adopted this scheme to optimize an act of employed system. Typically, this scheme assigns a time quantum for each tasks that has taken place in ready queue for execution. After setting quantum time span, the whole process executes in a circular order without considering the process priority. In execution state, if a process completes its execution within allocated time period, then system takes next process in an account but if an active process has not yet finished its execution, then it added at last position of employed queue and wait for next turn time. Typically, this practice upholds a queue that executes process in FIFO manner without considering process

implementation priority. This scheme is especially intended for time sharing systems. Few noticeable reward and restraint of RR scheduling technique are:

- Straightforward operational style.
- Offer squat amount of overheads by effective set up process of time quantum.
- Free mechanism from an issues of starvation, work for interactive systems
- Struggle for maintaining efficient tasks waiting and reaction time.
- With elevated amount of context switching, this scheme attains low throughput.

3 Related Work

Till the current time, huge pains have been taken and continuously accounted by numerous investigators to shrink an associated issues of task scheduling algorithms. In [2, 3], a naïve optimize version of RR scheme has discussed that has compute time quantum length vigorously on the base of average time span. The approach animately altered set volume of quantum time span after completion of each process of scheduling. Each and every time, the intended method computes naïve time quantum value by using the mean amount of tasks that remain under ready queue for course of implementation. With the integrating features of pipelining and RR scheduling algorithm, a naïve endeavor has been made in [4]. The intended algorithm utilizes pipelining practices in corporation of round robin schemes in naïve mode that efficiently improve the scheduling task of process over CPU. A naïve algorithm IRRVQ has discussed in [5] that utilizes irregular quantum time parameter in company of SJF and round robin schemes. To overcome starvation issues in obtainable task scheduling algorithm, a naïve approach has discussed in [6]. In addition of above-discussed process scheduling schemes, a number of investigators have made different efforts to optimize an act of obtainable scheduling procedures. Some of the recent published efforts carry out different simulation to suggest the suitability and affectivity of their intended task scheduling procedures [7–11].

4 Proposed Methodology

In direction to optimize an act of task scheduling process, the intended method has put main focus on computing an effective figure of time quantum by considering of average time span of ready queue tasks burst time. At initial level, the incorporated method of build model has set the whole process of ready queue according to their burst time and then computes an amount of quantum time on the base of average of process burst times. At beginning, the build method allocates system resource to very first task of ready queue, and at completion of either task process or set time quantum duration, the associated mechanism has checked the status of process. If current executed task requires some little bit more time of CPU that is less than the half amount of current set time quantum span than intended approach allocate CPU to

same process else switch that process in ready queue. Additionally, after completion of each cycle, the designed mechanism have verify the occurrence of naïve task in ready queue, arrange whole process set of ready queue according to their burst time and energetically compute naïve time quantum length for further scheduling practices. If two or more processes have taken place in ready queue with same length of burst time, then, they put in ready queue on the base of their occurrence. Such adopted procedure efficiently improves an act of process scheduling with low length of task switching, average waiting, and turnaround time.

5 Experiment and Result Discussion

To confirm an act of build method, it has simulated with the considered task parameters illustrated in [12]. Table 1 illustrated the tasks details that has considered for experimental process. Gant chart of proposed approach (Fig. 2).

Average Turnaround time = 9.33 ms.

Figure 3 depicts the difference and efficiency of proposed approach in better way.

Above figure clearly demonstrate that intended practice is more effectual in contrast of conventional RR and its other optimized version IRR [12]. To verify the suitability of build method in front of most current offered technique, other simulation has carried out with the same parameters as taken by recent published efforts. Table 2 demonstrated the tasks parameters that has considered by recent offered method investigator [13]. The authors of published efforts have depict that they have attained 222.6 ms average waiting time and 141.0 ms average turnaround time span against the classical MRR algorithm that achieve 223.2 average waiting and 141.6 ms average turnaround time.

Time quantum computed by proposed approach = 82 ms.

Gant chart of proposed scheme (Fig. 4).

Table 1 Tasks details

Tasks IDs	Arrival time	Burst time (ms)
T1	3	2
T2	8	1
T3	2	6
T4	5	5
T5	4	3
T6	2	4

T2	T1	T5	T6	T4	T4	T3	T3
1	3	6	10	14	15	19	21

Fig. 2 Proposed scheme Gant chart

Fig. 3 Proposed scheme versus classical RR and IRR [12]

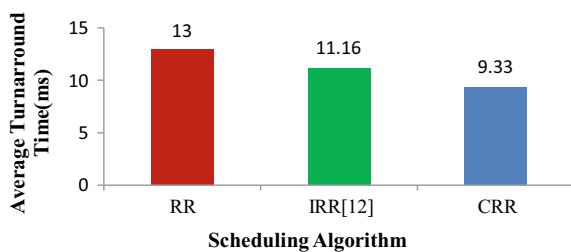


Table 2 Tasks details consider by investigators in [13]

Tasks IDs	Arrival time	Burst time (ms)
T1	0	105
T2	0	60
T3	0	120
T4	0	48
T5	0	75

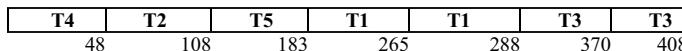


Fig. 4 Proposed scheme Gantt chart

$$\begin{aligned} & \text{Average Turnaround time computed by proposed approach} \\ & = T4 \rightarrow 48, T2 \rightarrow 108, T5 \rightarrow 183, T1 \rightarrow 288, T3 \rightarrow 408 \\ & (48 + 108 + 183 + 288 + 408)/5 = 207 \text{ ms.} \end{aligned}$$

$$\begin{aligned} & \text{Average Waiting time computed by proposed approach} \\ & = T4 \rightarrow 0, T2 \rightarrow 48, T5 \rightarrow 108, T1 \rightarrow 183, T3 \rightarrow 288 \\ & (0 + 48 + 108 + 183 + 288)/5 = 125.4 \text{ ms.} \end{aligned}$$

Both attained figure is more effective in comparison of previously offered and classical RR scheduling method. Following graph demonstrated the difference in better way.

Values indicated in Fig. 5 clearly shows that proposed approach offered more effective fallouts in comparison of MRR and modern offered algorithm.

6 Conclusion

This paper proposed a naïve customized version of classical round robin scheduling algorithm to enhance an efficiency of utilized system. The build method put focus

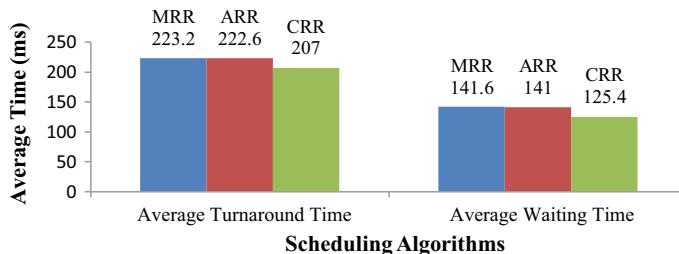


Fig. 5 Proposed scheme versus MRR and ARR

on reducing the switching amount of process with computation of an efficient time quantum figures. In place of utilize, a fix figure of quantum time span as traditional round robin method employ for scheduling purpose and the build method integrate a mechanism that compute naïve efficient time span at dynamic time on the base of average burst time length of tasks that remain in ready queue for further process. Additionally, the designed approach not switch an active task from CPU to ready queue if executed task required more time span to complete its process that is less than from the current set quantum time span. Such adopted methodology in proposed approach has made it more effective and suitable in comparison of classical version of round robin scheduling scheme as well as it modern offered methods. Number of simulated and comparative fallouts of proposed approach has evidently shown the efficiency of propose algorithm with an explanation that build method competently shrinks an amount of task switching among CPU and utilized ready queue.

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Handwritten Digit Recognition Using CNN



Himanshi Jain and Neelam Sharma

Abstract In recent years, identification process of handwritten digits has turned out to be an important and notable issue. From early age of this system, a measureless methods have intended by research community for improving an accuracy rate of recognition but due to associated issues of offered methods field is still open for research. This paper explores handwritten digits recognition act of five different schemes over MNIST dataset that consist huge handwritten digits. Experimental fallouts denoted that CNN technique is most suitable scheme for recognizing hand written digits, obtained 99.99% accuracy in contrast of ANN, KNN, SVM, and RFC algorithm.

Keywords Convolution neural network (CNN) · Artificial neural network (ANN) · Support vector machine (SVM) · K-nearest neighbor (KNN)

1 Introduction

Since 1980s, the recognition process of handwritten digits progressively gain considerable consequence in research field. Typically, recognition process of handwritten digits can be classified under offline and online mode, if digits recognized through touchpads using a stylus pen, then it is known as online recognition and if it scanned and then recognized by the computer known as offline recognition. In between a huge variety of languages for hand writing, the recognition process of such digits is highly tricky as compared to printed character. However, required efforts diminish by research community with offering of huge machine learning routine. Among of several handy algorithms, five most adopted machine learning process CNN, ANN, KNN, SVM, and RFC has taken in account in this paper to analyze digit recognition

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accuracy act of each algorithm and to discover best process for such task. Opted schemes have applied at MNIST dataset, containing 70,000 handwritten digits (0–9) images for digit recognition.

2 Classification Models: CNN and ANN

Initially, mechanism of CNN was intended in 1980 by Fukushima. Intended process was not careful for training process; so, in 1990, a naïve effort has proposed by Yann LeCunn, gradient-based learning algorithm to CNN that improve an act of this technique. Basically, CNN is a form of deep learning mechanism that consists three layers input, hidden, and output layer, take image as input, allot learnable weights and biases to a variety of aspects and more talented to discriminate one from other. However, preprocessing step of this algorithm is much inferior against to other methods. Architecture of CNN for detection of handwritten digits is shown in Fig. 1.

Input layer contains the realistic image pixels without any filtration. Subsequent layer acquires the output from the input layer. The architecture of ANN is same as that of neural network. It consists of an irregular mapping architecture, and it is the form of a collection of nodes or artificial neurons. They are highly capable of predicting values, recognizing pattern, compressing data, decision-making, etc. Recently, ANN is utilized for classification. Different architectures for ANN are introduced. It consists of three layers input, hidden, and output. The information in this network flows from the input to output layer, input layer outcome behaves like an input to the hidden layer and then taken by output layer and finally produces as output. The hidden layer and input layer are connected via weights (Fig. 2).

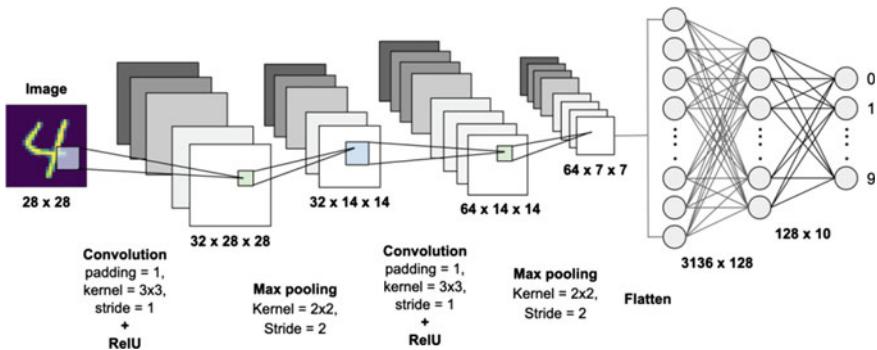
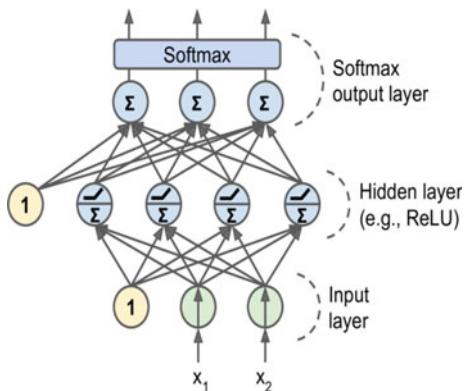


Fig. 1 CNN architecture for handwritten digit recognition

Fig. 2 ANN multi-layer perceptron architecture



3 Research Methodology

To discover best suited classification scheme for identifying the handwritten digits, KNN, SVM, RFC, CNN, and ANN have taken in account and applied over MNIST dataset, most demanding dataset in pattern detection area that contains 70,000 scanned images of digits written by different writers out of which 60,000 are used for training purpose and 10,000 are used for testing purpose. Sample digits from MNIST dataset are shown in Fig. 3.

Additionally, before implementing an analyzing process, PCA, LDA, and ICA techniques are applied for extracting the best data variance. Figure 4 demonstrates the flow steps that have adopted for recognition process of handwritten digits.

Fig. 3 Sample images from MNIST dataset

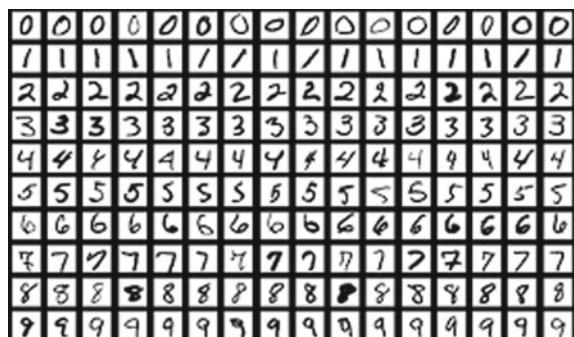
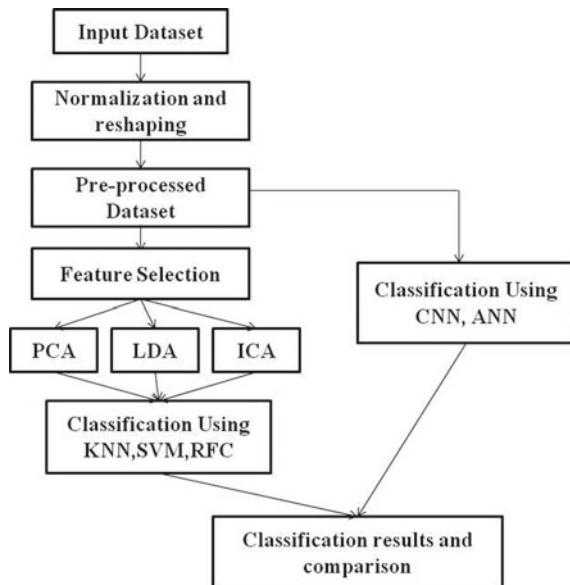


Fig. 4 Handwritten digit recognition and analyzing act of classification process



4 Experimental Setup and Result Discussion

At initial stage, considered dataset has examined to discovered the corrupted images or missing values, all such entries remove from the dataset. After applying pre-processing process, the exploited dataset has divided into the ratio, contains 36,000 image samples for training set and 24,000 images samples for testing phase. Furthermore, PCA, LDA, and ICA feature extraction techniques have exploited for feature extraction and then KNN, SVM, RFC, ANN, and CNN techniques are implemented for the classification of handwritten numerals. Figure 5 demonstrates the evaluation act of considered algorithms.

The relative recognition accuracy depicted in above figure evidently proves that CNN technique is more suitable for such process in comparison of other implemented algorithms. The comparative figure depicts that ANN has offered better results in

Fig. 5 Classification acts of exploited techniques

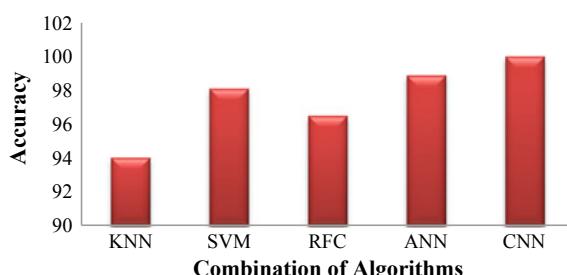


Table 1 Accuracy act of ANN and CNN

ANN train	ANN test	CNN train	CNN test	Epochs
95.88	96.97	98.79	98.65	3
97.13	97.36	99.41	98.67	5
97.62	97.62	99.81	98.79	8
97.83	97.57	99.94	98.97	10
98.32	97.64	99.95	98.95	14
98.32	97.63	99.99	99.12	15
98.32	97.74	99.71	98.84	18
98.82	98.67	99.99	99.09	20
98.8	98.01	100	99.06	23
98.72	98.03	99.99	99.12	25
98.88	98.01	100	99.12	28
98.88	98	100	99.16	30

comparison of KNN, SVM, and RFC but fail to compete an act of CNN. Table 1 shows the results obtained from CNN and ANN at epoch from 1 to 30 with train and test dataset.

An epoch is a forward and backward passage of neural network. As the number of epoch changes, the variation in training accuracies is observed. The described values of above table denoted that CNN approach attained 100% accuracy with training dataset and 99.16% with testing statistics. ANN attained 98.88% with training and 98% accuracy level with testing dataset at epoch 30. Additionally, average loss rate of CNN technique is 0.39% and for ANN is 0.99%; hence, CNN has low loss rate than ANN. Figures 6 and 7 depicts the efficiency of CNN over ANN in better way.

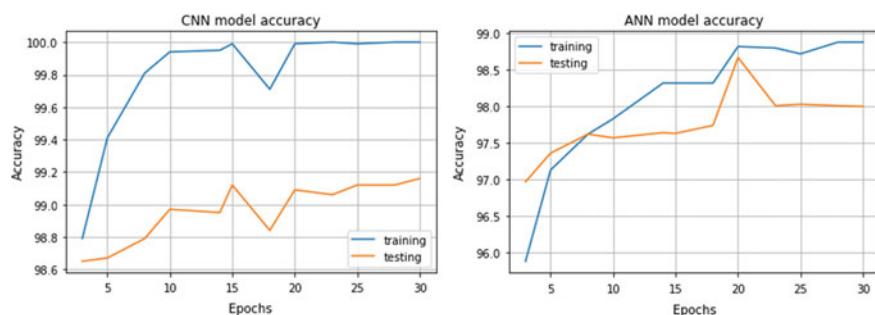
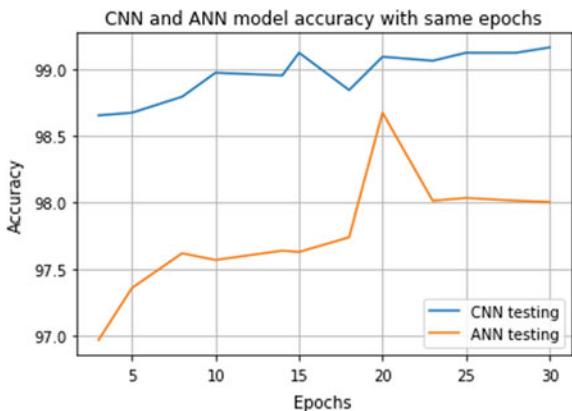
**Fig. 6** Recognition accuracy of CNN and ANN over training data

Fig. 7 Accuracies of ANN and CNN over testing data



5 Conclusion

This paper analyzes an act of CNN and ANN for recognition of hand written digits. The evaluation fallout concludes that CNN is best approach for recognition of such digits, as its performance is much better than ANN. With training and testing data, the accuracy of CNN is 100 and 99.16% at epoch 30. Similarly, ANN obtained accuracy is 98.88 and 97.66%. Additionally, the loss rate observed for test data with CNN is 0.39% and with ANN is 0.99% that shows CNN technique is more suitable for recognition of hand written digits in comparison to ANN scheme.

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Review of Parallel and Distributed Community Detection Algorithms



Raguru Jaya Krishna and Devi Prasad Sharma

Abstract Community detection is an important part of the analysis of the social networks. In the present era of digital world, online communication, content sharing, and maintaining contacts are mostly happening through online social networks. These networks are ever increasing and they are becoming very complex to analyze information. The traditional techniques which are available for community detection in social networks are not able to process this large-scale social networks data in efficient manner. This brings an essential and efficient ways to find large social network communities. In this paper, we review different algorithms available in the literature to find communities in large-scale community detection. In addition, we also discuss about various types computing frameworks available to process community detection algorithms in parallel like GraphX, Map reduce.

Keywords Community detection · Complex networks · Parallel algorithms

1 Introduction

Complex networks are present at almost everywhere in our daily life. Some examples include online social platforms, mobile communication networks and citation networks, and so on. Nowadays, among the most popular websites, online social networks have occupied one of the top positions and most popular websites are also social networks. In online social networks, people maintain their profiles, update content like videos or photos, maintain social relationships, share their views or comment on the content shared by their friends or participate in a game, and many other features. In social networks, people often try to find the others with similar type of interests and try to join the community with people of similar interest or

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people having a single topic of interest. So, in general, a community can be defined a subset of nodes which are having strong or dense connections among them in a group in comparison with rest of the nodes in the network. In general, there is no agreed definition is available in a community in social networks, but research says that if we represent people in social networks as nodes and friendships among them as links, then in a community there will be much denser interaction in comparison with rest of the interactions outside the community. Communities are basically classified in to two groups (1) Disjoint Community: Interactions within the community is very high in comparison with the interactions among the other communities in the same network and (2) Overlapped Community: Interactions among the communities found in the network are high, and there is no proper metric to separate the nodes and there may be common group of nodes present in each of the community. An efficient and scalable community detection algorithm is needed to evaluate these complex networks and detect overlapping and disjoint communities. Community detection algorithms are of NP-complete as well as NP-hard.

Most of the community detection algorithms available are not able to detect the communities in complex networks in an efficient manner, and it has taken a very high computational cost to process this large-scale networks and identify communities. At sometimes, these algorithms may also not be able to handle such a large of data also at once. So, there is very high demand to device a scalable and fast community detection algorithms in large-scale social networks. Grouping of nodes in large-scale networks as communities, like equal size and by maintaining a high density within community, is necessary in parallel computing [1]. Parallelizing traditional algorithms involves allocating processes and data equally to the cores/processors and at the same time communication traffic should also be taken into consideration. In case of large-scale networks, partitioning a network at random for load distribution among the processors is not considered as an effective solution and this approach may not converge to exact solution. In the era of big data analytics, information processing is drifting from computationally intense to data intense in nature [2]. In the era of hardware technology, processors are developed with multi-core architecture rather than traditional single core architecture. Now, many of the mainstream computers are equipped with multi-core CPUs or many core GPUs, but their hardware is underutilized or not utilized due to single core architecture-based traditional algorithms. These limitations had brought many improvements in the traditional algorithms to perform better on this new hardware platform on these large-scale networks. In this paper, we study, analyze, and review some of the best algorithms available on literature to detect communities in parallel ways. In this paper, our discussion mainly focuses on study, understand and review various parallelization techniques, and frameworks available for community detection algorithms.

Social networks or complex networks data can be visually represented as graphs. Through graphs, we can infer more meaningful information like interactions and able to take better decisions. A graph can be represented as $G = (V, E)$ where V is the set of vertices/nodes, and E is set of edges/interactions/links between nodes. For example, Fig. 1 shows a sample small network with 15 nodes and 28 edges. This network can be portioned into three communities like $\{1, 2, 3, 4, 5\}$, $\{6, 7, 8\}$,

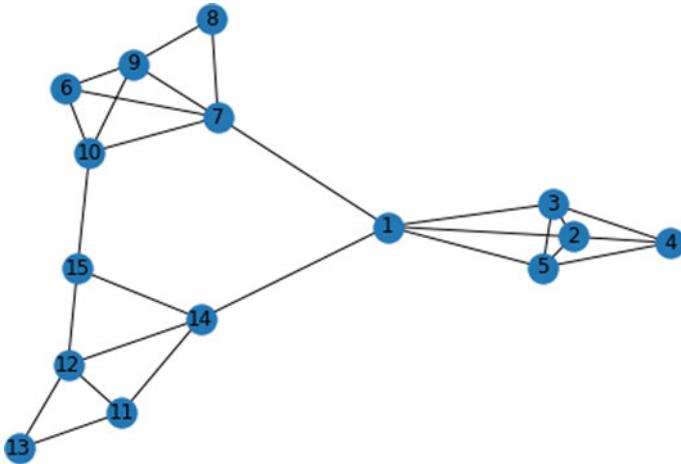


Fig. 1 Small network with three communities

9, 10}, and {11, 12, 13, 14, 15}. A graph can be partitioned into approximately an equal sized partition where applicable and there should dense connections between communities and less links among the communities.

2 Parallel Community Algorithms

As the size of the analysis of online social networking is reaching millions or billions of participants, this large data is becoming a challenging task for researchers to accurately find the communities in such a huge network. To speed up the process of community detection, a distributed and parallel algorithms need to be device and implement. In this approach, a graph needs to be partitioned initially among available processors and communication among these processors should be minimum. In many algorithms discussed in the literature consider the graphs to be static and in reality dynamic social networks processing poses the real challenge to analyze and process the network for communities. So, there is a need to process this data at faster rate and analysis need to be performed in an accurate manner. We try to study most popular methods proposed in the literature, which has processed this graph structures parallel and in various parallel supporting frameworks.

In [4] authors are able to perform graph partitioning and able to perform parallel community detection with a minimum communication among processors. Authors have implemented their algorithm successfully on an MPI-based HPC cluster. In this article, authors proposed a distributed memory-based parallel algorithm based on modularity maximization proposed by Louvain [5]. In order to minimize the execution time, authors focused more on the first iteration of Louvian algorithm and made this iteration in parallel. One of the noticeable observation is vertex ordering

may also has an impact on the performance speedup and suggested to consider descending order of edge degree of vertices has improved the convergence. The only drawback of technique [4] is authors not able to perform this test on real-world datasets.

In [3] authors have proposed a fast parallel community detection model based on approximate optimization known as picaso; here, in this paper, authors combined two different new approaches were combined to form a new approximation technique. (1) Mountain model: using the concepts of graph theory, approximate optimization and modularity, selection of nodes are done for merging. By using modularity ΔQ , each mountain with highest modularity reaches peak and other will remain as small mountains. Mountains with highest modularity are chosen and depicted as a community. (2) Landslide algorithm: In case of modularity maximization technique, modularity should be calculated incrementally and iteratively. This step is very expensive in case of computation, to reduce this authors have proposed a land sliding model in which approximate optimization technique is applied to identify nodes which is present at boundaries to reduce this computation. The proposed algorithm is implemented using spark with GraphX to achieve parallelism. Major drawbacks of this technique is not tested on very large graphs like over 1 billion, and this algorithm will not able to find the communities with overlapping.

A fast parallel modularity optimization algorithm (FPMQA) proposed in [7] uses modularity technique to identify communities in the social networks. Initially, authors have created a network called as interest network in which nodes/people who are taken part in a common discussion group and connected based on their common interests. An edge between two nodes is created if nodes u and v are given some comments on a similar topic of interest. Using statistical method, authors have calculated the consistency value about the belongingness of a topic and this value lies between 0 and 1. This updated network is named as similar view network (SVN). FPMQA algorithm is executed parallel on this similar view network, as there will be a group of nodes connected in this SVN due to common interest. For this SVN, initially, all the nodes are assigned with unique labels and is evaluated for gain modularity. The community pair that exists locally are considered and gain modularity is calculated. If the gain modularity high communities are merged and there is not improvement in gain communities are left as it is. Authors have also used concept of balanced binary tree to track highest gain in modularity. Finding the calculation of maximum gain, modularity is done in parallel. While performing parallel merge operation, there may be communities which are overlapping between other communities. So, to resolve this issue, an interactive way of label identification and current state of the community is checked before merging. The major drawback of this technique is ground truth communities available in the network are not taken into consideration and only similar view network-based communities are discovered. Here, authors are not discussed about the people who are participating in more than one common group. Overlapping of similarity interests are not discussed.

In [8] authors able to address the problem which is commonly present in the above discussed papers like finding both overlapping and non-overlapping-based communities in the given network. In general, people participate in more than one

topic of interest will form overlapping communities. In this paper, authors have proposed a label propagation-based parallel community detection algorithm with nodes confidence (PLPAC) taken in to consideration. Using MapReduce, parallel execution of label propagation is executed. In label propagation algorithm (LPA), each node changes its label which is unique initially is updated based on the labels which is highest among its neighbors. In this paper, authors are able to resolve the problem of label selection process in case of multi label and LPA is modified, and label are also updated based on the node influence. In case of bipartite networks, labels get oscillated and a label never gets fixed to resolve this issue; authors have considered both synchronous and asynchronous way of updating a label. The proposed parallel algorithm is implemented using MapReduce principle to achieve parallel execution and speedup. While calculating the labels, the network is split into n divisions and processed on p processors. Using Map function new label ID is calculated. Reduce spreads the label and calculates the label weight. The output extracted after Map function is fed as an input to Reduce function. The drawback for this approach is while the number of processors are increased, the performance of speedup is reduced to high time that is spent for communication among the processors. In [9] authors have proposed three algorithms for disjoint community detection algorithms on large-scale networks. Authors have proposed a shared memory-based parallel community detection framework. In this framework, a parallel label propagation method, parallel Louvain method, and parallel Louvain method with refinement are proposed. In parallel label propagation technique, instead of choosing a most frequent label, authors have proposed to select the most dominant label among the neighbors. Instead of choosing the allocation in random order, this is made as an optional. Authors have also avoided the calculation of label weights, if the label weights are not updated in the previous iteration, these labels are not recomputed, and labels are computed for the active nodes. Load balancing in label propagation is achieved by using guided scheduling for execution. For parallel Louvain method, node movements are considered for maximum modularity value and this is performed in parallel manner. Authors have also proposed a parallel Louvain method with refinement by adding an additional move phase in which a recursive implementation of Louvain method is proposed. All these algorithms are added in Networkkit.

Community detection and link prediction techniques have their applications in computer networks and cyber security also as discussed in [10, 11].

3 Conclusion

In this paper, we investigate various techniques that can be used to detect communities in a social network which is considered as one of the common and challenging tasks in the complex networks. Different types of parallel community detection algorithms and their possibilities are discussed. We observed that for parallel implementation purpose, the given network can be portioned into many small groups and can be allocated to various processors for computation. Many authors have used modularity and

label propagation as a basic method for community detection. Various architectures and frameworks like Spark GraphX, MapReduce, OpenMP, and MPI-based frameworks are used to implement these algorithms. Communities are in general are of two types like overlapping and non-overlapping, and there were very few algorithms are available for finding communities with overlapping. Another complexity which is usually present are based on the type of network taken into consideration like static networks and dynamic networks, most of the algorithms are discussing only about static networks and dynamic networks are taken into consideration.

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Implementation and Application of Machine Learning in Health Care: A Review



Harimohan Singh and Amit Kumar Gupta

Abstract Today in the medical science, the clinicians require huge information to diagnose and treatment of diseases by analyzing the data in cost- and time-efficient manner. Nowadays, machine learning methodology has vided applications in the field of finance and medical science. The medical science uses the machine learning methods to predict the diseases on the based on pattern recognition from the huge medical data set which is beyond to a human capability. This may be helpful to physician for planning of diagnosis, caring, best possible outcomes, cost reduction to diagnose and customer satisfaction. So machine learning and artificial intelligence become more powerful tool in the field of health care sectors and also become most study of point in the research as well. In this paper, we have presented the research that has been carried out in the field of medical sciences with using the machine learning. From whole discussion, it is defined that artificial intelligence and machine learning solve the problem of managing health care data in efficient way with respect to time and cost.

Keywords Machine learning · Medical science · Data mining · Artificial intelligence

1 Introduction

As we are moving toward the digitization of clinical information, clinical testing results of medical equipments, patient information, patient history and huge dimensional patient data, which becomes more challenging task. To manage the data, we such require the techniques of data analytics which can efficiently manage and

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analyze the data to diagnose the diseases in very time specific and cost specific. To make solution for the problem, the artificial and machine learning methodology has encountered which play vital role to analyze and manage such huge clinical data. The industries and academia are starting to make huge investments in application of data science technologies to help with analyzing medical data [1–7].

Machine learning is the method of analyzing the data set which is inputted to the ML program makes an experience with some performance measures and it applies the performance measures to the data set for improvement in the experience. In simple form, the machine learning techniques are learned from the data and applying this learning to newer set of data for enhancing the performance. The ML is mainly focused on automatic learning without any human interactions. The ML algorithm categorizes into the four categories which are shown in following section.

- (A) **Supervised learning**—This type of machine learning algorithm uses the labeled data set (which has features and labels). It learns the experience from the labeled data set and applies experience to new data set and predicted the results. It is also classified in two categories which are namely known as regression and classification.
- (B) **Unsupervised learning**—This type of machine learning algorithm uses the unlabeled data set (which has only labels no features are available). This type of algorithm extracts the features from the unlabeled data set. The features are extracted using the method of identification of pattern or cluster in the data set.
- (C) **Semi-supervised learning**—This type of machine learning algorithm uses labeled and unlabeled data set. The classifier is trained to learn the patterns to classify and label the data as well as to predict.
- (D) **Reinforcement learning**—This type of machine learning algorithm works on mapping of the action to the current situation for maximizing the reward or feedback. In this learning, the classifier is not designed to select the particular action, but it always tries to find out most rewarding action by trial methods.

2 Application of Machine Learning in Medical Science

Machine learning methodology has vided applications in the field of finance and medical science. The medical science uses the machine learning methods to predict the diseases on the based on pattern recognition from the huge medical data set which is beyond to a human capability. This may be helpful to physician for planning of diagnosis, caring, best possible outcomes, cost reduction to diagnose and customer satisfaction. For heart dieses discovery, the scientist are using the support vector machine (SVM) or naive Bayes algorithm and artificial neural network (ANN). For predicting diabetes, random forest, KNN, decision tree, or naive Bayes, ML algorithm are used to classify the types of diabetes. The ML algorithms are widely used in the R&D field of drug discovery and manufacturing plants. The ML algorithm is also implemented in various medical illness like prediction of liver disease, robotic

surgery, cancer detection and prediction, personalized treatment, smart electronic health recorder, machine learning in radiology [8].

The medical science uses the machine learning methods to predict the diseases on the based on pattern recognition from the huge medical data set which is beyond to a human capability. This may be helpful to physician for planning of diagnosis, caring, best possible outcomes, cost reduction to diagnose and customer satisfaction. So machine learning and artificial intelligence become more powerful tool in the field of health care sectors and also become most study of point in the research as well. The rest of section shown literature review which has been done in the field of ML implementation and application in health care and conclusion.

3 Literature Review

In this section, we have presented the some latest work that has been carried out in the field of health care services using machine learning methods. The below mentioned literature survey clearly shown that machine learning and artificial intelligence have a vital role in health care.

Maheshwari et al. (2018) have used the neural network concept of machine learning on health care data for visual analytics. The authors define three tier architectures to process the data which are namely known as user tier, processing tier and model tier. The conclusion of paper that their model provides efficient way to predict as well as analyze the medical data set [9].

Penikalapati and Rao (2020) have defined that machine learning plays vital role to analyze the electronic health record (EHR) in efficient and accurate way. This paper has shown that increasing of EHR requires a more sophisticated solution. This paper has shown a survey on the supervised and unsupervised machine learning algorithm which are performed on medical data set. The accuracy of the model is also shown in this paper. The authors have concluded that approaches of classification and clustering are very much useful concept of ML for enhancing the quality of medical services in order to early prediction and diagnosis of disease [10].

Al-Shedivat et al. (2017) shown the definitions, nuances, challenges for implementing the ML in health sector. It is also discussed that why the interpretable machine learning models may useful for the health care and how the ML can be implemented for health care. This paper is also shown that which type of ML methodology can be used for one particular problem in health care [11].

Dou (2019) has shown the ML algorithm like decision tree-based methods, naive Bayes and Bayesian belief networks, K-means, artificial neural network (ANN), support vector machine (SVM), etc. The authors also shown the application of ML in the health care as tumor diagnosis, medical imaging traditional way and recent way with ML in health care. It is concluded that ML provides a mutual combination of computer industry with medical industry [12].

Sutabri et al. (2019) have discussed about the machine learning concept in medical data. The authors have describe the neural network concept and stated that the artificial intelligence is powerful tool to boost the process of medical industry. Authors also marked that ML can boost the analytic process if the accuracy of data is high [13].

Maity and Das (2017) have demonstrated the two case study of ML algorithm on health care data. The first case study has been carried out on Bayesian interface which uses the test result and demographic data for Alzheimer's disease. The second case study is carried out over breast cancer clinical data set for advancement in the prediction of results using artificial neural networks. The authors have concluded that ML helps to provide more accurate results for early diagnosis, which may help to a patient for making decisions on treatment [14].

Winter (2019) has studied about the ML algorithm like decision support system, support vector machine, K-nearest neighbor for health care data. The authors have shown that naive Bayes given 86% accuracy results in case of heart disease, SVM gives 96.40% accurate results for breast cancer and CART gives 79% accurate result in case of diabetic disease [15].

Sarwar et al. (2018) done predictive analysis on diabetic patient data with six different machine learning algorithm (NB, KNN, SVM, LR, DT and RF). The authors have concluded that KNN and SVM have given better accuracy results in comparison to NB, LR, DT and RF methods of ML. The authors have tested the experiments on small data set [16].

Khan et al. (2018) suggested and discussed the application of machine intelligence in health care. The authors have used the simple linear multivariate regression method for predicting the specific symptom of dieses. Authors have experimentally stated that LR techniques give the better solutions in terms of accuracy. Aggregation is also used to convert the uncertain probabilistic data into a certain data [17].

Abdelaziz et al. (2018) proposed a new model to optimize the virtual machine (VM) selection using the parallel particle swarm optimization (PPSO) mathematical optimization techniques. It is also proposed a new model chronic kidney disease (CKD) which is hybrid methodology of linear regression (LR) and neural network (NN). The authors shown that the execution time of model is improved by 50%, the efficiency of data retrieval increased by 5.2%, accuracy of proposed model was found 97.8% [18].

Naseer Qureshi et al. 2020 have discussed the mobile health system, statistical and machine learning models and proposed Android application which may keep all relevant information of patient. The authors also suggested a new predictive model to classify the cardiovascular diseases as per nature of seriousness of diseases. It is also experimentally shown that the suggested model gives better results in comparison to existing algorithm [19].

4 Conclusion

From above study, it is clearly shown that to manage the health care data, we such require the techniques of data analytics which can efficiently manage and analyze the data to diagnose the diseases in very time specific and cost specific. To make solution for the problem, the artificial and machine learning methodology has encountered which play vital role to analyze and manage such huge clinical data. The industries and academia are starting to make huge investments in application of data science technologies to help with analyzing medical data. The medical science uses the machine learning methods to predict the diseases on the based on pattern recognition from the huge medical data set which is beyond to a human capability. This may be helpful to physician for planning of diagnosis, caring, best possible outcomes, cost reduction to diagnose and customer satisfaction. From whole study, it found that artificial intelligence and machine learning solve the problem of managing health care data in efficient way with respect to time and cost. But every system has some pros and cons, from the study, it is also found that accuracy of results depends upon the choosing of right ML algorithm, realness and availability of the data which is challenging task for the researcher.

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Applying Software Agents to Make City Traffic Management Smarter



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Abstract With the emergence of IoT technologies, autonomous vehicles, and introduction of 5G networking, the idea of a smart city is considerably more achievable than before. One of the ways of reaching this goal would be improvement of traffic management. In this contribution, we suggest how an agent-based system can optimize vehicular travel, thus reducing CO₂ emission, decreasing time spent in traffic jams, and improving overall city travel experience. We propose the design of an agent system describes how agents communicate and, experimentally, validates the design in two use case scenarios.

Keywords Smart city · Software agents · Traffic management · Traffic simulation

1 Introduction

As the concept of autonomous vehicles continues to develop, they bring enormous potential for improvement of daily lives. As Nico Larco suggested in his TEDx talk [1], this technology will transform our cities in multiple ways. With cars becoming smart, it is logical that, with use of IoT devices, “streets” (and city infrastructures,

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in general) can also become “smart.” In this context, we focus on one aspect of potential use of these technologies—traffic management.

Let us consider two scenarios that guide our work. (1) Assume that vehicles and traffic lights can communicate. Here, vehicles may inform traffic lights that they will “arrive soon” (even, communicating the ETA). This, in turn, may allow the traffic system to decide if the lights should be changed earlier/later. It can be stipulated that having such infrastructure in place could decrease the overall travel time. Obviously, it could also lead to the reduction of CO₂ emission (by making travel “smoother”). (2) Let us now assume that citizens can use their phones to communicate with both the city transport infrastructure and the traffic lights. Hence, they could, for instance, inform public transport that they are near a bus stop¹ (possibly, providing it with the ETA). This may allow the bus to wait (for a limited time), and assure that the majority of potential passengers will board the vehicle. Obviously, traffic lights adjustment, similar to that in the first scenario, can be envisioned also for pedestrians, e.g., those approaching the specific bus stop.

Let us observe that both scenarios depend heavily on two factors: (a) message-based communication, and (b) some form of “intelligence,” which would facilitate “strategic decisions.” These two features are very often used in the context of software agents and agent systems (see, for instance, [2]). Moreover, agent-based approaches have materialized in the context of traffic management, i.e., in taxi services simulation [3], taxi service optimization [4], or autonomous car system simulation [5]. With this in mind, our goal is to develop a realistic agent-based traffic management system simulator and experiment with its capabilities.

2 Related Work

Let us start by summarizing related work. Here, we do not discuss “general work” related to issues such as 5G networks, Internet of things, and smart cities. While pertinent, they are not necessary to provide context to our approach.

Let us start from *agent-based simulation of autonomous cars* [5], which focuses on possible applications of autonomous vehicles. It also provides examples of interactions with public transport, which is a subset of functionality considered in our project.

Second, *Public Transportation Simulation by Using Agent-Based Simulation: Case of Tirana* [6] describes traffic situation in the said city and shows that usage of agent-based modeling can help pinpoint the causes of existing problems. In contrast, we focus on modeling and exploring possibilities for traffic management.

Finally, other contributions dealt with the use of software agents as related to specific aspects of traffic management. Here, (1) *agent-based design of intermodal freight transportation systems* [7] focused mainly on cargo transport; (2) *software*

¹We will use the generic terms: *bus* and *bus stop* to denote any form of public transport, e.g., bus, tram, trolley, etc., and its respective stopping locations.

agents in support of a taxi corporation [4] and *(3) agent-based modeling for simulating taxi services [3]* concentrated on supplying an “on-demand taxi” service. While those projects dealt with a specific aspect of smart transport management, our work attempts at developing a complete simulation ecosystem.

3 Agent System Design

Let us start from general assumptions that underline our work. (1) We consider traffic within a single city. Specifically, we use an actual map of Warsaw, Poland. However, our system works with any city map. (2) 5G networking has been installed within the city. (3) Vehicles can use 5G infrastructure to communicate with each other (which is not used, for the time being), and with city infrastructure. (4) Citizens can use their (5G) phones to communicate with city infrastructures (as needed). (5) Software agents will be used as the conceptual and technological foundation of the developed smart traffic simulator. (6) The goal of the project is to study how to use software agents to optimize city traffic.

Based on these assumptions, and keeping in mind the two (above outlined) scenarios, let us now summarize main functionalities that are to be realized at this stage of the project. (a) *Cars interacting with traffic lights*. Here, intelligent intersection systems will be proposed. They should make decisions based on the current situation, e.g., number of cars waiting for the green light, number of cars known to approach, etc. Furthermore, our system will place traffic lights in their actual locations within the city. (b) *Citizens interacting with public transport system*. Citizens that plan to use public transport will specify where they are, and where they are going. Here, the infrastructure should make decisions based on, for instance, number of travelers waiting at a given bus stop, and the estimated time of traveler’s arrival at the stop. Moreover, while the schedule of public transport may be chosen arbitrarily, we believe that it should be based on the real-life schedule of the simulated city. Therefore, we have used an actual Warsaw public transport timetable. This decision allows comparison of simulated scenarios with real-life ones, as the actual performance of the public transport system can be used as a reference.

3.1 Agent Specification

When designing the agent system, we have used GAIA methodology [8]. As a result, we have identified six different types of agents.

- *CentralAgent*: This is the core agent, which retrieves all data necessary for the simulation to be instantiated. Next, it manages the creation of agents needed in the system. Then, it activates agents and starts simulation. Finally, it is responsible for GUI, and time measurements (for the test cases).

- *LightManager*: Agent(s) that manage(s) all lights on a particular crossing (one agent per one crossing). Furthermore, it decides when, and which group of lights, will change color. Its responsibilities include also: communicating with agents representing vehicles and travelers, keeping track of their number (as they approach and leave), and informing them when to pass. *LightManager* should have a strategy (possibly, strategies), aiming at optimizing traffic.
- *CarAgent*: Agent(s) representing cars traveling in the city. *CarAgents* inform *LightManagers* about their intention of passing the light in two cases: (i) when they have already arrived, and (ii) when they are approaching the light. There is no imposed limit on the number of *CarAgents*.
- *TravelerAgent*: Agent(s) which represents traveler(s). It communicates with *StationAgents* to notify them about travel details needed to facilitate use of public transport. Moreover, while traveling by public transport, *TravelerAgent* receives information, from *BusAgent*, when it reaches the destination. Finally, *TravelerAgents* can communicate with *LightManagers*, the same way as the *CarAgents*. There is no imposed limit on the number of *TravelerAgents*.
- *BusAgent*: Agent(s) that represent public transportation vehicles, traveling between assigned stations. *BusAgents* communicate with *LightManagers* the same way that *CarAgents* do. *BusAgents* communicate also with *StationAgents* and *TravelerAgents* (to keep track of their number and to inform them, later, that they arrived at the desired station). There is no imposed limit on the number of *BusAgent*.
- *StationAgent*: Agent(s) representing public transport stops. Their number equals that of the number of stops in the simulated area. It is assumed that stations are placed based on their real-world location (to use transport schedules). *StationAgents* communicate with: (i) public transport (*BusAgents*) to receive information about their location; (ii) *TravelerAgents* to receive information about potential passengers. They also decide (apply strategy) about possibly delaying the time of bus departure to serve late passengers.

3.2 Communication Flow

The agent knowledge map is shown in Fig. 1. This map overlaps with the information exchange map. Connected agents send messages both ways.

CarAgent, *BusAgent*, *TravelerAgent* \longleftrightarrow *LightManager*. Upon starting the journey, and after passing through the previous light, agents send an *INFORM* message to the *LightManager*, representing the next light, containing the ETA. After reaching the light, they send a *REQUEST-WHEN* message to the *LightManager*, asking for the information when to pass (note that, to make system more fun, for the time being, we assume that passing is “message-managed”), then the *LightManager* responds with the *AGREE*, and waits for the moment when vehicle/traveler is allowed to pass. When this moment occurs, *LightManager* sends a *REQUEST* message to the vehicle/traveler. The *REQUEST* message is sent only for simulation purposes. Obvi-

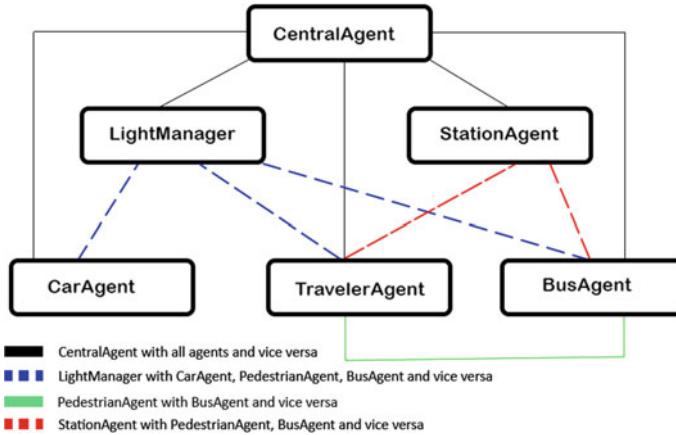


Fig. 1 Agent knowledge and information exchange map

ously, pedestrians can see the light without the need to check the message. The vehicle/traveler responds *AGREE* and passes through the light.

TravelerAgent \longleftrightarrow *StationAgent*. When moving to the bus stop, *TravelerAgent* sends an *INFORM* message to the *StationAgent* containing the ETA, and the number of bus line of interest. When the traveler arrives at the bus stop, *TravelerAgent* sends a *REQUEST-WHEN* message to the *StationAgent*, asking to enter the bus as soon as possible. Here, the *StationAgent* acknowledges with the *AGREE* message. When the bus arrives, the *StationAgent* sends a *REQUEST* message, asking to enter a particular bus, using which the traveler will move toward her/his destination. The request contains the *BusAgent* ID, so that the *TravelerAgent* can communicate with it.

BusAgent \longleftrightarrow *StationAgent*. While approaching the next station *BusAgent* sends the *INFORM* message to the *StationAgent*, containing the ETA. After arrival, *BusAgent* sends a *REQUEST-WHEN* message to the *StationAgent*, asking to gather people and pass. Next, the *StationAgent* responds with the proposed departure time (capturing approaching passengers). Upon departure, the *BusAgent* informs the *StationAgent* about this fact.

TravelerAgent \longleftrightarrow *BusAgent*. When the traveler enters the bus, he/she waits for the *REQUEST* message from the *BusAgent*, which will indicate arrival at the destination. Upon reception of such message, *TravelerAgent* answers (*AGREE*) to confirm that the traveler left the bus.

4 Simulator Implementation

The proposed traffic simulation system has been implemented in Java 8, using the JADE agent platform (version 4.5). Information regarding location of traffic lights and bus stops has been obtained via Overpass API (OpenStreetMap). To get data for

a given route, system sends requests to Overpass API and parses the results using the GraphHopper library [9] to find traffic lights and stations on the route. Furthermore, information about (all) bus timetables was obtained from the Warsaw public transport API [10].

To visualize simulated traffic, we prepared an user interface with a customizable map (provided by JXMapView2 [11]). Our system allows to select, which entities spawn on the map (cars or/and travelers or/and buses), choose the simulation area, adjust simulation time, and number of created agents. To measure time, we have *BusAgent*, *PedestrianAgent*, or *CarAgent* communicate with the *CentralAgent* that “runs the system time” and inform it about pertinent events.

Since, for the time being, our focus was on testing the usability of the system, only extremely simple strategies (managing when buss will leave and when lights will change) were implemented. Exploring possible strategies is part of research planned for the future.

In Fig. 2, we present an image of a simple simulation.

Here, we can see generated cars, with their corresponding routes, the simulation area with the chosen center, and crossing lights (from the Overpass API).

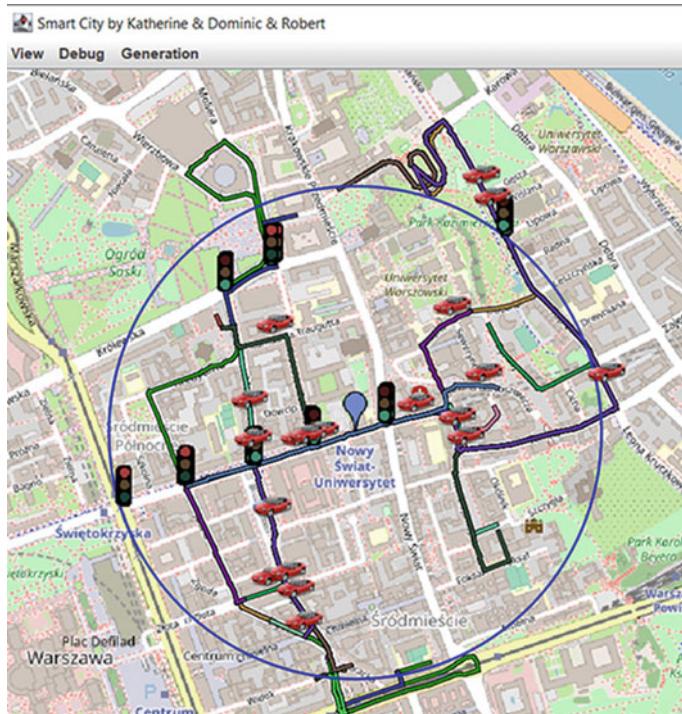


Fig. 2 Example of simulation

5 Experimental Validation

The developed system realizes use case scenarios, described in Sect. 1. This allows us to, jointly, validate the design of the system, and address two questions: (1) Does vehicle lights communication reduce journey time? and (2) Does traveler station communication improve travelers' life?

To answer the first question, we have measured the average time it takes for a car to travel from point A to point B with, and without, smart lights. Normally, lights change, without delay, after 60 time units. Here, light smartness will be represented by possible delay, of up to 30 time units, in changing the lights (depending on the number of cars that are to pass the crossing). Worth mentioning is that this 2:1 ratio needs further adjustment to ensure better strategy effectiveness. In experiments, we have increased the number of cars 5, 10, 15, . . . , 35, 40. The test is designed to gradually increase the traffic, while maintaining the same size of the simulation area. When the traffic is dense enough, strategy is more needed, because the queues of cars, waiting to cross (all) lights gets filled quite fast, in comparison with the "normal conditions." Results are depicted in Fig. 3.

It is noticeable that applying the strategy for light management slightly—by ~6%—improves the average journey time. Here, note that this difference concerns area with just four intersections.

For the second question, we have also measured average journey time, with possible delay of up to 60 time units at a bus stop. Results have been mixed. In the simplest case, when each bus stop allowed delay, such delays could accumulate (even if they were relatively small) and, while some travelers were "winners," others were "losers." This resulted in strategy change, and waiting only if the *total delay* time was less than 60 time units. This, in turn, practically eliminated the overall average travel time gains. Therefore, returning to the issue of making public transportation more flexible is one of the open issues that require further research.

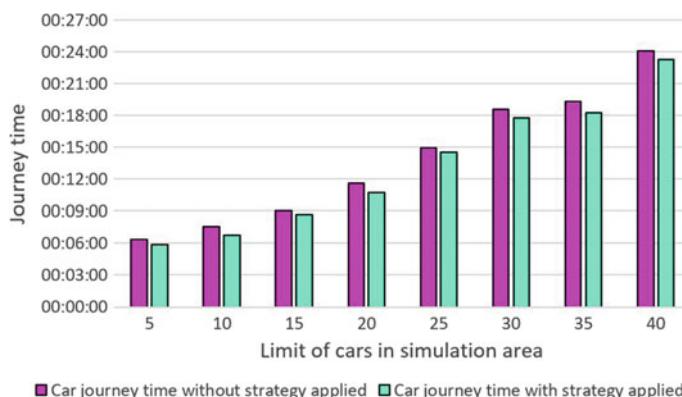


Fig. 3 Experimental validation for average car travel time

Interestingly, the current design of the simulator is heavily dependent on the quality of the Internet connection. Each time a vehicle/traveler is created, simulator Internet-connects to external APIs, for route calculation. Weak Internet connection resulted in not realizing the preset generation interval, directly affecting the traffic conditions (interfering with the structure of planned experiments).

6 Concluding Remarks

In our work, we have designed and implemented an initial version of an agent-based smart city traffic simulator. Developed system works on a map provided by the Open-StreetMaps and uses actual street light locations and public transportation schedules. We have initially validated the design against two use case scenarios. We were able to establish that improving car flow can be achieved when cars communicate with traffic lights. Here, even an extremely simplistic strategy of “slightly delaying light change in response to incoming traffic” can reduce the average travel time. The situation is more complex with travelers using public transport. Here, the obvious delay strategy did not work, because of the constant accumulation of passenger travel time. While, after reconsideration, a “better” solution was found, it was not as effective as desired. Hence, there is a lot of open questions, how to improve public transport management. Nevertheless, let us recall that, at this stage, our goal was to develop (and validate) a working agent-based smart city traffic simulator. With the working simulator in place, we can start extending it and explore approaches to traffic management.

Here, we plan to consider multiple pathways. (1) Making public transportation multi-modal, by introducing rail, subway, tram, trolley, etc. Each of them would be represented by an agent, which would be based on the design of the *BusAgent*. (2) Including also other forms of transportation, such as: taxi, bicycle rentals, electric scooters, etc., as means of getting from point A to point B, either directly, or in multi-modal combinations. (3) Exploring ways of proposing complex multi-modal transport routes, while making them flexible and optimal. The latter would require research in answering the question: what makes the transport route optimal (e.g., price, time, CO₂ consumption, etc.). (4) Introduction of electric vehicles and charge stations. (5) Adding autonomous vehicles to the mix or replacing human-driven vehicles with autonomous ones completely. (5) Adding (possibly autonomous) freight/supply transportation and exploring models of optimization of their use. (7) Exploring strategies for each stakeholder entity (agent representing it). We will proceed with this work and report on our progress in the next publications.

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Optimal Placement of Internet of Things Infrastructure in a Smart Building



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Abstract Recently, there is a growing trend to improve the quality of life, while reducing energy consumption and emissions of CO₂. Here, the use of sensors, controllers, and indoor positioning brings us closer to achieving this goal. The aim of this note is outline an attempt at use of modern infrastructure for optimization of energy management in a building. An architecture of a solution that uses data from sensors to control the state of the object is presented. Performed experiments focus on optimal placement of networking infrastructure inside the building.

Keywords Smart building · IoT · Optimal infrastructure placement

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1 Introduction

Internet of things (IoT) is one of the fastest growing “branches” of ICT. While the concept originated in 1999 [2], recently its share of the market grew almost 10 times [35]. Currently, IoT deployments consist of over 25 billion of connected devices. It is also predicted that, by 2025, this number will surpass 75 billion [19].

IoT-based solutions are to improve quality of life, work efficiency and have positive environmental impact; for example, in building management [29]. Here, note that almost 90% of people spend most of their life inside of buildings [32]. Hence, the reduction of energy consumption by buildings (and thus of CO₂ emission) can make a difference. While the global demand for electricity is rapidly growing, buildings consume its significant share [10]. Moreover, in many countries (including Poland [16]), electricity is still obtained from non-renewable sources, with large, adverse, and environmental impact. Hence, the need for IoT solutions to manage electricity consumption, without decreasing the user comfort. Two of the most energy-consuming systems in a building are HVAC¹ and lighting. Automation of operation of these systems, using data from sensors, external systems, historical data, and appropriate controllers, should improve energy efficiency.

The aim of this note is to outline our initial explorations into intelligent building management system (IBMS) that aggregates, and processes, data from sources, such as: sensors, external services, user location and schedules, and other data influencing energy consumption. However, due to space limitation, we focus on simplifying installation of the infrastructure, by automatically creating a map of internal locations, and using it to plan deployment of components.

1.1 Internet of Things in Smart Buildings

The history of IBMSs dates back to the 1970s. The first prototypes were very simple with limited functionality. However, the development of devices and technology, resulted in a rapid progress [36]. The IoT-related theory and practice greatly influenced the IBMSs, delivering the “tools” needed for further development. Nowadays, an IBMS can collect data from sensors, such as: temperature, air humidity, motion, and light intensity [25]. Moreover, the use of *beacons*² accurately determines user location [11]. Furthermore, access to weather forecast may allow “preparation for incoming changes,” impacting future energy consumption [27].

There exist multiple *commercial* solutions optimizing energy consumption in smart buildings. However, little is known how they work. For obvious reasons, their specifications are a closely guarded intellectual property, and the available materials provide only a “residual commercial/marketing information.” Popular, robust commercial IBMS are delivered by: (i) Schneider: EcoStruxure™ Building and Elec-

¹HVAC—heating, ventilation, air conditioning.

²Beacon—device that sends localization-oriented radio signals; accuracy ~1.5 m.

tric StruxureWare™ [33], (ii) Siemens: Sync™ [34], and (iii) Honeywell [18] or Cylon [8].

In academic work, currently, the most frequent architecture of IBMS is *fog-based* [4, 6], consisting of three layers: (1) cloud, (2) fog devices, and (3) edge devices. Such architecture can be extended by adding elements like, for instance, data analytics modules, used to improve quality of building management [15].

Note that poorly maintained, degraded, or inadequately controlled IBMS can increase energy consumption from ~ 15 to $\sim 30\%$ (see, [20]). Hence, automating error/anomaly detection and system diagnostics are very important. Here, IBMS anomaly detection can be facilitated by an external diagnostics system (see, [23]). However, it can also be obtained by internal analysis of data within the ecosystem [22]. Appropriate data analytics can “catch” communication problems, as well as problems related to individual components [21].

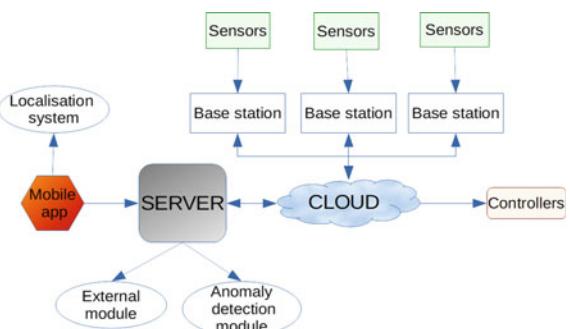
2 Explored Approach

Based on analysis of commercial solutions and literature, we have decided to explore an extended version of a *Fog architecture*. Its main components have been outlined in Fig. 1.

Functions of depicted modules are as follows:

- *Cloud* is the “central element” of the system. It facilitates data processing/analysis and visualization [17]. It can be realized as a “local cloud” (within the IBMS), or using an actual (external) cloud infrastructure. For instance, the implemented simulator uses the *Azure IoT Hub* [3].
- *Server* module can be realized (a) within the *cloud*, or (b) as a physical server (as in Figure 1). Its combines data processed in the *cloud* with that from *external modules* to effectively manage HVAC and lighting *controllers*. The *server* communicates also with the *mobile application* to obtain location of users inside the building. Finally, the *server* collaborates with the *anomaly detection module*, which spots anomalies in the infrastructure.

Fig. 1 Overall structure of the system



- *Base stations* pre-process data to increase the throughput of data streams (see, [7]) and support communication between *sensors*, with limited capabilities (e.g., low power Wi-Fi signal), and the *cloud*. The correct placement of the *base stations* in the building is crucial for the efficiency of the IBMS. *Base stations* should efficiently relay data streams from *sensors* to the *cloud*. Note that placing too many *base stations* is a waste of resources. Problem of optimal arrangement of *base stations* is NP-complete [5] and was solved using a genetic algorithm, described in Section 3. Note that the *base station* can be realized, for example, by a *Raspberry-Pi* SoC [30].
- *Sensors* are distributed throughout the building to collect all pertinent information needed to optimize energy consumption [25]. They communicate with *base stations* using open communication protocol(s) [28].
- *Controllers* deliver actions needed for actual management of key building elements such as: HVAC and lighting, in an attempt to reduce electricity consumption (and the total cost of building operation [37]).
- *Mobile application* monitors employee position in the building. It is assumed that it will be used by all (or, at least, a majority) of regular users. Such application can use an NFC reader³ located at the entrance to the building to capture when the user enters and leaves it.
- *Localization system* determines the exact position of users in the building, by interacting with the *mobile application*. Such system may require installation of additional sensors, e.g., beacons [1, 11].
- *Anomaly detection module*—facilitates autonomous detection of infrastructure errors, e.g., using root cause analysis (RCA [31]).
- *External modules* deliver additional information used by the IBMS. They communicate with the *server*. Examples of possible *external modules* are:
 - *Employee information*, which facilitates schedules of all employees (including, for instance, holidays, business trips, or absence from work).
 - *Weather information* provides current/future weather information [27].
 - *Building information* may provide parameters necessary for proper functioning of the IBMS. It also may calculate selected information, related to building control, using data provided by the *server*.

3 Placing Networking Infrastructure Within the Building

The IBMS requires plan of the building, in which it is installed. Knowing how rooms are arranged, where *sensors* are placed, and where people are located, is used to optimize energy consumption. Building plans used by different IBMSs may be in different formats [1]. There exist wizards [24] that produce building plans, but they may not deliver the needed format. This problem can be solved with help of, for

³NFC—Near-field communication—a communication standard that allows for short-distance wireless data exchange.

example, Estimote Beacons, which automatically generate plan of a building [13]. Note that many beacons can capture: motion, temperature, light intensity, or air pressure, which can be used in the IBMS [14]. They also can facilitate person localization. Building layout can also be automatically generated using: (i) a dedicated application or (ii) the UWB⁴ (see, [12]).

3.1 Determining the Position of the Base Stations

Let us assume that the map of a building is available. Now, we need to address the question how to optimally place the *base stations*. Here, the IBMS should use as few of them as possible (considering cost and radio pollution). On the other hand, minimization of their number should not affect system operation. Note that the *base stations* can communicate with *sensors* using different protocols. Each of them has a predetermined maximum range, which may be further limited by used construction materials, building structure, and the elements therein (see, [9]). The problem of optimal placement of multiple *base stations* in a building is NP-complete [5]. Hence, there is no polynomial-time algorithm. Therefore, we have decided to apply a genetic algorithm, which is one of well-known approaches to solving similar problems (see, [26]).

The system stores the plan of the building as a set of points, with coordinates expressed in centimeters. The algorithm represents the building (floor) as a rectangular grid with accuracy of $1\text{m} \times 1\text{m}$. This mesh is transformed into a matrix of size $N \times M$, where N is the total length, and M is the total width. The matrix holds: 0 for “empty field,” 1 for field with the *base station*. While, in initial experiments, we have used rectangular floor plans, proposed approach can be adjusted to deal with more complex geometry. The algorithm parameters are: P_1 —coverage error—representing cells not covered by any *base station*, P_2 —*base station* overlapping, representing cells where the coverage from multiple stations overlaps, and P_3 —the total cost (of installed stations). The fitness function is a simple weighted sum:

$$f = \sum_{i=1}^3 \alpha_i \cdot P_i,$$

where α_i is the weight of the i th parameter.

The key optimization parameter is the coverage error (P_1), since the sensors may need to be located “anywhere.” Hence, the corresponding weight is the largest. We have assumed that the least important parameter is the total cost of the *base stations*. After running a number of experiments, we report results for: $\alpha_1 = 30$, $\alpha_2 = 1$, and $\alpha_3 = 0.3$, which gave us reasonable price/coverage ratio. However, obviously, differ-

⁴UWB—a radio communication technique based on the fast sending of short-term pulses.

ent choice of weights is possible. The optimization parameters have been calculated as follows:

$$P_1 = \frac{n_{\text{or}}}{n_{\text{total}}}, \quad P_2 = \frac{\text{overlaps}}{n_{\text{bs}}}, \quad P_3 = n_{\text{bs}} * c,$$

where n_{or} is the number of cells out of range of *base stations*, n_{total} is the number of cells, *overlaps* is the number of cells with coverage overlap, n_{bs} is the total number of *base stations*, and c is the cost of a single *base station*. Note that the strength of signal of a *base station* is represented in the two coverage-related parameters.

In our work, we have used standard genetic algorithm, with cross-over (probability 0.9) and mutation (probability 0.1) and elitist selection. Mutation turned no-station locations into ones with stations and vice-versa. The “building matrix” was turned into the “vector-gene.”

The proposed approach was tested for multiple, relatively simple, and floor plans. Here, we report results obtained for two of them (depicted in Fig. 2) with *base stations* with different ranges (final placement of *base stations* is also presented). We have tried two initial population of *base stations*: (a) random population (Set 1) and (b) no stations (Set 2). In the latter case, the initial populations was “all zero” and stations have been introduced via mutation. Presented results are averages of multiple runs. Note that similar results were obtained for all experiments (regardless of floor layout, *base station* strength, or initial population).

Results for Floor 1 are presented in Fig. 3. The best fitness function result has been reached after approximately 6000 epochs. Moreover, results for the optimization process starting from randomly placed *base stations* were slightly better. Interestingly,

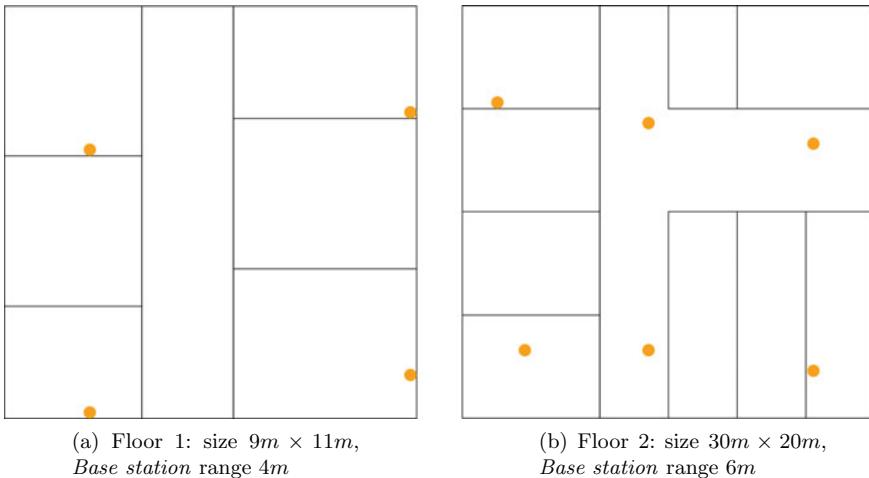
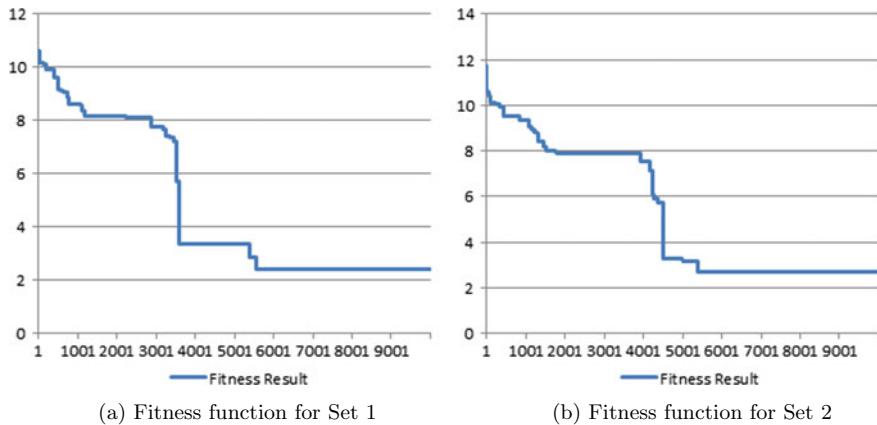
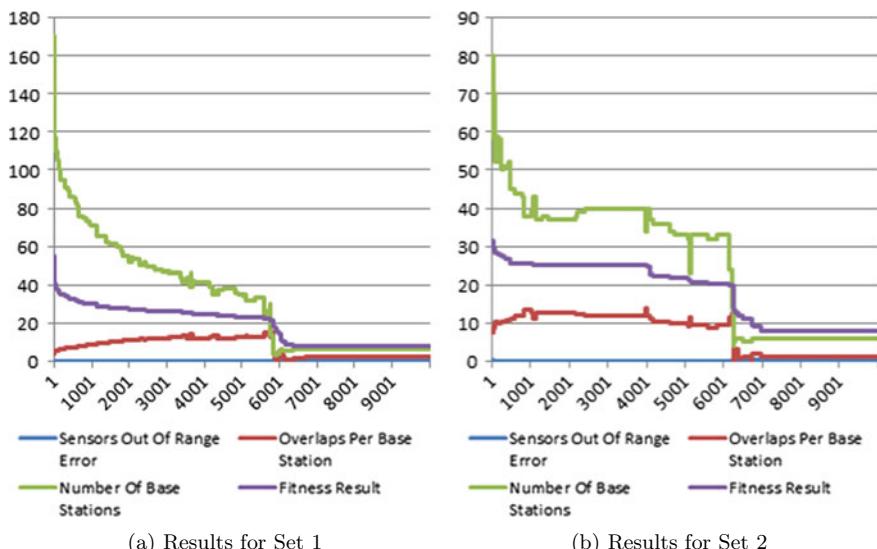


Fig. 2 Localization of *Base stations*

**Fig. 3** Comparison fitness functions for Floor 1**Fig. 4** Results for Floor 2

in majority of our experiments, no overlap between *base station* coverage has been reported.

In the case of Floor 2 (results depicted in Fig. 4), the population consisting of randomly distributed *base stations* achieved a better result for only one parameter, the *coverage error*:

Fitness function – $7.73 < 7.8$
 Coverage error – $0.12 < 0.16$
 Device overlapping – $2.33 > 1.0$
 Number of base stations – $6 = 6$

The last step in infrastructure setup is to place the *sensors*, as needed to track selected parameters and/or fit into the building. Proposed approach to the determination of the position of *base stations* allows to avoid places where the *sensors* will not be able to communicate, due to lack of coverage. Upon slight modification it can also allow estimating/taking into account how many sensors can be associated with each individual *base station*.

4 Concluding Remarks

We have developed an IBMS simulator that allows control of: (i) user positioning system, (ii) employee schedule, (iii) users entering and leaving the building, (iv) system time, (v) outdoor temperature/weather, and (vi) internal temperature and humidity. In this way, we have realized the complete architecture, as presented in Fig. 1. The *anomaly detection* module was realized as a simple function to test its integration with the other parts of the system.

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A Efficient Approach for Securing Images Using RSA and Arnold Technique Metamorphose



Kanak Giri, Pankaj Dadheech, and Amit Kumar Gupta

Abstract People across the globe exchange information but security remains primary concern while sharing information (data or images). This paper highlights the encryption technique using Arnold's cat mapping and RSA algorithm in which first images are jostled using Arnold technique and then encrypted these jostled images using RSA algorithm. This concludes that the suggested new method will improve the security and encrypted and decrypted quality of images.

Keywords Cryptography · Image encryption · Image decryption · Asymmetric RSA · Arnold's cat mapping

1 Introduction

In any case, the world is digitised. Each division of government agencies and private companies search for digital images using each department as a method to transfer all important data. These online images are not secure. Therefore, it is necessary to protect the image. With the rapid growth of digital communication and multimedia application, security of storing image and its transmission is a big issue for the current system. Cryptography is a way to give high data security. Images are used in many areas, such as medicine and military science. The latest encryption technology provides technology to protect information and multimedia data. In recent years,

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cryptography technology has evolved rapidly and many image encryption methods are used to protect sensitive image data from unauthorised users or system.

Many fields, like medical industrial, research, and military, are sharing information mostly in form of images. So, many images are transfer through the Internet which is highly insecure so that it is very important to provide a proper security approach that can secure data unauthorised users. The advantage of this paper is to protect and secure different types of multimedia information. Main aim of proposed approach is to provide image security system which supports image integrity, confidentiality and originality because of this we can send and save images online.

Encryption is the most effective way, but if we use large amount of grey-level data, security issues is again appear [4].

2 Arnold's Cat Mapping

Arnold's mapping is based on two-dimensional matrix conversion. In this mapping function, one point changes to another point in a plane without any changing in information. Let (x, y) is the unit function of a plane Z . This mapping function changes the point (X, Y) to point (x', y') using the below written Eq. [1].

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} \bmod 1 \quad (1)$$

Here, $N = 1$. Inverse transformation [1] is moving the pixels of the square digital image $I = [I(i, j)]_{N \times N}$ to (i, j) .

$$\begin{bmatrix} i' \\ j' \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} \begin{bmatrix} i \\ j \end{bmatrix} \bmod N \quad (2)$$

Arnold's forward and inverse mapping function work in a periodic manner. The number of iterations needed to restore the image can be $< N^2$. Arnold's period's linear approximation is shown in Eq. 3, as in [1].

$$\begin{aligned} T' &= 40.8689 + 1.4938N \\ 2000 &\geq N \geq 2 \end{aligned} \quad (3)$$

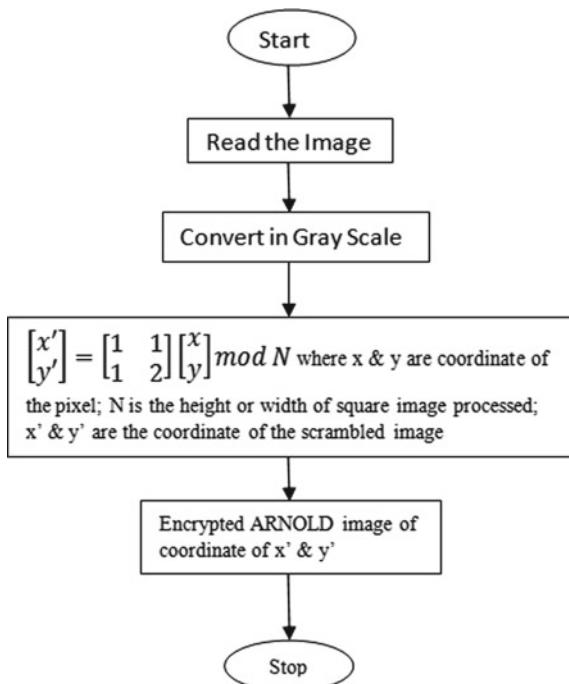
According to Arnold's concept, the encode of the Arnold's cat mapping algorithm is the safeguard of the image without reducing the value or information of an image. It is good enough to provide security to the pixels of the images. Encoded image compared with initial image ("chao") which means that random mapping function is more efficient. Arnold's conversion is used to increase image protection.

Figure 1 depicts the basic flow chart of the image using Arnold's mapping.

Using the Arnold's Cat Mapping

Arnold's mapping first to encrypt images and then secured the images using image encryption techniques. Figures 2 and 3 show final result of image transformation.

Fig. 1 Flow chart of randomisation of image



Original Image



After Arnold Transform

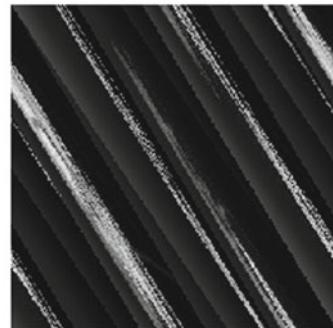


Fig. 2 Initial image and randomised image after applying Arnold's cat mapping

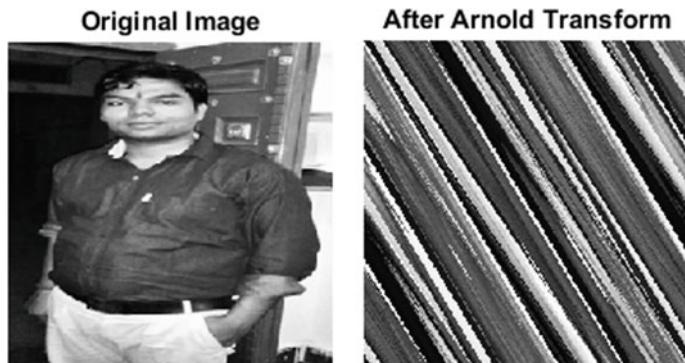


Fig. 3 Initial image of person and randomised image of person after applying Arnold's cat mapping

3 Asymmetric RSA Algorithm

RSA is known as asymmetric cryptographic algorithm where it uses two keys as it is asymmetric (public and private key). In this process, public key is available for every receiver but the private key is only available for the user who is at decoding end. Factorization of a large number is a key terminology of RSA. Public key consists of multiplication of two large prime numbers. Private key is also only derived from the same two prime numbers hence this process can create more difficulties for unauthorised users.

RSA algorithm is one of the most commonly used in digital image security or encryption. Encryption is one of the best ways to protect data or images while using internet. Once initial image is encrypted, no one can see the initial image, only after decrypting the encrypted image, for again finding initial image decrypting is needed of encrypted image.

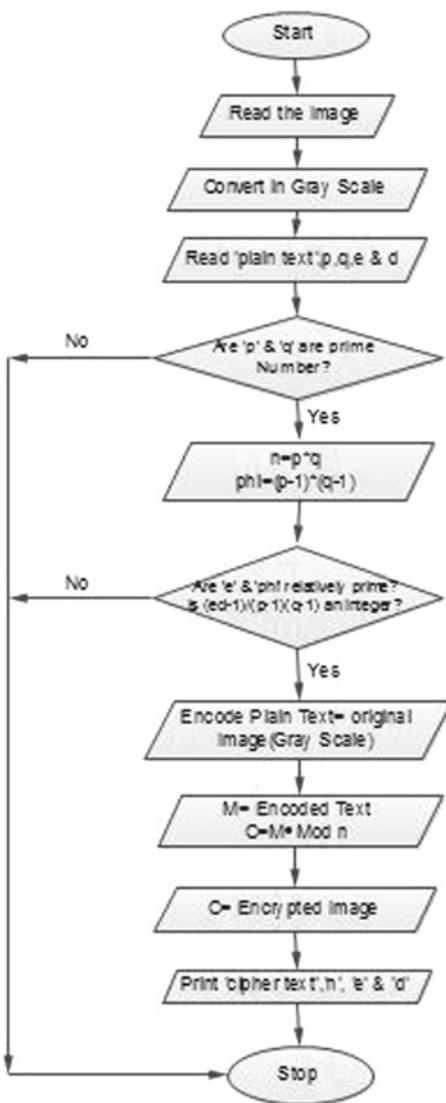
Basic flow chart of image encryption using RSA (Figs. 4, 5 and 6).

4 Proposed Image Encryption Technique

RSA algorithm is the asymmetric cryptography algorithm where asymmetric means that it works on two different keys, i.e. private and public here decryption key kept secret so that receiver can easily trusted onto sender. One more advantage of RSA is difficult to decrypt images because this algorithm includes a second private key which is difficult to reproduce by unauthorised user. Using permutations or hacking attempts by one or the other, can get a decryption key, which is almost the same as the original key. It can exit and decode 65–85%. Then, it is possible that image can be decrypted (obtained original image).

So that to increase this percentage, we are using Arnold's cat mapping algorithm, is the safeguard of the image without reducing the value or information of an image that

Fig. 4 Flow chart of RSA algorithm



means image data is secured and this is one of the best advantages of this algorithm hence it is easy to provide more security to the image pixels.

The random function is one important part of Arnold's algorithm which may lead unauthorised user to understand original images 75–85% before applying inverse function, so for safety, we should always try to increase the complexity of the image so that it will become more confusing for the unauthorised user.

The flow chart of the proposed new method is shown in Fig. 7.

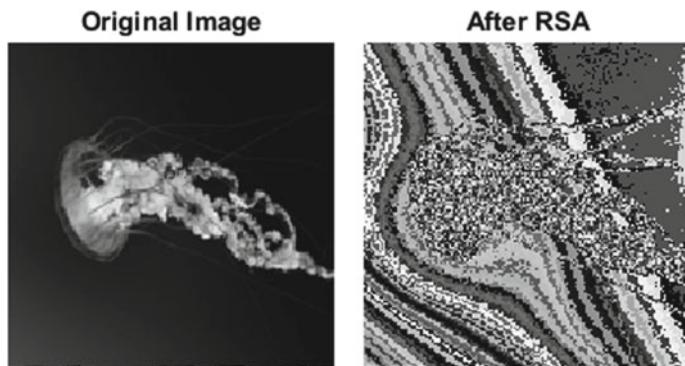


Fig. 5 The original image and encrypted image using the RSA algorithm

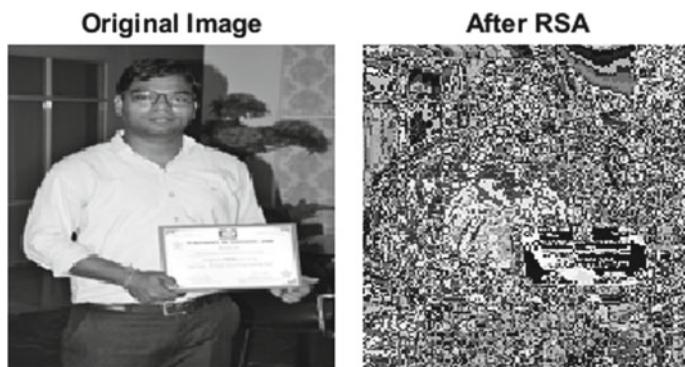


Fig. 6 The original image and encrypted image of a person using the RSA algorithm

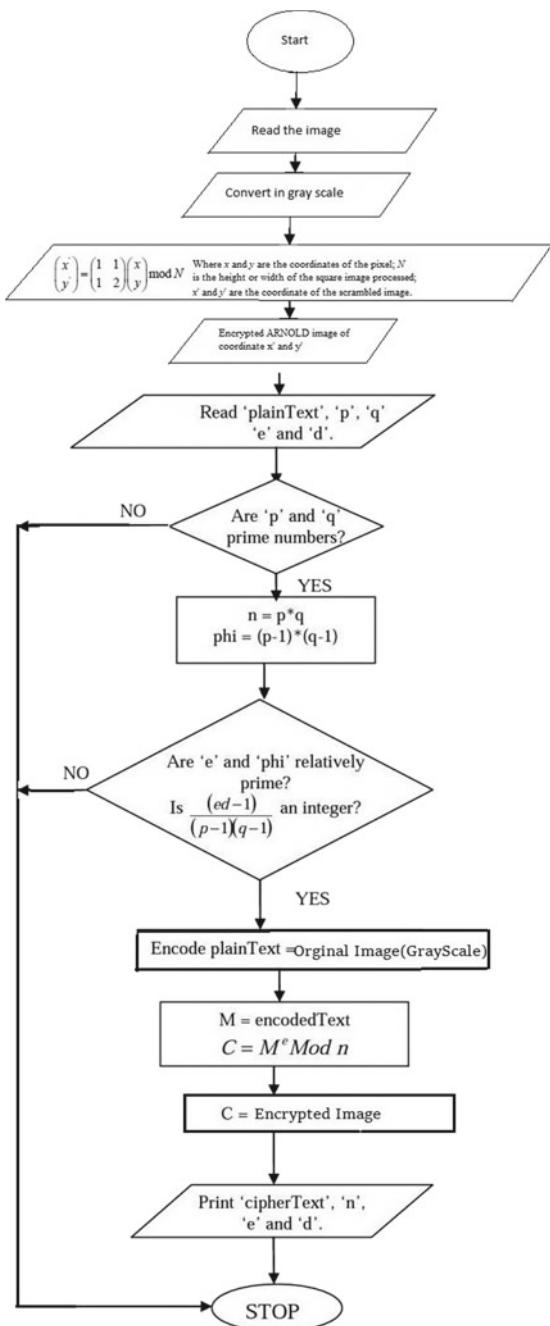
Therefore, the proposed method uses Arnold mapping and asymmetric RSA algorithm. The final results of using proposed image encryption method are shown in Fig. 8.

5 Conclusion

This paper includes our proposed technique presents the various analyses of image encryption and decryption using Arnold's cat mapping algorithm and asymmetric RSA algorithm.

RSA algorithm is the asymmetric cryptography algorithm where asymmetric means that it works on two different keys, i.e. private and public here decryption key kept secret so that receiver can easily trusted onto sender. One more advantage of RSA; i.e. difficult to decrypt images because this algorithm includes a second

Fig. 7 Proposed algorithm's flow chart



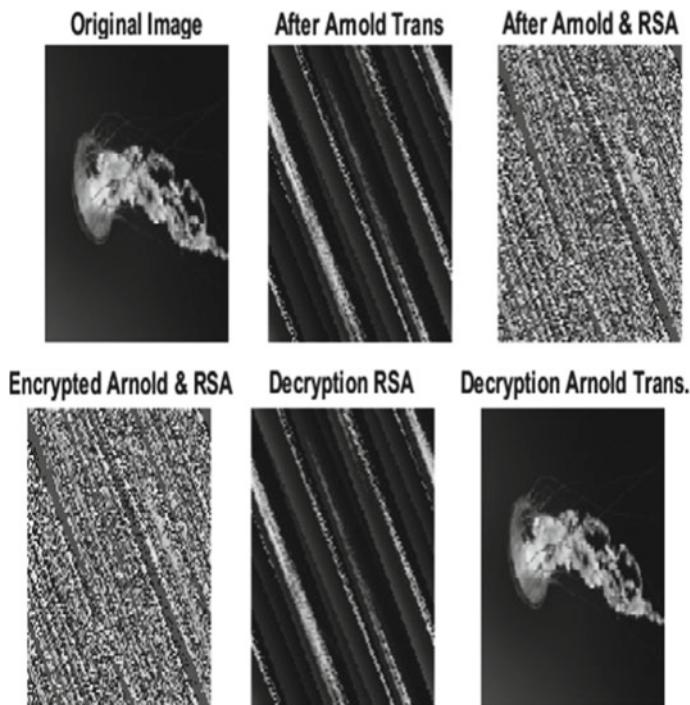


Fig. 8 Arnold's mapping and RSA algorithm for image encryption and decryption

private key which is difficult to reproduce by unauthorised user. Using permutations or hacking attempts by one or the other, can get a decryption key, which is almost the same as the original key. It can exit and decode 65–85%. Then, it is possible that image can be decrypted (obtained original image).

So that to increase this percentage, we can use Arnold's cat mapping algorithm, is the safeguard of the image without reducing the value or information of an image. It means image data is secured and this is one of the most advantages of this algorithm. so that it is good enough to provide security to the pixels of the images. The shuffling function is the one important part of Arnold's algorithm which may lead unauthorised user to understand original images 75–85% before applying inverse function, so for safety of we should always try to increase the complexity of the image so that it will become more confusing for the unauthorised user.

This concludes that the suggested new method (Arnold's cat mapping and RSA algorithm) is the more secured or provide a reliable image with minimum quality losses in the original the image.

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An Overview to Automated Home Based on Internet of Things



Pinki Yadav, Anamika, Aditya Srivastava, and Swadesh Deepak

Abstract Automated home is a process of digitizing the home appliances based on the Internet of Things (IOT) and smart phones. Nowadays, smart phones are accessible to almost everyone, and technology is also growing rapidly and getting advanced at high pace. It makes people's living easier and comfortable. It is boon to the older and disabled people in case of emergency. Automated home technology can be used to integrate almost all appliances of a house. It saves not only the efforts of individuals but also time and energy. This paper gives the complete workflow of automated homes using an Internet of Things-based network. The standards of human's comfort in homes can be categorized into several types. The most significant are the thermal comfort followed by the visual comfort. The system will be monitored through an embedded web server using mobile applications so that they can be controlled from anywhere. Devices that can be controlled are lights, fan speed, light color changing. The control over home appliances is achieved by using a bluetooth module (HC-05).

Keywords Arduino · Raspberry pi · Bluetooth (HC-05) · Internet of Things (IoT) · Wi-fi · Automated home · Smartphone

1 Introduction

The Internet of Things (IoTs) can be used to connect everyday objects such as smart phones, Internet TVs, sensors, and actuators to the Internet where the devices are smartly connected together allowing for new ways of communication between things and people, or even between things themselves [1].

Automated home is a mechanism focused on the IoT and smart phones to digitize home appliances. Figure 1 shows a sample of automatic homes. Home automation is house, household activity, or housework automation. It refers, to the use of

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Fig. 1 Automated home system

computer/IT to control home e-appliances. It combines electrical equipment to each other in a building. This may include centralized control of lighting equipment, door lock protection to provide enhanced convenience, comfort, resources, performance, and security. In recent years, acceptance of home automation has increased considerably due to substantial affordability and accessibility via smartphone and tablet access. Home automation methods include those used in building automation, as well as domestic operation monitoring such as lighting control systems, and the use of other electrical appliances. Devices can be linked via a home network to allow remote Internet access and personal computer control.

Through integrating IT with the home environment, devices and equipment can connect in an integrated way that results in comfort, energy conservation, and safety benefits. Much progress has been documented with the passage of time in the field of home automation in connection with control and connectivity, security, entertainment, energy management, appliances, and comfort, and lighting. Data-wise growth can be seen in Fig. 2 which pictorially involves all of these entities [2]. The automated home system software has to meet the specifications for home conditions assessment, instrumented data processing, and home appliance control. The method uses sensors enabled by microcontrollers to measure home conditions, and actuators enabled by the front end microcontroller to monitor home appliances [3–6].

This paper illustrates the circuit design of automated home and protection devices, using the credit-sized device Arduino Node MCU. Arduino Node MCU provides a mini computer with the features, in addition to its input–output pins, where other components and devices can be connected. Arduino Node MCU Input–output registers are used for processing purposes. We need to build a power strip for easy connection to Arduino Node MCU input–output pins.

IoT describes a special, addressable network of interconnected objects around the world. According to Gubbi et al. [7], IoT is an interconnection between sensing

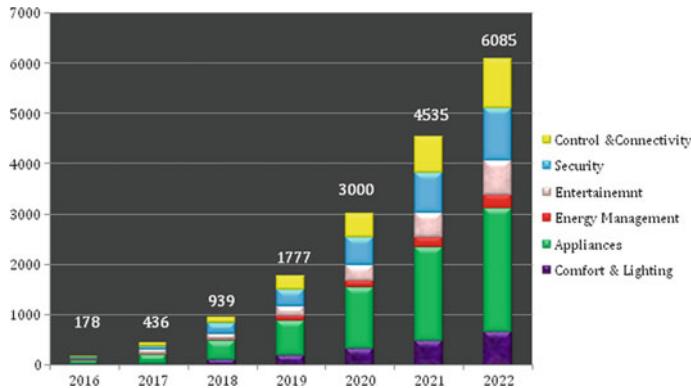


Fig. 2 Growth in automated home entities over time

and actuating devices which offer the opportunity to exchange information across platforms via a unified network, creating a shared operating picture to allow innovative applications. The Internet of Things therefore aims to boost one's comfort and efficiency, by allowing communication between smart objects.

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It presents automation systems design and implementation capable of monitoring and controlling home appliances via android phone or tablet [8].

In this paper, we present a detailed strategy to integrate state-of-the-art IoT (or near IoT) technologies into the automated home, taking into account both domestic energy management requirements and architectural issues and approaches focusing on data processing issues, networking, and interoperability features of the smart home protocol.

For this reason, we surveyed the IoT frameworks present in the literature, evaluated some state-of-the-art solutions and established problems for future study. The

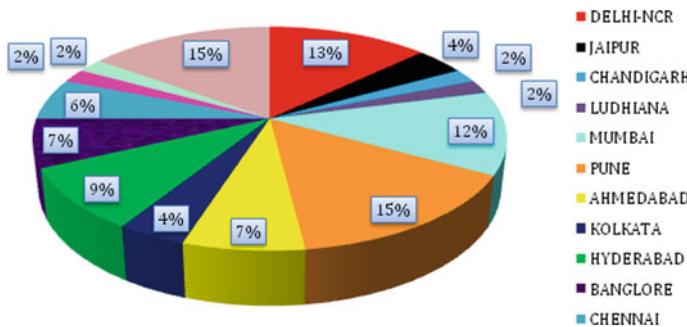


Fig. 3 Percentage-wise growth in home automation in different Indian states

automated home cycle also gets high attention and acceptance with fast speed in India. Nearly, all states have approved it and are collaborating with various mechanisms to its development [9].

Percentage-wise growth in automated home [11, 12] in different Indian states can be viewed in Fig. 3

2 In-Depth Analysis of the Literature

Day by day modern techniques are developed in the world for new changes in the automated home. There are various techniques for home automation [13, 14], which has been used worldwide till date. However, most commonly used are described here.

- Bluetooth-based home automation system
- Voice recognition-based home automation
- ZigBee-based wireless home automation system
- GSM-based home automation system
- An ocean-based home automation system.

Home Automation Using Internet of Things

Khatu and Kaimal [8] used IOT to present a paper on home automation. This paper focuses mainly on IoT coverage that connects various objects in the Internet, such as smart phones, tablets, digital cameras and sensors, and thus offers many services and huge amounts of data and information. Society needs modern and scalable, reliable and stable approaches to help handle larger, complexly networked stuff Internet.

Home Automation System Based on Bluetooth Using Cell Phones

Murali Krishna and Nayak [9] presented a paper about home automation systems based on Bluetooth. In home automation systems based on Bluetooth, the home appliances are connected to the Arduino BT board via relay at the input and output ports. Arduino BT board's program is based on the microcontrollers' high-level

interactive C language; the connections are made via Bluetooth. Protection of the password is provided, so that only authorized users can access the appliances. The Bluetooth connection is established for wireless communication between Arduino, BT board, and phone. The python script is used in this framework and can be mounted on all of the Symbian OS environments; it is portable.

Home Automation System Based on Zigbee Using Cell Phones

The system is designed and controlled using Zigbee to monitor and control the home appliances. The performance of the device is recorded and stored by network coordinators. It is used for this Wi-Fi network, which uses the standard wireless ADSL modem router for the four-switch port. The parameters of the SSID network and of Wi-Fi protection are preconfigured. The message for security purposes is first processed by the virtual home algorithm and is re-encrypted and forwarded to the home's real network computer when it is declared secure. The Zigbee controller sent messages over the Zigbee network to the edge. Safety and security of all messages received through the virtual home algorithm. Zigbee contact is helpful in reducing system expenditures and interference with respective system deployment.

3 Bluetooth-Based Home Automation Using Arduino

Bluetooth is favored because people nowadays still have their smartphones with them, because every smartphone has Bluetooth features in it, and it is simpler to use Bluetooth instead of remote IR or RF. Have anyone ever seen remote haulers?

Advantages of Using Bluetooth

- Secure connectivity
- It is very easy to use
- Suitable for short distances.
- App. easily available on smartphone.

4 Parts and Component

Parts and component used are:

- ATmega8
- ULN2803
- V-reg 7805 and LM317
- HC-05 Bluetooth module
- Most important is an android phone with blue control v1.0 or above installed on it.

5 Bluetooth Module

The Bluetooth module employed at this automated home is the HC-05 Linvor Bluetooth module. To build 3.3v performance for the Bluetooth module, we used LM317 IC v-reg with a 10 k-potentiometer ULN2803A IC in Darlington is an array of high voltage, high-current transistor modules.

Steps to Connect Bluetooth HC-05 to Arduino

- Connect Arduino's GNDpin to the breadboard bus strips and connect 5 V HC-05 module into it.
- Connect the HC-05 module to Arduino by inserting its 5 V and GND pins into breadboard bus strips.
- Connect a TXD pin to an Arduino RXD pin (Pin 0) on the HC-05 module.
- TXD on HC-05: It transmits Bluetooth transceiver data in signals format.
- Pin 0 on Arduino (RXD): Receives data in the form of Arduino bidirectional signals by connecting those pins; here, we create a bidirectional connection between Arduino and HC-05, so that we can switch the system on/off properly.
- First, because the receiver data lines on HC-05 are 3.3 V tolerant, Arduino's 5 V input signal needs to be transformed into a 3.3 V signal. With a bidirectional logic level converter, this can be easily achieved; we use a voltage divider to transform the 5 V input signal to a 3.3 V signal.
- Voltage divider: Connect 1 k ohm and 2.2 k Ω resistors through GND and TXD to Arduino, and we get the 3.3 V tolerant input directly from the two resistor intersection.

6 Checking/Project Validation

When connection between HC-05 module and Arduino is completed, power the Arduino with the 12 V DC supply/USB cable. If the red and blue LEDs on HC-05 blinks, then it means that Bluetooth module is successfully paired with Arduino. State pin on Arduino also shows the Bluetooth connectivity.

Setting Up the Relay Circuit

After configuring the setup on Arduino, the next step is to connect the load to the relay module, i.e., the lamp. The relay module acts as an electronic interrupter. We connect this in series, so that from the microcontroller module, we can open and connect the circuit. Now to wire Arduino's relay module up.

- Firstly, connect the 5 V and GND pins to the bus terminals on the breadboard.
- Connect the PIN 1 pin on the relay board with PIN 4 of Arduino.
- If you have a multi-channel module (2, 4, or 8 channels), then connect the relay module IN to different Arduino digital pins and repeat steps to set up other pins.

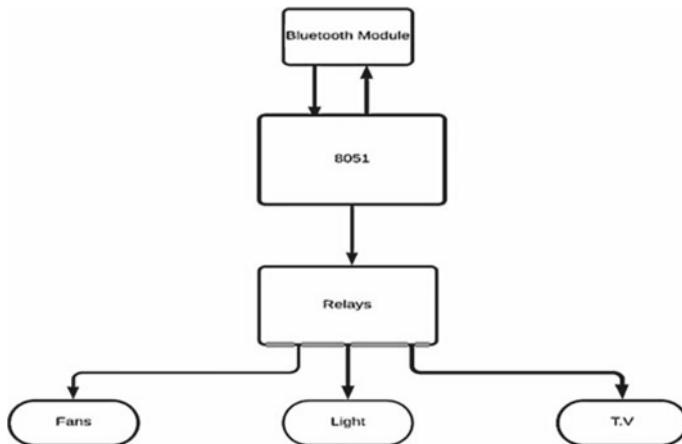


Fig. 4 Block diagram of automated home system

Now, the relay board and Bluetooth both are connected to the Arduino. Hence, the whole connection is established.

After the completion of all the steps, Bluetooth-based automated home is ready. The complete working process is illustrated in the block diagram of automated home system as shown in Fig. 4.

7 Edge (Fog) Computing

Edge computing is a solution which facilitates the processing of data at or near the data generation source. For example, the sources of data generation are usually objects with sensors or embedded devices in the sense of the Internet of Things (IoT). Edge computing serves as the decentralized extension of campus, cellular, and data center or cloud networks. There are several explanations for using this approach, but some of the most common ones are the saving of resources, reducing data volume, and reducing latency.

That method would lower the amount of data and prevent sending large quantities of raw data. Just metadata (data about the data) will be transmitted, instead. Reducing the number of transmissions between IoT devices is also very important to avoid problems with latency and the saturation of the wireless channels.

Big Data

The IoT-generated data comes in large quantities which is structurally variable and often arrives in real-time. Such quantities, velocity (not to mention variable veracity) allow the solution for storage and analytics, which will deliver valuable insights. The IoT Cloud would allow long-term storage and complex data analysis. The task of managing big data [10] is a crucial one, since total efficiency is proportional to

the data processing service's assets. Until now, however, there is no clear solution to Cloud's big data management security and privacy.

One of the most critical concerns about the evolving requirements facing the implementation of the smart grid is cyber security. The smart grid may be a trap for cyber criminals, which for network designers arises as a crucial concern. In order to provide authenticity, integrity, and confidentiality, different approaches that provide safety lightweight crypto-primitives should be investigated because of the way in which data is transmitted.

8 Conclusion and Future Scope

This paper deals with the vision of residential buildings shifting toward modern households that would be a passive evolution of the household. They should have their own solar panels and small wind turbines to generate their own electricity, so they could buy/sell electricity from/to the smart power generated. It would be inevitable to need IoT-based applications for automated homes, as smart devices are projected to become omnipresent both on the market and in consumer household over the next few years. In this paper, a methodology is established using different search queries to select the most important papers from the literature addressing this subject. Selected papers were semantically divided into two major categories: Wireless Sensor Network (WSN) solutions and IoT concepts. Given the fact that WSN is the main technology which allowed IoT to evolve, it was somewhat anticipated. This paper addressed the concept to the automated home by combining IoT with Web services and Cloud computing. This approach includes embedding information into sensors and actuators using the Arduino framework to allow interactions with smart devices utilizing Cloud technology to facilitate fast access at different locations and improve data sharing productivity. The methodology has been widely used to show household conditions assessment services and to track home appliances. The system may be deployed or adapted to other uses.

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A Review of Plant Diseases Identification Using Deep Learning



Pooja Sharma, Amit Kumar Gupta, and Rahul Chandra Kushwaha

Abstract Smart farming signifies the application of modern information and communication technologies (ICT) into agriculture; plant disease is a threat globally as it reduces the quality of food as well as harmful to health also. To overcome the problem, an automatic detection of diseases is needed that can prevent plants or crops from it by analyzing at early stage and on other hand taking precautions at plantation stage so crop will not have effected by diseases. For easy implementation, deep learning technique is used. DL learns by itself from environment without having human expert. In this survey paper, various deep learning approaches and models been reviewed in recent research papers of plant diseases identification and classification.

Keywords Classification · Convolution neural network · Deep learning · Plant diseases · Smart farming

1 Introduction

Food safety is an important aspect for global scale from health issues as per fulfillment of production verses demand; it has estimated that due to the continuous increase in the human population, food demand would continue for the next 40 years. Data analysis shows that by 2050, there will be more than 70% more requirement of food to fulfill human needs. However, agriculture production is continuously decreasing due

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to large loss in farming by using chemical pesticides. Due to pathogenic infection, loss of crop yield occurs in between 20 and 40% [1].

Accurate diagnosis of plant diseases has been an important challenge. Plant disease called as the loss of the general condition of a plant that interrupts or modifies its important functions. Types of plant diseases that arising from plant living organisms are biological [2]. A biotic, on the contrary, created by nonliving ecological conditions such as hail, spring frost, weather conditions, burning of chemicals, etc.

Smart farming represents the application of modern information and communication technology (ICT) in agriculture, which is a pioneer in the field of a third Green Revolution. Demand for smart technologies like big data, cloud-based services, GPS, Internet of things (IoT) sensors, cameras, drones, robots and so on distributes farming that is more productive and IoT is accelerating in the agricultural industry. In recent years, with the implementation of computer added techniques like image processing, pattern recognition and machine learning performed well in many application areas. These techniques are based on handcrafted features. To automatically diagnose crop diseases, deep learning models convolution neural network are very effective in feature learning that automatically extract features from raw data [3]. It can solve various complex problems [4].

2 Problem Statement

Traditionally, plant diseases identified by visual observations through eyes. However, this requires constant monitoring of experts who can be prohibitively expensive in large fields. When it identified, at that moment crop is infected 1020%. Identification of crop disease using automatic techniques at initial stage prevents crop deficiencies and increases production as well as it must be farmer-friendly (no need of farmer training). So automatic identification and classification are needed of plant diseases.

Present review of plant diseases identification is helpful to analysis how deep learning is useful to automatic identification of diseases. It also shows the required steps to compute image-based large dataset before applying deep learning-based CNN models like dataset preparation, data preprocessing, data augmentation, setting hyperparameters for training and testing. It also shows kind of software and hardware used by various authors required for deep learning-based CNN models. It also shows different models of CNN like learning from scratch and transfer learning for identification of diseases. This review paper also investigates recent and future research possibilities in the field of plant diseases identification using deep learning.

3 Literature Review

Mohanty et al. [5] presented a method of using publicly available dataset and implemented deep learning models using smartphone application on larger scale. They

used color, gray and segmented images of dataset and trained AlexNet and GoogleNet from scratch and transfer learning. They used different variations of training and test sets. Authors have identified the limitations and future scope of proposed model also [5].

Sladojevic et al. [6] proposed a model that can classify 13 dissimilar kind of plant diseases from leaves, having capacity to differentiate plant leaves from their overall area with deep neural network. Authors have created their own dataset of images and then they applied suitable data augmentation. Fine-tuning has not shown significant changes in the overall accuracy, but augmentation process had greater influence to achieve respectable results [6].

The survey of deep learning in plant diseases identification and classification conducted in view of the following research points.

3.1 Data Sources

In survey of research papers, most of papers used dataset is plant village that is publicly available [7–11]. One of the authors used AI Challenger Global AI Contest (www.challenger.ai) for the analysis of his research [12]. By collecting public dataset of 4,234 images, an author used radiance camera with support of University of Southern Denmark [13]. Using IOT datasets are collected using different electronics equipment's like camera, autonomous spray robots, pinking robots for deep learning in a smart farming process [14]. Another research used tea leaf images for analysis that are collected manually using camera; total of 3810 samples are collected [15]. Using Google websites and open sources, around 3060 samples collected for maize leaf diseases identification [16].

3.2 Data Variation

To classify features and characteristics data variation is applied so that classification can be accurate. Data variation is based on learning through healthy and unhealthy samples from dataset. Such as for tomato crop, an author identified six diseases from village plant dataset [7]. Similarly, nine diseases of different plants are identified using 45 severity estimation and 27 from healthy and diseased plant classification [12]. Rice plants are classified by considering three classes as normal, unhealthy and golden apple snail infested [17].

One author used variation of 25 plants for preparing 58 classification set of plant and disease that is combination of 80–20% ratio of healthy plants for training the system and another for testing sets [18].

3.3 Data Pre-Processing

Much of the related work involved some preprocessing steps of images, before the image be taken out as input to the DL model. The most common pre-processing process to suit the needs of the DL model was image size, which is small in most cases. The sizes of 256×256 , 128×128 , 96×96 and 60×60 pixels were normal. Image segmentation was also a popular practice.

3.4 Data Augmentation

Data augmentation techniques used to enlarge artificially the number of training images so the model served with varied data and translations- horizontal reflections of training images. Another way of data augmentation is to add external disturbances like Salt-Gaussian noise, brightness or saturation changing, making images blur or deformation, cropping or rotations along with selecting particular part or size of testing images [12, 17, 19].

Thus, it has obtained a dataset composed of 711 images for training dataset, such as random mirroring and rotation, as well as randomized changes in image brightness, image transforms: resize, rotate, flip, scaling and histogram equalization [19, 13]. Author proposed geometrical transformations and intensity transformations contrast and brightness enhancement, color, noise [15, 16, 18].

3.5 Technical Details

Almost all papers were used convolution neural network as deep learning model (11 papers, 55%). The learning was from scratch and transfer learning from pretrained model. AlexNet, VGG16 and Inception-ResNet and Google Net were used by many authors. Some authors have developed their own CNN models like PD2SE-Net50 [12], high-order residual CNN [8], CropDeep including VGG16, VGG19, SqueezeNet, InceptionV4, Densenet121, Resnet18, and Resnet50 [14], CNNs model named Leaf Net [15], CNN autoencoder [9] are some samples that are used by different authors to implement CNN.

Regarding the framework used, all the work that employed some famous CNN architecture also used a DL framework, in which MATLAB 2017 is most popular (5 papers), keras/tensorflow (2 papers) and caffe (2 papers). PyTorch Framework (1), Torch Framework (1 Paper) studies divided their datasets between training and test/verification data using a ratio of 80–20 or 90–10, respectively.

The Adaptive Moment Estimation (ADAM) optimization algorithm is an extension to stochastic gradient descent that has seen broader adoption for deep learning

applications, procedure to update network weights iterative based in training data [9, 10, 12, 20].

A common transfer learning technique is the use of pre-trained CNN; this method was followed by [7, 11, 17, 20–22]. As the networks get large dataset, accuracy gets saturated of CNN and then decreaseS rapidly. Residual Learning followed in [8, 11].

3.6 Performance Metrics

Classification accuracy (CA) is refers to as “DL performance.” CA was the most common metric used in all the papers. On the scale of performance out of 24 papers, 19 papers included CA as a metric with the accuracy of above 90%. Other metrics were F1, precision and support. Performance table attached for comparison of all papers.

Recent Work In plant disease identification, recent work is focused to increase model accuracy over real-time dataset, as model performs better on training and test set. Many authors are trying to best identify features of diseased leaf by applying various visualization techniques for intermediate layers of CNN. Many authors developing method to overcome limitation of deep learning, i.e., large dataset by exploring data augmentation.

Geetharamani et al. [23] proposed a method to identify leaf diseases of plants by applying nine layers of deep convolutional neural network. Authors have used PlantVillage dataset for training and validation purpose. Proposed approach compared with other transfer learning approaches; various hyperparameter settings were applied to get 96.46% accuracy. In future work, other plants parts such as flowers, fruits and stems can be used for research [23].

Toda et al. [24] identified the problem to visualize the features of diseased leaf so they have compared various visualization methods like to show hidden layers output, visualization of features, semantic dictionary and output of attention layer. To extract features of leaf semantic directory is used to classify diseased images. The work can be used to better understand plants for expert of biology [24].

Arsenovic et al. [25] focused on the current limitation of less dataset for training and validation and proposed own dataset of 79,265 images. Authors have proposed novel two-stage architecture object detection and CNN for plant disease identification. The dataset was collected under real-time conditions to avoid problem of over fitting. Conventional methods of data augmentation were compared with generative adversarial networks. Authors proposed to develop a mobile application and provide extensive solutions [25].

Lee et al. [26] compared various transfer learning CNN models on PlantVilage dataset like VGG16, Google Net (34layers) and InceptionV3 (48 layers). Here, VGG16 model has shown better accuracy to verify new data. In future work, they proposed to create more diversified plant disease database in real-time environment [26].

Goncharov et al. [27] developed own dataset called as PDD and applied Softmax regression with single-layer perceptron. They compared accuracy of data on already available mobile application with their own developed mobile application to identify plant diseases. Finally, they got classification accuracy as 95.71% [27].

Li et al. [28] proposed method for rice plant diseases and Pests Video Detection by using faster-RCNN. Authors have created their own dataset of images and videos for training in this process first video was converted into still frame then finally synthesized the frames into video. The proposed approach is more applicable to identify plant disease in untrained rice videos [28].

Sun et al. [29] proposed plant diseases identification using over own created dataset of lesion citrus canker and synthesized plant lesion leaf image by that accuracy got improved. Authors have applied various methods to improve enhancement of image by using image pyramid and edge-smoothing algorithm [29].

Karthik et al. [30] proposed method to identify disease in tomato leaves from PlantVillage dataset; first they learned features using residual learning, then they applied attention mechanism and finally resulted accuracy of 98% in fivefold cross validation [30].

Yang et al. [31] applied segmentation techniques for recognition of rice lodging identification in multi-date UAV visible images based on FCN-AlexNet, and SegNet two deep learning-based semantic segmentation networks [31]. Lia et al. [32] compared deep learning models to identify crop pest in real-time environment and shown that GoogleNet model resulted best accuracy [32]. Giménez-Gallego et al. [33] compared SVM and deep learning models to identify multiple tree leaves images and observed that deep learning models have outperformed [33].

4 Results and Discussion

Most of the papers have used publicly available datasets as mentioned in data sources in table; many authors have generated their own datasets by various methods. Data divided into various classes by labeling the datasets into healthy and diseased. As deep learning models need large amount of data for training purpose for better classification results. Various techniques discussed for data augmentation to increase the size of datasets.

In many of the papers, authors have used transfer learning for training the deep learning models. It has shown that transfer-learning models were giving more accuracy than end to CNN models.

Authors have checked the network accuracy by changing the hyper parameters at different learning rate. It has shown in papers that capacity to execute feature engineering on its own. Main limitation of deep learning technique is its training dataset as it needs large dataset for training. There is requirement of millions of training samples for precise results and further learning from environment [13].

There are some challenges like due to lack of availability of good GPU, training time was very big, but using high-speed GPUs, this can be resolved. Work for other

plants and plants can be increased so that a wide range of diseases of common plants can be covered, which will be more favorable in agriculture to increase productivity.

As recent work shows authors now focusing to identify and visualize individual features of leaves so that diseases prediction accuracy can be increased. Authors are also applying exploring data augmentation methods to overcome the limitation of deep learning. Earlier research was focused to identify diseases from leaves, now a time more research is conducting to include all parts of plants.

Current research is also focused for general mobile application that can help farmers to automatic identify the kind of diseases with accurate classification. Smart farming is definite option to increase the overall productivity of agricultural farms by development of smart mobile applications, farm monitoring system, early disease and pest detection. Industrial IOT-based smart solutions helping farmers to resolve various real-time problems like climate conditions, weed detection, crop monitoring system.

4.1 Conclusion

The paper conducts a survey of plant diseases identification through deep learning approach. It has observed that they focused on various domains like data source, data preprocessing, techniques for data augmentation, technical details of papers and performance matrices. Paper also compared deep learning models with other models also. The findings of the survey are to show case deep learning models give best results as compared to other popular image processing techniques.

5 Future Scope

All the datasets are available and some need to be collected for current analysis. As various techniques used for analysis of different issues for plant diseases, farmer needs a single point solution for all problems. Artificial intelligence is widely used for all kind of solutions due to its versatile property of learning from environment. CNN technique mostly implemented to develop such a solution. Creating a smartphone application for farmers and experts automatically identify the disease as they upload to, age in application, it could give the classification of diseases and its prevention in early time (Table 1).

Table 1 Comparative review of papers on the basis of identified parameters and issues

S. No.	Author (1)	Problem description	Data	Classes and labels
1	Rangarajan et al. [7]	Crop disease classification	PlantVillage dataset	6 different diseases and healthy samples
2	Liang et al. [12]	Automatic plant disease diagnosis	AI challenger global AI contest	Nine diseases of different plants are identified using 45 severity estimation and 27 from healthy and diseased plant classification
3	Zeng et al. [8]	Fast and accurate recognition of crop diseases	PlantVillage and AES-CD9214	6 different classes species
4	Atole et al. [17]	Rice plant leaves classification as per healthy status	227 rice leaves images	Rice plants are classified by considering three classes as normal, unhealthy and golden apple snail infested
5	ArnalBarbedo et al. [19]	Automatic identification of plant diseases	Different sensors	On the basis of diseases as fungi, viruses, pests, bacteria, phytotoxicity, algae, non-nutritional and senescence having 77%, 8%, 6%, 3%, 2%, 2%, 1% and 1% respective variations while identifying 171 diseases with 21 plant sample datasets
6	Kaya et al. [21]	Transfer learning for DNN-based plant classification	Flavia and Swedish Leaf UCI Leaf dataset, Plantvillage dataset Flavia and Swedish Leaf 54,306 images	132 type and 1900 images 15 tree classes 40 types of plants 43 images 14 type of plants and 38 classes (healthy diseased)

(continued)

Table 1 (continued)

S. No.	Author (1)	Problem description	Data	Classes and labels
7	Coulibaly et al. [22]	TL in millet crop images	ImageNet	2 classes consisting in analyzing the presence or the absence of mildew
8	Barbedo [34]	Factors influencing the use of deep learning for plant disease recognition corn diseases	Freely available	171 diseases determining 21 plant species
9	Wang et al. [20]	TL implementation for automatic image-based classification of crop disease	Author defined	2430 number of diseased images of cucumber and rice, 8 classes of labels
10	Picon et al. [35]	Fungal infection crop disease classification in the wild	Wheat database	Wheat 2016 (W-2016) Rust 3338 Septoria 2744 Tan 1568 Spot 1116 Other/Healthy 8178 Total 8178
11	Attique Khan et al. [36]	Poor visual quality of input image	Plant Village CASC IFW	Apple fruit, 2 types of disease are selected with healthy images. 4 types of banana diseases are selected
12	Polder et al. (2019) [37]	Virus diseases are of high concern in the cultivation of seed potatoes	Author defined	Na
13	Alimboyong et al. [13]	Classification of plant seedling images using DL	Using a public dataset of 4, 234 plant images	Na
14	Ferentinos et al. [9]	CNN models were developed to perform plant disease detection	Open database of 87,848 images	Containing 25 different plants in a set of 58 distinct classes of [plant, disease]

(continued)

Table 1 (continued)

S. No.	Author (1)	Problem description	Data	Classes and labels
15	Khamparia et al. [18]	Detect crop diseases with the help of CEN using crop leaf images	Plant village dataset	6 classes diseases and healthy leaves 3 crops: potato, tomato and maize
16	Zheng et al. [14]	CropDeep: the crop vision dataset for DL-Based classification and detection in precision agriculture	Various equipment including cameras of IoT, autonomous spray robot, autonomous pinking robot, mobile cameras, and smartphones	31 categories according to the agricultural biological taxonomy proportions make up the imbalance pro
17	Chen et al. [15]	Develop a deep CNNs to identify tea plant disease types from leaf images	Manually photographs 3810 tea leaf images	Seven different diseases
18	Zhang et al. [16]	Three-channel CNN for vegetable leaf disease recognition	Plantvillage tomato leaf database	8 kinds of diseases
19	Zhang et al. [16]	Identification accuracy of maize leaf diseases and reduce the number of network parameters	The plant village and google websites, including different periods of occurrence of maize leaf diseases	9 categories. 8 infected and healthy maize leaves
20	Khandelwal et al. [11]	Analysis of transfer and residual learning for detecting plant diseases using images of leaves	Plant village dataset	25 crops across 57 classes (healthy and specific diseases). Banana, tomato, cassava
S. No.	Data pre-processing	Data augmentation	DL model	
1	Dimension of 227×227 for the AlexNet model and 224×224 for the VGG16 net	Na	AlexNet and VGG16 net	
2	Na	Translations and horizontal reflections of training images, adding noise, changing brightness or saturation, blur or deformation in training images	ResNet50 network and the building blocks of ShuffleNet-V2	
3	Na	Na	high-order residual CNN Author defined	

(continued)

Table 1 (continued)

S. No.	Data pre-processing	Data augmentation	DL model
4	Resized into 227×227	Cropping and rotations	Alex Net deep network
5	Data segmentation	Zoom in and select the region of interest	GoogLeNet CNN using MATLAB
6	Na	Na	End-to-end CNN model, cross dataset fine-tuning, deep feature extraction
7	Na	Transformations, zoom, rotation, flip rescale	VGG16 model with ImageNet as source
8	Na	Na	CNN (GoogLeNet)
9	Resize $256 * 256$	Na	Author-defined CNN pertained Model, transfer learning
10	Segmented and labeled	Na	Deep residual neural networks
11	For stretching the contrast of input image	Na	VGG16 and Caffe-AlexNet
12		Such as random mirroring and rotation, as well as randomized changes in image brightness	Fully convolutional neural network (FCN)
13	Color space conversion and image enhancement, 54×54 to as much as 3991×3557	Image transforms: resize, rotate, flip, scaling and histogram equalization	convolution neural network
14	Size reduction and cropping to a 256×256	Na	AlexNet, GoogLe Net VGG
15	Na	Na	CNNautoencoder Python language using Anaconda Spyder tool
16	1000 * 1000 px size	Geometrical transformations and intensity transformations	VGG16, VGG19, SqueezeNet, InceptionV4, Densenet121, Resnet18, and Resnet50
17	Resized to 256×256 pixels	Flip horizontal, flip vertical, rotated 180, randomly cropped	Author defined A CNNs model named LeafNet
18	128 * 128 pixels	Rotating, skewing, interpolating, mirroring, adjusting contrast, and introducing slight distortion to the original images, and adding a noise	Author TCNN

(continued)

Table 1 (continued)

S. No.	Data pre-processing	Data augmentation	DL model
19	Images are resized	Rotating the images by mirroring each rotated image; by cutting the center of the image, and by converting all processed images to grayscale	GoogLeNet and Cifar10
20	Na	Na	Transfer learning residual learning CNN

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Evaluation of Digital Image Forensics



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Abstract The development of modern picture handling and altering programming has made the control of advanced pictures simple and impalpable to the unaided eyes. This has expanded the interest to evaluate the dependability of advanced pictures when utilized in wrongdoing examination, as proof in official courtroom and for reconnaissance purposes. This paper presents a complete examination of the advancement and difficulties in the field of computerized picture crime scene investigation to help the apprentices in building up the comprehension, catching the necessities and recognizing the exploration holes in this area.

Keywords Digital image forensics · Forgery · Image authentication · Tampering detection

1 Introduction

The turn of events and simplicity of accessibility of picture handling programming and picture catching gadgets along without hardly lifting a finger of availability of the Internet has expanded the vacillation in the genuineness of the computerized pictures [1–5]. Employments of advanced pictures as proof for dynamic or decisions and as help for a logical contention are models where not just responsibility for pictures is required to be set up; however, it is similarly critical to set up their legitimacy. Advanced picture watermarking and computerized marks have been utilized as dynamic strategies to reestablish the lost trust in advanced pictures [3]. These methodologies insert some self-verifying data in the advanced media with the goal of evaluating the legitimacy and respectability of the computerized pictures. Computerized picture watermarking has a place with the class of dynamic

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methodology [1–3] for picture crime scene investigation as it requires the information on the validation code and the strategy used to implant it into the picture. The concealed data is commonly indistinct and hearty against the greater part of the expected and unintended assaults like histogram balance, pressure, pivot, editing, resampling, sifting, expansion of commotion and so forth. In any case, a significant inconvenience of dynamic methods is that they require control of the first picture either during catching or during stockpiling. In addition, the need of producing the computerized mark or watermark before sparing the pictures calls for extraordinarily prepared picture catching gadgets. Consequently, the utilization of advanced marks and watermarking as picture criminological instruments is not generally embraced [3].

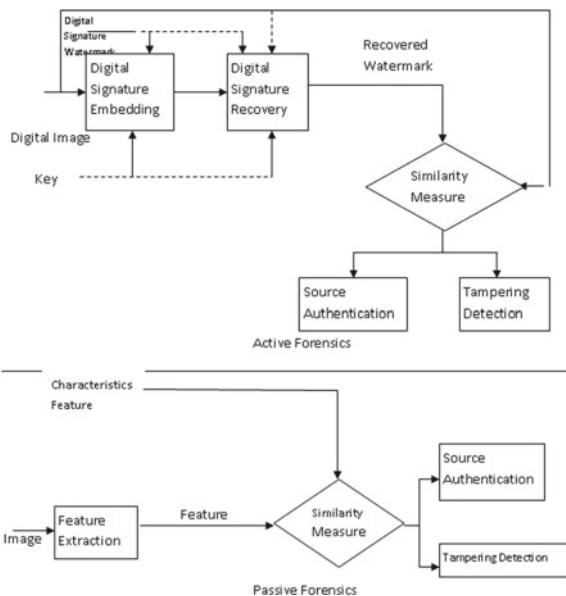
Rather, inactive computerized picture crime scene investigation [1–3] has been viewed as the arrangement with the essential goal of approving the realness of the advanced pictures by either recognizing altering or recuperating data about their history. The inactive confirming techniques are visually impaired as these do not require the information on the first picture, however depend on the way that the greater part of the picture catching gadgets and picture handling tasks present particular follows inside the picture for the most part alluded to as the fingerprints [4, 5]. Uninvolved computerized picture scientific strategies study fundamental fingerprints concerning the two significant working spaces [3]. The main area relates to source verification where the design is to distinguish the gadget utilized for catching the picture and recreate its age procedure. The second domain of advanced picture crime scene investigation is worried about the identification of altering to set up if the picture has been controlled and conceivably recognize the procedures in question. Duplicating a computerized picture without leaving any detectable follows is not so troublesome now with the progressed and easy to use picture handling and picture altering programming. Figure 1 portrays the nonexclusive dynamic and uninvolved picture criminological strategies.

This paper presents an inclusive report about the advancement and difficulties in the field of computerized picture crime scene investigation and is sorted out as follows: Sect. 2 explains the arrangement of pictures utilizing an advanced camera to comprehend the existence pattern of a computerized picture. Section 3 offers a portrayal of the examination planning to distinguish and validate the gadget used to gain a given advanced picture. Section 4 presents the major abused possibility of research in computerized picture legal sciences space that is altering recognition. At long last, Sect. 5 finishes up this paper and endeavors to distinguish significant difficulties around there.

2 Formation of Digital Images

An advanced picture life cycle [4, 6] can be spoken to in three stages: securing, sparing and altering. During procurement stage, the sensor controls the measure of light from the genuine scene falling onto the picture sensors, the shade speed decides

Fig. 1 Generic active and passive image forensic methods



the hour of presentation and the focal point get together centers the light beams to frame a rational picture onto the sensors [7]. Computerized cameras [4, 8] for the most part utilize either a charge-coupled gadget (CCD) or a reciprocal metal oxide semiconductor (CMOS) as picture sensor. Every sensor is made of light touchy diodes called photo sites that convert photons falling on it into electric charge corresponding to the power of the light. Every sensor catches the information for a solitary picture component or pixel in the picture. This will create grayscale pictures on the grounds that the sensors cannot recognize hues. As a rule, shades of a picture are spoken to as a blend of differing rates of the three essential hues red, green and blue. The shading data is obtained by utilizing a mosaic of the essential shading channels known as the color filter array (CFA) [8, 9].

The camera in this way changes over light into relative electrical charge comparing to a shading an incentive for every pixel. In any case, this change procedure is rarely great. For instance, polluting influences in the silicon wafers utilized for making the sensors make unmistakable examples in each picture which are vague to the natural eye. These examples are classified “photograph reaction non-consistency commotion,” which portray the advanced cameras dependent eager for advancement of the sensors utilized. To separate these fingerprints from those presented by the later phases of picture life process, they are alluded to as the sensor fingerprints.

3 Digital Image Forensics for Source Authentication or Identification

Computerized pictures can be caught by some advanced cameras or scanners and can be produced on PCs as well. Detached picture scientific strategies for source distinguishing work on the essential supposition that the fingerprints of the imaging sensors, in-camera preparing activities and pressure are consistently present in pictures [10, 11]. Recognition of camera explicit fingerprints distinguishes the picture catching gadget and legitimizes that the picture is not PC rendered. The two pictures having the equivalent in-camera fingerprints are decided to be taken by a similar gadget. The nonattendance of fingerprints in pictures recommends that either the picture is PC created or has been vindictively altered in this manner calling for picture trustworthiness confirmation. In light of the above suppositions, the distributed works are introduced in this segment as for two issues: right off the bat, to recognize the common and PC produced pictures; and besides, to distinguish the picture catching gadget if the picture is normal.

3.1 Natural or Computer-Generated Images

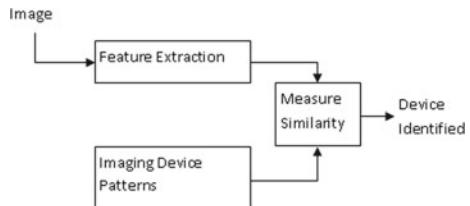
With the advancement in PC designs innovation, some of the time, PC created pictures are practical to such an extent that they are erroneously thought to be normal by human recognition. In any case, PC created pictures do not completely adjust to the common picture qualities on the grounds that the PC cannot completely incorporate the mind-boggling genuine marvels.

The work introduced in [12] utilizes direct discrimination analysis (LDA) and non-straight support vector machine (SVM) classifiers dependent on first-request and higher-request wavelet measurements to recognize the PC created and normally shot pictures. The picture is deteriorated into four-level distinct quadrature reflect channels to extricate the initial four-request measurements of the sub-band coefficients. For each shading channel of a picture, a 72-dimensional component vector of coefficients and mistake measurements is produced. The recognition precision of the proposed strategy with LDA classifier is 54.6% with low bogus negative identification pace of 0.8%. The non-direct SVM classifier indicated improvement in recognition precision and had the option to arrange roughly 66.8% of PC created pictures at the expense of expanded bogus caution pace of 1.2%.

3.2 Device Identification

Diverse imaging gadgets portray various fingerprints relying upon their physical equipment and in-camera preparing activities and different parameters bringing about

Fig. 2 Imaging device identification



various examples on the pictures caught. Figure 2 traces the essential procedure required for imaging gadget distinguishing proof. Accepting that the picture under test has been caught by one of the applicant imaging gadgets, its highlights are extricated. These highlights are then contrasted, and the trademark fingerprints of the competitor gadgets and dependent on some likeness measure the catching gadget is recognized.

4 Digital Image Forensics for Tampering Detection

Picture altering is a purposeful endeavor to include, expel or conceal some significant subtleties of a picture without leaving any conspicuous hints of the control [1]. The advanced pictures are for the most part altered by area duplication, picture grafting or picture modifying. Area duplication is likewise perceived as cloning or duplicate move assault, where specific locales from a picture are replicated, at times changed, and afterward glued to new areas inside the picture itself with the primary point of covering some unique picture substance. Picture joining then again utilizes chosen districts from at least two pictures to be glued together for delivering another picture. Another usually utilized altering activity is picture correcting, where pictures with low quality are adjusted for improved intrigue (Fig. 3).

Some scientific devices depend on factual peculiarities presented at pixel levels for recognition of cloning, resampling and joining, while some other are affected by measurable connection presented by explicit handling like JPEG or wavelet-based pressure [7, 13]. Some scientific devices depend on factual peculiarities presented at pixel levels for recognition of cloning, resampling and joining, while some other are affected by measurable connection presented by explicit handling like JPEG or wavelet-based pressure. These devices have a place with the class of pixel-based and position-based instruments individually. In the event that the picture securing gadget is known, altering can be recognized utilizing camera-based measurable procedures

Fig. 3 Forensics tools for different devices

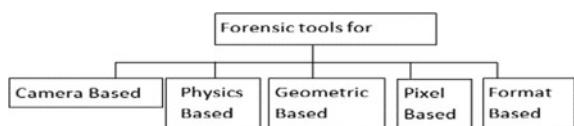
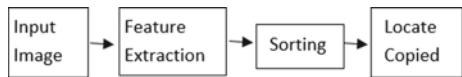


Fig. 4 Fabrication discovery

that identify consistency in camera explicit fingerprints by displaying and assessing diverse camera antiques like chromatic variation and camera reaction work.

Overviews and studies dependent on aloof visually impaired procedures for imitation discovery [2, 5, 14, 15] have concentrated for the most part on district duplication. Cloning is hard to be recognized on the grounds that the duplicated partition is exceptionally associated with the foundation. Control of the replicated locale by including Gaussian commotion, scaling, turning and utilizing JPEG pressure before gluing intensifies the location of duplicate move activity further. A decent cloning recognition strategy is relied upon to be powerful to these controls. General methodology broadly rehearsed by criminological specialists for identifying the duplicate move fraud is to partition the picture into covering squares and analyze the highlights of the squares. These methods are called square-based strategies. Discrete cosine transform (DCT), discrete wavelet transform (DWT) and principal component analysis (PCA) and so on have been utilized to distinguish the square element vectors in the earlier works. The fundamental way to deal with duplicate move fabrication discovery is appeared in Fig 4.

The fingerprints because of picture pressure are likewise investigated by the specialists as a device to identify altering. The histogram of discrete wavelet transform coefficients gives the fingerprints of set partitioning in hierarchical trees (SPHIT) pressure, investigated in [5] by paying special mind to any adjustment in them for compacted and uncompressed pictures.

5 Conclusion

The development of the imaging and technology, the exchange of images has turned into simple and widespread. But at the same time, the instances of manipulations in the digital images have also increased, thereby resulting in greater need for establishing ownership and authentication of the media. Digital image forensic researcher community is continuously attempting to build up technique for detection of the imaging device used for image acquisition, tracing the dispensation history of the digital image and locating the region of tampering in the digital images. These use different aspects to help image processing smoother and faster. The anti-forensic techniques surveyed in this paper aim for one of the above-said methods of compression at a time. JPEG compression is found to be countered widely based on two important artifacts introduced because of its lossy nature. First, due to quantization, DCT coefficients are closer to the multiples of the step size which is visible on the histogram of the DCT coefficients of the compressed image. Second, blocking artifacts introduce due to pixel worth discontinuities crosswise building block boundaries.

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Malarial Parasite Detection by Leveraging Cognitive Algorithms: A Comparative Study



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Abstract Malaria alludes to an infectious mosquito-borne malady brought about by parasite sort plasmodium transferred by female anopheles mosquito. In the host liver, the parasite duplicates itself and starts annihilating the red blood cells. The visual examination of disease is inspected by a magnifying instrument for diseased red cells. Doing diagnosis manually majorly relies on the pathologists with good skills and expertise, and reports may change in various laboratories. Another route around, many ML algorithms have been applied for the unconstrained location of blood spread. This paper features the headway in the field of ML and its useful applications in the discovery, distinguishing proof and finding of the malarial disease. This paper gives an insight of how transfer learning and deep learning is considered a prominent technique in computer vision, it is entirely possible to achieve certain rather good

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performance contrasted with other conventional ML algorithms that need a thorough feature engineering and complex information pipelines.

Keywords CNN · Image processing · Machine learning · Transfer learning · Malaria parasite detection

1 Introduction

Intestinal sickness called malaria is an irresistible and hazardous infection brought about by protozoan plasmodium parasite with at least a span of a week of the hatching time frame [1]. As indicated by the World Malaria Report in the year 2018, various malarial passing's, i.e., 435,000 were accounted [2]. The manual methodology of the conclusion is significantly tedious as it has various strides for leading the tests. In this paper, several deep neural network architectures are manufactured for the purpose of the detection of malaria in a more advanced way. We show that using transfer learning and deep learning, is considered a prominent technique in computer vision, it is entirely possible to achieve certain rather good performance contrasted with other conventional ML algorithms that need a thorough feature engineering and complex information pipelines as found in the writing [3]. Along these lines, this examination tends to the territory of a computer-aided malarial parasite detection frame work utilizing DL and ML techniques. The layout of the paper is intended as follows: Literature review is discussed in Sect. 2 Methods and materials are discussed in Sect. 3 elaborating the dataset and algorithms used. After that results, discussion and conclusion of this research article are discussed in Sects. 4 and 5, respectively.

2 Literature Review

Recently, researchers are showing great interest and capabilities in adapting complex patterns with images using deep learning techniques and so now it is being utilized for developing an automatic system for the diagnosis of malaria [4–6]. Using earlier traditional machine learning techniques, Diaz et al. [7] proposed a model to detect the infected stages and infected erythrocytes to classify images smeared blood applying support vector machine (SVM). Das et al. [8] used statistical techniques like SVM and Bayesian network for categorization which achieved the maximum precision of 84%. Krizhevsky et al. [9] 2012 demonstrated a structure that outperforms the pre-trained AlexNet model with custom CNN with an accuracy rate of 97.37%. Malihi et al. [11] utilized the Otsu thresholding technique to recognize four types of the malarial parasite and accomplished an exactness of 91% utilizing K-nearest neighbor classifier. Kumarasamy et al. [13] proposed a spiral premise bolster vector machines to decide the phases of parasite contamination and accomplished 86%

Table 1 Comparative study of malaria parasite detection

S. No.	Author	Method	Performance (%)
1	Diaz [7]	SVM	99.7
2	Das [8]	SVM and Naïve Bayes	68.91–88.51
3	Gopakumar [10]	SVM, CNN	93.82–98.50
4	Rajaraman [14]	Pre-trained CNN (ResNet)	0.992
5	Krizhevsky et al. [9]	AlexNet	97.37
6	Malihi et al. [11]	KNN	90
7	Memeu [12]	ANN	79.7
8	Kumarasamy et al. [13]	SVM	86

precision. The itemized outline of comparative study of malarial parasite detection appears in Table 1.

3 Methods and Materials

3.1 Data Collection and Preprocessing

Our dataset is collected from Chittagong Medical College Hospital, Bangladesh [15]. The set of data consists of a sum of 27,558 cell pictures with equivalent cases

**Fig. 1** Parasitized images and uninfected images**Table 2** Description of dataset

Total number of images	Parasitized images	Uninfected images
27,588	13,779	13,799

of uninfected and parasitized cells. To recognize intestinal sickness disease, parasite-infected platelets and non-parasitic platelets appeared in Fig. 1 segments. Table 2 gives an insight of dataset.

3.2 Algorithms/Techniques

The current work shows the comparison of classification of malaria using different ML algorithms and DL algorithms.

Logistic Regression. Logistic regression is among the popular algorithms used for making machine learning classification models. Mathematical expression:

$$\hat{y} = \beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n \quad (1)$$

where \hat{y} denotes the predicted value, x denotes independent variables and $\beta_0, \beta_1, \dots, \beta_n$ are the coefficients determined at the time of training [16].

Random Forest. It is formed by an assembly of many tree classifiers. The given input vector is classified based on the vote casted by each tree [17]. The Gini index:

$$\sum_{j \neq i} \left(\frac{f(C_i, T)}{|T|} \right) \left(\frac{f(C_j, T)}{|T|} \right) \quad (2)$$

where $f(C_i, T)/|T|$ is the probability that the choice of case related to C_i class.

Decision Tree. A supervised learning algorithm, DT, trains the model to predict the output class by learning some basic decision rules deduced from the training data. It calculates the information gain (IG) using the following formula:

$$\text{Information Gain} = \text{Entropy}(\text{before}) - \sum_{j=1}^K \text{Entropy}(j, \text{after}) \quad (3)$$

Naïve Bayes. This classifier is established on the popular Bayes's theorem. It is named so due to the Naïve assumption, often called conditional independence presupposition, that all the features are completely liberated of each other [18].

Convolution Neural Network. The last layer of network in CNN is fully connected, whereas the hidden layers may or may not be fully connected. In order to solve complex image recognition tasks, CNN is capable of reducing the number of parameters [19]. Figure 2 depicts CNN model architecture.

MobileNet V2. MobileNet is a design which is increasingly appropriate for Android and implanted-based vision applications where there is absence of computational power. It is a CNN model that consists of 53 deep layers and is open-source. Table 3 shows the tabular representation of MobileNetV2 architecture.

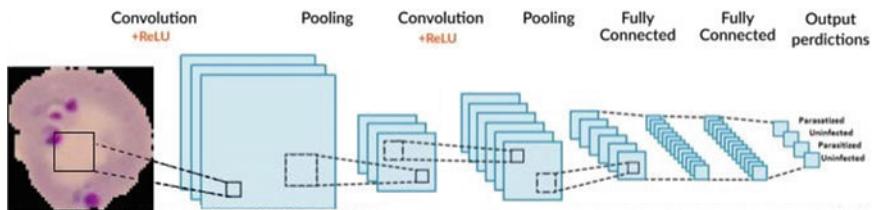


Fig. 2 Architecture of CNN model

4 Result Discussion

To evaluate the classification algorithm and techniques, Python 3.6 was used on the jupyter notebook environment. Heat map implementation for classification algorithms is shown in Fig. 3 which is derived from their confusion matrices, and each block of matrix represents the overall summary of algorithms representing truth and predicted values.

The model accuracy curves for deep learning-based algorithms are shown in Fig. 4. In our writing, we used two neural network-based techniques, i.e., CNN and MobileNet.

In this study, we derived the accuracy and log loss for different classifiers on the dataset. We found that CNN brings out to the highest accuracy after training and

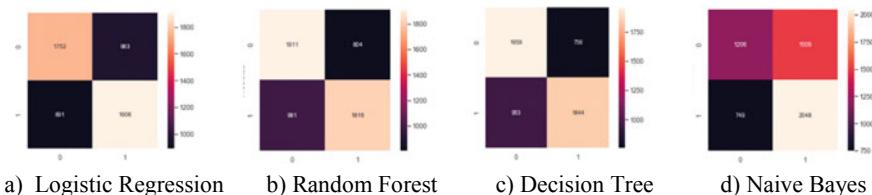


Fig. 3 Heat map of classifiers used

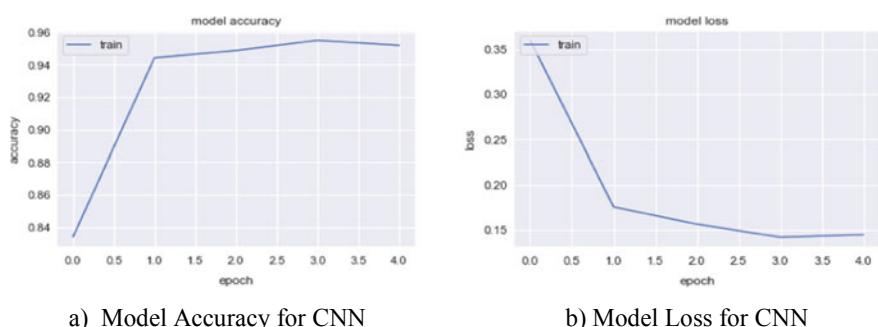


Fig. 4 Model accuracy and loss curve for neural network classifiers

Table 3 Accuracy comparison of ML and DL classifiers for malarial parasite detection

Algorithms/models	Accuracy (%)	Log loss
Logistic regression	66.3643	0.61
Random forest	67.6161	0.60
Decision tree	68.9949	10.70
Naïve Bayes	59.0348	14.01
CNN	96.20	0.14
MobileNet	94.82	0.15

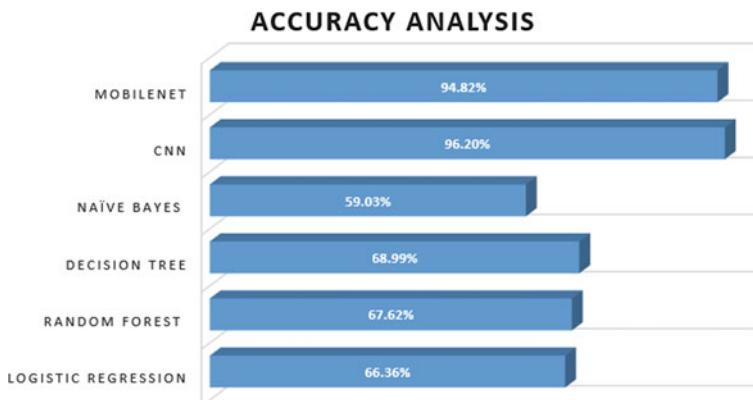


Fig. 5 Graphical representation of accuracies of ML and DL algorithms

testing different classifiers. Table 3 and Fig. 5 represent accuracy and log loss of different classifiers utilized for malarial parasite detection.

5 Conclusion

Despite the fact that current cutting edge profound learning approaches have demonstrated promising outcomes in malarial parasite recognition, yet at the same time, there is opportunity to get better. Once in a while, uninfected blood tests do not consist of plasmodium yet may consist of different kinds of leftovers that are wrongly delegated contaminated by a classifier. In this manner, shading standardization procedures are required before the order. The fundamental target of the malaria detection is to distinguish whether the individual is contaminated with intestinal sickness or not. This study has demonstrated that malaria parasites can be adequately perceived on dainty blood spreads utilizing diverse AI and profound learning calculations.

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Proposed Methodology of Text CAPTCHA for Security with Cloud



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Abstract Verification strategies are wont to handle an extremely significant issue, the digital security. It assists with keeping away from the unlawful use or abuse of touchy information. Totally Automated Public Turing Test to Tell Computer and the Humans Apart (CAPTCHA) is the programmed security component which is utilized to decide if the client is a human or the robot. In this paper, we specialize in this various sorts of CAPTCHAs which are often simply broken due to its style purpose. We have a tendency to address this downside by presenting a replacement CAPTCHA style principle to differentiate human (robot) from human (user). The core plan is that the challenge method of the CAPTCHA ought to contain the distinctive info with a private attribute. The perception of this paper is to show our plan is based on the data imbalance between humans.

Keywords CAPTCHA · Artificial intelligence · Machine learning · Cloud computing

1 Introduction

The Web has been assuming a progressively essential job in our way of life, with the measure of the different Web administrations like email and Web crawlers. Be that as it may, these are regularly compromised by assaults from PC programs like bots. To manage this issue, Completely Automated Public Turing Test to educate Computers and Humans Apart (CAPTCHA) was created to separate between PC drivers and social clients. In spite of the fact that this system offers great security and cutoff points programmed record keeping to web benefits, some CAPTCHAs have a few shortcomings which grant programmers to break into the apparatus of the

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CAPTCHA. This paper examines late exploration on different CAPTCHA strategies and their classes. In addition, it talks about the shortcoming and quality of those sorts. CAPTCHA might be a program which produces and assessments the tests that are social answerable yet is past the current PC infection capacity. CAPTCHA is likely exceptionally helpful inside such a twisted content, numerical, One Time Password (OTP), Audio, 3D, Graphical, and Gaming CAPTCHA. The intention of this paper is to audit the predominant CAPTCHA methods inside the field of Web security offices and gracefully best degree of security that can't be split and prepared to supplant the overall frameworks [1]. The arranging and usage of CAPTCHAs fall inside the domain of AI. We plan to use CAPTCHAs as a device to upgrade the security of Internet-based applications. During this examination, we present a system for a book-based CAPTCHA bolstered Greek words, Spanish, and French words which may misuse the distinction inside the perusing capability among people and work-station programs. Our choice of content put together CAPTCHA is predicated with respect to the very truth that it is not utilized by an out estimated number of people on the grounds that these three dialects having the different watchwords. There is potential for an exponential ascent inside the applications that are probably going to be created there in content along these lines making it simple to make sure about Indian language-based applications. Unfortunately among several CAPTCHA techniques, the text CAPTCHA is often straight forwardly hacked and are not dependable for the information security. In spite of the fact that CAPTCHA's which may be strong like confounded photo CAPTCHA, graphical CAPTCHA, iCAPTCHA are accessible, yet limit of the websites don't place in power as they have to confide in the outsider CAPTCHA specialist organization and furthermore on account of the very reality that the size inhabitance which hundreds their database at the server which is of less size and intention progressive activity of the site [2]. We formalize, design, and implement two models on our proposed standard, a character—fundamentally based and a datagram—basically based case, predictable with a web collaboration and secret phrase adapting to program. We task the individual to pick the secret key from the arbitrary characters that aren't in the secret phrase succession or to position the haphazardly cared for arrangements into the best possible request. An absolutely one of a kind innovation set of rules with a fluffy coordinating methodology has been proposed to highlight the limit of human blunder resistance, and in this way, the issue of arbitrary wager ambushes. In contrast to different arrangements, our strategy would not found a workable pace essential validation convention, interface, and aptitude of the regular old web access. The few customer studies' results suggest that our proposed system is both straightforward (might be unraveled by people precisely inside anyway 20 s) and proficient (the Typercan handiest set up an irregular theory assault with a plainly low accomplishment rate). The flow diagram of online CAPTCHA is shown in Fig. 1 given below [3].

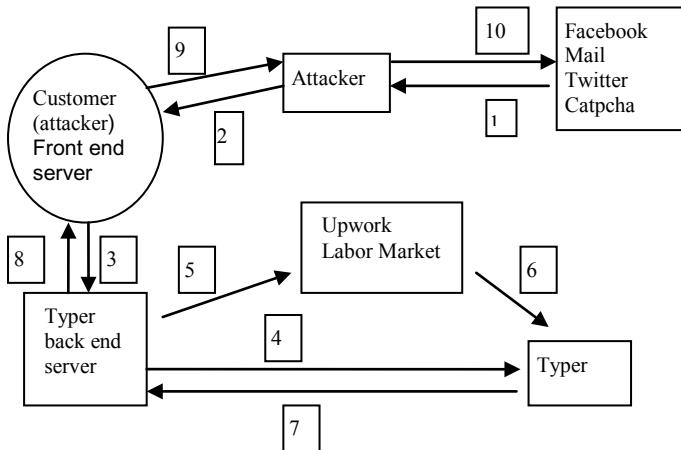


Fig. 1 Flow diagram of online CAPTCHA

2 Literature Review

CAPTCHA might be a program or a framework that ensures against computerized contents (or bots). This paper will portray the new sorts of CAPTCHAs proposed in ongoing distributed papers which depict their characterizations, contrasting between CAPTCHA upheld shortcoming and quality of them. This paper portrays the shifted classifications of the CAPTCHA frameworks, their applications, and subsequently the disadvantages of each CAPTCHA procedures. It produces tests that people can pass yet PC programs can't. CAPTCHA frameworks are broadly utilized these days for protecting and giving security to web-based administrations for people from maltreatment by bots. Varying sorts of CAPTCHA advancements are talked about during this paper, and an inside and out investigation on their unwavering quality is performed. Subsequently, a substitution CAPTCHA system is proposed which is predicated on face location. The web contributes significantly to a few parts of human life like correspondences, training and online business exercises, and so forth. Some web administrations have online enrollment where the clients give data in order to join and use administrations like email in Yahoo, Gmail, and Hotmail. In any case, numerous projects are created by programmers which naturally complete site enrollment pages with falsehood which may cause road turned parking lot, limiting the presentation of the framework and now and again, in any event, making it come up short, especially where a web webpage includes countless records. Along these lines, analysts built up a component to separate between human clients and PC programs inside the instance of online enlistment. The quality instrument utilized right now to manage this issue Completely Automated Public Turing Test to advise Computers and Humans Apart (CAPTCHA). The idea of CAPTCHA is predicated on the intensity of individuals to endeavor to attempt to specific errands which PC programs can't, such as asking clients to a mutilated book picture or pick a particular

picture from many showed pictures [4]. As of late, numerous sorts of CAPTCHAs are created. Some are bolstered Optical Character Recognition (OCR) like content CAPTCHA, though others are upheld Non-Optical Character Recognition (Non-OCR) which utilizes sight and sound, similar to voice and video. Some of these sorts of CAPTCHAs are broken by new bot programs. For example, a book CAPTCHA is regularly broken by utilizing the component of division letters. A CAPTCHA, which means “Totally Automated Public Turing Test to illuminate Computers and Humans Apart,” might be a test which will recognize human clients from PCs/robots. At the end of the day, it is a test, which most people can pass, however PC programs can't. Such tests are typically upheld hard, open AI issues like the fame of contorted content. The idea of a CAPTCHA originates from “Turing test,” and however it is occasionally depicted as an “opposite Turing test.” The method of reasoning is that contrasting from the principal Turing test, which is controlled by an individual's and focused to a machine; CAPTCHA challenges are naturally produced and reviewed by a PC. Besides, the objective of structuring a CAPTCHA is to separate, rather than to neglect to separate, which is that the primary motivation behind Turing tests. Another distinction between a CAPTCHA and a Turing test is that the past was intended to go about as a proportion of progress for AI; nonetheless, the last might be a security component. The P for public methods the code and along these lines the information utilized by a CAPTCHA ought to be openly accessible. Along these lines, a program which will produce and grade tests that recognize people from PCs, however whose code or information are private, isn't a CAPTCHA [1]. It is significant for the difficulties to be considerably extraordinary a large portion of the occasions; else, they could be recorded, unraveled by people, at that point wont to answer future difficulties. Therefore, they should be created pseudo arbitrarily from an extremely huge space of unmistakable difficulties [2]. Utilizing a CAPTCHA as a security component is critical in the light of the fact that it can keep noxious projects from pursuing a great many records, posting numerous remarks in weblogsthen on.

2.1 Current CAPTCHAs

Generally, CAPTCHA methods are often divided into five groups:

- Text-basedCAPTCHAs,
- Image-basedCAPTCHAs,
- Audio-basedCAPTCHAs,
- Motion-basedCAPTCHAs,
- HybridCAPTCHAs.

In content-based frameworks, twisted variants of characters of a word rendered as an image and are introduced to the client. At that point, the clients are approached to type the arrangement that necessities recognizing all characters inside the right request. Since the picture contains enhanced visualizations, it is hard for a PC to recognize the words. Content-based CAPTCHAs have the shortcoming of being

deciphered by OCR programming. To beat this risk, different sorts of CAPTCHAs are presented. A book-based CAPTCHA might be a mutilated picture of a grouping of characters on which varying sorts of debasements, foundation messes, and shading blends are applied to shape it harder for attackers [5]. We will present current content-based CAPTCHAs in six sub-gatherings:

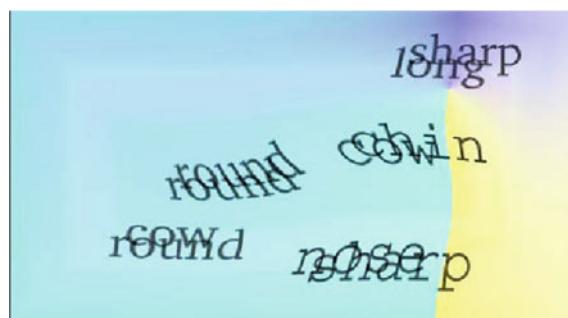
- CAPTCHAs with “English words” as their CAPTCHAtext,
- CAPTCHAs with “irregular strings” as their CAPTCHAtext,
- CAPTCHAs bolstered written by hand message,
- CAPTCHAs bolstered phonetic information,
- CAPTCHAs that require increasingly physical association with clients,
- Non-English CAPTCHAs.

CAPTCHAs with “English words” as their CAPTCHA content: In some CAPTCHA frameworks, as Gimpy, EZ-Gimpy, Captcha Service.org, PessimalPrint, and reCAPTCHA, the CAPTCHA picture contains English word(s).

2.2 *Gimpy*

It is one of the most acclaimed CAPTCHAs which are essentially established on bended substance (Fig. 2). This CAPTCHA was made in a joint exertion with Yahoo with the purpose of protecting talk rooms from spammers to make them unsuitable to post requested advancements and make substance to deliver free email addresses. Gimpy picks seven words from a vocabulary; by then delivers a deformed picture containing those words. It finally presents them to its customers and requests them to type three from the declarations of the image to get area to the organization [6].

Fig. 2 Gimpy CAPTCHA



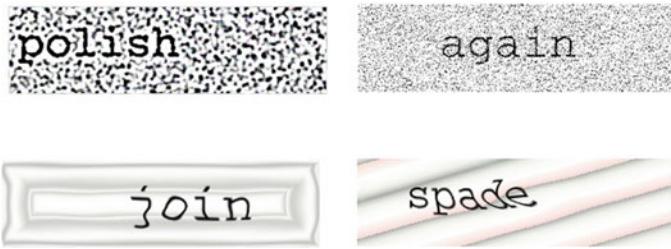


Fig. 3 EZ-Gimpy CAPTCHA

2.3 EZ-Gimpy (CMU)

In this CAPTCHA, from the start, a word is looked over a lexicon. In the following stage, the word is rendered to a picture utilizing different textual styles;

and various sorts of bends, for example, dark or white lines, foundation lattices and angles, obscuring and pixel clamor are included (Fig. 3). At that point, the client is approached to type the word [7].

2.4 Captchaspbservice.org

Right now (4), each challenge is a six-letter English word browsed a lot of 6000 words. The bending technique utilized is arbitrary shearing [8].

2.5 Pessimal Print

PessimalPrint (Fig. 4) focuses on corruptions, for example, adding commotion to or obscuring the pictures to vanquish OCR methods; the originators of this CAPTCHA contend that under the states of second rate picture quality, there is a huge hole in design acknowledgment capacity among people and machines [2]. This CAPTCHA fills in as follows. Initial, a word is pseudo haphazardly chose from fixed rundown containing 5-to-8-letter English words. At that point, it is rendered with a typeface (from a fixed rundown of five textual styles) and a fixed text dimension (size = 8). At long last, a lot of picture corruptions including x-scaling, y-scaling, skewness, haziness, and adding clamor are applied to the image [8] (Fig. 5).

Picture-based CAPTCHAs as a rule utilize the predominance of people over PC vision associations in perceiving such an article in an image. In spite of the fact that it is more proper for the human to disentangle picture-based CAPTCHAs rather than text-based ones; picture-based CAPTCHAs have the issue of requiring an outsized space for putting away.



Fig. 4 Captchasure.org

Fig. 5 Pessimal PRINT



A sound-based CAPTCHA picks a string, removes it to a shallow clasp, and contributes it to the clients who are solicited to recognize the substance from the sound clasp. Steady with an outsized scale concentrate on the ease of use of CAPTCHAs, sound-based CAPTCHAs are more dangerous than different kinds [5].

Another class is movement-based CAPTCHAs during which a film or liveliness is introduced to the clients and that they are approached to recognize an activity, energetic word, or picture inside the film. This CAPTCHA is fitting for clients. Furthermore, since the predefined time stretch during this CAPTCHA is nearly high, it is more secure. Be that as it may, the high stacking occasions are frequently a deterrent from a convenience perspective. Another disservice is requiring an outsized database of liveliness. Finally, the term "hybrid CAPTCHA" has been nominated for a CAPTCHA that is a mixture of various types or considered for superior purposes [9].

3 Application of All Kinds of CAPTCHA

There are numerals of sales of CAPTCHA on the online which are characterized as follows.

- (1) Registering the online structures: There are numerous destinations on the web which gives free enrollment to benefit their administrations. Be that as it may, they are powerless against web bots. It will acquire the state of screenplays which may enroll a large number of email accounts on the web, hence declining the significant universe of web [10].
- (2) Online surveying locales: These destinations take client's reaction or input inside such a polls to ensure that lone human causes the reaction they to make utilization of CAPTCHA.
- (3) To maintain a strategic distance from web crawling: If a webpage wouldn't like to encourage recorded by an enquiry motor, then they will utilize CAPTCHA.
- (4) E-Ticketing.
- (5) Thwarting dictionary attacks and E-mail spam.

3.1 *Disadvantages in CAPTCHA*

- Text-based CAPTCHA—during this, there are different sizes font, blurring of the text is that the major issue, and its OCR value is definitely guessed by bots.
- Image-based CAPTCHA—The user having low image or color sightlessness will face identify problems.
- Audio-based CAPTCHA—This CAPTCHA is predicated on English, so if the user won't know English language, then he is unable to seek out it, and also he will learn the Language.
- Math-based CAPTCHA—It requires problem solving Skills and wish longer to unravel the CAPTCHA.

4 Proposed Methodology

We are proposing a methodology for introducing the CAPTCHA on cloud. The following steps are required to implement this methodology.

1. Initially, the CAPTCHA is created and stored in Cloud database.
2. User request CAPTCHA.
3. Extract IP/Mac address and check in database.
4. First, dashboard frame is shown where CAPTCHA occurs having six keys.
5. User will press the shown characters through keys which will occur on virtual keyboard.
6. Now, after pressing the keys, response is recorded with time stamp.

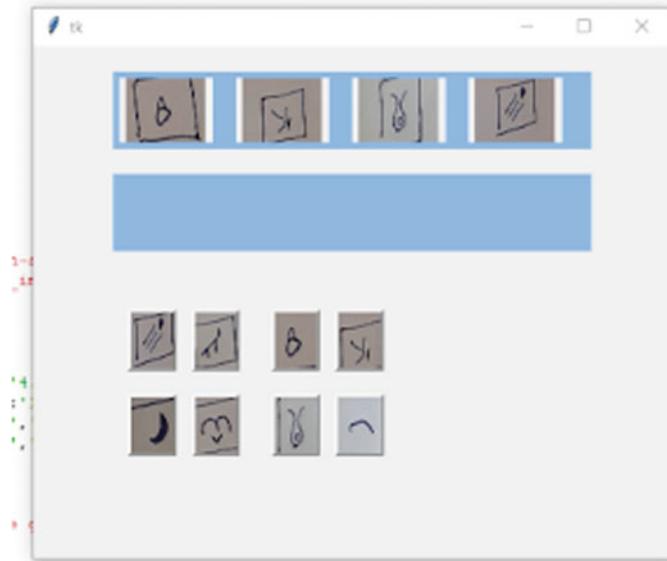


Fig. 6 Proposed CAPTCHA in Greek words

7. If the threshold time exceeds, then user ask for retry.
8. If the pressed keywords are found in database, then prompt the message.
9. If the pressed keywords are not found in database, then prompt the message “retry” and follow the below steps.
10. Second frame 12 keys to press with six Greek words and six Spanish words.
11. Follow step 5–8 database, IP address or Mac address is recorded after each retry.
12. After three retry, the suspicious message is displayed.

4.1 Result Analysis

Here, we have two snapshots of our result which shows the CAPTCHA in Greek words (Fig. 6).

5 Comparison of CAPTCHA in Accuracy

The investigation of the contemplated work is done in this area and is organized in Table 1. In Table 1, the % achievement rate speaks to that out of 100 assaults done on a CAPTCHA the worth related with it is the occasions; the CAPTCHA is “broken” effectively. It has been for the most part utilized due to effectively open on the

web. The CAPTCHA usage is dangerous without cautious plan. There are numerous assaults on text-based CAPTCHA framework. The majority of result from helpless security and indiscreet plan ignore. For this purpose, they design good and well security to prevent from attacks.

S. No.	Types of CAPTCHA	Success rate (%)
1.	Text based (Microsoft CAPTCHA)	92
2.	EZ-Gimpy	97
3.	Audio-based CAPTCHA	78
4.	Audio-based CAPTCHA	71
5.	Our approach	99

6 Conclusion

CAPTCHA plays important role in World Wide Web security where it prevents Bot programs and Hackers from abusing online services. In this paper, we have provided a set of techniques that would allow for the system to be secure and less vulnerable to bot attacks. CAPTCHA plays important role in World Wide Web security where it prevents Bot programs and Hackers from abusing online services. In this paper, we have provided a set of techniques that would allow for the system to be secure and less vulnerable to bot attacks. CAPTCHA plays important role in World Wide Web security where it prevents Bot programs and Hackers from abusing online services. In this paper, we have provided a set of techniques that would allow for the system to be secure and less vulnerable to bot attacks.

7 Conclusion

CAPTCHA shows a vital starring role in the life of safety wherever it precludes the Bot hackers from abusing the web service area. This research methodology proposes the CAPTCHA on cloud and provides the scheme to be safe and less defenseless.

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Analysis of Career Development Opportunities in IT Sectors in Jaipur



Ashish Jain, Swati Mishra, and Ruchi Goyal

Abstract Career development programs are gaining significance as a stimulus that drive the employee growth as well as organization productivity, and hence, all the organizations are attempting to adopt the concept and offering career growth opportunities to their employees. Career development programs in organizations are regarded as an important HR practice to create competitive advantage through better productivity and efficiency, and also it yields better employee satisfaction and commitment. Career development programs are emerging as a potential force that affects employees and their working efficiency for the ultimate benefit of both employees as well as organizations. Thus, the field has attracted many academicians to focus on the effect of these career development programs for investigating employee as well as employer perception regarding these career development programs and factors associated with it. The present research is thus performed for finding out the employees' and employers' attitude toward effect of career development programs in small scale IT companies. The implication of the research will be helpful for the HR department and the policy makers to be able to strategize to respond to the employee growth demands and also enable them to understand the underlying factors thereon.

Keywords ANOVA test · IT companies · KMO · Barlett test

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1 Introduction

Employee satisfaction and organization productivity are imperative for every business's sustainability and survival. The small-scale IT industry is struggling to fight high raised competition due to the emergence of numerous new players in the sector. In this global world to gain a competitive advantage, all IT sector players are focusing their potential in providing best quality products to their clients to sustain the competition imposed by the new entrants, and this can be successfully gained through skilled and satisfied employees [1]. Recent studies suggest that career development programs have a positive effect on employee's efficiency.

Small-scale IT sector holds tremendous future prospects, and many industry experts believe that the career development programs in these IT companies will certainly explore in a positive direction for the betterment of both employees as well as organizations. For achieving the objectives of an organization, it must endeavor to align employees' personal career goals along with organizational productivity goals. For this purpose, organizations need to frame suitable strategies for developing a workforce with the necessary career development goals [2]. Providing career development opportunities serve several key benefits to organization and employees.

The present study named as "A study of employee career development and its impact on organization productivity in IT sector SSIs," intended to investigate how the career development programs and policies in organization can influence organization productivity in small-scale IT companies. Career development has evolved in relation to organization productivity in small-scale IT companies in Jaipur region of India, and the factors and impact level are analyzed using different tests and research analysis. For achieving the objectives of the study, Jaipur region of Rajasthan has been selected for data collection and analysis [3].

Further, questions are designed to elicit qualitative responses from respondents (employee and employers) about their perception, satisfaction, and the awareness and expectation from the career development policies and programs in enhancing and providing employee satisfaction and employee performance that will further lead to increasing the growth of organization productivity in small-scale IT companies. 9, both qualitative and quantitative methods are used for collecting and interpreting the data, and the analysis is performed and presented carefully in a systematic way [8].

2 Literature Review

The author led an investigation on the connection between information the executives and vocation improvement among IT experts. The thoughts were that, to address the new difficulties and holding great workers, associations ought to need to build up the information the board practices to improve mindfulness with respect to vocation advancement, sharing information in regards to profession plans, profession guiding,

from the earliest starting point of their professions. It was discovered that the absence of preparing and the absence of information sharing are the principle social boundary among information the executives, and data over-burden is a major issue for the maintenance of information. In this way, they discover that most significant elements that are identified with the information the board and vocation improvement are promotion and expert specialization that can be influenced [4, 5].

An examination directed by author framed that worker work fulfillment is subject to profession improvement openings in their individual associations in the financial area. It very well may be commonly inferred that financial part in Karachi is giving vocation improvement openings. Representatives concurred that they may leave their association on the off chance that they feel the absence of profession improvement exercises [6].

The author led an investigation in Ghana in one of the telecom organization (Vodafone) found that workplace and vocation improvement openings essentially influence representative maintenance. In addition, it was recognized that profession advancement openings likewise showed a solid sign for maintenance. Subsequently, it is suggested that administration of the association give advancement chances to build representatives' vocation development and to make them fulfilled to stay in the association with an example size of 142 workers speaking to 10% of the objective populace of 1420 [9].

The target of the examination study was to set up the connection between profession advancement openings and representative maintenance. It can be noticed that 8.8% of the respondents emphatically concurred that their professions were developing with their present associations, with 29.4% consenting to the announcement. In any case, 39% didn't know whether their profession was developing or not, with 18.4% differing and 4.4%, firmly differing that their vocation is developing with their association. Ruler (2005), prompts that associations should bolster representatives to make long haul promise to them through expanded preparing and advancement programs [7, 11].

The investigation led by author on effect of T and D on representative execution concerning retail banking part of India, analyzed the impact of preparing on execution. By presenting additionally preparing programs in the association workers become intrigued to get more information about their occupations which are in the long run causes them in getting advancements among their companion gatherings. Since preparing has huge impact on worker's work duty and execution, it is imperative to fortify and apply preparing as a feature of authoritative plans in accomplishing hierarchical objectives [8].

3 Methodology

Collected data is tabulated and analyzed for meeting the objectives of the research and is presented systematically in different parts of the research. The present research is framed to analyze the collected data for finding the significant difference among

various age groups of employees and their perception about the career development **opportunities in organization**, and its impact on organization productivity in IT sector and factors of career development.

The study makes use of different kind of statistical tools and analysis applied over the questionnaire like “descriptive statistics, frequency distribution, one-sample test, Anova and KMO and Barlett test, and others. The reliability of data captured through entire questionnaires was measured through Cronbach’s alpha (α) reliability test” [10].

Hypothesis: “Reliability of collected data was measured by Cronbach’s alpha (α) analysis, which is a commonly used method where alpha coefficient values range between 0 and 1 with higher values indicating higher reliability among the indicators. According to this analysis, the captured data was up to mark and can be used for further analysis.”

Researcher has selected 218 employees of small-scale IT companies of Jaipur region as sample population. The employees sample includes employees from all levels and of all type. These questionnaires were given to the respondents on the basis of convenience sampling method, where the researcher gave personal attention to all those respondents who can fill the questionnaire systematically. All these questions further analyze the relationship between the demographic variables of employees such as gender, age, marital status, with independent variables of factors of career development in small scale IT companies. The discussion and interpretations of results obtained after the analysis of some parts and sections of the questionnaire is given below;

3.1 Analysis for Questionnaire for Employees

Part A (Demographic profile)

This part analyzed the data collected about the age, marital status, educational qualification, gender, etc., of the employees.

Further, from frequency Table 1 and Fig. 1 show the results of the analysis done over the data collected about the demographic profile of the respondents. Results obtained from this analysis show that the sample respondents are young age group of less than 30 years who are qualified and holding B Tech (computer science) and MCA.

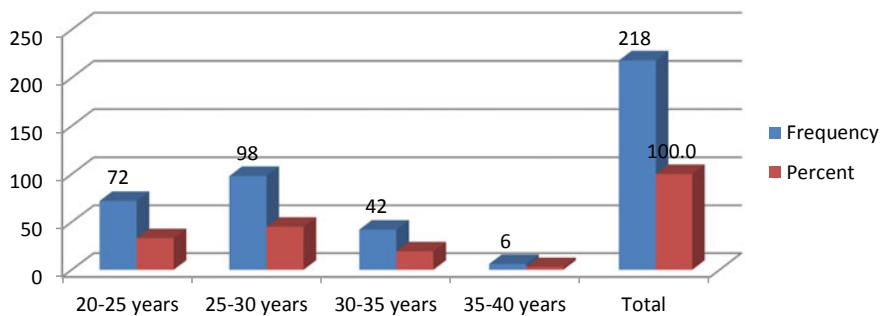
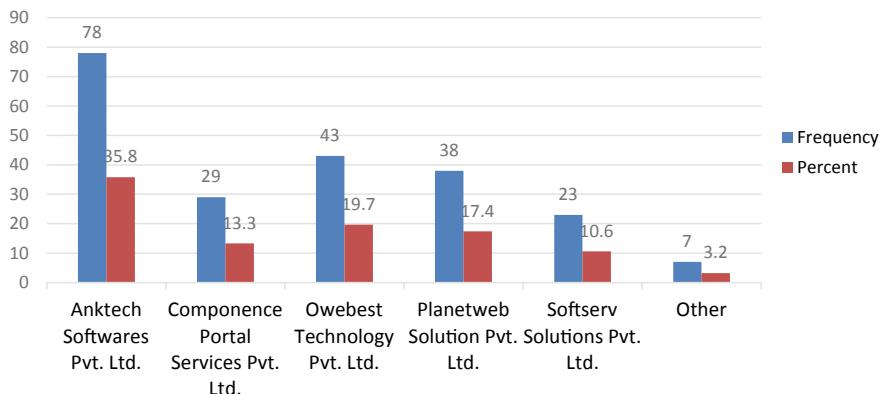
Above Table and graph show the data tabulated for the age of the respondents. The collected data represents that 33% belongs to 20–25 years of age group, 45% are from 25 to 30 years, 19% are coming under 30–35 years of age group, and 2% are from 35 to 40 years of age group. Thus, the sample respondents are mostly from young age group of less than 30 years that will give results that can be applied to young groups effectively (Fig. 2).

Above Table and Graph show the organization-wise classification of respondents. From data, it is clear that 35.8% of respondents are from Anktech Softwares Pvt. Ltd., 19.7% are from Owebest Technology Pvt. Ltd., 17.4% are from Planetweb Solution

Table 1 Frequency table of age

Age		Frequency	Percent	Valid percent	Cumulative percent
Valid	20–25 years	72	33.0	33.0	33.0
	25–30 years	98	45.0	45.0	78.0
	30–35 years	42	19.3	19.3	97.2
	35–40 years	6	2.8	2.8	100.0
	Total	218	100.0	100.0	

Source Primary data

**Fig. 1** Frequency graph of age. Source Primary data**Fig. 2** Frequency graph of organization. Source Primary data

Pvt. Ltd., Compotence Portal Services Pvt. Ltd. has 13.3%, and Softserv Solutions Pvt. Ltd. has 10.6% (Table 2).

Next section analyses the level of agreement toward the career development of programmer level employees for improving organizational productivity from

Table 2 Frequency table of organization

A7

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Anktech Softwares Pvt. Ltd.	78	35.8	35.8	35.8
	Componence Portal Services Pvt. Ltd.	29	13.3	13.3	50.0
	Owebest Technology Pvt. Ltd.	43	19.7	19.7	70.2
	Planetweb Solution Pvt. Ltd.	38	17.4	17.4	87.6
	Softserv Solutions Pvt. Ltd.	23	10.6	10.6	98.2
	Other	7	3.2	3.2	100.0
	Total	218	100.0	100.0	

Source Primary data

Table 4.10. Results here display that mean value is highest for B16 “Do these trainings help you in getting promotion or higher position?” and B21 for “New technical skills” have helped you in increasing your efficiency/productivity? And minimum for B25 “Trust of management” has increased our confidence, which helped you in higher efficiency/productivity? And B 15 Do your efficiency/productivity increase after attending these trainings.

Also from results, we have there are eight factors extracted that contribute toward career development opportunities viz. career development, training and learning, growth, efficiency, and productivity, what attracts employee most, what is most important for an employee, management values and organization practices and employee values.

Analysis of part B of questionnaire

This section is presented to perform a careful analysis over the section of the questionnaire which is framed for analyzing the level of agreement toward the career development of **programmer level employees for improving organizational productivity**. For this purpose, following hypothesis is framed and tested;

H₀₁ Career development of programmer level employees improve organization's productivity in small IT companies

H₁₁ Career development of programmer level employees do not improve organization's productivity in small IT companies

Above table gives the representation of descriptive statistics of the data collected. Complete details for all the variables (parameters) like their mean, standard deviation, and variance for the collected data is presented here. Mean value is highest

2.99 for B16 “Do these trainings help you in getting promotion or higher position?” and B21 2.44 for “New technical skills” have helped you in increasing your efficiency/productivity? and minimum 1.26 for B25 “Trust of management” has increased our confidence, which helped you in higher efficiency/productivity? And B 15 Do your efficiency/productivity increase after attending these trainings? (1.26) (Table 3).

4 Conclusion

This paper was designed to evaluate the viewpoint of employees as well as employers regarding the impact of career development programs on organization productivity with special reference to the selected small-scale IT companies of Jaipur. This will further assist in examining the implications of career development as a factor leading to growth of training and development for employees of IT companies with the help of various analysis and research.

The research was aimed analyzing the career growth of employees and its future prospects as well. Researcher has framed two systematic and structured questionnaires to be filled in by the employees and employers that hold various different parts for the purpose of achieving the research objectives. The questionnaires were presented for collecting the required data which was then analyzed using several statistical tools, and hence, results were obtained.

Table 3 Descriptive statistics table of factors

Variables	Item statistics			
		Parameters	Mean	Std. deviation
B11	Do you get enough opportunities to grow/develop your career in current company?	1.45	0.623	216
B12	Does your company provide you enough learning opportunities?	1.44	0.645	216
B13	Does your company provide internal/external trainings to help you learn new things?	1.95	0.797	216
B14	Do these trainings help you with your career development?	1.58	0.774	216
B15	Do your efficiency/productivity increase after attending these trainings?	1.26	0.568	216
B16	Do these trainings help you in getting promotion or higher position?	2.99	1.342	216
B19	After training, are you more confident in taking new responsibilities in company?	1.57	0.804	216
B20	“New learning’s” have helped you in increasing your efficiency/productivity?	1.67	.904	216

(continued)

Table 3 (continued)

Variables	Item statistics			
		Parameters	Mean	Std. deviation
B21	“New technical skills” have helped you in increasing your efficiency/productivity?	2.44	1.869	216
B22	“New technical skills” have helped you in taking more challenging roles, which give you more satisfaction?	1.71	0.716	216
B23	“New responsibilities” have helped you in increasing your efficiency/productivity?	1.60	0.715	216
B24	“Trust of management” motivates you to put extra efforts in work and do your best for company?	1.21	0.569	216
B25	“Trust of management” has increased our confidence, which helped you in higher efficiency/productivity?	1.26	0.666	216
B26	“New learning’s from seniors and environment” have helped you in increasing your efficiency/productivity?	1.35	0.566	216
B28	“Money” attracts you most in your job?	1.35	0.568	216
B29	“Stability” attracts you most in your job?	1.61	0.616	216
B30	“Position” attracts you most in your job?	1.51	0.594	216
B31	“Respect/value in company” attracts you in your job?	1.91	0.953	216
B32	“Money” is very important for you in professional career?	1.48	0.528	216
B33	“Stability” is very important for you in professional career?	1.82	0.868	216
B34	“Position” is very important for you in professional career?	1.40	0.528	216
B35	“Respect/value in company” is very important for you in professional career?	1.45	0.714	216
B36	“Location of job” is very important for you in professional career?	1.31	0.483	216
B39	Does your company follow some sort of development processes/best practices?	1.97	0.886	216
B40	Do you get enough opportunities to interact with client?	1.53	0.553	216
B41	Do you understand clients’ business value, ethics, and policies very well?	1.38	0.567	216
B42	Do you get enough opportunities to understand full life cycle of a project?	1.72	0.607	216
B43	Does your company motivate you to spend your free time in “exploring latest technologies” or “new learnings”?	1.61	0.653	216

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Technology Enabled Progress of Digital India—COVID-19 and Beyond!!!!



Ruchi Goyal and Tanya Garg

Abstract The program of digitization essentially lies on the core of having a digital network by which services will be delivered to all in an efficient, transparent, and timely manner. Countries around the world have to face crisis due to Covid-19 also finding difficulty in coping with social isolation, physical-distancing measures, and financial growth. Despite the enormous economic and social issues, the governments are left with little choice now.

Keywords Digital technology · Progress · Covid-19 · Government

1 Introduction

An initiative naming “**Digital India**” welcomed by government of India to take the benefits of public services available to citizens of the country electronically by enabling digital empowerment in the field of technology [1]. This was aimed to achieve a better infrastructure online as well as increasing Internet connectivity both in urban and rural area. This technology enabled digitization, and ordination will take India to a path of progress. COVID-19 has severely damaged the economic prospects of India. The country is now following the “Atmanirbhar Bharat Campaign.” Digitization has played a very important role during COVID-19. Thus, even after COVID-19, a combination of Atmanirhar Bharat supported by digital technology can help India in finding it way on the path of economic development and modernization.

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2 Amidst Corona Virus Pandemic Technology Paved the Way for Digital India progress

Lockdown was imposed on March 24, 2020, in India so that the spread of corona virus could be stopped, and as a result, it gave boom to technology use in India.

Within 48 days, there was a hike in the use of artificial intelligence (AI) and social media and transformed society into formidable users of technology.

According to the reports, there was an increase of 12% in mobile consumption from 23 h per week to 27 h. Social media platforms such as Watsapp, facebook, twitter, etc. gained spike of 87% of usage. As well as gaming platforms also witnessed 26% rise in their users.

Many video conferencing apps like ZOOM, Weebex, Google Meet, Google classroom, etc., were the major winners. Usage of virtual meeting spaces increased due to “work from home” policy introduced by many companies. ZOOM, is the app which came out as a surprise hit among the working sector for doing day-to-day work.

During first week of lockdown, there was a spike of 72% in internet browsing. Besides this, streaming platforms and television viewership also increased during this period (Fig. 1).



Fig. 1 Tech Arc. *Source* <https://www.gizbot.com/mobile/news/coronavirus-lockdown-could-cripple-smartphone-industry-067071.html>

2.1 Review Literature

The program of digitization essentially lies on the core of having a digital network by which services will be delivered to all in an efficient, transparent, and timely manner (Fig. 2).

Government of India's Digital India program is like a big umbrella and for its effective implementation under it has several projects are running under it, aiming to bring good internet speeds to India's rural areas. Some important policies and projects are as follows:

- In order to minimize the use of physical papers or documents, a new system of digital locker came up, which helps people to share e-documents and assure them of authenticity of online available documents [2].
- ESign is a technology which helps a person to put digital signature on the document available online, only by providing his/her Aadhaar card, hence making it more authentic.
- For carrying out mission of cleaning India, a new app is launched for smart phone's which is named after 'Swachh Bharat Mission'.

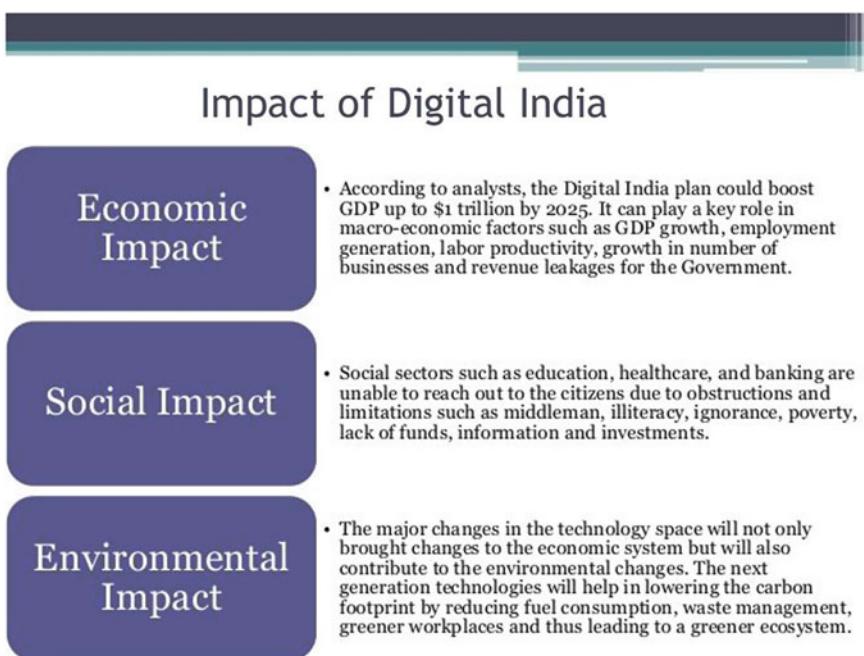


Fig. 2 Impact of digital India. *Source* <https://www.slideshare.net/TRIPLESORTFOLIO/digital-india-presentation-77952002>

- A new gift to Indian citizens is provided in the form of hospital application under the digital week campaign, which provides online facilities like online diagnostic report, online payment, online registration, online enquiry, etc [3].
- A promising platform for the people is provided by the Indian government for increasing engagement of people in the governance system, i.e., MyGov.
- Talking about educational areas, a portal for various scholarships has been launched (National Scholarship Portal); it will increase scholarships in the country.
- With the motive of achieving rural India modernization, Barat Net introduced for enhancing connectivity through a broadband technology.
- IP-based technology. This will help manage data, multimedia, voice, video, and other services. Additionally, BSNL has started deployment of Wi-Fi hotspots on a very large scale.
- In the next 5 years, it will cultivate a skilled workforce for BPO and IT departments.

2.2 *Use of Digital Technology During COVID-19 Period*

“People who never expected—nor ever wanted—to use digital technology to communicate or work now must, and so they are learning how,” explained by Sean Michael Morris, director of the Digital Pedagogy Lab at the University of Colorado Denver. “We could look at this integration of technologies into family life in a positive light, in that, the use of these technologies at home necessitates a new level of digital literacy for everyone, but there is an equally important downside to the movement of work-related technologies into home life, too. Technology is useful, but it is not a substitute for the classroom.”

CLSA stated that “digital payments in India are surging in the ongoing Covid-19-led lockdowns. Already these had jumped three-fold over the last two years to 3 billion transactions a month. Within digital, mobile accounts for 50–75% of transactions in volume and value. However, India’s mobile data penetration is still only 57% even as mobile penetration is 87%. Growing digital payments will accelerate mobile data/4G penetration and build an ecosystem of service,” the report said.

Phil Harding wrote an article titled ‘Pandemics, Plagues and Panic’ (2009) in British Journalism Review which highlighted “how the spread of an illness and the resultant human behavior can be influenced significantly by the flow and vectors of information.”

Reviews of Abhay Kadam and Sachin Atre (2020) in Journal of Travel Medicine points out that “social media reach has risen three times during the lockdown period in India, with Covid-19-related search spiking significantly. The inherent insecurity and lack of daily structure during the lockdown makes us feel inadequate without the constant feed of health-related information. It is indeed challenging to find a fine balance between the toxic overuse of technology and healthy and systematic harnessing of healthcare data.”

Dating apps like Tinder reported “highest number of swipes, crossing more than 3 million. Online shopping apps like Amazon offered the delivery of essential items,

ensuring that people use this feature and stay at home. Moreover, the access to medical checkups and therapy sessions provided online, helped many dealing with physical or mental illnesses.” “While the system of food distribution and retailing in rich nations is organized and automated, systems in developing countries are ‘labor intensive,’ making these supply chains much more vulnerable to COVID-19 and social distancing regulations,” mentioned by Johan Swinnen, Director General of the International Food Policy Research Institute (IFPRI) in the *New York Times* article “Instead of Corona virus, the Hunger Will Kill Us.’ A Global Food Crisis Looms.”

2.3 *Objectives of Study*

- This study aims at accessing the Digital India program of the government with its execution during Covid-19.
- It aims to study the role of technology during COVID-19 and beyond.
- Problems and challenges faced due to COVID-19 for technology enabled development in India.
- Also, it will suggest a roadmap for technology enabled progress in India.

2.4 *Research Methodology*

For the purpose of this study, secondary data was collected from various newspapers, Websites, and Journals. It was then analyzed foreseeing and drawing the final conclusion.

2.5 *Findings*

2.5.1 Assessment of Digital India Program

Expected Impact pre COVID

The following are the various impact of Digital India campaign on economy of India. Figure below discusses the Economic, Social, and Environmental Impact of Digital India.

Digital India by numbers

Initiatives Statistics Digital Identity (AADHAR)

- 1.2 billion users of internet
- 450 million users of mobile phone



Fig. 3 Lessons At Startup. *Source* <https://www.lessonsatstartup.com/2020/01/24/how-digitalization-has-changed-the-face-of-indian-economy/>

- 1.18 billion users of smartphone
- 468 million connections social media users
- 250 million ration cards
- 100% digitized government market place 263,731 products by 105,889 sellers listed, with 22,598 buyer [4].

Source—digitalindia.gov.in (Ministry of Electronics & Information Technology, Government of India) (Fig. 3).

The numbers show that considerable effort has already been put by the government of India but still a lot needs to be done. As per the impact on various sectors says that the execution needs to be better planned for effective implementation and visible impact on the economy.

Supporting the Digital Economy (COVID and Beyond)

For many companies, technology is a key tool to cope with the new demands brought about by the COVID crisis. For other companies, it is also crucial to adjust their processes and continue operations [5]. Policy decisions in this area will directly affect how easy it is for companies to adapt to new realities, whether it is in supporting companies to move forward or removing obstacles to new business models. Technology-driven economies also provide various opportunities for economic decision makers so that they can be aware regarding to obtain real-time situations.

Business Continuity and Digitisation—Changing trends Nowadays, businesses modified their operations from old traditional to online or revamp themselves altogether to deliver timely and appropriate services during the tough times of COVID [6]:

- The crisis due to corona viruses has toppled the powerful inertia of many traditional systems and prompted the acceptance of digital (online) services, which have found new tools and adapted them to their backgrounds. In the long run, this may make the economy better able to increase productivity, growth, and adaptable.
- For businesses, the fulcrum of online exchange includes everything from restaurant-based delivery to fitness classes via video link. Not all content can be moved online, but the wide availability of tools that support the Internet age means that the businesses that manage them are far more likely to have them than they might have before.
- Marketing and advertising need to be sustainable for the basic growth of businesses. In order to continue for long run, digital marketing is required. For helping the start-ups, Indian government is providing financial support for advertising.
- Patreon, for example, is a paid membership platform for online creators, with an average user growth rate of about a third higher than in February, while the video conferencing platform Zoom grew from 10 million to 200 million. Behind the scenes, insurance start-ups are also adjusting their policies to achieve more on-demand and flexible services as the nature of their activities changes, while digital identity providers are stepping up efforts to facilitate remote on boarding, right-of-work checks, and electronic signatures.
- Since the current transition is based on market-based accessible and affordable tools, government support should focus on raising awareness, convening, and sharing lessons learned. The most effective interventions may be based on amplification and convening (e.g., through online resources or digital networking plans) to accelerate the growth and impact of these steps.

Challenges for India

1. **Rural Background:** Almost 70% of India still resides in rural areas, where the people are traditional. They are still following the customs of the society and are not ready to accept the change. It is very difficult to change the mindset of the people living in rural areas; thus, the new technology may not appeal to them [7].
2. **Low internet speed and connectivity:** The internet connectivity in India is also very poor. We urgently need to upgrade it for promotion of the policy of digital India.
3. **Need of huge public expenditure:** Such policies can only be implemented and be successful if the government is ready to incur huge expenditure required for the implementation of the new technology. But the present economic condition of India may not permit us to spend such a huge amount of money [8].
4. **Literacy:** In India literacy rate is still very low. In spite of various government, **illiteracy** policy initiatives to make India literate the percentage of the literate people is still low. In such a case, it is very difficult for a person who cannot read and write to use the digital platforms.
5. **Poverty:** Still a lot many people are living below poverty line in India. Thus, it is very difficult for the us to make them digital as they are still not able to

fulfill their basic necessities. The digital technology is costly and needs to learn before reaping its benefits.

6. **Ignorance of the people:** This new initiatives require a lot of awareness, focusing on the various aspects of the plan. People are still unaware about the initiatives and the benefits they will be having from the policy. Because any change to be implemented must be bagged by the acceptability of the people at first place.
7. **Unsecure:** The digital technology must be updated to be more secure and should be friendlier to the people. The possibility fraud in this system cannot be underrated.
8. **Infrastructural facilities required** the mode of digital communications that are still lacking in India. This requires a lot more investment after doing the cost benefit analysis to make it more viable for the people. We require a high speed network, greater connectivity, many more towers to be installed, easy availability of devices supporting digital technology.
9. **Not easily accepted by the traditional society:** Any new technology is not accepted easily by the traditional society. As they still very strongly believe that there older modes of communication are good and easy for them. They are comfortable and are use to using new technology. They are not ready to change for the better as they are unable analyze the benefits of the new technology.
10. Correct execution and implementation for growth: Any new policy or any change to be implemented on a large scale requires correct implementation and execution, as per the situation prevailing in the country. Thus, it has to be modified to suit in Indian context.

3 India Goes Online

Corona Kavach

It is a location-based app introduced by MeitY (Ministry of Electronics and Information Technology). In order to track the user, it traces location of smart phone for checking if they are coming in contact with positive case of covid-19 (Fig. 4) [9].

Google SOS alert in search in India

This feature shows a detailed dashboard where people can search for corona related news. This dashboard is customized according to the countries from where people are using it. Indian users can easily seek information along with the link of Ministry of Health and Family Welfare [10].

Flipkart, Zomato and others are operating in India

Many e-commerce platforms like Amazon, Grofers, Flipkart, Zomato, Swiggy, etc. were operating during corona outbreak for delivering essential items.

Digital India – Vision Areas



Fig. 4 Source <https://www.slideshare.net/vijaykumarsarbu/digital-india-67743219>

Reliance Jio, Airtel and BSNL change caller tunes to make people aware

Many telecommunication companies changes their caller tune to an alerting message about the preventing measures for corona outbreak.

Arogya Setu

It is an app which is launched by Indian government for connecting health services with the people of India to fight against corona virus. This app provides information to the users regarding risk and advisories of covid-19.

3.1 Suggestions for Policymakers

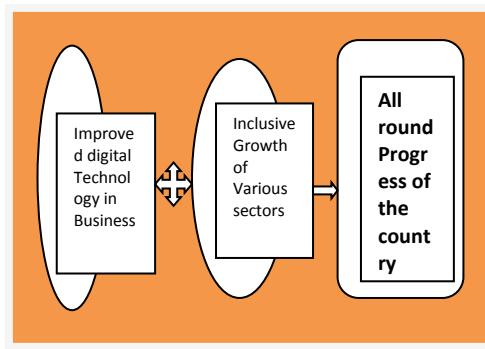
Technology has a pivotal role to play in find solution to various the economic and social issues arising due to Covid-19. Following are certain suggestions for policymakers:

1. For digital transformation of the businesses (small and start-ups), some physical support like digital marketing, logistics, etc., could be provided.
2. Government can encourage new technological innovation which helps customers and businesses to cope up with the detachment and separation [11].
3. For the vulnerable sections of the society, a technical market place to provide grocery delivery can be used.
4. Government transactions now can be replaced with the digital alternatives to reduce physical transactions, which have more risk to lives.
5. To start or extend digital authentication, to make it easier for people, to get support, and allow government teams to quickly build services. A wider range of digital ids will also help in the economic revival.

6. Encourage enterprises and technology to develop real-time, data-driven observatories of economic revival. Responding to crises can get data as quickly as possible, and technology can sort out new insights from novel sources.
7. During tough situation, services like telemedicine or online consultations with the doctors, is the right substitute for several cases and will also make it easier for some patients.
8. E-learning system will reduce hardship of teachers and help in progress of learners. It can be used as a foundation for future.
9. Prioritize new online legislation and require social media platforms to strengthen its protection from vulnerable users; the digital platform is now a vital social infrastructure, and the crisis has added huge responsibility to the people who manage the Internet. Ensuring proper management will protect users and the company itself [12].
10. The platform needs to reduce and eliminate harmful content available while adding and maintaining the important content to enhance the role of Internet.
11. Support for those who use the Internet more or for the first time as a result of the covid. This should include clear guidelines to help people to identify, avoid and report fraud, and cybercrime [13].
12. Purchase and distribution of good quality equipments at less cost and subsidized software packages for increasing its use.

4 Conclusion

The theoretical framework of the Digital India project is a state-of-the-art network. The extent to which the strategy can achieve its intended objectives depends to a great extent on various factors outside the digital technology area and its management.



The success of this system is depends on commitment of the government, and it also support of the people in order to reduce the constraints of historical and cultural identity and the constraints of wisdom threatened by adapting change, which will free them from difficulties in the present times.

There are many obstacles to successfully implementing the “Digital India Plan,” but in the current scenario, there is no second idea. Thus, we highly hope to accelerate the launch of the Digital India program. In addition to providing opportunities for education, health care and financial services, India can also improve the social and economic conditions of its people by carrying out non-agricultural economic activities.

However, it must be pointed out that ICT alone cannot directly lead to the country’s overall development. Inclusive growth and development will be achieved by supporting and enhancing factors such as knowledge, improved economic conditions, infrastructure, and overall business environment.

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Evolution of Education System and Techniques: A Comparative Study



Tanya Garg and Ruchi Goyal

Abstract The main aim of this paper is to analyze the features and the nature of the modern education system and its processes in India where culture and ethnicity are not only the base of diversity but also the affordability and purchasing power of the Indians (Jha and Shenoy in IOSR J Bus Manag 18(10):131–139, [1]). Education system is a hope to everyone, and therefore it must not focus on creating hype. With the passage of time, various changes have raised in diverse sectors of the economy which also consists of the education system. Unlike any other sectors of the economy, education sections have been through different stages of evolution. From the traditional system of Guru-shishya of conducting classes under the tree in an open garden to walled classroom lectures, from presentation teaching method with the help of LCD and projectors to providing online notes, we have come a long way. And now, WhatsApp messages and live lectures through online platforms have become the trend among the students (Marathe in Digitalization in education sector, [2]). The fact cannot be ignored that these days WhatsApp is considered to be the most used and reliable formal means of building up communication among the academicians and students. Not only this, but screenshots have affected many businesses of photocopy outlets operating within many college and school premises. India is constituted of a variety of cultures and ethnic groups, but besides these differences, the most noticeable difference that directly affects the Indian Education System is the capability and power of diversity of the Indians.

Keywords Traditional education · Digital education · Education system and techniques · COVID-19 · Strategies for increasing effectiveness

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1 Introduction

Innovation and technology have now become a predominant platform in every sector of the nation [3]. This is due to the impact of change in the past few years. There is no doubt that technology or digitalization has made our lives easier than ever before. The fact cannot be ignored that digitalization has grasped the economy so fast that there is no option left to adapt the changes according to time.

In the current scenario or era of digitalization, it has become necessary for education sectors to adapt to the dynamic environment as it enables it to match the footsteps of a fast and competitive world. The digitalization in India is a result of the Western Education System that came into existence with the British Raj. British have evolved diverse ways of educating and learning, and India still lags. It has been noticed that teaching is still carried out in traditional classrooms with a rigid syllabus dominating the daily curriculum.

Digitalization in education has added fluidity and flexibility in the prevailing education system [4]. While the existing or traditional education system follows a uniform approach, at the same time digital platform follows a customized approach with the help of which requirements can be customized as per the students' requirements. In other words, it can be modified or molded according to the requirement and capability of students to understand and subject.

Apart from this, the [5] digitalization seems to be a more practical platform for tracking the performance of the students. The progress of a student can easily be evaluated through his attendance, examination score, assignments, etc. Also, one of the biggest advantages of digitization in education is "no requirement of physical appearance." Unlike the traditional education system where students were required to be present in the classroom, digital methods of teaching have given relief to students as well as teachers to learn and teach from anywhere and at any time.

In today's fast world, the only thing people run out of is time. And [6] digitalization in education has proved as a big time saver for all. Not only metro or fully developed cities are adopting this platform of education, but also remote areas are trying to walk with the pace of the urban world education system. Well, it can be said that digitalization in education has come as a rescuer for the students as well as for the system. Now at present, digitalization in education is considered to be one of the most powerful trends in terms of modernization and reformation of the global education environment.

This paper explores the digitalization in education and its influence or impact on the global education system.

2 Evolution of Indian Education System

Indian education system has transformed a lot in various aspects from ancient times [7]. Indian system of education is uniquely diverse in dialect, language and culture.

In former times, Gurukula system of education was prevailing in India where pupils and teachers lived together at distant place and various philosophies, science, arts and techniques were taught to them. Students used to help their teachers in their daily chores as a favor returned to them and guru was considered as a central persona.

Before British rule, madrasas and vedic schools were prominent in medieval period. During British rule, a new modern system of education was introduced. Lord Thomas Babington Macaulay in the 1830s introduced English, mathematics, language, science, civics, geography and history to India. According to them, metaphysics and philosophy were unnecessary. The teaching mode was restricted to traditional classroom which made the relationship between teacher and student stronger.

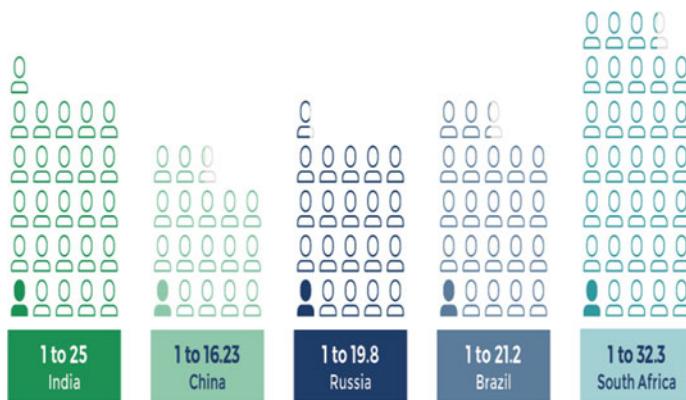
Modern system of education evolved gradually after the independence of India from British rule. Here, in India school system of education was divided into four levels which is pre-primary, primary, secondary and higher secondary. Central Board of Secondary Education (CBSE) and Indian Certificate of Secondary Education (ICSE) are two of the nation boards as well as state boards. With the advancement of technology and education, various private schools forward to digitization through e-learning. This increased the engagement of students with the smart learning such as digital textbooks.

Stages of the Indian School System



There are many fundamental changes in education system of India starting from religious teaching of Vedas and scriptures to virtual teaching through programming and others. A number of schools were established in India in various regions of the country to foster education in every aspect if society includes English medium schools. Schools today have 1:1 ratio of student and computer. Technologies like projections, online assignments, online classes, etc., are used in teaching for making students and their parent's technology sound. There are more than 1.5 million schools, 8.5 million teachers and 250 million students belonging to various backgrounds comprising education system of India (Source: Performance Grading Index 2017–18 under Sarv Shiksha Abhiyan).

Pupil-to-Teacher Ratio in Elementary Education in BRICS Economies in 2014



Source: MHRD, India

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3 Difference Between E-Education and Traditional Education [8]

E-Education	Traditional education
Individuals can study from the comfort of their home or office	Teachers and students can interact only in walled classrooms
E-education is based on learning management system	Traditional education is completely based on books

(continued)

(continued)

E-Education	Traditional education
Learning process is faster than traditional education	Learning process is slow
This method results in saving time, money and efforts [9]	This method requires more time, money and efforts
This is a flexible method as it just requires an online platform to teach and learn	Both students and teachers need to be physically present
Students can pause, read and test out of content	Students need to be more attentive to understand the lectures
The students can go back to the lecture again and again to understand it	The students can ask the questions at the time of lecture
E-education can help teaching large number of students at a time	Limited number of students can be taught at a time
The study material is present on electronic media	The study material is given in a written or printed form

4 Literature Review

Madhumathi—A computing system which is based on provision of learning anywhere, any device and anytime is known as e-learning-based cloud computing. With the development of cloud computing, every research scholar, faculties, students and administrators are being benefitted.

Manoj Kumar, who has worked with professional education and also with technical applications in learning in Indian education system discussed on the very popular strategy or using smart phones in education technology.

Prof. Abu El—The cloud computing is known to be helpful in solving different kinds of e-learning problems. He further proposed that the environment emphasizes on monitoring and designing an environment that is based on the reuse of existing web techniques, services and tools for providing browser-based application.

Shikha Dua et al.—They outlined that the future of digital education is based on video learning, learning based on gaming, digital classroom, etc.

Pooja Thakar, Manisha and Anil Mehta reviewed about mining of educational information based on various results of survey. Technological or mechanical learning helps people to be informative so that they can solve a problem.

Radhika R Halde introduced mechanical learning as one of the approaches for finding out the performance of students.

Jinal Jani and Girish Tere—Digital India is a program which is introduced by the government for the digital education development in India. It has various important factors; one of them is digital education.

Tunmibi, Ayooluwa Aregbesola, Pascal Adejobi and Olaniyi Ibrahim proposed that the increased use of digitalization or we can say e-learning at various

schools and universities showed that most of the educators were in favor of this technology and also stated that e-learning helped their students to get more resources and knowledge.

Jayesh—Nowadays, many teachers and students are generating interest in digital learning tools (Moodle, Twitter, Diigo, Glogster and Dropbox). These tools help to make learning process interesting and also help in student's motivation, which is not possible in traditional classrooms. The use of digital learning makes boring learning joyful and interesting for teachers and students.

5 COVID-19: A Case Study on Digital Education

- Around the world, almost 1.2 billion of students are staying at their homes due to COVID-19 which resulted in shutting down of educational institutes all over the world [10].
- So, digital or technical platforms are taken into account for teaching, leading to change in education adequately.
- According to recent research, it was noticed that e-learning holds the data prominently and less time consuming, seeing that coronavirus is going to stay for a while.

The acceptance of online education was started even before outbreak of COVID-19, as the figures of investments in online education in 2019 were approximately 18.66 billion dollars and were expected to reach 350 billion dollars by 2025. This growth of e-learning is rushed since COVID-19 situation, whether it is the use of various learning apps, learning software, video calling toolset.

According to the Chief Operating Officer of BYJU'S, Mrinal Mohit, there is an increase in number of students using this platform to about 200%. Not only that companies like BYJU'S are providing free access to students for their facilities.

Meanwhile, Tencent Classroom started to be used at a larger number by students and teachers after the government in China announced to the billion of students to start learning through electronic platforms which resulted in initiation of an online movement with the attendance of 730,000 students of K-12, in Wuhan.

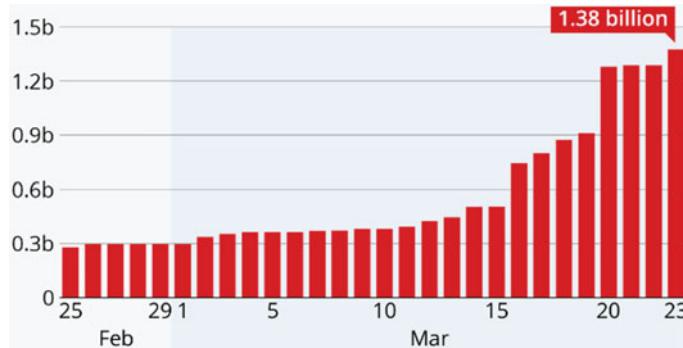
Apart from this, according to Chen Hang, CEO of the DingTalk, Alibaba distance learning, they tapped Alibaba Cloud so that they can deploy 100,000 cloud servers within two hours, resulted in a new record.

IMAGE

Not only this Prof Dr Amjad, from the University of Jordan stated that e-learning has totally changed the idea of teaching. Now, the teachers are able to reach the students very effectively and efficiently by using various online tutorials, video meetings, presentation or document sharing, etc. According to him, traditional learning and e-learning can be worked together in upcoming future.

6 Impact of COVID-19 on Education Level Globally

Learners who are affected or impacted by closure of national schools worldwide



This figure showcases the numbers of students and educators who enrolled at different levels of education like schools, colleges and universities, also education at tertiary level.

7 Strategies for Increasing Efficiency of E-Learning System [11]

For the smooth engagement and captivation of online learning, there are five strategies worked out as an instruction.

First will be making emergency plans for the problems which are unexpected
As we know, at present time most of the courses are switched to electronic education mode, and as a result it is possible that sometimes computer servers would not be able to host a large number of users. So, to solve these kinds of issues, faculties must be ready with some other plans for the students.

Secondly, teaching content can be divided into small parts to increase the focus of students

For ensuring full concentration of the students in online studies, it is required that educators should try to divide the content of teaching into various topics and acquire flexible methods of teaching or we can say they can adopt a new structured curriculum divided into small modules of 20–25 min.

Third, laying more stress on the use of “voice” while teaching

When talking about traditional method of teaching, the important tools are teachers' voice, facial expressions, body language, etc. But in online teaching, these tools are

not much of importance except “voice.” Hence, faculties required to control their speech accordingly so that it will allow students to grab key points.

Fourth, strengthening of learning ability of students outside the classroom

During online learning or teaching, teachers tend to have no control; as a result, some students are likely to bunk or leave the class. For this, it is necessary that faculty should try to use different methods of modifying students’ homework for strengthening active learning of student outside the classroom.

Lastly, combination of e-learning and self-learning

In traditional classroom, teaching common problems is insufficient preparation before class, less class discussion participations, etc. So not to face these issues in online teaching, faculties can create two-phase process: One is self-learning offline phase, where students need to read some literatures and do short papers based on their reading material, on which faculties can provide their feedback later on, and the other is online teaching, in which faculty can exchange their views with the students. It will help students to experience depth learning.

8 Conclusion

This paper concludes that [12] online learning is very effective in present world taking into consideration the present situation of COVID-19, which made almost all the educational institutes around the world to learn the importance of e-learning system. Also, it helped to modify education system for future perspective. However, it requires some improvements in its implementation strategies and techniques, which are suggested in this paper.

More in-depth study may be conducted based on the levels of education, namely primary, secondary and higher education level by the future researchers.

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Coiflet Wavelet Transform-Based Protection Scheme for Wind-Fed Series-Compensated Transmission Line



Gaurav Kapoor

Abstract This paper proposes a relaying technique for recognition of faults in a series-compensated transmission line (SCTL) connected with wind energy conversion system (WECS). The proposed relaying scheme is designed using coiflet wavelet transform (CWT) which is used to recognize the fault and identify the phase type involved in the fault, based on the amplitude of energy content in the CWT coefficients, in a relaying of transmission line. The samples of three-phase fault currents are recorded at Bus-1 of the system and are then processed using CWT. Thereafter, the amplitude of energy content hidden in the CWT coefficients is calculated. The practicability of the CWT-based relaying technique is tested on a SCTL connected with WECS under numerous fault situations using MATLAB, and the simulation outcomes demonstrate that the CWT relaying technique is effectual and precise.

Keywords Coiflet-4 wavelet · Distributed generation · Fault recognition · Fault categorization · Series-compensated transmission line · Wavelet transform

1 Introduction

The transmission lines compensated through series compensation (SCTLs) carry extensive capacity of electrical power. The fault occurrence and subsequent tripping of a SCTL would outcome in widespread disruption of electrical power. Therefore, an accurate recognition of fault in a SCTL turns out to be very important for dropping the thrashing of turnover and providing speedy continuation [1, 2]. In the most recent years, plenty of explorations have been dedicated for the relaying of SCTLs. The small assessment of recent investigations is described henceforth. In [3], a phase comparison technique of protection using the fault current signals of two terminals of power system has been used to protect SCTLs. A communication aided-based pilot

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protection scheme for thyristor-controlled series capacitor-connected transmission line is proposed in [4] in which the fault currents of remote-end terminal of transmission line are utilized in this scheme. Furthermore, the artificial neural network and wavelet transform have been adopted in [5], for differential relaying scheme of a wind-fed transmission line compensated by the static VAR compensator (SVC).

The originality of this paper is the use of a new coiflet wavelet transform-based technique using coiflet-4 mother wavelet for recognizing faults and identifying the faulty phase(s) in transmission lines connected with WECS and series compensation, respectively. In this work, the proposed scheme makes use of current signals only for measurement purpose. Such type of exploration has not been represented so far to the finest of the information of the author. The simulation outcomes demonstrate that the CWT-based scheme expertly recognizes all types of faults.

This article is structured as: Sect. 2 describes the power system studied. Section 3 contains the steps describing the proposed fault recognition scheme. Section 4 presents the performance review of the explorations which are performed in this paper. Section 5 presents the concluding comments.

2 Power System Studied

To evaluate the effectiveness of the CWT-based relaying technique in the WECS connected with SCTL, a power system as demonstrated in Fig. 1 is designed and simulated in MATLAB. The power system involves 400 kV grid substation and WECS interconnected through SCTL of 200 km total length and operating at 400 kV. The transmission line is the 40% SCTL and series capacitors installed at the middle of the transmission line. The CWT technique and the current transformers are connected at Bus-1 which employs only Bus-1 measurement using current transformers connected at Bus-1. The power system is working at 50 Hz frequency. The WECS has a voltage rating of 400 volts and the power generation capacity of 5 MW. There are totally five wind turbine units connected together at Bus-2 of the power system.

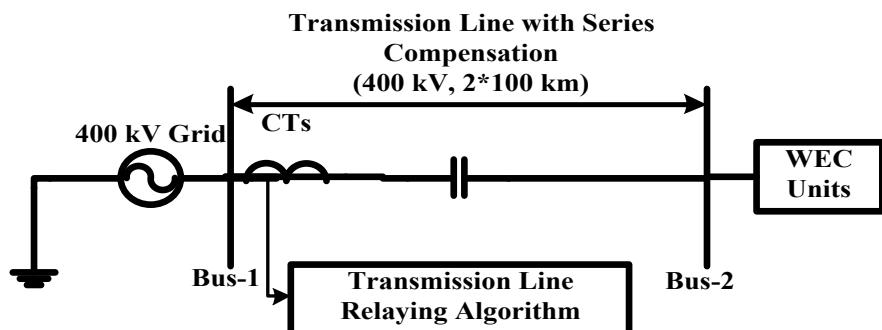


Fig. 1 Schematic of 400 kV SCTL connected with WEC units

3 Steps of CWT-Based Relaying Scheme for SCTL

The steps illustrating the CWT-based relaying scheme for WECS connected with SCTL are shown below.

1. Create faults and record the current samples at Bus-1 of power system.
2. Analyze the recorded current samples using CWT-based relaying algorithm.
3. Retrieve the amplitude of energy content from the CWT output.
4. If the amplitude of energy content is larger in the faulty phase, then the algorithm will generate the trip signal and if not then no trip will be issued.

4 Performance Review

The CWT-based relaying scheme has been tested on SCTL for the evolving faults and boundary faults. The outcomes of simulations are revealed below.

4.1 The Effectiveness of CWT for Evolving Faults

In this section, the CWT technique has been explored to detect the evolving faults [6]. Figure 2 depicts the plot of an evolving fault ($R_F = 1.45 \Omega$ and $R_G = 2.25 \Omega$) when the CG fault which is originally switched at 0.07 s is converted to the ACG fault at 0.15 s at 50% length of the SCTL. The CWT outputs are plotted together and presented in Fig. 3. It is detected from Fig. 3 that phases A and C have larger amplitude of energy content while that of phase B has lower energy content. It is evident from Table 1 that the CWT technique can well recognize any type of evolving fault.

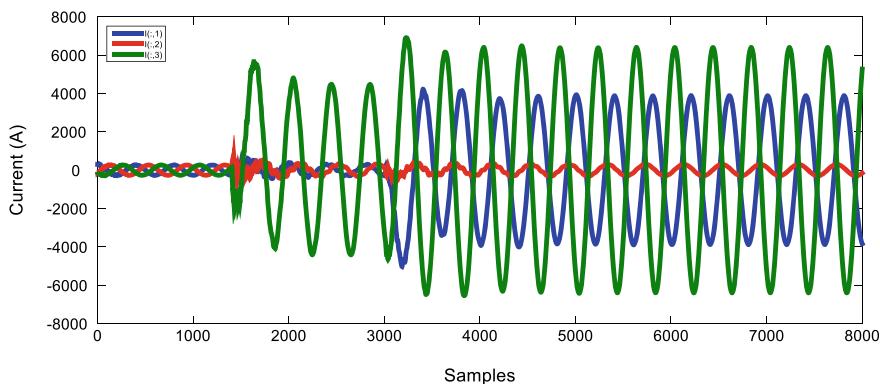


Fig. 2 Fault currents when CG fault at 0.07 s is converted to ACG fault at 0.15 s

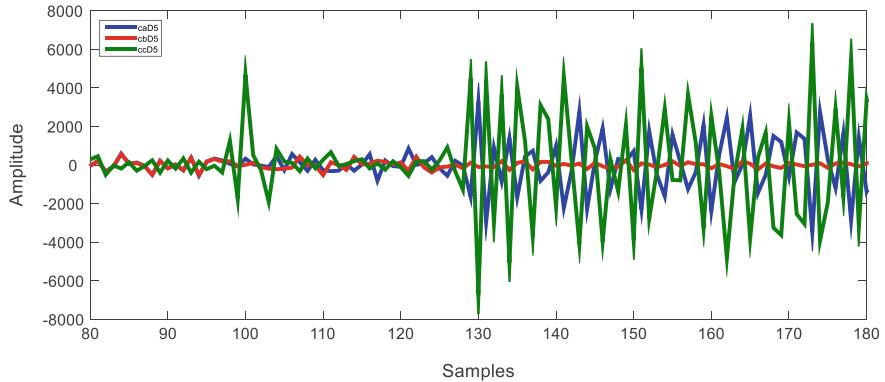


Fig. 3 Amplitude of energy content for CG to ACG evolving fault

Table 1 CWT simulation outcomes for evolving faults

Fault-1	F_L (%)	R_F (Ω)	R_G (Ω)	Fault-2	Amplitude of energy content		
					EC_A	EC_B	EC_C
CG (0.07)	50	1.45	2.25	ACG (0.15)	$3.2687 * 10^3$	576.4206	$6.3496 * 10^3$
BCG (0.05)	50	1.45	2.25	BG (0.2)	$3.6177 * 10^3$	$1.2895 * 10^4$	$1.3912 * 10^4$
AG (0.1)	50	1.45	2.25	ABG (0.17)	$5.1139 * 10^3$	$3.1894 * 10^3$	752.2525
BG (0.08)	50	1.45	2.25	AG (0.25)	$2.9940 * 10^3$	$3.2325 * 10^3$	$1.0862 * 10^3$
ABG (0.1)	50	1.45	2.25	CG (0.2)	$1.5605 * 10^4$	$9.3999 * 10^3$	$5.2390 * 10^3$

4.2 The Effectiveness of CWT for Near-in Relay Faults

In this section, the CWT technique is tested for near-in relay faults [7]. Hence, a two-phase-to-ground fault “ABG” is simulated ($R_F = 1.25 \Omega$ and $R_G = 2.15 \Omega$) at 2.5% length of a SCTL from Bus-1 at 0.1 s. The current waveform is presented in Fig. 4. The outcome has been presented in Fig. 5. It can be evident from Fig. 5 that the CWT output of phases A and B has more energy content than phase C and this states that the fault is ABG. It is studied from Table 2 that the CWT is resistant to near-in faults as well.

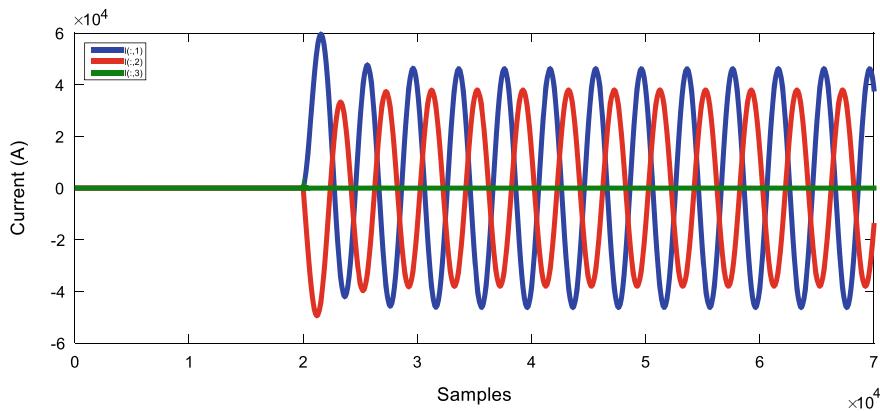


Fig. 4 Fault currents when ABG near-in relay fault occurred at 2.5% length at 0.1 s

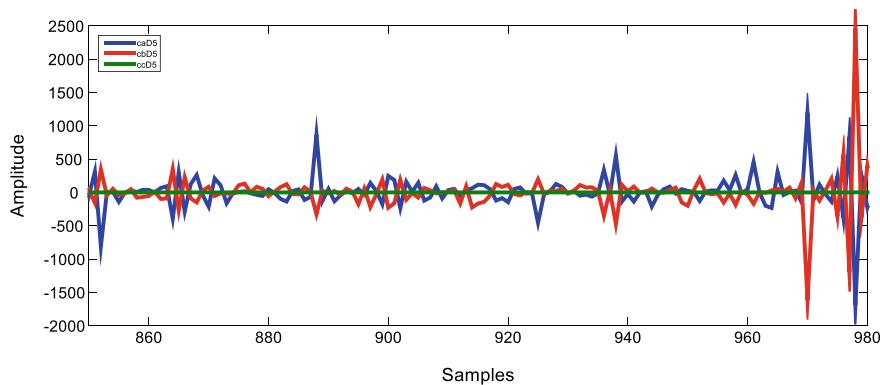


Fig. 5 Amplitude of energy content for ABG near-in relay fault

Table 2 CWT simulation outcomes for near-in relay faults

Fault case	F _L (%)	FST (s)	Amplitude of energy content		
			ECA	EC _B	EC _C
ABG	2.5	0.1	$1.1974 * 10^3$	$2.4578 * 10^3$	327.3102
ACG	3	0.1	725.7283	374.4960	986.1203
BCG	3.5	0.1	4.1908	$4.4929 * 10^3$	$2.6036 * 10^3$
BG	4	0.1	573.4838	$2.2077 * 10^3$	573.6066
AG	4.5	0.1	$1.8746 * 10^3$	68.9773	293.8815

4.3 The Effectiveness of CWT for Far-End Relay Faults

In this section, the effect of far-end relay faults on the execution of the CWT technique has been scrutinized [8]. As an example, the three-phase current waveform and the amplitude energy content during a three-phase-to-ground ABCG far-end relay fault ($R_F = 2.75 \Omega$ and $R_G = 1.95 \Omega$) created at 0.05 s at 97.5% length of the SCTL are demonstrated in Figs. 6 and 7, respectively. From Fig. 7, it is clearly seen that in phases A, B and C, the amplitude of energy content increases during the occurrence of a three-phase ABCG fault and this clearly indicates the happening of a three-phase-to-ground fault in the SCTL. From Table 3, it is apparent that the CWT technique is immune to far-end relay faults in SCTL as well.

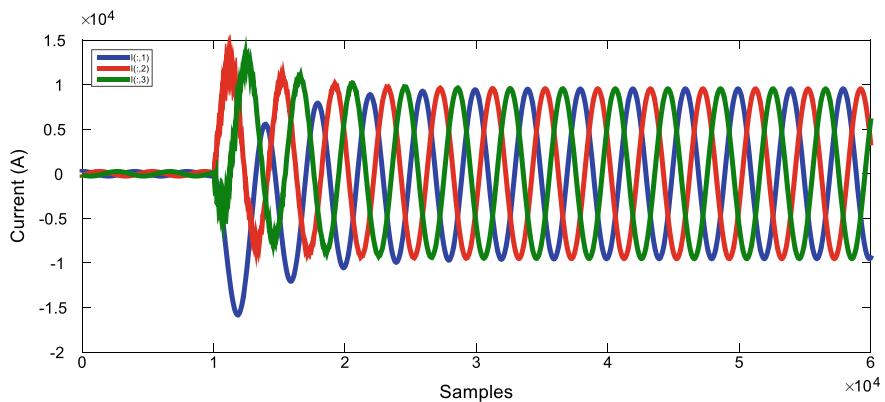


Fig. 6 Fault currents when ABCG far-end relay fault occurred at 97.5% length of SCTL

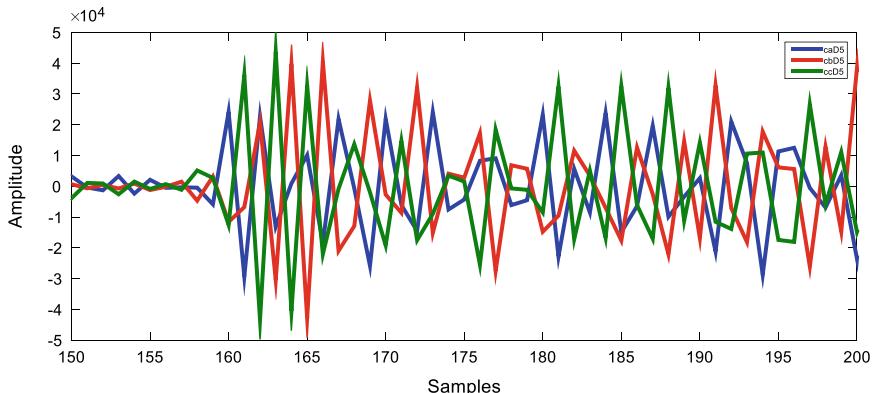


Fig. 7 Amplitude of energy content for ABCG far-end relay fault

Table 3 CWT simulation outcomes for far-end relay faults

Fault case	F _L (%)	FST (s)	Amplitude of energy content		
			ECA	EC _B	EC _C
ABCG	97.5	0.05	4.4344 * 10 ⁴	4.0503 * 10 ⁴	4.3648 * 10 ⁴
ACG	98	0.05	1.0755 * 10 ⁴	588.6450	1.1608 * 10 ⁴
BG	98.5	0.05	818.6768	4.8273 * 10 ³	817.8740
ABG	99	0.05	1.5889 * 10 ⁴	1.3132 * 10 ⁴	576.5702
BCG	99.5	0.05	483.9577	2.0514 * 10 ⁴	1.5069*10^4

5 Conclusion

A relaying technique based on CWT for recognition of faults in SCTL connected with WECS has been presented in this paper. The amplitude of energy content contained in the CWT outputs of three-phase fault currents of the SCTL is used for fault recognition and identification of faulty phase. The samples of three-phase fault current signals under fault situation recorded at only Bus-1 of power system are used to calculate the amplitude of energy content of CWT outputs. The simulation studies carried out in MATLAB substantiate the effectiveness of the CWT-based relaying technique under modifications in system's input parameters.

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