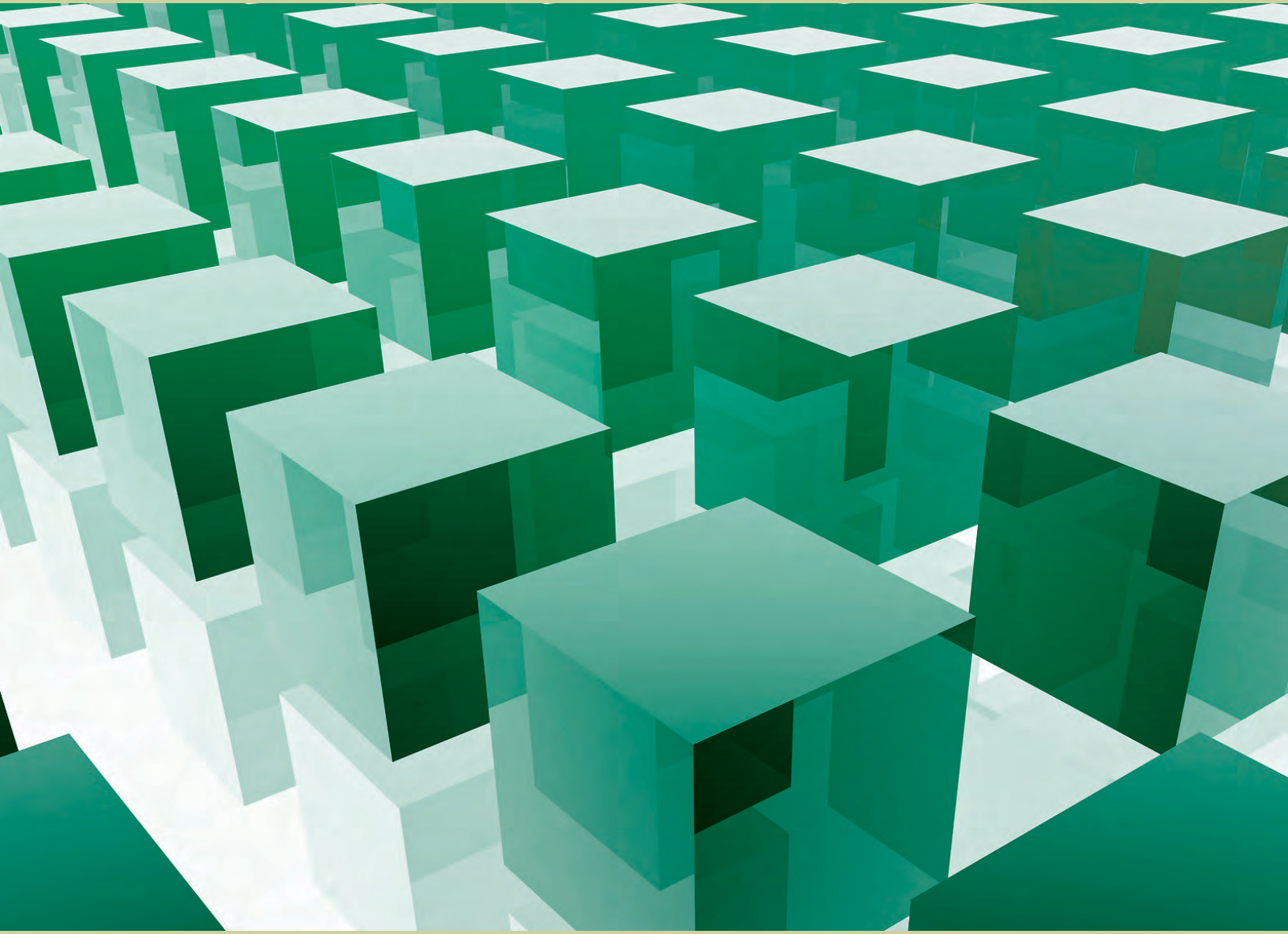
Vol. 13, Special Issue No. 5, November 2022 ISSN 2229-4678

IJNGC International Journal of Next-Generation Computing

SPECIAL ISSUE

2nd International Conference on Innovative Computing and Application's- ICICA'22



Editor-in-Chief
Prof. Vijay Kumar
University of Missouri-Kansas City
USA

Guest Editor
Dr. Dattatraya S. Adane
General Chair, ICICA'22
Shri Ramdeobaba College of Engineering and Management Nagpur-440013 (Maharashtra)

Website: http://ijngc.perpetualinnovation.net
E-mail: ijngc@perpetualinnovation.net

Perpetual Innovation
together let's innovate

IJNGC International Journal of Next-Generation Computing

The International Journal of Next-Generation Computing is a peer-reviewed journal published three times a year in March, July and November. It invites submissions of original high-quality works from authors in the form of research, review, technology discussion/overview papers and short-papers. IJNGC endeavors to provide a fast review cycle and decision dissemination with helpful feedback to authors.

Editor-in-Chief

Dr. Vijay Kumar, University of Missouri-Kansas City, USA

Editorial Advisory Board

Dr. Sitharam Iyenger, Lousiana State University, USA
Dr. Sushil Jajodia, George Mason University, USA
Dr. Mahadev Satyanarayanan, Carnegie Mellon University, USA
Dr. Sartaj Sahni, University of Florida, USA
Dr. Masaru Kitsuregawa, University of Tokyo, Japan
Dr. Vijay P. Bhatkar, ex-Director, Center for Advanced Computing (C-DAC), India
Dr. M. Tamer Özsu, University of Waterloo, Canada

Editorial Board

Dr. Gagan Agarwal, *Ohio State University, USA*
Dr. Farhad Arbab, *Leiden University, The Netherlands*
Dr. Bharat Bhargava, *Purdue University, USA*
Dr. Shu-Ching Chen, *Florida International University, USA*
Dr. Mukesh Mohania, *IBM Research, Australia*
Dr. Stefan Fischer, *Universitat zu Lubeck, Germany*
Dr. Ling Liu, *Georgia Institute of Technology, USA*
Dr. Sanjay Madria, *Missouri University of Science and Tech., USA*
Dr. Sham Navathe, *Georgia Institute of Technology, USA*
Dr. Evaggelia Pitoura, *University of Ioannina, Greece*
Dr. Peter Scheuermann, *Northwestern University, USA*
Dr. Mukesh Singhal, *Chancellor's Professor at University of California at Merced*
Dr. Valentina E Balas, *UAV Arad, Romania*
Dr. Domenico Talia, *University of Calabria, Italy*
Dr. Ouri Wolfson, *University of Illinois, USA*
Dr. Chao-Tung Yang, *Tunghai University, Taiwan*
Dr. Arkady Zaslavsky, *Lulea University of Technology, Sweden*
Dr. Sherali Zeadally, *University of the District of Columbia, USA*
Dr. Athman Bouguettaya, *RMIT, Australia*
Dr. Ching-Hsien (Robert) Hsu, *Chung Hua University, Taiwan*
Dr. Leszek T. Lilien, *Western Michigan University, USA*
Dr. K. C. Li, *Providence University, Taiwan.*
Dr. Lalit Kumar Awasthi, *National Institute of Technology, NIT, India*
Dr. Anirban Mondal, *Ashoka University, India*
Dr. Senthilkumar S, *Vellore Institute of Technology, India*
Dr. Roberto Baldoni, *University of Rome, Italy*
Dr. Torsten Braun, *University in Bern, Switzerland*
Dr. Chakravarty Sharma, *Unviersity of Texas at Arlington, USA*
Dr. Panos K. Chrysanthis, *University of Pittsburgh, USA*
Dr. Prasad M. Deshpande, *IBM Research, India*
Dr. Indrakshi Ray, *Colorado State University, USA*
Dr. Aditya Bagchi, *Indian Statistical Institute, USA*
Dr. Xu Chu, *University of Waterloo, Canada*

Managing Editor

Dr. Ankur Gupta, *Model Institute of Engineering and Technology, India*

SubScription form

Please enter our/my annual subscription to the International Journal of Next-Generation Computing (3 issues) at:

- ☐ ₹ 5,000 (Institutions - Indian)
- ☐ USD 200 (Institutions - Foreign)
- ☐ ₹ 4,000 (Individuals - Indian)
- ☐ USD 100 (Individuals - Foreign)

Name (Institution/Individual): _____

Address (Line 1): _____

Address (Line 2): _____

City: _____ State: _____ Pin/Zip Code: _____

Phone: _____ Fax: _____

Email: _____

Contact Person (Institutions Only): _____

payment option:

- ☐ Cheque/Demand Draft (Within India Only)
- ☐ NEFT (Online Payment)

NOTE: • Demand drafts/cheques should be made in favor of **"perpetual innovation media pvt. Ltd"** payable at Jammu.

• For payment through NEFT
Name : Perpetual Innovation Media Pvt. Ltd.
Bank : Punjab National Bank
Branch : MIER B. C. Road, Jammu
Account No. : 7182002100000281
IFSE Code : PUNB0718200

Library Recommendation Form

I would like to recommend the International Journal of Next-Generation Computing for subscription by our Library. The subscription cost and other details are provided overleaf.

Regards,

Name: _____

Designation: _____

Perpetual Innovation Media Pvt. Ltd.
5006, Hauz Qazi, Near Canara Bank, Delhi-6
Mob: 09560404488, 09990893093

TABLE OF CONTENTS

Message from the Editor-in-Chief	i
Message from the Guest Editor	ii
Detection of Diseases in Tomato Plant using Machine Learning *Ashish Chandak, Anshul Sharma, Aryan Khandelwal and Raunak Gandhi*	942
Design of an Ensemble Segmentation, Feature Processing & Classification model for identification of Cotton Fungal diseases *Sandhya N Dhage and Vijay Kumar Garg*	953
Machine Learning for Non-Invasive Diagnosis of Glucose Metabolism Disorder *Suruchi Dive and Gopal Sakarkar*	967
Feature Selection for Ranking using Heuristics based Learning to Rank using Machine Learning *Sushilkumar Chavhan and R C Dharmik*	976
Development of Air Purification Facial Shield with Real Time Health Monitoring System *Suchet Nawade and Vishal Rathee*	984
A Covid Outbreak Prediction using Machine Learning *A Chandak, Purshottam J Assudani, S Saklani, A Rahangdale and A Loya*	991
Improved Salp Swarm Optimization-based Fuzzy Centroid Region Growing for Liver Tumor Segmentation and Deep Learning Oriented Classification *Suraj Patil, Dnyaneshwar Kirange and Ramchand Hablani*	999
Novel approach to Create Human Faces with DCGAN for Face Recognition *Roshni Khedgaonkar, Kavita Singh and Sunny Mate*	1006
Ensembled Approach to Heterogeneous Data Streams *Lalit Agrawal and Dattatraya Adane*	1014

TABLE OF CONTENTS

Design and Development of a system for corrosion detection using Image Segmentation algorithms *Praful Sonarkar, Gaurav Patil and Pranav Chalasani*	**1021**
Robust Image Encryption Scheme for Biometric Finger Print Images using Bit Planes, DWT and Cubic Map *Gouri Morankar*	**1029**
Lost + Found: The Lost Angel Investigator *H Shrirame, B Kewalramani, D Kothari, D Jawandhiya and Rina Damdoo*	**1036**
Automatic Adaptive Filtering Technique for Removal of Impulse Noise using Gabor Filter *Swati Rane, L K Ragha and Siddalingappagouda Biradar*	**1043**
A Machine Learning approach for Fake News Detection *Wani H. Bisen, A Paunikar, B Thakur, A Garg and K Nangliya*	**1050**
Employing Biomedical Signals as a Means of Biometric Identification *J Rathi, H Lakhwani, N Kulkarni, S Ramani and V Rathod*	**1057**
Detection of Cloud Cover in Satellite Imagery Using Semantic Segmentation *S Jaju, M Sahu, A Surana, K Mishra, A Karandikar and A Agrawal*	**1064**
Computerized System to Audit and Sharing Feature of Medical Life History *Bhagyashree Hambarde and Priya Parkhi*	**1071**
Outage Probability and Capacity Analysis for NOMA based 5G and B5G Cellular Communication *M Kinhikar, A Agrawal, D Tiwari, I Kohad, P Thakre and S Pokle*	**1078**
Covid Security System Using IOT Monitoring System *C Mohadikar, R Najbile, V Kaushik, Y Konghe, D Khushalani and P Joshi*	**1084**
Video Lecture Summarization System *Sujal Agrawal and Shubhangi Tirpude*	**1091**

TABLE OF CONTENTS

Pragmatic evaluation of privacy preservation security models targeted towards fog-based deployments *Roshan Gunwantrao Belsare and P B Ambhore*	**1098**
DIVVA: Disaster Information Verification and Validation Application Using Machine Learning *V Bongirwar, S Shekhar Mishra, A Bisen, S Mundhada and U Singh*	**1109**
An Effective Framework for design of Dataset Using Twitter *Monal R Torney, K H Walse and V M Thakare*	**1117**
Human Recognition Model Using CNN *Mridula Korde, Abhishek Joshi and Aditya Shrivastava*	**1125**
Pneumonia detection through Image Classification Using CNN *Karan Badlani, Shreya Sawal, Mohit Nilkute, Shruti Belekar and Ajinkya Nilawar*	**1133**
ManiacNFT : An Application for NFT Marketplace *P Adane, A Pardhi, A Wadekar, G Laud, S Shukla, V Loya and V Dhawan*	**1140**
Data Analytical Approach for Evaluating Locus of Control among Private Banks Employees *Monika R Seth, Vinod H Asudani, Sachin Upadhye and Satyajit S Uparkar*	**1147**
Using Marchenko–Pastur SVD and Linear MMSE Estimation for Reducing Image Noise *Swati Rane, L K Ragha, Siddalingappagouda Biradar and Vaibhav R Pandit*	**1156**
Comparative Analysis of Scalability Approaches using Data Mining Methods on Health Care Datasets *S S Uparkar, S N Dhote, S S Pathan, P D Shobhane and D Das*	**1165**
Identification of Source Camera by Amalgamation of PRNU and Noise Print Using Dimensionality Expansive Residual Network *S Telang, K D Bharadwaj, S Anjankar and R R Khandelwal*	**1172**
Improving Health WSN with Distinguished Cloud Computing for Multi-Sensor Analytics *Mirza Moiz Baig and Srikant V Sonekar*	**1181**

IJNGC International Journal of Next-Generation Computing

TABLE OF CONTENTS

Optimal power allocation for NOMA-based Internet of things over OFDM sub bands *Prasheel N Thakre and Sanjay B Pokle*	**1189**
Improved League Championship Algorithm (ILCA) for Load Balancing in Cloud Computing *Amol D Gaikwad and Kavita Singh*	**1197**
Object Detection using Speech Recognition *C Thaokar, G Ladsawangikar, T Wadibhasme and S Sureka*	**1205**
Design and Analysis of Multipliers for DNN application using approximate 4:2 Compressors *Hemant Gillurkar, Pravin Dwaramwar, Shubham Anjankar and Pankaj Joshi*	**1212**
A Model for Rainfall Forecasting using Distinct Machine Learning Algorithm *Sachin Upadhye and Lalit Agrawal*	**1220**
Blockchain Technology: Growing Usecases and Issues to Tackle *Firdous Sadaf Mohd Ismail and Dattatraya S Adane*	**1227**
Plagiarism Detection in Programming using Performance Analyzing Features *D S Adane, Abhishek Angale, Ayush Singh, Rituj Aryan and Sumeet Yadav*	**1235**
IoT Based on Potholes and Speed Breakers Detection and Alert System *Rakesh K Kadu, Ayushi Mishra, Devang Baheti and Himangi Pilkawar*	**1243**
Identification and Evaluation of Factors Influencing Software Quality using Pythagorean Fuzzy DEMATEL Approach *Mangesh Joshi, Rahul Mankar and Himanshu Shukla*	**1251**
Energy Aware Job Scheduling and Simulation in a Cloud Datacenter *Purushottam J Assudani, Mehvash Khan, Mukesh Kumar and Tejas Bhutada*	**1258**
Mathematical Word Problem Solver System Using Deep Learning *Rohini Joshi, Kalpak Punwatkar, Chinmay Wankhede and Parth Dhorajiya*	**1267**

TABLE OF CONTENTS

Role of Blockchain Technology and Machine Learning in Design of Smart and Secure Warehouse Management System: A Survey *Kapil N Hande and Manoj B Chandak*	**1274**
Smart College Campus Recruitment System *Purshottam J Assudani, Rakesh K Kadu, Rizwan Sheikh and Tushar Khanna*	**1280**
Options Trading using Artificial Neural Network and Algorithmic Trading *S Ghosh, S Kumar, A Deshmukh, A Kurve and R Welekar*	**1286**
Analysing the Factors Influencing the House Prices and Studying House Price Prediction Methods *Purshottam J Assudani and Chinmay Wankhede*	**1294**
Plant leaves disease detection using Image Processing and Machine learning techniques *P Kokardekar, A Shah, A Thakur, P Shahu, R Raggad, S Keshaowar and V Pashine*	**1304**
Voice Based Authentication System for Web Applications using Machine Learning *R K Kadu, P J Assudani, S Bhojane, T Agrawal, V Siddhawar and Y Kale*	**1312**

Message from the Editor-in-Chief

Dear Friends,

I am pleased to bring you the special issue 5 of 13 volumes of IJNGC. This special issue contains 48 selected papers on advanced research topics, presented at the International Conference on Innovative Computing and Applications (ICICA'22), held on November 25-26, 2022, organized by Shri Ramdeobaba College of Engineering and Management, Nagpur, India.

This special issue of IJNGC is a collection of articles focusing on current research areas within the scope of this journal. These issues provide space for research in emerging areas, highlight important disciplinary processes, or describe new interdisciplinary applications of Intelligent Database Systems, Big Data, Mobile and Wireless Networks, Networks and Communications cybersecurity, internet of things, next generation internet and information search and recommender systems, machine learning, natural language processing, computer vision, health information, cloud computing. The articles published in this special issue are selected after rigorous peer review to ensure they are timely, relevant and relevant to their reading. This publication will provide an advanced theoretical foundation and practical application of mathematics and its applications.

I hope you will enjoy browsing through this special issue and encourage your fellow researchers, graduate students and academic researchers in your various universities to consider IJNGC as a place they will publish their research.

I thank you very much
Respectfully submitted

Vijay Kumar
Editor-in-Chief.

Message from the Guest Editor

Dear Friends,

I am very pleased to share the International Journal of Next-Generation Computing (IJNGC) special issue no. 5, Vol 13, November 2022, containing 48 selected papers from the International Conference on Innovative Computing and Applications (ICICA'22) conducted during 25-26 November, 2022.

The main objective of ICICA'22 was to promote, deliberate and discuss current research and application development activities in identified domains of Information Technology such as Artificial Intelligence, Machine Learning, Internet of Things, Cloud Computing and Information Security. The conference also aimed to provide a common platform for academicians, industries, researchers and students to share information, ideas and promote professional interaction. To increase awareness on the current trends in Technology and Research, four pre-conference talks and two keynote addresses by eminent people from academia and industry were arranged during the conference.

This special issue contains 48 papers presented at conference and selected for publication after double-blind peer review. In the selection of papers, an attempt was made to ensure the novelty and quality of the research.

I am confident that the readers of this issue will greatly benefit from the research experiences of the authors of the various papers and provide them with a road map for future research in their identified field of work.

I would like to express my sincere thanks to IJNGC for being the publishing partner of the conference. I also thank all the authors for their interest in the conference.

Respectfully submitted

Dr. Dattatraya S. Adane
General Chair, ICICA'21
Shri Ramdeobaba College of Engineering
and Management Nagpur-440013 (Maharashtra)
Email: adaneds@rknec.edu

Detection of Diseases in Tomato Plant using Machine Learning

Ashish Chandak, Anshul Sharma, Aryan Khandelwal
and
Raunak Gandhi
Shri Ramdeobaba College of Engineering and Management, Nagpur, India

A major part of the Indian economy relies on agriculture, thus identification of any diseased crop in the initial phase is very important as these diseases cause a significant drop in agricultural production and also affect the economy of the country. Tomato crops are susceptible to various diseases which may be caused due to transmission of diseases through Air or Soil. We have tried to automate the procedure of detection of diseases in the Tomato Plant by studying several attributes related to the leaf of the plant. Using various machine learning algorithms such as Support Vector Machine (SVM), Convolutional Neural Network (CNN), ResNet, and InceptionV3 we have trained the model, and based on the results obtained we have evaluated and compared the performance of these algorithms on different features set. For the dataset we had 10 classes (healthy and other unhealthy classes) having a total of 18,450 images for the training of the models. After implementing all of the algorithms and comparing their results we found that the ResNet was most appropriate for extracting distinct attributes from images. The trained models can be used to detect diseases in Tomato Plant timely and automatically.

Keywords: machine learning, performance of algorithm, deployment of model

1. INTRODUCTION

Tomato plants are rich in nutritional content; thus, they are one among the crops that are extensively grown worldwide, it's full of vitamins and nutrients, including antioxidants. Leaves are the most sensitive part of these plants which show disease symptoms at the earliest. These crops need to be frequently assessed and inspected for illness throughout their lifecycle. Although the primary method used in practice for the detection and identification of plant diseases is the expert's naked eye observation, this method requires ongoing expert surveillance, which can be costly and challenging, especially on big farms. Therefore, it is essential to assist farmers in automatically identifying disease symptoms as soon as they emerge by examining digital photographs. Aiming to reduce significant economic and production losses, ensure the viability of agricultural goods, and reduce the use of agrochemicals. The proposed solution includes:

• Preprocessing of photos from a public image dataset (PlantVillage) and extraction of image features (color and texture features).
• To diagnose diseases, Deep Learning classification networks (ResNet34, Inception V3) and standard ML algorithms, such as the Support Vector Machine (SVM), Convolutional Neural Network (CNN), and Random Forest (RF) algorithms are used.
• To find the most efficient ML/DL models for the tomato disease classification problem, we examined the classification outcomes of machine learning and deep learning techniques.

The rest of the article is organized as follows. Related work is described in "Literature Review". The proposed flow of operations is described in the "Proposed Model". The description of the used algorithms is discussed in "Algorithm Description". Outcomes obtained are discussed in "Results". The conclusion is made in "Conclusion".

2. LITERATURE REVIEW

This section describes previous work in this area, as well as findings and researchers' suggestions for a framework for implementation.
Based on various studies in this field, many researchers have used preprocessing, segmentation, training, and classification for the disease detection process. Different methods of color conversion are also considered for the same. Trait extraction is of primary importance in determining disease in leaves, stems, or other parts of plants and fruits. Much work has been done to obtain color, texture, and shape-related features from images of diseased plants. Depending on the purpose, many techniques have been proposed to clarify or at least minimize the problem using image processing, pattern recognition, and some automatic classification tools. (Salih, Ali, and Ahmed, 2020)

2.1 Effects of Diseases

Gavhale and Gawande (2014) defined crop disease as a major cause of production and economic losses, reducing both viability and aggregate of agricultural products. Their study identified the need for a basic plant leaf disease detection system that would advance agricultural progress. Early information on plant health and disease detection can facilitate disease control through appropriate management strategies. This white paper also compares the advantages and limitations of these potential methods. This involves several steps. Image acquisition, image pre-processing, feature extraction, neural network-based classification. (Gavhale and Gawande, 2014)

2.2 Need for Disease Detection in plants

Fuentes et al. (2016) analyzes the importance and effectiveness of plant disease detection as a plan to increase yields and reduce economic losses in the agricultural domain. According to their research due to the advancements in the technology, current studies in the field of agriculture have suggested to utilise non-destructive methods to detect plant diseases, thus imaging-based techniques are being adopted widely. Their research describes the challenge of accuracy in computer vision, and the proper use of data is a key issue of any intelligent system. Several diseases affecting the tomato plants and their characteristics were the main part of this study. (Fuentes, Yoon, Kim, and Park, 2017)

2.3 Outcome of Literature Survey

In developing countries like India, the financial system is often based on agriculture. Due to plant diseases, the quality and quantity of agricultural products are reduced. Plant diseases can often be seen through leaves, stems and fruits. Detecting this disease is important at an early stage to treat and manage the disorder. According to previous research, many researchers have proposed an implementation framework that includes a series of steps including pre-processing, segmentation, training, and classification. (Hasan, Tanawala, and Patel, 2019; Ishak, Fazalul Rahiman, Mohd Kanafiah, and Saad, 2015)

3. PROPOSED MODEL

3.1 Flow of Operations

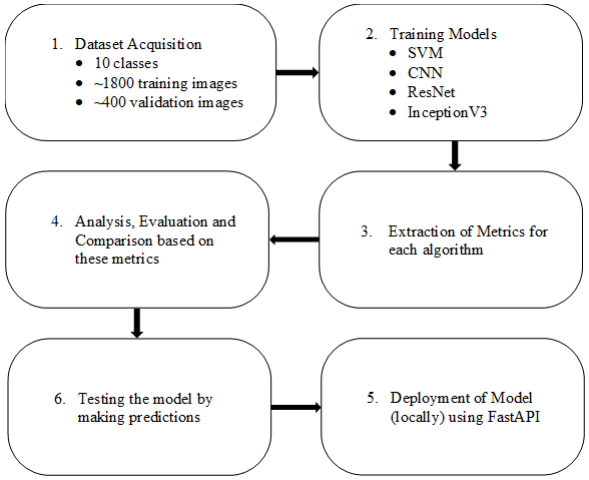


Figure 3.1. Flow chart of proposed work

3.2 Dataset Distribution

For our implementation, the dataset that we used had a total of 18,405 images of the leaf of the tomato plant. The images were categorized into 10 different classes, where one of the classes is healthy and the other remaining nine classes are unhealthy which included diseases caused in tomato plant (such as bacterial spot, early blight, leaf mold, Septoria leaf spot, target spot, two-spotted spider mite, late bright mold, mosaic virus, and yellow leaf curl virus). The 9 unhealthy classes are categorized into five subgroups (namely-bacterial, viral, fungal, mold, and mite disease). Figure 3.2 below shows the distribution of the dataset images into 10 different classes for training and validation purpose.

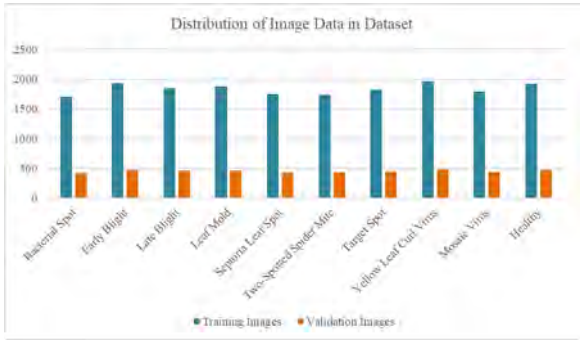


Figure 3.2. Dataset Distribution for Training and Validation Images

3.3 Deployment of Model

The models obtained in previous stages are now deployed locally and tested. The deployment part is done using Fast API. A contemporary, quick (high-performance), web framework called Fast API is used to create APIs. Two endpoints were created one as a deployment check and another for testing the application functionality. The first endpoint /ping is a GET request that returns a response message about the status of the deployment. The second endpoint /predict_disease is

a POST request that takes input as a file and returns a JSON output having details about the prediction.

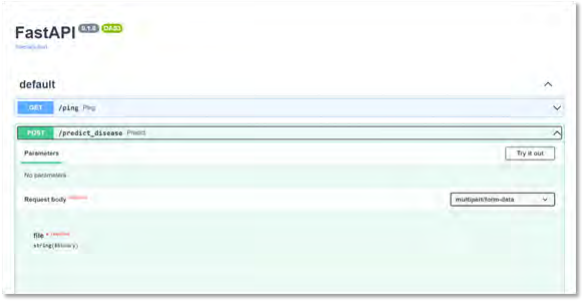


Figure 3.3. FastAPI Interface (Swagger API)

The above figure 3.3 shows the FastAPI Interface displaying the information regarding the two endpoints that were created. The testing of this API is done using Postman. Postman is an API platform for building, using, and testing APIs.

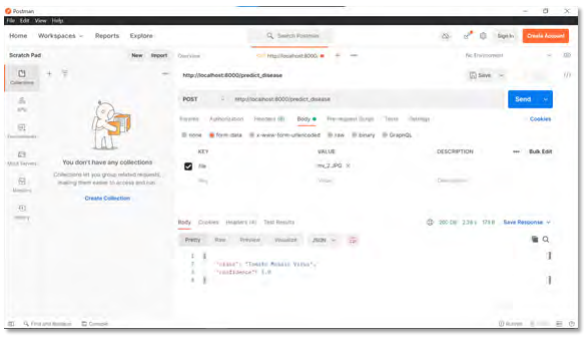


Figure 3.4. Response of '/predict_disease' request

The above figure 3.4 shows the response received from the deployed model by specifying the URL and selecting the tomato plant leaf image that is to be tested. The image to be tested is given as an input file to the POST request

3.4 Web Interface as Application

To make the service available to the end user a Web interface is created using React framework. The user can give input by providing the image file of the plant leaf the application will use the API created in the previous stage to get the prediction of the specified file. The back will respond with the JSON object having two fields, one is the class of prediction made by the underlying algorithm and the second field is the confidence score with which the prediction is made. Both these fields are parsed accordingly and shown clearly in the GUI to the user.

The above figure 3.5 shows the interface of the React application when the prediction output was received.

4. ALGORITHM DESCRIPTION

Our proposed work includes the implementation, training and testing of models by using the algorithms like Support Vector Machine, Convolutional Neural Network, ResNet and Inception V3. Further using these trained model's ensemble learning approach is applied to simulate the part of Random Forest Algorithm.(Sabrol and Satish, 2016; Polikar, 2006; Wu, Xu, and Goodman,

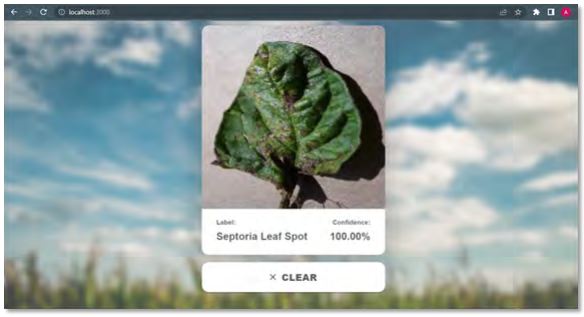


Figure 3.5. Response of the application

2021) Ensemble learning is a common meta-approach to machine learning that aims to improve prediction performance by combining predictions from multiple models. Although the number of ensembles that can be developed for predictive modelling problems is seemingly unlimited, there are three approaches that dominate the field of ensemble learning. Algorithms are not unique, but a field of study where each algorithm has resulted in more specialized methods.

4.1 Support Vector Machine

The SVM algorithm is a supervised learning method that is often used in pattern recognition problems. In the context of classification, it learns a mapping between input vectors and output classes. A typical application would be to classify handwritten digits. The training data consists of examples where each example is labelled with its correct class. An SVM constructs a hyperplane that separates the two classes. If the training set contains linearly separable patterns, then the hyperplane can be chosen to separate the points of the different classes.(Cortes and Vapnik, 2004; Osuna, Freund, and Girosi, 1997)

4.2 Convolutional Neural Network

A deep learning artificial neural network called a convolutional neural network, or CNN is made to evaluate visual data. An input layer, numerous hidden layers, and an output layer are common components of a CNN architecture. Each neuron in the first layer is connected to each neuron in the second layer, forming a matrix called a weight connection. Each neuron in the final layer produces a vector indicating how much it contributes to the prediction. These vectors are then combined using a nonlinear activation function to produce the final result.(Patil and Rane, 2021)

4.3 Inception v3

The inception_v3_algorithm is a deep neural network model that was developed by the Google Brain team. It is designed to classify images into 1000 classes. It uses residual connections, shortcut connections, batch normalization, and pooling layers. (He, Zhang, Ren, and Sun, 2016)

4.4 Resnet

The ResNet algorithm was developed by Google's DeepMind team. It is a deep learning algorithm that uses convolutional neural networks (CNN) to detect objects in images. CNN's have been shown to perform well at object detection tasks. In addition, they can learn features automatically, without being explicitly programmed. (Szegedy, Vanhoucke, Ioffe, Shlens, and Wojna, 2016)

5. RESULTS

5.1 Outcomes

Each model was trained on a total of 18,405 images and validated on 4,585 images belonging to 10 different classes for 50 Epochs. For each epoch, various performance metrics were extracted like

Accuracy, Loss, Precision, and Recall. Below is the graphical representations of the performance of the SVM, CNN, ResNet and Inception V3 algorithm with respect to training data and the validation data for 50 epochs.

5.1.1 *Support Vector Machine.*

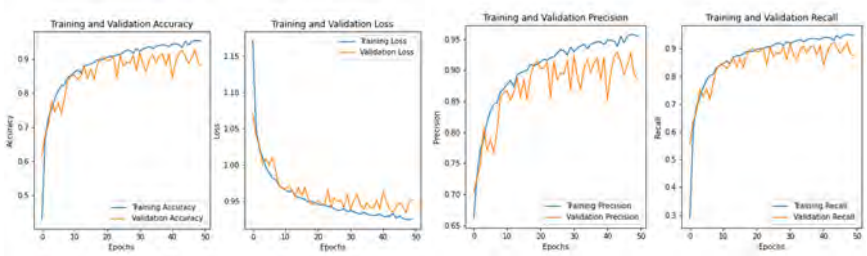


Figure 5.1. Accuracy, Loss, Precision and Recall of SVM

For the Support Vector Machine Algorithm after 50 Epochs the Final Accuracy was found to be 95.17%, the Final Loss was 92.53%, the Precision was 95.51% and the Recall was 94.90% as shown in figure 5.1.

	precision	recall	f1-score	support
0	0.09	0.07	0.08	425
1	0.11	0.15	0.13	480
2	0.12	0.09	0.10	463
3	0.11	0.11	0.11	470
4	0.08	0.06	0.07	436
5	0.09	0.09	0.09	435
6	0.11	0.09	0.10	457
7	0.11	0.11	0.11	490
8	0.10	0.10	0.10	448
9	0.11	0.16	0.13	481
accuracy			0.10	4585
macro avg	0.10	0.10	0.10	4585
weighted avg	0.10	0.10	0.10	4585

Figure 5.2. Classification Report of SVM

Figure 5.2 above shows the classification report of the SVM algorithm after implementation, we can infer various metrics belonging to each of the classes, and using these metrics we can analyze, evaluate and contrast our model's performance with other models.

5.1.2 *Convolutional Neural Network.*

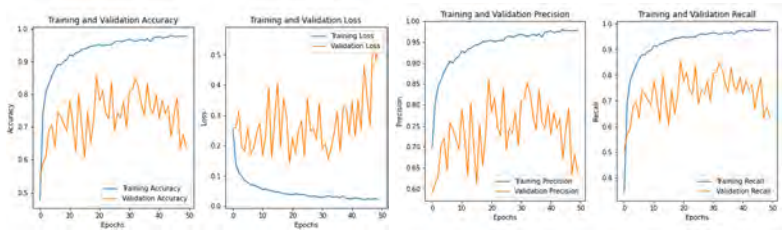


Figure 5.3. Accuracy, Loss, Precision and Recall of CNN

For the Convolutional Neural Network Algorithm after 50 Epochs the Final Accuracy was found to be 97.78%, the Final Loss was 2.2%, the Precision was 97.86% and the Recall was 97.74% as shown in figure 5.3.

	precision	recall	f1-score	support
0	0.07	0.09	0.08	425
1	0.09	0.03	0.05	480
2	0.10	0.33	0.15	466
3	0.08	0.05	0.06	470
4	0.13	0.02	0.03	436
5	0.10	0.18	0.13	435
6	0.11	0.07	0.09	459
7	0.13	0.11	0.12	490
8	0.06	0.01	0.02	448
9	0.12	0.10	0.11	481
accuracy			0.10	4590
macro avg	0.10	0.10	0.08	4590
weighted avg	0.10	0.10	0.09	4590

Figure 5.4. Classification Report of CNN

Figure 5.4 above shows the classification report of the CNN algorithm after implementation, we can infer various metrics belonging to each of the classes, and using these metrics we can analyze, evaluate and contrast our model's performance with other models.

5.1.3 *ResNet.*

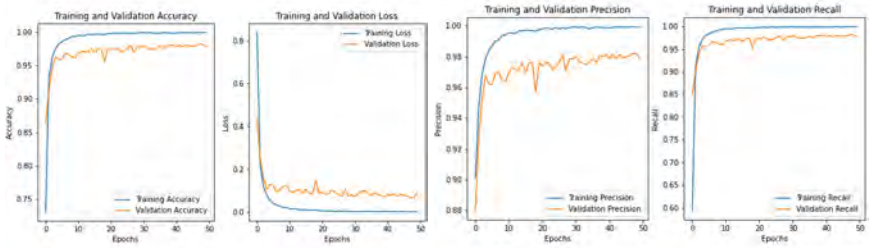


Figure 5.5. Accuracy, Loss, Precision and Recall of ResNet

For the ResNet Algorithm after 50 Epochs the Final Accuracy was found to be 99.92%, the Final Loss was 0.28%, the Precision was 99.92% and the Recall was 99.92% as shown in figure 5.5.

	precision	recall	f1-score	support
0	0.11	0.11	0.11	425
1	0.09	0.09	0.09	480
2	0.11	0.11	0.11	463
3	0.10	0.09	0.09	470
4	0.06	0.06	0.06	436
5	0.11	0.11	0.11	435
6	0.11	0.10	0.11	457
7	0.10	0.10	0.10	490
8	0.09	0.09	0.09	448
9	0.10	0.10	0.10	481
accuracy			0.10	4585
macro avg	0.10	0.10	0.10	4585
weighted avg	0.10	0.10	0.10	4585

Figure 5.6. Classification Report of ResNet

Figure 5.6 above shows the classification report of the ResNet algorithm after implementation, we can infer various metrics belonging to each of the classes, and using these metrics we can analyze, evaluate and contrast our model's performance with other models.

5.1.4 *Inception V3.*

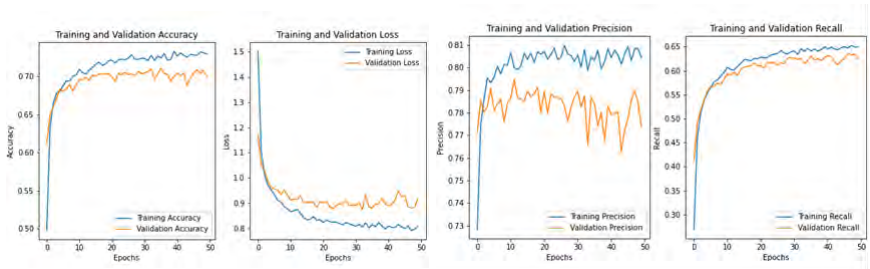


Figure 5.7. Accuracy, Loss, Precision and Recall of Inception V3

For the InceptionV3 Algorithm after 50 Epochs the Final Accuracy was found to be 72.94%, the Final Loss was 80.70%, the Precision was 80.43% and the Recall was 64.98% as shown in figure 5.7.

	precision	recall	f1-score	support
0	0.09	0.12	0.10	425
1	0.11	0.15	0.12	480
2	0.10	0.08	0.09	463
3	0.11	0.10	0.10	470
4	0.11	0.07	0.09	436
5	0.10	0.10	0.10	435
6	0.09	0.07	0.08	457
7	0.08	0.08	0.08	490
8	0.10	0.13	0.11	448
9	0.10	0.11	0.11	481
accuracy			0.10	4585
macro avg	0.10	0.10	0.10	4585
weighted avg	0.10	0.10	0.10	4585

Figure 5.8. Classification Report of Inception V3

Figure 5.8 above shows the classification report of the InceptionV3 algorithm after implementation, we can infer various metrics belonging to each of the classes, and using these metrics we can analyze, evaluate and contrast our model's performance with other models.

5.2 Comparison

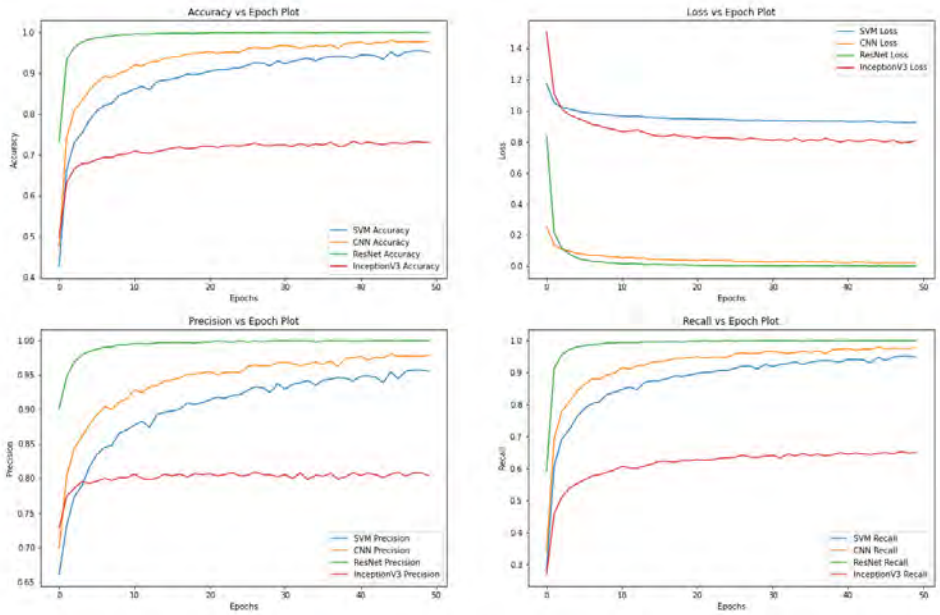


Figure 5.9. Comparison of Algorithms

5.2.1 *Comparison of Algorithms.* The above figure 5.9, shows the comparison between the results obtained from all 4 algorithms i.e., Support Vector Machine, Convolutional Neural Network, ResNet, and Inception V3. The Algorithms are compared on metrics like Accuracy, Loss, Precision and Recall for 50 epochs.

Algorithm	**Accuracy**	**Loss**	**Precision**	**Recall**	**Macro Avg F1-Score**	**Weighted Avg F1-Score**
SVM	0.9517	0.925	0.9551	0.9490	0.10	0.10
CNN	0.9778	0.022	0.9786	0.9774	0.08	0.09
ResNet	0.9992	0.003	0.9992	0.9992	0.10	0.10
InceptionV3	0.7294	0.807	0.8043	0.6498	0.10	0.10

Table I: Table 5.1. Performance Metrics of each algorithm

Above table 5.1 shows the data of various extracted parameters of all algorithms after iterating through the full dataset 50 times. These metrics can be used to evaluate the performance of the algorithms.

6. CONCLUSION

A disease classification algorithm was implemented on tomato plants by analyzing leaf images. After implementing all the algorithms and comparing the results, we found that ResNet is superior at identifying features from photographs. The trained model can be used for early and disease detection in plants automatically. Therefore, rapid action can be taken to implement preventative measures. This can help in early and automatic tomato disease detection. The proposed framework can be combined with a feedback system that offers appropriate understanding, treatment, disease prevention, and control methods to achieve higher yields by integrating the use of technologies like cell phones, drone cameras, and robotic platforms.

References

Cortes, C. and Vapnik, V. N. 2004. Support-vector networks. *Machine Learning 20*, 273–297.

Fuentes, A., Yoon, S., Kim, S. C., and Park, D. S. 2017. A robust deep-learning-based detector for real-time tomato plant diseases and pests recognition. *Sensors (Basel, Switzerland) 17*.

Gavhale, K. R. and Gawande, U. H. 2014. An overview of the research on plant leaves disease detection using image processing techniques. *IOSR Journal of Computer Engineering 16*, 10–16.

Hasan, M., Tanawala, B., and Patel, K. 2019. Deep learning precision farming: Tomato leaf disease detection by transfer learning. *SSRN Electronic Journal*.

He, K., Zhang, X., Ren, S., and Sun, J. 2016. Deep residual learning for image recognition. *2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 770–778.

Ishak, S., Fazalul Rahiman, M. H., Mohd Kanafiah, S., and Saad, H. 2015. Leaf disease classification using artificial neural network. *Jurnal Teknologi 77*.

Osuna, E., Freund, R. M., and Girosi, F. 1997. Support vector machines: Training and applications.

Patil, A. and Rane, M. 2021. *Convolutional Neural Networks: An Overview and Its Applications in Pattern Recognition*. 21–30.

Polikar, R. 2006. Polikar, r.: Ensemble based systems in decision making. ieee circuit syst. mag. 6, 21-45. *Circuits and Systems Magazine, IEEE 6*, 21 – 45.

Sabrol, H. and Satish, K. V. R. 2016. Tomato plant disease classification in digital images using classification tree. *2016 International Conference on Communication and Signal Processing (ICCSP)*, 1242–1246.

Salih, T., Ali, A., and Ahmed, M. 2020. Deep learning convolution neural network to detect and classify tomato plant leaf diseases. *OALib 07*, 1–12.

Szegedy, C., Vanhoucke, V., Ioffe, S., Shlens, J., and Wojna, Z. 2016. Rethinking the inception architecture for computer vision. *2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2818–2826.

Wu, Y., Xu, L., and Goodman, E. 2021. Tomato leaf disease identification and detection based on deep convolutional neural network. *Intelligent Automation Soft Computing 28*, 561–576.

Prof. Ashish Chandak has done his B.E from Amravati University and M.Tech (CSE) from NIT,Rourkela. He has more than 9 years of Teaching and 2.5 years of Industry experience. He is currently working as Assistant Professor in Department of Information Technology, Shri Ramdeobaba College of Engineering and Management, Nagpur. His area of Interest includes Distributed System, Web Technologies, Fog Computing and Grid Computing.
E-mail: chandakav@rknec.edu

Anshul Sharma is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.
E-mail: sharmaar_4@rknec.edu

Aryan Khandelwal is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.
E-mail: khandelwalar$_2$@$rknec.edu$

Raunak Gandhi is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.
E-mail: gandhird@rknec.edu

Design of an Ensemble Segmentation, Feature Processing & Classification model for identification of Cotton Fungal diseases

Sandhya N. Dhage
and
Dr. Vijay Kumar Garg
Lovely Professional University Phagwara, Punjab,India

Cotton fungal diseases include rust, alternarialeaf spot, fusariumwilt, grew mildew, and root rots. Identification of these diseases requires design of efficient fungi segmentation, feature representation & classification models. Existing methods that perform these tasks, are highly complex, and require disease-specific segmentation techniques, which limits their scalability levels. Moreover, low-complexity models are generally observed to showcase low accuracy levels, which restricts their applicability for real-time use cases. To overcome these issues, proposed designfocused on a novel ensemble segmentation, feature processing & classification model for identification of cotton fungi diseases. The proposed model initially uses a combination of Fuzzy C Means (FCM), Enhanced FCM, KFCM, and saliency maps in order to extract Regions of Interest (RoIs). These RoIs are post-processed via a light-weight colour-feature based disease category identification layer, which assists in selecting the segmented image sets. These image sets are processed via an ensemble feature representation layer, which combines Colour Maps, Edge Maps, Gabor Maps and Convolutional feature sets. Due to evaluation of multiple feature sets, the model is able to improve classification performance for multiple disease types. Extracted features are classified via use of an ensemble classification model that combines Naïve Bayes (NB), Support Vector Machines (SVMs), Logistic Regression (LR), and Multilayer Perceptron (MLP) based classifiers. Due to this combination of segmentation, feature representation & classification models, the proposed Model is capable of improving classification accuracy by 5.9%, precision by 4.5%, recall by 3.8%, and delay by 8.5% when compared with state-of-the-art models, which makes it useful for real-time disease detection of crops.

Keywords: CottonCrop, Ensemble Segmentation, Feature Representation, Classification.

1. INTRODUCTION

Designing cotton crop disease classification models is a multidomain task that involves identification of relevant segmentation regions, evaluation of region-level feature sets, design of classification models, and evaluation of post-processing disease-level operations. A typical cotton crop disease identification model used Convolutional Neural Networks (CNNs) for the classification process. The model initially uses a region-level segmentation & feature representation technique, that assists in identification of multiple relevant feature sets. These feature sets are post-processed via feature selection techniques, which aim at maximizing inter-class feature variance levels. Based on these features, a classification engine is deployed, which assists in identification of cotton crop disease types. But such models are highly generic by design, and can be applied to any-image classification application, but has low accuracy levels. This is because of the use of general-purpose classifiers like CNNs, which limits their applicability when used for large-scale disease detection applications. A study of similar models (Priya, Ramesh, and Udutalapally, 2021), (Melo, Lopes, Andrade, Trindade, and Magalhaes, 2017), (Wang, Wang, Han, Wang, Zhao, and Juan, 2020) in terms of their disease-specific uances, species-specific advantages, functional limitations, and contextual future scopes is discussed in the next section of this text. Based on the results of this study, it was determined that the current methods for doing these tasks are very complicated and require disease-specific segmentation techniques, which makes them hard to use on a large scale. Also, low-complexity models tend to have low levels of accuracy, which makes it hard to use them

in real-time situations. In section 3 of this text, a new ensemble segmentation, feature processing, and classification model for identifying cotton fungi diseases is proposed as a way to deal with these limitations. The proposed model was validated in section 4, wherein its performance was compared in terms of accuracy, precision, recall, and delay levels w.r.t. different state-of-the-art methods. Finally, a contextual conclusion is discussed based on characteristics of the proposed model, and various recommendations are made to further improve its performance levels under different crop disease types.

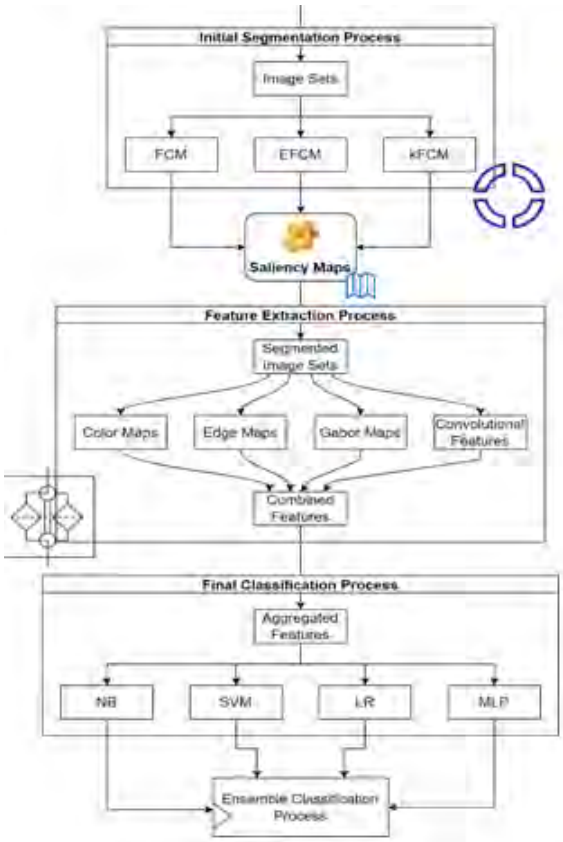
2. LITERATURE REVIEW

A wide variety of cotton crop fungi detection models are proposed by researchers, and each of them vary in terms of their internal operating characteristics. For instance, work in (Liu, Min, Mei, Wang, and Jiang, 2021), (Delnevo, Girau, Ceccarini, and Prandi, 2021) propose use of Long Short-Term Memory (LSTM), and Convolutional Neural Networks (CNNs) for high-density classification operations. But these models are not scalable, which limits their applicability for different dataset & image types. To overcome these issues, work in [7] proposes use of Super Resolution Generative Adversarial Network (SRGAN) that assists in improving classification levels for large-scale images. Similar models are discussed in (Cap, Uga, Kagiwada, and Iyatomi, 2020), (Sunil, Jaidhar, and Patil, 2021), (Kumar, Kumar, and Palaparthy, 2020), which propose use of Leaf Generative Adversarial Networks (Leaf GAN), UNet, and work Artificial Neural Nets (ANN) for multiple disease types. Extensions to these models are discussed in (Hassan and Maji, 2022), (Chen, Chen, Zeb, Yang, and Zhang, 2022),(Amin, Darwish, Hassanien, and Soliman, 2022) which propose use of Depth-wise CNN, Lightweight Inception Networks (LINs), and EfficientNetB0, & DenseNet121 based methods, which aim at improving classification efficiency levels. Models that use VGG16, ResNet50, with ResNetl52V2 (Bhatheja and Jayanthi, 2021a), Deep Learning Models (Harshitha, Kumar, Rani, and Jain, 2021), Support Vector Machine (SVM) (Shakeel, Ahmad, and Mahmood, 2020), Multiple Deep CNNs (Sivakumar, Mohan, Kavya, and Teja, 2021) and combination of VGG16, ResNet50, with ResNetl52V2& SVM (Kilaru and Raju, 2022),(Zekiwos, Bruck, et al., 2021) that assists in improving classification performance under different image and fungi types. Extensions to these models uses CNN, Deep Learning and Neural Networks which assists in improving classification performance for multiple disease types.Some models proposes use of Neural Networks, Deep Learning Models, agro-ecological measures with linear classifiers, plant shape based classification models, and dual cascade classifiers for improving classification performance under different fungus types. However, the level of scalability of these existing methods is constrained by their high complexity and requirement for disease-specific segmentation methods. Additionally, it has been found that low-complexity models typically exhibit low accuracy levels, which limits their applicability for real-time use cases. The next section of this text suggests creating a novel ensemble segmentation, feature processing, and classification model for identifying cotton fungi diseases as a solution to these problems. Multiple scenarios were used to compare and validate the model for various fungal disease types of cotton crop.

3. PROPOSED METHODOLOGY

Based on the review of existing Cotton Fungi disease detection models, it was observed that existing methods are highly complex, and require disease-specific segmentation techniques, which limits their scalability levels. Moreover, low-complexity models are generally observed to showcase low accuracy levels, which restricts their applicability for real-time use cases. To overcome these issues, this section proposes design of a novel ensemble segmentation, feature processing & classification model for identification of cotton fungi diseases. Flow of the model is depicted in figure 2, wherein it can be observed that the proposed model initially uses a combination of Fuzzy C Means (FCM), Enhanced FCM, k FCM, and saliency maps in order to extract Regions of Interest (RoIs). These RoIs are post-processed via a light-weight colour-feature based disease

category identification layer, which assists in selecting the segmented image sets. These image sets are processed via an ensemble feature representation layer, which combines Colour Maps, Edge Maps, Gabor Maps and Convolutional feature sets. Due to evaluation of multiple feature sets, the model is able to improve classification performance for multiple disease types. Extracted features are classified via use of an ensemble classification model that combines Naïve Bayes (NB), Support Vector Machines (SVMs), Logistic Regression (LR), and Multilayer Perceptron (MLP) based classifiers.



Overall flow of the proposed ensemble classification process

Based on figure 1, it can be observed that the model initially performs 3 types of clustering, that includes, Fuzzy C Means (FCM), Enhanced FCM, and kFCM for segmentation of crop region sets. Methods such as the threshold method, the edge detection segmentation method, the wavelet transform method, the genetic algorithm, and the neural network algorithm are all examples of typical segmentation techniques. It is constantly unpredictable and inaccurate in image processing because of the intricacy and association in images of crop nutrient shortage. The fuzzy set theory has been effectively employed in the image segmentation process because it has the greatest capacity to express uncertainty in images. Yet the Fuzzy C Means (FCM), which is based on fuzzy set theory, is the most common method since it has the benefit of not requiring the selection of thresholds. In particular, the FCM method is well-suited for uncertain image segmentation procedures. The FCM method separated images by marking and fuzzy clustering the related pixels in image sets. This allowed the program to create new image segments. The model works via the following process:

—setup $x = NM$ which represents total pixels in the image sets.

—Initial cluster category 'C', a fuzzification factor 'α' , and a pre-set stopping threshold $\varepsilon > 0$.
—Setup initial cluster centroids stochastically 'V', also setup iteration counter 't=0'.
—To start the clustering process, evaluate fuzzy dividing matrix U via equation 1,

$$u = [\sum_{i=1}^{c} (\frac{d_{ij}}{d_{jk}})^{\frac{2}{\alpha-1}}]^{-1} \tag{1}$$

Where, 'd' represents distance between pixels and their initial stochastically selected centroids.
—Update the centroid via equation 2,

$$V(New) = \frac{\sum_{i=1}^{\alpha} u^{t+i} * x_i}{\sum_{i=1}^{\alpha} u^{t+i}} \tag{2}$$

Where, 'x' represents image pixel sets.
—Repeat the process till $V(New) - V < \varepsilon$
—Upon completion of the process, de-fuzzify pixel classes via equation 3,

$$c = arg(max(u)) \tag{3}$$

Similar processes are applied for enhanced FCM and kFCM with 2 clusters, and 3 different image sets are obtained, which are further processed via colour thresholding operations. These operations allow the model to extract crop regions via the following process,
—For each RGB (Red, Green & Blue) pixel sets, calculate green coefficients via equations 4 & 5 as follows,

$$GR = \frac{G}{R} \tag{4}$$

$$GB = \frac{G}{B} \tag{5}$$

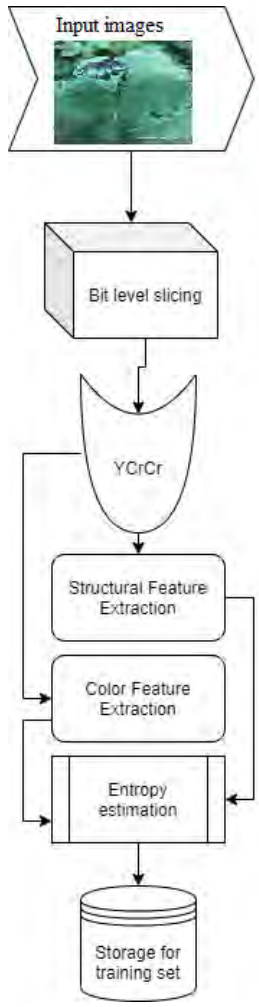
—If $GR > 1$ and $GB > 1$, then the pixel is passed, else pixel is removed from the image sets.
—For each cluster, check number of pixels that are passed, and select cluster with maximum passed pixels.
All the 3 images are combined via equation 6,

$$I_{out} = \frac{I(FCM) + I(EFCM) + I(kFCM)}{3} \tag{6}$$

Due to integration of these 3 image sets, the model is able to improve the segmentation performance by finding out regions which might be skipped by individual segmentation methods. This assists in improving the efficiency of disease classification for the segmented image sets. These images are then placed into a saliency map detection algorithm to provide an estimate of the saliency map. This model uses procedures including bit-level slicing, color space conversion, feature extraction (including structural and color characteristics), feature selection, and entropy evaluation. Image 3 shows the steps involved in this process, which includes color conversion and entropy evaluation. The figure illustrates this circulation in operation. Cutting each frame into its component bit levels is the initial stage of the process. Each of these slices is constructed from bit-level images to enhance pixel-level interpolation, and they are generated via equation 7,

$$S_i = \bigcup_{r,c}^{N,M} (P_{r,c} \oplus 2^i) \tag{7}$$

Where, S_i represents i^{th} bit's slice number, while $P_{r,c}$ is the pixel intensity for each of the pixel sets, and R, C represents total rows & columns in the image sets.



Saliency Map Detection Process

After this, each slice is put through the YCbCr conversion, which entails determining an approximation of the slice's energy (Y), brightness (Cb), and chrominance (Cr) from the red, green, and blue component colour intensities (RGB) using the aforementioned equations 8, 9, and 10. Each of the 24 images produced in this way is a unique permutation of the original image's feature levels.

$$Y = 16 + (65.481 * R + 128.553 * G + 24.966 * B) \tag{8}$$

$$C_b = 128 + (-37.797 * R - 74.203 * G + 112 * B) \tag{9}$$

$$C_r = 128 + (112 * R - 93.786 * G - 18.214 * B) \tag{10}$$

Now estimate an average image set via equation 11,

$$I_\alpha = \frac{1}{N * M} * \sum_{r,c}^{N,M} C_i \tag{11}$$

Where, C_i represents colour level for i^{th} set of image components, and I_α is the average image pixel density level for different image sets. Now estimate distance between different image slices via equation 12,

$$d(s_i, s_j) = \frac{1}{N * M} * \sum_{i=1}^{N_s} I_{avg_i} * \sqrt{\sum_{r,c}^{N,M} \frac{(P_{i_r} - P_{j_r})^2 + (P_{i_c} - P_{j_c})^2}{Var(s_i, s_j)}} \tag{12}$$

Where, $d(s_i, s_j)$ represents Euclidean distance for slice sets i,j ; while $Var(s_i, s_j)$ is the level of variance between image sets, N_s is total quantity of slices and P_{x_y} is the pixel intensity for X^{th} image in the yth dimension sets. In order to define the extracted features as feature vectors, these distance metrics are given to color and shape feature extraction units. The steps below outline how the color feature extraction unit works in tandem with the shape feature extraction unit to complete its objectives.

—Quantize each pixel in the range 0 to 128 using equation 13, which is done for standardizing output features, and reduce the number of extracted colour map values

$$P_{quant} = \frac{P_{in} * 128}{P_{max}} \tag{13}$$

where $P_{quant}, P_{in}, P_{max}$ are the input image pixels, quantized pixels and maximum intensity of pixel sets.

—Estimate output colour features (CF_{out}) via equation 14 as follows,

$$CF_{out} = \bigcup_{i=1}^{N_s} \sum_{r,c}^{N,M} |P_{r,c} == P_{quant_{r,c}}| \tag{14}$$

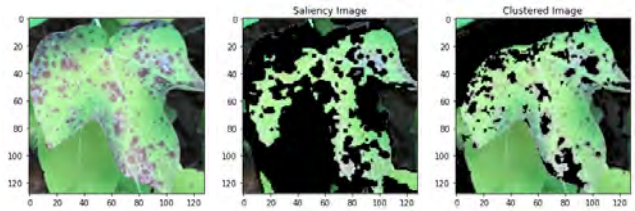
Now estimate output edge features via equation 15,

$$SF_{out} = \bigcup_{i=1}^{N_s} \sum_{r,c}^{N,M} |Canny(P_{r,c}, P_{r,c+1}) == 1| \tag{15}$$

Where, SF_{out} are output edge feature sets, and $Canny(P_{r,c})$ is the Canny edge detected image sets. Based on these feature sets, a combination vector is obtained, and is processed via an entropy evaluation block, which estimates coarse entropy levels via equation 16,

$$E_{f_i} = \sum_{r=1}^{N} \sum_{c=1}^{M} p(F_{r,c_i}) * log(p(F_{r,c_i})) \tag{16}$$

Where, $p(F_{r,c_i})$ represents probability of image pixels that are higher than average pixel values, and are used to estimate entropy levels. These entropy values are used as ceilings for each input image slice in order to carry out thresholding at the bit level. Each of these "slices" contributes to the final silhouette map by filling in missing details. Some of the silhouette maps that were recovered are shown in Figure 4, giving insight into how the object of study might be accurately extracted for different image types.



Segemntation for diseased cotton images

This approach is used for the purpose of extracting regions of interest (RoI) from input images due to the high efficiency segmentation that is achieved by multimodal feature extraction with entropy detection. These Regions of Interest undergo further processing, known as feature extraction, in order to enhance the image representation capabilities.To perform this task, Colour Maps, Edge Maps and Gabor Maps are extracted via equations 17, 18 and 19 as follows,

$$CMap_s = \bigcup_{c=1}^{255} \sum_{i=1}^{R} \sum_{j=1}^{C} \sum_{a=1}^{Colors} (I_{i,j,a_s} == c) \tag{17}$$

$$Edge_s = \sum_{i=1}^{R} \sum_{j=1}^{C} \frac{\sum_{a=1}^{Colors} P(E(I_{i,j,a_s}))}{R * C * a} \tag{18}$$

$$G(x,y)_s = e^{\frac{-x'^2+\partial^2 * y'^2}{2*\phi^2}} * cos(2 * \frac{pi}{\lambda} * x') \tag{19}$$

Where, E, λ, ∂, ϕ represents image edge pixels, wavelet in the Gabor domain, scaling Gabor constants, and angular values for Gabor components. Along with these components, convolutional feature sets are extracted via equation 20,

$$Conv_{s_{i,j}} = \sum_{a=\frac{-m}{2}}^{\frac{m}{2}} \sum_{b=\frac{-n}{2}}^{\frac{n}{2}} I_s(i-a, j-b) * ReLU(\frac{m}{2}+a, \frac{n}{2}+b) \tag{20}$$

Where, m,n represents convolutional window sizes, while I_s and ReLU represents saliency image, and Rectilinear Unit activation functions, and represents stride sizes. The 2D ReLU is represented via equation 21,

$$ReLU(x,y) = x, when x >= 0, else ReLU(x,y) = y * (e^x - 1), when x <= 0, \tag{21}$$

All these feature sets were combined to form a Mega Representation Vector (MRV), which is classified via Naïve Bayes (NB), Support Vector Machine (SVM), Logistic Regression (LR), and Multilayer Perceptron (MLP) based classifiers. These classifiers are pre-configured depending upon the input datasets, and their configurations can be observed from table 1 as follows,

Using these parameters, images are classified into different cotton crop disease types at individual classifier level, which is then aggregated via equation 22 to obtain the final class,

$$C_{out} = A(NB)*C_{out}(NB)+A(MLP)*C_{out}(MLP)+A(SVM)*C_{out}(SVM)+A(LR)*C_{out}(LR) \tag{22}$$

Where, A and C_{out} is testing accuracy, and output class obtained by individual classifiers.Results of this classification are evaluated on large datasets compared with existing models, which can be observed in the next section.

Classifier	Parameter Used
NB	Priors = Variance of selected features, Smoothing Value $SV = \frac{Var(F)}{Mean)f)}$, Where, Var and Mean represents variance levels, and average of selected features
MLP	Number of hidden layers = $N_{classes}$, Activation function = Rectilinear Unit, Solver Type = Adam, Learning Rate = 0.5
LR	Tolerance = 0.001 Class Weights = Class-based variance levels, Solver Type = Linear, Maximum Iterations = $10 * N_{feat}$
SVM	Error Tolerance = 0.0001, Kernel Type = Radial Basis Function, Class Weights = Class-based variance levels

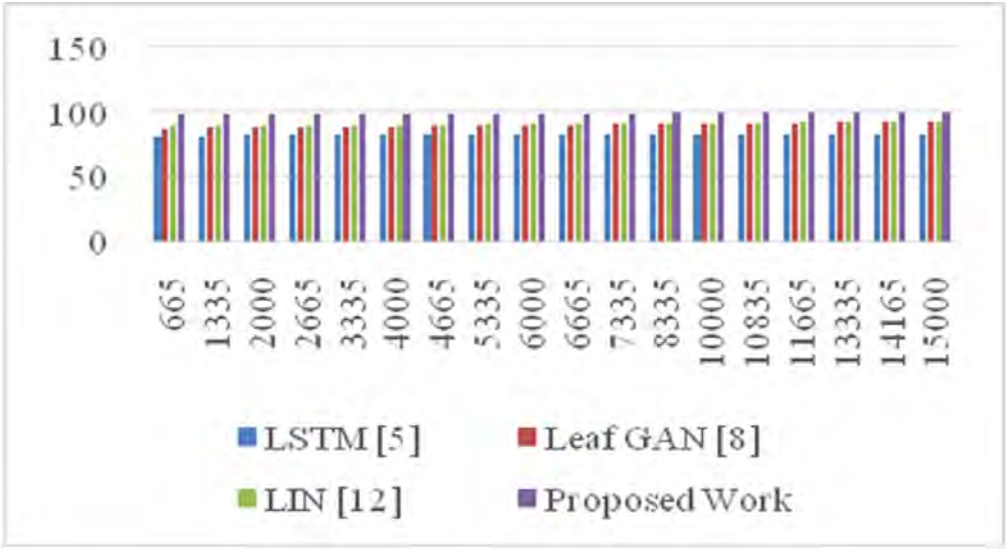
Table I: Parameters used for configuration of different classifiers

4. RESULT ANALYSIS COMPARISON

The proposed model uses a combination of multimodal FCM with Saliency Maps and multiple feature extraction layers for representation of input images into high-density feature sets. These sets are classified via use of an ensemble classification layer, which assists in high efficiency classification into different fungal diseases. Performance of this model was evaluated based on accuracy of classification (A), precision (P), recall (R), and delay needed for classification of cotton crop samples. Sample images of cotton crop are captured offline from field and some datasets are considered from kaggle. The model was compared with LSTM [5], Leaf GAN [8], and LIN [12], which are recently proposed classification models, and showcase high performance levels. The accuracy, precision, recall delay were evaluated via equations 23, 24, 25 26 as follows, A total of 15000 samples were used for evaluation, out of which 75% were used for training, 15% for testing & 10% for validation operations. Based on this strategy, accuracy was evaluated in table II, where it was compared w.r.t. Number of Test Images (NTI) as follows,

NTS	A (%) LSTM [5]	A (%) Leaf GAN [8]	A (%) LIN[12]	A (%) Proposed Work
665	82.04	87.52	89.45	98.67
1335	82.10	87.86	89.65	98.75
2000	82.15	88.17	89.84	98.83
2665	82.20	88.47	90.03	98.92
3335	82.25	88.77	90.23	98.99
4000	82.30	89.08	90.43	99.06
4665	82.35	89.42	90.61	99.11
5335	82.41	89.76	90.80	99.15
6000	82.46	90.10	91.01	99.19
6665	82.51	90.42	91.23	99.22
7335	82.56	90.75	91.45	99.26
8335	82.61	91.07	91.67	99.31
10000	82.67	91.39	91.87	99.35
10835	82.72	91.71	92.07	99.41
11665	82.77	92.03	92.28	99.46
13335	82.82	92.35	92.48	99.53
14165	82.88	92.67	92.68	99.60
15000	82.93	92.99	92.88	99.67

Table II: Accuracy levels for classification of different Cotton Fungal diseases

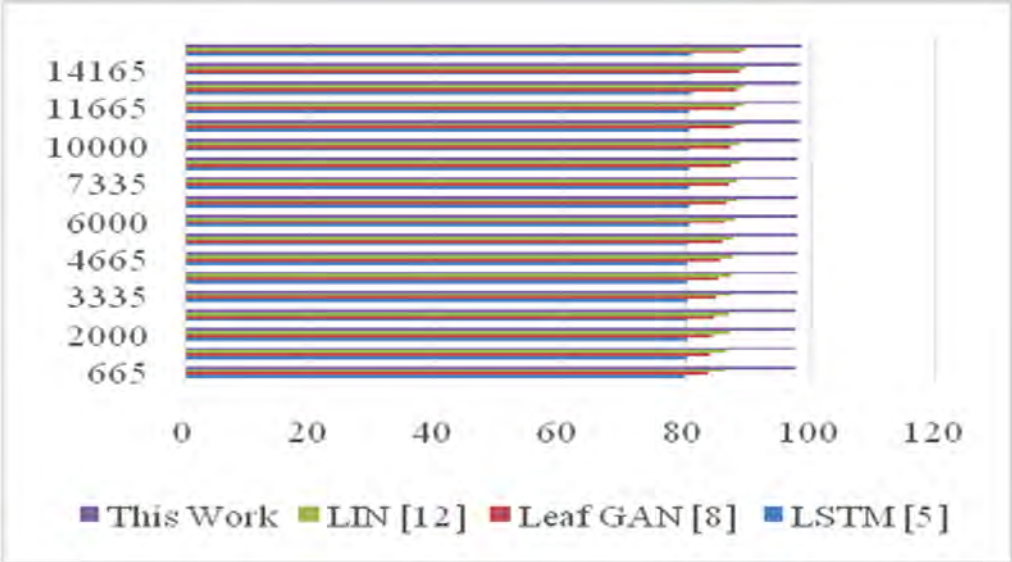


Accuracy levels for classification of different Cotton Fungi diseases

Referring to these analyses and looking at figure 4, it is clear that the proposed classification model is able to achieve 15.5% better accuracy than LSTM [5], 6.4% better accuracy than Leaf GAN [8], and 6.5% better accuracy than LIN [12], making it extremely useful for a variety of real-time classification scenarios. Similarly, precision of classification was evaluated in table III as follows,

NTI	**P(%) LSTM [5]**	**P(%) Leaf GAN [8]**	**P(%) LIN[12]**	**P(%) Proposed Work**
665	80.12	83.81	86.50	97.58 1335
80.17	84.11	86.69	97.66	
2000	80.22	84.40	86.88	97.73
2665	80.27	84.70	87.06	97.80
3335	80.32	85.01	87.25	97.85
4000	80.37	85.32	87.43	97.90
4665	80.43	85.64	87.62	97.94
5335	80.48	85.96	87.83	97.98
6000	80.53	86.28	88.03	98.02
6665	80.58	86.58	88.24	98.06
7335	80.63	86.89	88.44	98.10
8335	80.68	87.20	88.64	98.15
10000	80.73	87.50	88.83	98.20
10835	80.78	87.80	89.03	98.26
11665	80.83	88.11	89.22	98.33
13335	80.88	88.41	89.41	98.39
14165	80.93	88.71	89.60	98.45
15000	80.98	89.01	89.79	98.51

Table III: Precision levels for classification of different Cotton Fungi diseases

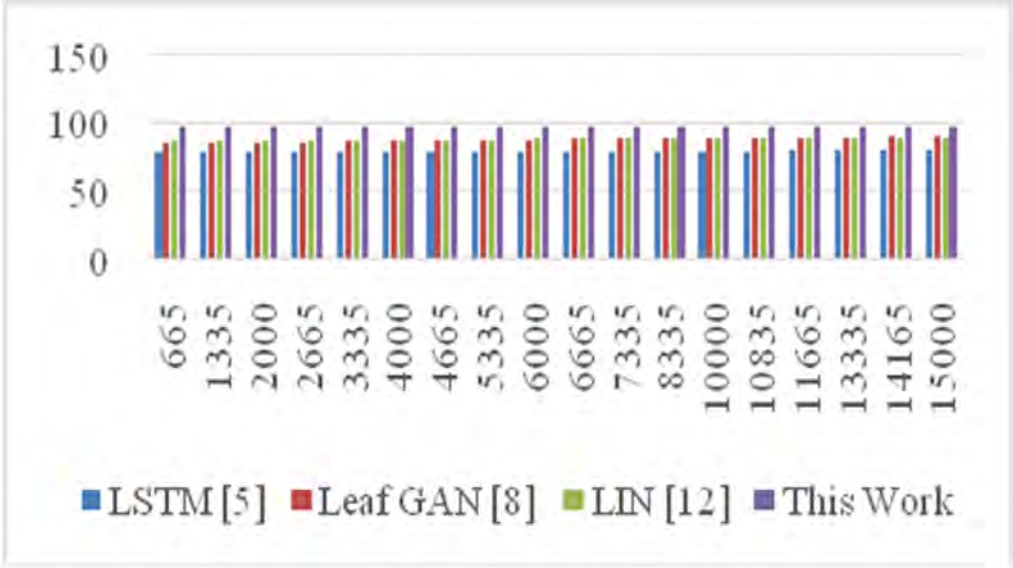


Precision levels for classification of different Cotton Fungal diseases

The proposed classification model is able to achieve 18.3% better precision than LSTM [5], 9.1% better precision than Leaf GAN [8], and 8.5% better precision than LIN [12] after referring to these evaluations and looking at figure 5, which makes it highly useful for a variety of real-time classification scenarios. Similarly, recall of classification was evaluated in table IV as follows,

NTI	**R(%) LSTM [5]**	**R(%) Leaf GAN [8]**	**R(%) LIN[12]**	**R(%) Proposed Work**
665	79.12	85.82	86.99	96.95
1335	79.17	86.14	87.18	97.03
2000	79.22	86.44	87.36	97.10
2665	79.27	86.73	87.55	97.17
3335	79.33	87.04	87.74	97.23
4000	79.38	87.37	87.93	97.29
4665	79.43	87.70	88.12	97.33
5335	79.48	88.02	88.31	97.37
6000	79.53	88.34	88.52	97.41
6665	79.62	88.57	88.71	97.47
7335	79.75	88.71	88.88	97.57
8335	79.83	88.97	89.06	97.63
10000	79.91	89.22	89.24	97.70
10835	79.99	89.46	89.42	97.78
11665	80.08	89.71	89.60	97.86
13335	80.16	89.94	89.78	97.94
14165	80.25	90.17	89.95	98.03
15000	80.30	90.49	90.14	98.09

Table IV: Recall levels for classification of different Cotton Fungi diseases

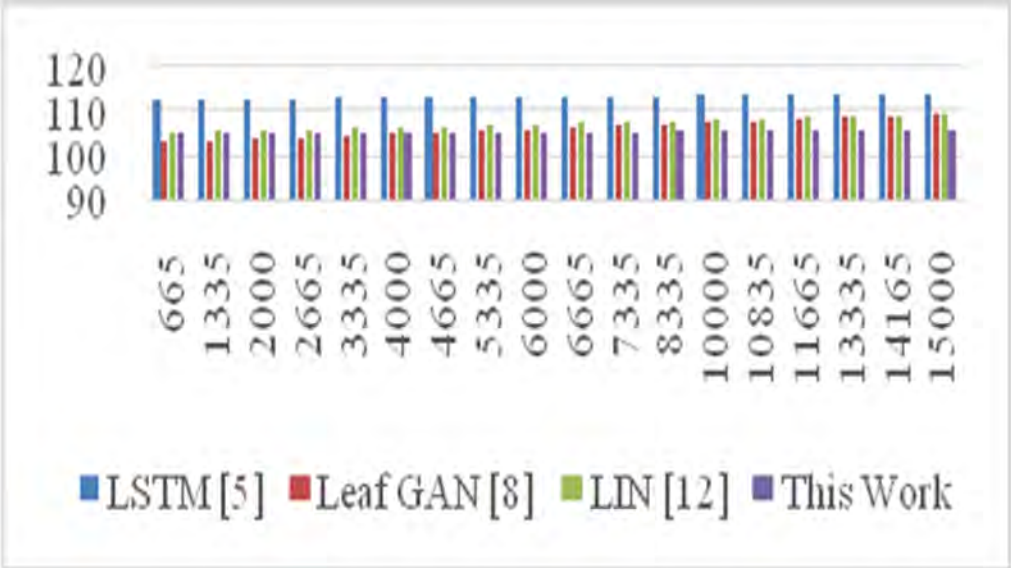


Recall levels for classification of different Cotton Fungi diseases

Referring to these assessments and looking at figure 6, it can be seen that the proposed classification model is able to achieve recall results that are 16.5%, 8.3%, and 8.5% better than those of LSTM [5], Leaf GAN [8], and LIN [12], respectively. This makes it extremely useful for a variety of real-time classification scenarios. This is because high-density feature extraction and ensemble classification were used along with effective segmentation operations. Similarly, delay of classification was evaluated in table 5 as follows,

NTI	**D(%) LSTM [5]**	**D(%) Leaf GAN [8]**	**D(%) LIN[12]**	**D(%) Proposed Work**
665	112.60	102.86	105.18	104.72
1335	112.67	103.24	105.41	104.80
2000	112.74	103.60	105.63	104.88
2665	112.81	103.96	105.86	104.96
3335	112.88	104.32	106.09	105.03
4000	112.96	104.71	106.32	105.09
4665	113.03	105.10	106.54	105.14
5335	113.10	105.50	106.78	105.18
6000	113.17	105.89	107.03	105.22
6665	113.24	106.27	107.28	105.26
7335	113.32	106.65	107.53	105.30
8335	113.39	107.02	107.78	105.35
10000	113.46	107.40	108.01	105.41
10835	113.53	107.77	108.25	105.47
11665	113.60	108.15	108.49	105.53
13335	113.68	108.52	108.72	105.60
14165	113.75	108.89	108.96	105.67
15000	113.82	109.27	109.19	105.74

Table V: Delay levels for classification of different Cotton Fungi diseases



Delay levels for classification of different Cotton Fungi diseases

5. CONCLUSION AND FUTURE WORK

The proposed model is able to combine multimodal segmentation models including FCM, EFCM, and kFCM in order to extract plant RoIs, which is followed by extraction of Saliency Maps for efficient segmentation operations. The segmented images are represented via Colour, Edge, Gabor and Convolutional feature maps, which assists in identification of high-density feature metrics from input image sets. These feature metrics are classified via use of an ensemble classification layer that combines Naive Bayes, Support Vector Machine, Logistic Regression and Multilayer Perceptron classifiers. The proposed model is able to achieve accuracy that is 15.5% better than LSTM [5], 6.4% better than Leaf GAN [8], and 6.5% better than LIN [12]. As a result of this combination, the proposed model is extremely useful for a wide variety of real-time classification scenarios. This is due to the high-density feature extraction and ensemble classification process that was used. In addition to this, the model achieves precision that is 18.3% better than LSTM [5], 9.1% better than Leaf GAN [8], and 8.5% better than LIN [12]. The main reason that our model is better than others is due to use of multimodal feature extraction along with a custom designed ensemble classification approach, which assists in efficient identification of different disease types under real-time scenarios. Another reason is the integration of Salient Regions, which assist in identification of low complexity segmentation process, that improves identification of image regions that contain disease parts.

References

Amin, H., Darwish, A., Hassanien, A. E., and Soliman, M. 2022. End-to-end deep learning model for corn leaf disease classification. *IEEE Access 10*, 31103–31115.

Bhatheja, H. and Jayanthi, N. 2021a. Detection of cotton plant disease for fast monitoring using enhanced deep learning technique. In *2021 5th International Conference on Electrical, Electronics, Communication, Computer Technologies and Optimization Techniques (ICEECCOT)*. IEEE, 820–825.

Bhatheja, H. and Jayanthi, N. 2021b. Detection of cotton plant disease for fast monitoring using enhanced deep learning technique. In *2021 5th International Conference on Electrical, Electronics, Communication, Computer Technologies and Optimization Techniques (ICEECCOT)*. IEEE, 820–825.

Cap, Q. H., Uga, H., Kagiwada, S., and Iyatomi, H. 2020. Leafgan: An effective data augmentation method for practical plant disease diagnosis. *IEEE Transactions on Automation Science and Engineering*.

Chen, J., Chen, W., Zeb, A., Yang, S., and Zhang, D. 2022. Lightweight inception networks for the recognition and detection of rice plant diseases. *IEEE Sensors Journal 22,* 14, 14628–14638.

Delnevo, G., Girau, R., Ceccarini, C., and Prandi, C. 2021. A deep learning and social iot approach for plants disease prediction toward a sustainable agriculture. *IEEE Internet of Things Journal 9,* 10, 7243–7250.

Harshitha, G., Kumar, S., Rani, S., and Jain, A. 2021. Cotton disease detection based on deep learning techniques. In *4th Smart Cities Symposium (SCS 2021)*. Vol. 2021. IET, 496–501.

Hassan, S. M. and Maji, A. K. 2022. Plant disease identification using a novel convolutional neural network. *IEEE Access 10*, 5390–5401.

Kilaru, R. and Raju, K. M. 2022. Prediction of maize leaf disease detection to improve crop yield using machine learning based models. In *2021 4th International Conference on Recent Trends in Computer Science and Technology (ICRTCST)*. IEEE, 212–217.

Kumar, M., Kumar, A., and Palaparthy, V. S. 2020. Soil sensors-based prediction system for plant diseases using exploratory data analysis and machine learning. *IEEE Sensors Journal 21,* 16, 17455–17468.

Liu, X., Min, W., Mei, S., Wang, L., and Jiang, S. 2021. Plant disease recognition: A large-scale benchmark dataset and a visual region and loss reweighting approach. *IEEE Transactions on Image Processing 30*, 2003–2015.

Melo, C. A. O., Lopes, J. G., Andrade, A. O., Trindade, R. M. P., and Magalhaes, R. S. 2017. Semi-automated counting of arbuscular mycorrhizal fungi spores using artificial neural network. *IEEE Latin America Transactions 15,* 8, 1566–1573.

Priya, R., Ramesh, D., and Udutalapally, V. 2021. Nsga-2 optimized fuzzy inference system for crop plantation correctness index identification. *IEEE Transactions on Sustainable Computing 7,* 1, 172–188.

Shakeel, W., Ahmad, M., and Mahmood, N. 2020. Early detection of cercospora cotton plant disease by using machine learning technique. In *2020 30th International Conference on Computer Theory and Applications (ICCTA)*. IEEE, 44–48.

Sivakumar, P., Mohan, N. S. R., Kavya, P., and Teja, P. V. S. 2021. Leaf disease identification: Enhanced cotton leaf disease identification using deep cnn models. In *2021 IEEE International Conference on Intelligent Systems, Smart and Green Technologies (ICISSGT)*. IEEE, 22–26.

Sunil, C., Jaidhar, C., and Patil, N. 2021. Cardamom plant disease detection approach using efficientnetv2. *IEEE Access 10*, 789–804.

Wang, C., Wang, P., Han, S., Wang, L., Zhao, Y., and Juan, L. 2020. Funeffectorpred: identification of fungi effector by activate learning and genetic algorithm sampling of imbalanced data. *IEEE Access 8*, 57674–57683.

Xu, Z., Latif, M. A., Madni, S. S., Rafiq, A., Alam, I., and Habib, M. A. 2021. Detecting white cotton bolls using high-resolution aerial imagery acquired through unmanned aerial system. *IEEE Access 9*, 169068–169081.

Zekiwos, M., Bruck, A., et al. 2021. Deep learning-based image processing for cotton leaf disease and pest diagnosis. *Journal of Electrical and Computer Engineering 2021*.

Zhao, Y., Chen, Z., Gao, X., Song, W., Xiong, Q., Hu, J., and Zhang, Z. 2021. Plant disease detection using generated leaves based on doublegan. *IEEE/ACM Transactions on Computational Biology and Bioinformatics*.

Dr. Vijay Kumar Garg pursued Bachelor and Master's degree in Computer Science from Punjab University, Chandigarh. He has done his Ph.D. degree from Guru Kashi University, Talwandi Sabo, Bathinda and currently working as Associate Professor in Department of Computer Science Engineering, Lovely Professional University, Punjab. He has published more than 20 research papers in reputed international journals and conferences including IEEE and it's also available online. His main research work focuses on Machine Learning, oft Computing, Reinforcement learning, Medical Informatics. He has 11 years of teaching experience and 8 years of Research Experience.
E-mail: vijay.garg@lpu.co.in

Ms. Sandhya Dhageis a research scholar of Computer Science Engineering department of Lovely Professional University, Phagwara, Punjab,India. She completed her M.E. from Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra, India. She had 11 years of teaching experience. She has published many research papers in international conferences and journals. She is life associate member of ISTE and student member of IEEE. Her area of interest is database and machine learning.
E-mail: dsand8@gmail.com

Machine Learning for Non-Invasive Diagnosis of Glucose Metabolism Disorder

Suruchi Dive
and
Dr.Gopal Sakarkar
School of Science,G.H.Raisoni University,Saikheda,Madhya Pradesh, India,

Glucose metabolism disorder known as Diabetes Mellitus is a state created by un-controlled blood sugar that may lead to serious damage to multiple organs in patients. Identifying and predicting this disease will save human life. While designing medical diagnosis software, disease prediction is said to be one of the capricious tasks. In the current scenario, many researchers have provided their ideas on using machine learning and artificial intelligence for automated prediction of Diabetes Mellitus. A set of five popular Naïve Bayes, Random Forest, SVM, KNN and Decision Tree have been identified as well as a set of four rarely used GPC, QDA, LDA and AdaBoost have been identified from literature survey. The study is an effort to make a comparative report of the accuracy of two sets and identify the best performer. In conclusion, Support Vector Machine achieved highest accuracy with 81.00% in popular classifiers whereas Linear Discriminant Analysis achieved highest accuracy with 82.00% in less frequently used classifiers. Hence, more such rarely used classifiers should be explored for the realistic health management of diabetes.

Keywords: Diabetes Mellitus, Machine learning, Prediction

1. INTRODUCTION

According to the International Diabetic Federation, in 2045, the section of total earth's population of diabetic patients will reach 783 million. One of the every ten adults in the future will be inflicted by diabetes mellitus with half of them not aware of it. It is a major contributor in morbidity with 4 million deaths per year. Diabetes was responsible for 6.7million deaths in 2021 - 1 every 5 seconds. Diabetes Mellitus (DM) is a serious ailment caused by uncontrolled levels of glucose in blood. About fifty percent of the patient population are associated with a hereditary trend, which makes it a paramount critical symptom of diabetes. Insufficient amount of insulin produced by pancreas of the patient can be the primary reason of Diabetes Mellitus. The second reason is inability of the patient's body to use the insulin provided to it. The Type1 Diabetes Mellitus (T1DM) is caused by genetic factors which lead to malformed β-cells of pancreas. Hence they lack the ability of timely reduction of sugar level in blood.

Type 2 Diabetes Mellitus(T2DM) is mainly caused by insufficient levels of insulin in blood stream to counter the sugar present. Also insulin resistance plays a major role in development of T2DM. This category of DM is also called noninsulin dependent DM (Wu, Yang, Huang, He, and Wang, 2018). Undetected Diabetes may result in severe damage to retina, kidneys and the nervous system. Predicting the ailment in individuals with current undiagnosed diabetes or those who fall in at-risk spectrum of acquiring T2DM in time ahead is of utmost importance. This identification will help in decreasing the damage caused by complications of other body organs due to diabetes (Sulaiman, Mahmoud, Hussein, Elbadawi, Abusnana, Zimmet, and Shaw, 2018). Medical practitioner through medical diagnosis aim to explain a patient's condition by assessing the symptoms. The complete procedure of diagnosis of a disease assisted by other details of the patient can be gathered by past medical records, laboratory tests and physical examination. Laboratory tests are used to assess the symptoms of the diseases and then categorized under various heads. The irrelevant data is eliminated from the diagnosis process which leads to proper

identification and treatment of the ailment (Gunčar, Kukar, Notar, Brvar, Černelč, Notar, and Notar, 2018)

Due to copious amount of data generated by the digitized health care systems, it is now possible to develop intelligent models for disease prediction. ML algorithms are extensively used in varied domain areas such as medical diagnosis mostly for diabetes, heart disease, cancer detection, etc. Machine learning algorithms can be used to create models of classifying systems to aid the medical practitioner to predict and diagnose diseases before any severe damage has arisen (Choudhury and Gupta, 2019).The work in prediction is divided into the following sections; Section 2 elaborates the related study in the field of predicting diabetes mellitus in recent years, Section 3 methodology is given followed by Section 4, where the experimental setup with analysis and discussion is given and finally concluded in Section 5

2. RELATED WORK

An intelligent model was developed by R.Krishnamoorthy et al. (Krishnamoorthi, Joshi, Almarzouki, Shukla, Rizwan, Kalpana, and Tiwari, 2022) which was uniquely named IDMPF based on ML Techniques. The researchers used association rule mining which depicted that sugar level and body mass index are strongly correlated. The researchers (Abbas, Alic, Rios, Abdul-Ghani, and Qaraqe, 2019) proposed the implementation of machine learning for identifying the risk of development of DM. As per the model, Support Vector Machine algorithm worked with high accuracy. R. Aminah et al. (Aminah and Saputro, 2019) found that Iris image could be used as an appropriate feature for prediction of Diabetes. They used k-means Nearest Neighbor and Support Vector Machine. Feature extraction was done using Gray Level Co-Occurrence Matrix technique was provided for excellent feature extraction culminating in highly accurate prediction. According to D. Vigneswari, (Dhamodaran, Napa, Raj, Gugan, and Vikash, 2019) when predicting diabetes mellitus, Logistic Model Tree classifier ranked highest in accuracy of 79.31% and was faster than other classifiers by 1.09 seconds.

The researchers (Anwar and Saian, 2020) experimented on diabetes dataset obtained from Frankfurt, Germany as well as the Pima Indian from UCI labs. The accuracy of prediction provided by the bio-inspired Ant-Miner algorithm was at par for every dataset employed. As per proposed model (Hasan, Alam, Das, Hossain, and Hasan, 2020) for diabetes prediction by combining adaptive (AB) and gradient (XB)), his method was assisted preprocessing of the data by using outlier rejection, standardization and substituting the values not available by average values. L.Miao et al.(Miao, Guo, Abbas, Qaraqe, and Abbasi, 2020) worked on UK based Framingham Heart dataset to explore prediction of future disease. As per proposed model employing SVM and KNN algorithms, heart disease as well as diabetes was predicted with 96.5 % of accuracy.

The authors (Lai, Huang, Keshavjee, Guergachi, and Gao, 2019) calculated the high risk prediction domain for diabetes by two machine learning techniques- (a) Logistic Regression (b) Gradient Boosting Machine. The model was validated on Canadian ethnicity with a count of 0.88 million records. Gradient Boosting Machine achieved the accuracy of 84.7% whereas Logistic Regression achieved 84.0% accuracy. Lv Wenqi (Lv, Fu, Lin, Su, Jin, Yang, Shan, Du, Jiang, Lin, and Huang, 2021) proposed a non-invasive AI model for diagnostics which calculates the occurrence of diabetes through 4-D eye images taken by a special camera. Within three minutes the model was able to analyse the image and predicted the risk of acquiring diabetes with average AUC of 0.876. The objective of the authors (Maniruzzaman, Rahman, Al-MehediHasan, Suri, Abedin, El-Baz, and Suri, 2018) was to propose a powerfully built machine learning model which could handle outliers without affecting the performance metrics. Random forest algorithm when paired with logistic regression gave satisfactory outcomes in terms of performance measuring to 92.26

M.F. Faruque et al. (Faruque, Asaduzzaman, and Sarker, 2019) state that Diabetes mellitus affects different organs of the human body which thus harms the body's system, in particular

the blood veins and nerves. The authors applied C4.5 and SVM methods. Other classifiers such as Naive Bayes (NB) and K-Nearest Neighbor (KNN) were applied on patient healthcare data to identify risk of acquiring diabetic mellitus. C4.5 decision tree ranked the highest when compared to other classifies. Naz H. (Naz and Ahuja, 2020) achieved the accuracy in the range of 90-98% in prediction of diabetes while using ANN, Naïve Bayes, Decision tree and Deep learning. Among the four algorithms Deep learning provided the highest accuracy of 98.07% for the onset of diabetes. As per proposed model, which a combination of wide and deep learning, the authors (Nguyen, Pham, Tran, Nghiem, Nguyen, Do, Tran, and Simpson, 2019) introduced the concept of Synthetic Minority Oversampling Technique (SMOTE). It was concluded that this technique performed well in terms of sensitivity as compared to other similar machine learning techniques.

Safial A.et al.(Islam Ayon, Department of Computer Science and Engineering, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh, and Milon Islam, 2019) suggested the usefulness of deep learning technology for prediction of diabetes. For five-fold cross validation accuracy of 98.35% was achieved whereas the ten-fold approach gave 97.27%. PID dataset being the most popular dataset explored by peers provided a base of comparison with other classifiers employed. Researchers (Sisodia and Sisodia, 2018) used the PID dataset for applying the algorithms such as DT, SVM and NB. The algorithms were evaluated on Precision accuracy, F-measure and Recall where Naïve Bayes outperformed other with accuracy of 76.30% for predicting diabetes. N. Sneha et al.(Sneha and Gangil, 2019) stated that the performance of any robust prediction model was based on the right choice of optimal attributes. Hence proper analysis of the features of a dataset should be done and irrelevant features should be omitted from further process. The optimal features were attached with a correlation value. The researchers then employed a multitude of classifier algorithms out of which SVM turned out to be the best performer with accuracy 77.73%

The authors (Srivastava, Sharma, Sharma, Kumar, and Darbari, 2019) state that Machine Learning, subsidiary of AI is used to create a diabetes prediction model. Artificial Neural Network (ANN) was applied for Type 2 Diabetes Mellitus risk detection model. The model worked credibily for predicting the possibility of diabetes with 92% accuracy. This result was obtained with the sample testing data. They deliberated that the model accuracy could be improved if it was trained increased dimensionality in further experimentation. The study made by the Xie Z. (Xie, Nikolayeva, Luo, and Li, 2019) experimented with a plethora of machine learning classifiers wherein Neural network model showcased the highest accuracy of 82.4 percentage. The sensi- tivity value for Decision tree algorithm scored 51.6% for prediction of diabetes. Apart other common parameters such as fasting glucose level new variables were identified for risk prediction. People sleeping for more than 9 or more hours per day or had a check-up frequency of less than 1 year had a higher risk for Type 2 Diabetes. The researchers(Xiong, Zhang, Bi, Zhou, Yu, and Zhu, 2019) proposed the findings that a combination model of different machine learning techniques was the best performer in terms of accuracy. Multilayer Perceptron(MLP), Adaboost(AD) and Tree Random Forest(TRF) performed well with 0.87, 0.86, 0.86. Support Vector Machine and Gradient Tree Boosting provided the accuracy of, 0.86.

A set of five popularly used algorithms- NB, RF, SVM, KNN and DT have been identified and a set of four rarely used algorithms GPC, QDA, LDA and AdaBoost have been identified from the literature survey.

3. PROPOSED METHODOLOGY

3.1 Machine Learning Methods Employed:

The study employed five classifiers: Naïve Bayes, Random Forest, SVM, KNN, Decision Tree as per observed in the literature study as the most popular classifiers. Naïve Bayes computes based on possibility by using the probability formula and the time complexity is short. Decision tree is a supervised learning method used for classification which classifies the data under diabetic and non-diabetic label. Random forest uses bagging and features randomness when building each

individual tree to try to create an uncorrelated forest of trees. This collection of trees show more accuracy in prediction than individual tree units. Support vector machine is an excludent classifier which formally characterizes the data by selecting a hyperplane. The identified hyper-plane separates two spaces into specified classes. KNN is a classification technique which segregates the new data is related to other data items.

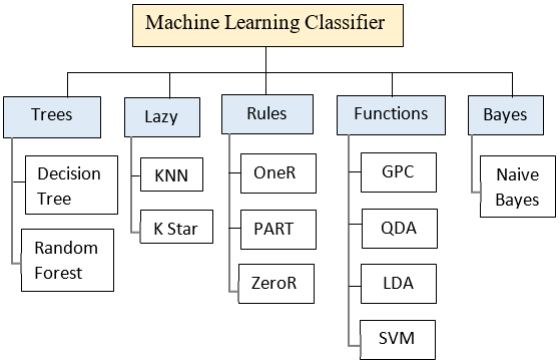


Figure 1. Categories of classifiers

GPC, QDA, LDA and AdaBoost were the least frequently used classifiers as per survey of related work. Gaussian Process Classifier is based on generalization of the Gaussian probability distribution and can be used for classification and regression. QDA is a classifier with a quadratic instead of linear function of predictors. It is generated by fitting proportion similar of data points to a class. LDA's main objective is to find the mean function for every class. This function works when all the independent variables are continuous and have a normal distribution. AdaBoost method pays more attention to the samples that are misclassified by the previous weak classifiers, which means the training instance who was mis-classified by the previous weak classifiers will have greater weight to be selected.

4. EXPERIMENTAL ANALYSIS AND DISCUSSION

4.1 Data Collection

Pima Indian Diabetes Dataset (PIDD) is a data set of 768 females of Pima Indian heritage of about age 21 and above of Phoenix, Arizona collected University of California, Irvine ML Repository. The parameters that were considered for the dataset to be established were frequency of pregnancy, age, blood pressure, glycemic index, skin thickness, BMI, level of insulin and family history. The ninth parameter specified whether they were suffering from diabetes or not. This dataset is selected as it is the most common and well-known dataset so it can be used as a benchmark.

Sr. No.	Parameter	Class Value
1	No. of Pregnancies	Num
2	Glucoselevel	Num
3	Bloodpressure	Num
4	Thickness of skin	Num
5	Insulin level	Num
6	Mass	Num
7	Familypedigree	Num
8	Age	Num
9	Class	Binary

Table I: Table 1. Description of Pima Indian Dataset

The dataset identifies is divided into 6:4 ratio of diabetic and non-diabetic cases. From the Figure1 of Heat Map it can be inferred that no two attributes share a factors have robust correlation. The age shares an average correlation with the number of times the patient was pregnant. Body mass index shared the same with the thickness of triceps skinfold. Sugar level and percentage of insulin have moderate correlation.

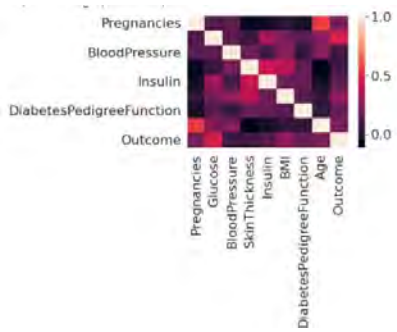


Figure 2. Heat Map of Pima Indian Dataset

4.2 Data Preprocessing

Before applying any classifiers the dataset has to be preprocessed which includes the removal of incorrectly entered or measured data assuring that it is in proper format. Preprocessed data is arranged properly so that anomalies are removed. This is required to increase preciseness and accuracy of outcome. The dataset preprocessed for missing values but no such values were observed. The next step was to search for irrelevant data or noise. The Pima Indian dataset was assessed for bio-chemical analysis results. The parameters such as Age, Glucose level, BMI, Blood pressure and Skin thickness cannot have zero as a value but number of pregnancy and outcome (Diabetic=1, Non- Diabetic=0) can have zero value. The instances which contained the value zero excluding the parameters, pregnancy and outcomes were removed. The classifiers were then applied to the noise free dataset to provide better accuracy.

4.3 Implementation and Results

The popular and non-popular group of classifier methods performance was judged by the measures- Accuracy, Precision, Recall and F1 scores.

Sr. No.	Method used	Accuracy	F1 Score	Precision	Recall
1	Support Vector Machine	0.8100	0.67	0.74	0.61
2	Naïve Bayes	0.7922	0.65	0.68	0.62
3	Random Forest	0.7864	0.65	0.73	0.58
4	K-Nearest Neighbor	0.7662	0.66	0.73	0.6
5	Decision Tree	0.6900	0.65	0.66	0.64

Table II: Table 2. Accuracy comparison for Popular Classifiers

The classifier Support Vector Machine achieved highest accuracy with 81.00% as compared to Random forest, Naïve Bayes, KNN and Decision Tree.

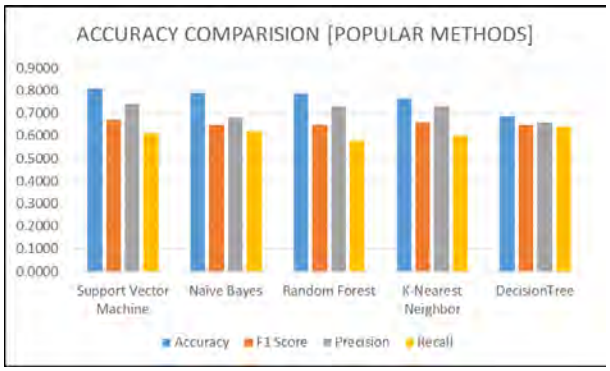


Figure 3. Accuracy Comparison of Popular methods

Sr.No.	Method used	Accuracy	F1 Score	Precision	Recall
1	Linear Discriminant Analysis	0.82	0.68	0.76	0.61
2	AdaBoost	0.81	0.69	0.68	0.7
3	Quadratic Discriminant Analysis	0.79	0.64	0.67	0.61
4	Gaussian Process Classifier	0.61	0.41	0.38	0.44

Table III: Table 3. Accuracy comparison for Non-Popular Classifiers

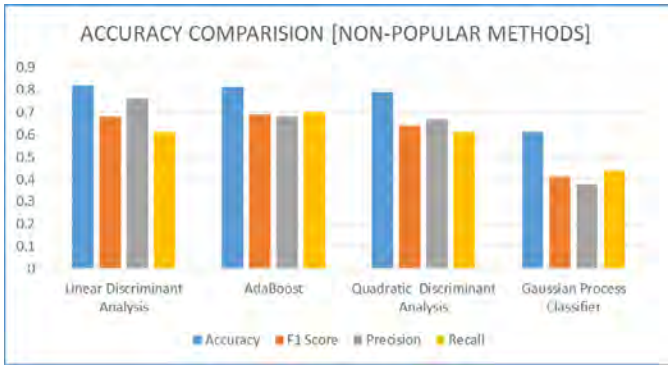


Figure 4. Accuracy Comparision of Non-Popular methods

5. CONCLUSIONS

The study shows that many models based on ML techniques have been developed for Diabetes Mellitus prediction. Although the prediction accuracy and data validity seems quite high but still the models created have not culminated in realistic applications. Out of popular methods identified through literature review Naïve Bayes method was found to be more accurate than random forest, SVM, KNN and decision tree. Support Vector Machine achieved highest accuracy with 81.00% in popular classifiers whereas Linear Discriminant Analysis achieved highest accuracy with 82.00% in less frequently used classifiers. So, it can be concluded that more such non-popular methods must be explored so that a more effective diagnostic model can be developed. Researchers working on same premise for diabetes diagnosis suffer from some drawbacks. The model cannot work with equal accuracy for different ethnicities. This limits the credibility of model for patients from different races and hence cannot be used practically. In our future work, we aim to identify a prediction model which works accurately for all races and ethnicities.

References

Abbas, H., Alic, L., Rios, M., Abdul-Ghani, M., and Qaraqe, K. 2019. Predicting diabetes in healthy population through machine learning. In *2019 IEEE 32nd International Symposium on Computer-Based Medical Systems (CBMS)*. 567–570.

Aminah, R. and Saputro, A. H. 2019. Diabetes prediction system based on iridology using machine learning. *2019 6th International Conference on Information Technology, Computer and Electrical Engineering (ICITACEE)*, 1–6.

Anwar, N. H. K. and Saian, R. 2020. Predictive accuracy for two diabetes datasets using ant-miner algorithm. *International Journal of Scientific & Technology Research 9*, 239–242.

Choudhury, A. and Gupta, D. 2019. *A Survey on Medical Diagnosis of Diabetes Using Machine Learning Techniques: IC3 2018*. 67–78.

Dhamodaran, V., Napa, K. K., Raj, V., Gugan, A., and Vikash, S. 2019. Machine learning tree classifiers in predicting diabetes mellitus.

Faruque, M. F., Asaduzzaman, and Sarker, I. H. 2019. Performance analysis of machine learning techniques to predict diabetes mellitus. In *2019 International Conference on Electrical, Computer and Communication Engineering (ECCE)*. IEEE.

Gunčar, G., Kukar, M., Notar, M., Brvar, M., Černelč, P., Notar, M., and Notar, M. 2018. An application of machine learning to haematological diagnosis. *Scientific Reports 8*.

Hasan, M. K., Alam, M. A., Das, D., Hossain, E., and Hasan, M. 2020. Diabetes prediction using ensembling of different machine learning classifiers. *IEEE Access 8*, 76516–76531.

Islam Ayon, S., Department of Computer Science and Engineering, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh, and Milon Islam, M. 2019. Diabetes prediction: A deep learning approach. *Int. j. inf. eng. electron. bus. 11,* 2 (Mar.), 21–27.

Krishnamoorthi, R., Joshi, S., Almarzouki, H., Shukla, P., Rizwan, A., Kalpana, C., and Tiwari, B. 2022. A novel diabetes healthcare disease prediction framework using machine learning techniques. *Journal of Healthcare Engineering 2022*, 1–10.

Lai, H., Huang, H., Keshavjee, K., Guergachi, A., and Gao, X. 2019. Predictive models for diabetes mellitus using machine learning techniques. *BMC Endocr. Disord. 19,* 1 (Oct.), 101.

Lv, W., Fu, R., Lin, X., Su, Y., Jin, X., Yang, H., Shan, X., Du, W., Jiang, K., Lin, Y., and Huang, G. 2021. A non-invasive diabetes diagnosis method based on novel scleral imaging instrument and AI. In *Optics in Health Care and Biomedical Optics XI*, Q. Luo, X. Li, Y. Gu, and D. Zhu, Eds. Vol. 11900. International Society for Optics and Photonics, SPIE, 109 – 117.

Maniruzzaman, M., Rahman, M. J., Al-MehediHasan, M., Suri, H. S., Abedin, M. M., El-Baz, A., and Suri, J. S. 2018. Accurate diabetes risk stratification using machine learning: Role of missing value and outliers. *J. Med. Syst. 42,* 5 (Apr.), 92.

Miao, L., Guo, X., Abbas, H. T., Qaraqe, K. A., and Abbasi, Q. H. 2020. Using machine learning to predict the future development of disease. In *2020 International Conference on UK-China Emerging Technologies (UCET)*. IEEE.

Naz, H. and Ahuja, S. 2020. Deep learning approach for diabetes prediction using pima indian dataset. *Journal of Diabetes Metabolic Disorders 19*.

Nguyen, B. P., Pham, H. N., Tran, H., Nghiem, N., Nguyen, Q. H., Do, T. T. T., Tran, C. T., and Simpson, C. R. 2019. Predicting the onset of type 2 diabetes using wide and deep learning with electronic health records. *Comput. Methods Programs Biomed. 182,* 105055 (Dec.), 105055.

Sisodia, D. and Sisodia, D. S. 2018. Prediction of diabetes using classification algorithms. *Procedia Comput. Sci. 132*, 1578–1585.

Sneha, N. and Gangil, T. 2019. Analysis of diabetes mellitus for early prediction using optimal features selection. *J. Big Data 6,* 1 (Dec.).

Srivastava, S., Sharma, L., Sharma, V., Kumar, A., and Darbari, H. 2019. Prediction of diabetes using artificial neural network approach. In *Engineering Vibration, Communication and Information Processing*. Lecture notes in electrical engineering. Springer Singapore, Singapore, 679–687.

Sulaiman, N., Mahmoud, I., Hussein, A., Elbadawi, S., Abusnana, S., Zimmet, P., and Shaw, J. 2018. Diabetes risk score in the united arab emirates: a screening tool for the early detection of type 2 diabetes mellitus. *BMJ Open Diabetes Research and Care 6,* 1.

Wu, H., Yang, S., Huang, Z., He, J., and Wang, X. 2018. Type 2 diabetes mellitus prediction model based on data mining. *Informatics in Medicine Unlocked 10*, 100–107.

Xie, Z., Nikolayeva, O., Luo, J., and Li, D. 2019. Building risk prediction models for type 2 diabetes using machine learning techniques. *Prev. Chronic Dis. 16,* 190109 (Sept.), E130.

Xiong, X.-L., Zhang, R.-X., Bi, Y., Zhou, W.-H., Yu, Y., and Zhu, D.-L. 2019. Machine learning models in type 2 diabetes risk prediction: Results from a cross-sectional retrospective study in chinese adults. *Curr. Med. Sci. 39,* 4 (Aug.), 582–588.

Suruchi Dive (Pimple) is a Research Scholar at School of Science , G.H.Raisoni University, Saikheda,Madhya Pradesh. She is working an Assistant Professor at Sadabai Raisoni Women's College, Nagpur, Maharashtra. She has an experience in teaching of 18 years.Her areas of interest are machine learning, biomedical sciences.She is a life member of the CSI.
E-mail: suruchi.pimple@raisoni.net

Dr.Gopal Sakarkar is Research Guide at G.H.Raisoni University, Saikheda, Madhya Pradesh.He has done his PhD in Computer Science and Engineering.The author has contributed to research in topic(s): Software agent Deep learning. He has an hindex of 4, co-authored 10 publication(s) receiving 101 citation(s).He was appointed Foreign Specialist in three member panel for PhD thesis review in University of Petrosani ,Romania.His research interests are in Software agent, Deep learning, Autonomous agent, Intelligent agent, Valence (psychology).
E-mail: g.sakarkar@gmail.com

Feature Selection for Ranking using Heuristics based Learning to Rank using Machine Learning

Mr. Sushilkumar Chavhan1 and Dr. R. C. Dharmik2
1. Research Scholar Department of Information Technology
2. Assistant Professor, Department of Information Technology
Yeshwantrao Chavan College of Engineering, Maharashtra India

Machine Learning based ranking is done every filed. Ranking is also solved by using (LTR i. e. learning to Rank) techniques. In this work, we propose a Heuristics LTR based models for information retrieval. Different new algorithms are tackling the problem feature selection in ranking. In this proposed model try to makes use of the simulated annealing and Principal Component analysis for document retrieval using learning to rank. A use of simulated annealing heuristics method used for the feature Selection to test the results improvement. The feature extraction technique helps to find the minimal subsets of features for better results. The core idea of the proposed framework is to make use of k-fold cross validation of training queries in the SA as well as the training queries in the any feature selection method to extract features and only using training quires make use of validation and test quires to create a learning model with LTR. The standard evaluation measures are used to verify the significant improvement in the proposed model. Performance of proposed model are measured based on prediction on some selected benchmark datasets, Improvement in the results are compare on recent high performed pairwise algorithms

Keywords: Information Retrieval, Machine Learning,Heuristics Approach, LTR.

1. INTRODUCTION

In Machine Learning goal of classification if to find the correct labels and goal of regression predict a number. For classification or regression first step is to get number which can be used for further process. How the value is fundamentally different from generated value so this class of problem can be called is called Learning to rank. The goal of ranking is to sort samples, objects, entities, information into the correct order. Any value which is assumes to be rank it is not a solution for the problem. Given some kind of query (Q) is finding the rank of relevant set of documents (D) is assumed to be result and it is result. This is the Learning to rank problem. It is different than the conventional IR models which having some problem such as Parameter values are usually given based on personal information and the accuracy of ranking is low compared expected ranking. Above problem is solved by machine learning called Learning to rank.

Learning to rank algorithm is divided into three different parts which includes Pointwise, Pairwise, Listwise Chavhan et al. [2021]. Many researchers proposed variety of Machine Learning ,Deep learning ranking models, which performed well in various formats and gives high accuracies Rahangdale and Raut [2019] Chavhan et al. [2021] over various state of arts algorithm. Recommendation Systems, Pattern Matching, Web information Retrieval with different inputs and many real time applications used the learning to rank model which required the feature set for training the models with large datasets Dependency of accuracy and models is depends on relevancy of features by removing the irrelevant features with respect to queries and document pairs.

A line of works has proposed to extracts best suitable learning-to-rank based feature selection. RankSVM Aljarah et al. [2018], RankBoost Freund et al. [2003], AdaRank Xu and Li [2007], LambdaMART Burges et al. [2006]and many more Feature Selection models are proposed for ranking. To extract the most relevant features are generated from the model which provides a pattern of data which result into the increased of predictive accuracy. In training phase if

model can reduce the irreverent features with respect to query and document. Motivation for the feature selection method to enhance the set of feature with better confidence level for the better accuracy for information retrieval.

This paper is organized as follows, and Section II describes the work of various researchers on Features selection. Section III gives a detailed overview of the technology used to select good features. Section IV uses this method to elaborate on the results. Section V provides an overview of the results description, better performance than other results, and shortcomings.

2. LITERATURE REVIEW

Most of models for feature selection using Learning to Rank has been used as an efficient way to handle large dimension and have a target to collect the optimal subset which provides suitable features. Feature selection methods are broadly classify into following different categories such as: filter, wrapper, embedded, and hybrid methods. If we find the candidate feature sets before the start of learning

then it perform well and provide better accuracies. To apply procedure to all real time application is not possible. In this section we have illustrate the various studies related to different Feature selection models.

Bai et al. [2010] proposed Supervised Semantic Indexing for ranking using query-document or document-document. Proposed model enhance existing model which focused the issues which address ranking issue including low rank and correlated feature hashing. Authors concluded with effective ways to reduce the function for feature space. Duan et al. [2010] suggested Dynamically adjusted Alpha Investing model for feature selection by dynamically which were able to handle the and able to handle the huge features. The Accuracy of model is low due its evaluation of features only one time which is consider to be a drawback. Kang et al. [2011] suggested combination of two ML re-ranking methods which focus on pairwise features and combine the features in base Function used for ranking. The proposed methods received potential gains in most of the query and able apply them with high confidence. Chelaru et al. [2012] proposed ranking model for YouTube videos which consider of social features for the video retrieval. Which received the 48% accuracy but it is improved version of previously mentioned feature selection algorithm. As a future works author suggest working on large set of annotated data for more general conclusion. Also they suggested extending work with the tail queries. Macdonald et al. [2012] proposed model which useful to improve the learning of LTR models by exploration the features which may be of query-dependent and query-independent document features attributes. Authors suggested to identify more such classes of attributed with multiple query features.

Yang and Gopal [2012] proposed multi-label classification for Learning to rank. By using these feature selection techniques one-to-many relationships from multi label classification effectively calculated over the various states of arts algorithms with good accuracy. Authors suggested to have combined objective function for better optimization and dimension deduction to get more accuracy also they suggested to focus on hybrid method for MLC. Zheng et al. [2013] proposed model to extract multiple features by TF or by using TF-IDF or by using language model. More Focus was given to find the experts and basic document features. They adopted RankSVM method for the features selection. Lai et al. [2013] proposed an FSM ranking algorithm for feature selection. A general convex optimization formulation was used to minimize ranking errors during feature selection. They used the complexity of Rademacher to provide a generalization limit for the proposed optimization problem.Sousa et al. [2019] suggested reducing the risk of trained models by extracting redundant and noisy features or features that interfere with other queries. This is usually exacerbated by learning methods that maximize the average metric, such as MAP or NDCG.Cheng et al. [2018] have proposed a multipurpose evolutionary algorithm using adaptive mutations that provides properties with high ranking accuracy and low redundancy. As a future direction, the author suggested developing feature selection algorithms for other types of listwise approaches, such as ranking learning. Rahangdale and Raut [2019] Deep learning model

for feature selection by L1 and L2 regularization. The author evaluated the results of standard learning on feature selection algorithms and ranks. In addition, they conclude that a deep neural network architecture with proper regularization techniques can help find better functionality. As future authors, they have proposed models proposed for various applications. Purpura et al. [2021] proposed a LETOR based feature selection approach which uses neural ranking. They focus on optimizing the performance of various models based on neural networks. The author validates the results

using two standard datasets that are excellent for most of the algorithms. Jen Yuan Yeh studied a graph-based feature selection method called FS SCPR. In this method, similarity-based undirected graphs are further clustered with eigenvectors to which scores are assigned using the PageRank algorithm. It is also optimized for maximum relevance. As a future direction, the authors suggested focusing on how to improve the relationships between features in feature similarity diagrams and how to improve clusters of goodness proposed by Yeh and Tsai [2021].By studying work of various authors it is found the, for retrieval using machine learning require the redundant set of feature selection and reduction of error in training and testing. It is applicable for filter, wrapper, embedded, and hybrid methods of feature selection.

3. METHODOLOGY

In this work, we aim to find the best subset of the training data's ability to rank issues that may have high rank accuracy during evaluation. For this optimization purpose, we will use a simulated annealing algorithm. Simulated annealing is a way to solve optimization problems with and without constraints.

3.1 Simulated Annealing

This algorithm is basically a combination of two methods: the hill climbing method and the random walk methodRajpurohit et al. [2017]Johnson et al. [1989]. The problem solved by SA is currently formulated by the objective function of many variables that are subject to some constraints. Constraints can be penalized as part of the objective function. At each step, the simulated annealing heuristic examines several adjacent states s * of the current state and probabilistically determines whether the system is in state s * or stays in states. These probabilities ultimately put the system in a lower energy state. This step is typically repeated until the system is in sufficient condition for the application or until a particular computational budget is exhausted. Mathematically this probability is,

$$probability = e(\Delta(E)/T)$$

Where ΔE is the difference between two stages.
T = Temperature drops from very high to zero at each iteration.
Basically, if the quality of the neighbor state is worse than the current state, the neighbor may be selected (or not selected).

In most cases, simulated annealing is known to work better than just a local search algorithm. Bellow is the simulated annealing process Algorithm.

Algorithm 1 Process of Simulated Annealing

• Create an initial random subset(Let s = s0) with iteration(K)
while k = 0 to kmax **do**
  o T ← T(1 - (k+1)/kmax);
  o Perturbed the current subset and fit the model;
  o Select a random neighbour. snew ← neighbour(s);
  if performance is better than Perturbed set **then**
    o Accept new subset
  else
    o Calculate the acceptance probability
    if P(E(s), E(snew), T) random(0, 1) **then**
      o s ← snew
    else
      o accept new subset
    end if
  end if
end while

4. EMPIRICAL RESULTS

A number of computational experiments are performed on various benchmark datasets dedicated to ranking training to analyze the performance of the proposed model. LETOR2 is a complete package containing a total of 10 datasets. Each dataset is divided into five-direction cross-validations, each of which consists of a set of training, testing, and validation. All are normalized data in the range [0, 1]. Out of all the databases we used TD2004, MQ2008, MQ2007 from LOTOR and the MSLR-WEB10K and MSLRWEB30K datasets are provided by Microsoft which is normalized using sklearn python machine learning library.

4.1 EVALUATING MEASURES

NDCG and MAP are two most popular evaluation matrix used for the performance of the LTR and sparsity ratio is used to evaluate the feature selection method. Details of above are as follows[20].

(1) Precision @k: The ratio of related documents to the searched documents. The accuracy P @ k (q) at k in the query looks like this:

$$P@k(q) = \frac{\sum_{i=1}^{k} r_i}{k} \tag{1}$$

(2) Mean Average Precision (MAP):First, calculate the precision at k when the query is P @ k (q) as described above. Then calculate the average precision of the query AP (q) with k elements as follows:

$$AP(q)@k = \frac{1}{\sum_{i=1}^{k} r_i}, \sum_{i=1}^{k} P@k(q) * r_i \tag{2}$$

(3) Normalized Discounted Cumulative Gain (NDCG) A new valuation scale called Normalized Discount Cumulative Gain [16] has recently been proposed to accommodate multiple levels of related valuations. When evaluating rankings, NDCG follows two rules:
1. Relevant documents are more important than irrelevant documents.
2. Users are less likely to be investigated, so the lower the ranking status of a document (at severity level), the lower the user's value.

According to the above rule, the NDCG value at position n is calculated as follows: First, define the discounted cumulative profit of the position as follows:

$$DCG@k = \sum_{i=1}^{|Li|} \frac{2^l i - 1}{log2(i+1)} \tag{3}$$

Where li is the ranking of relevance at rank i. The normalized DCG is defined as:

$$NDCG@k = \frac{DCG@k}{IDCG@k} \tag{4}$$

Where IDCG @ k is the ideal DCG @ k given the result. It is DCG @ k that is calculated by reclassifying a given list by its true relevance tag. In other words, IDCG @ k is the maximum value of DCG @ K that can be obtained when obtaining the ranking.

As for LTR algorithm RankNet, LambdaNet, LambdaMart are choose for evaluation because all are performed well in various application. FSM rank and heuristic rank (HA) choose for evaluation of features selection. We begin with LOTOR dataset. Experiments are carried out with low value of K which is assumed in temperature which starts from low value to high value. We first compare the features in interval of try to find best suited values of features for better accuracy. Then we try same experiments on MSLR datasets. Feature comparison depict through graphs shown below. Further mostly used ranking algorithms are check with the features selection with wrapper method and Heuristic based feature selection algorithm using simulated annealing.

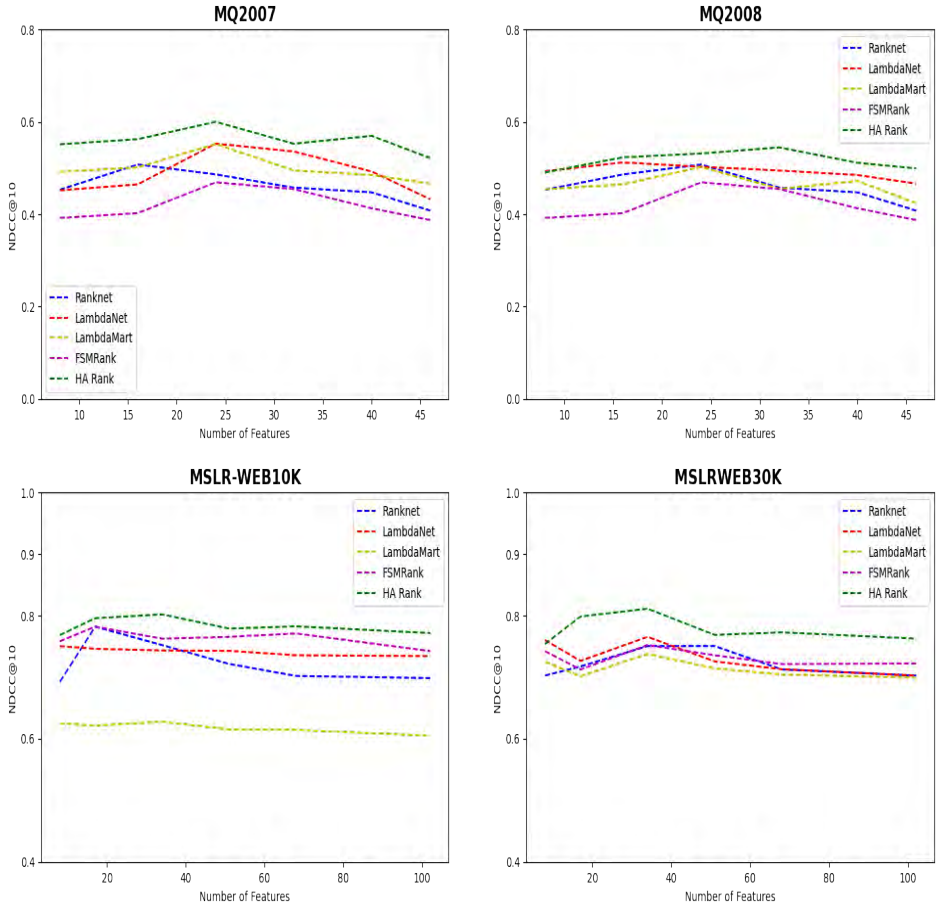


Fig 1 : Comparative Scores of NDCG@10 scores with respect to different features interval i.e

(a) on MQ2007 dataset (b) on MQ2008 dataset (c) on MSLR-WEB10K dataset (d) on MSLR-WEB30K dataset.

Above figure depict that proper subset give the better accuracy. All the considered dataset are of different size and with different normalization every figure having the different numbers of features sequence. In every algorithm the required features are varies according to applied SA algorithm with heuristic approach. For LOTOR is to in between 24 to 30 and for MSLR it is ranges from 35 to 40. SA accepts more numbers of features and converge to suitable range. Above figure depict that proper subset give the better accuracy. All the considered dataset are of different size and with different normalization every figure having the different numbers of features sequence. In every algorithm the required features are varies according to applied SA algorithm with heuristic approach. For LOTOR is to in between 24 to 30 and for MSLR it is ranges from 35 to 40. SA accepts more numbers of features and converge to suitable range.

5. DISCUSSION

Earlier, using standard ranking algorithm and Beysian wrapper based feature selection method results are used where standard ranking algorithm are evaluated by using NDCG@10, on various sets of features. All the datasets required to set proper selection of feature are needed to improve the accuracy. Mostly, all data sets appear to improved feature using heuristic algorithm feature selection method over the Beysian wrapper based feature selection method. Meta-heuristic algorithm will be used for further improvement. Variations in all the graphs are minimized by using cross folding technique.

Fig 1 shows the average evaluations measures on ranking algorithms and Feature selection method. NDCG@10, P@10 and MAP of all the algorithm shows in the above figure. A feature selection using heuristics algorithm with other future selection method is investigated and shows improvement of ranking for the information retrieval. 27.29% w.r.t. NDCG @ 10 and 9.74% w.r.t. P @ 10, 26.65% MAP gain is obtained in the LATOR dataset.Mentioned values are the average of all the graph values mentioned in graph. MSLR is large dataset. By using heuristic approach helps to find the stable machine learning models which provides less gain as compared to LOTOR datasets. Comparative analysis depict the same.

6. CONCLUSION AND FUTURE SCOPE

In this paper, Implementation of heuristic based features selection technique and analysed performance with learning to rank techniques. A result clearly indicates from the performance of the models that as the number of features increases the accuracy slowly decreases. Also Average run-time also consider for the extraction of features. The performance of the Learning-to-Rank and various feature selection algorithms for the proposed HA-based simulated Annealing was also compared using the benchmark of few datasets available in the Learning-to-Rank. Our analysis provides analysis of the model for better accuracy. From the above results, the proper characteristics of the machine model will improve the results of the associated ranking model. As a future direction, dig deeper into the choice of functions that maintain similar accuracy. You can also use the other three fitness functions, reciprocal rank, accuracy, and error rate, in various simulated glow methods or make them metaheuristic algorithms. You can use the appropriate dimensionality reduction technique.

References

Aljarah, I., Al-Zoubi, A., Faris, H., Hassonah, M., Mirjalili, S., and Saadeh, H. 2018. Simultaneous feature selection and support vector machine optimization using the grasshopper optimization algorithm. *Cognitive Computation 10*.

Bai, B., Weston, J., Grangier, D., Collobert, R., Sadamasa, K., Qi, Y., Chapelle, O., and Weinberger, K. 2010. Learning to rank with (a lot of) word features. *Information Retrieval 13*, 291–314.

Burges, C., Ragno, R., and Le, Q. 2006. Learning to rank with nonsmooth cost functions. 193–200.

Chavhan, S., Raghuwanshi, M., and Dharmik, R. 2021. Information retrieval using machine learning for ranking: A review. *Journal of Physics: Conference Series 1913*, 012150.

Chelaru, S., Orellana-Rodriguez, C., and Altingövde, I. 2012. Can social features help learning to rank youtube videos?

Cheng, F., Guo, W., and Zhang, X. 2018. Mofsrank: A multiobjective evolutionary algorithm for feature selection in learning to rank. *Complex. 2018*, 7837696:1–7837696:14.

Duan, Y., Jiang, L., Qin, T., Zhou, M., and Shum, H.-Y. 2010. An empirical study on learning to rank of tweets 1. Vol. 2. 295–303.

Freund, Y., Iyer, R., Schapire, R., and Singer, Y. 2003. An efficient boosting algorithm for combining preferences. *Journal of Machine Learning Research 4*, 933–969.

Johnson, D., Aragon, C., McGeoch, L., and Schevon, C. 1989. Optimization by simulated annealing: An experimental evaluation. part i, graph partitioning. *Operations Research 37*, 865–892.

Kang, C., Wang, X., Chen, J., Liao, C., Chang, Y., Tseng, B., and Zheng, Z. 2011. Learning to re-rank web search results with multiple pairwise features. 735–744.

Lai, H., Pan, Y., and Tang, Y. 2013. Fsmrank: Feature selection algorithm for learning to rank. *Neural Networks and Learning Systems, IEEE Transactions on 24*, 940–952.

Macdonald, C., Santos, R., and Ounis, I. 2012. On the usefulness of query features for learning to rank. 2559–2562.

Purpura, A., Buchner, K., Silvello, G., and Susto, G. A. 2021. *Neural Feature Selection for Learning to Rank*. 342–349.

Rahangdale, A. and Raut, S. 2019. Deep neural network regularization for feature selection in learning-to-rank. *IEEE Access 7*, 53988–54006.

Rajpurohit, J., Sharma, D. T., and Abraham, A. 2017. Glossary of metaheuristic algorithms. 181–205.

Sousa, D., Canuto, S., Gonçalves, M., Couto, T., and Martins, W. 2019. Risk-sensitive learning to rank with evolutionary multi-objective feature selection. *ACM Transactions on Information Systems 37*, 1–34.

Xu, J. and Li, H. 2007. Adarank: a boosting algorithm for information retrieval. In *SIGIR*.

Yang, Y. and Gopal, S. 2012. Multilabel classification with meta-level features in a learning-to-rank framework. *Machine Learning 88*.

Yeh, J.-Y. and Tsai, C.-J. 2021. A graph-based feature selection method for learning to rank using spectral clustering for redundancy minimization and biased pagerank for relevance analysis. *Computer Science and Information Systems 19*, 42–42.

Zheng, H.-T., Li, Q., Jiang, Y., Xia, S.-T., and Zhang, L. 2013. Exploiting multiple features for learning to rank in expert finding. In *Advanced Data Mining and Applications*, H. Motoda, Z. Wu, L. Cao, O. Zaiane, M. Yao, and W. Wang, Eds. Springer Berlin Heidelberg, Berlin, Heidelberg, 219–230.

Mr. Sushil kumar Chavhan is an Assistant Professor in YCCE, Nagpur. Has received Bachelor of Engineering Degree and M .Tech in computer science and Engineering from Nagpur university. Currently he is research scholar at YCCE. His area of interest include Machine Learning, Artificial Neural Network, pattern recognition.
E-mail: schavhansushil@gmail.com

Dr. R. C. Dharmik is head of Department of Information Technology. His area of interest include Cloud Computing,High Performance Computing, pattern recognition.
E-mail: raj$_d harmik@yahoo.com$

Development of Air Purification Facial Shield with Real Time Health Monitoring System

Suchet Nawade, C. Rohit
Research Scholar, Electronics Engineering Department, R.C.O.E.M., Nagpur, Maharashtra, India
and
Vishal Rathee
Assistant Professor, Electronics Engineering Department, R.C.O.E.M., Nagpur, Maharashtra, India

IoT-based healthcare systems can ensure better patient health monitoring conditions especially in remote areas as IoT has found its reach in the daily lives of every person let it be in the way of remote messaging, data transfer, wearable devices monitoring your location, health status or any other. Quick and robust Health monitoring systems has again gained popularity with the advent of Corona Virus in recent times. Nearly everyone in today's world after attaining an appropriate age is using the health monitoring system to measure vital parameters of the body. In rural areas, monitoring systems are not easily available, and even if acquired, they are largely very bulky and require expertise to use. So, the need is for small, remote and easily available and usable devices which have extra features to measure and display vital health parameters that can be integrated with a system to broadcast the live data to central station which can be monitored by experts. In this work, health vital signs like body temperature and pulse are measured using sensors like MAX30102 and the measured data is sent to the IoT cloud for scheduling a patient's recorded history. We have utilized Wi-Fi convention IEEE 802.11, standard IPv4 address, next to a 3G cellular arrangement to send information from sensors to versatile application "Blynk". Besides, Node MCU and Arduino UNO microcontrollers are also connected to the facial shield.

Keywords: IoT, Blynk, Pulse rate, Oximeter, Human-to-human, Human-to-machine.

1. INTRODUCTION

By the concept of IoT, we can control or observe anything remotely in this whole world. IoT also gives a communication pathway between human-to-human, human-to-machine and machine-to-machine, thus allowing transfer or flow of data between all of these without any direct human interaction. In the present time, IoT has expanded to vast places and has also taken over the healthcare domain by storm along with wellness applications. There is still little insecurity regarding this technology, such as privacy and data security as mentioned in Jayaysingh et al. [2020] and Al-Sheikh and Ameen [2020].

IoT innovation utilizes different sorts of communication conventions for different cases like (IPv6) Wi-Fi, (IPv4) Wi-Fi, 6LoWPAN, ZigBee, (BLE) Bluetooth Moo Vitality, Z-Wave, (NFC) Close Field Communication, SigFox, 2G-3G-4G Cellular, String, and LoRaWAN. Each convention has recognized properties that allow IoT venture originators to utilize any convention to meet their prerequisites and limits. This is discussed in Agustine et al. [2018], Hassan et al. [2021]. In this project three parameters such as body temperature, heart rate and SPO2 are observed in real time as some persistent illnesses, such as cardiovascular disease and diabetes require continuous monitoring to prevent the situation from getting worse. This information is gathered from Prasanth et al. [2021] and also from Bhattacharya et al. [2017].

The body temperature is one of the crucial signals that ought to be observed for patients since it advises the patient's digestion system situation, a few medications' side-effects, and adjusts the rate between warm era and warm misfortune. MAX30102 is a sensor that measures heart rate, temperature, and oxygen saturation. It operates on the basis of photodetection. There

will be no piercing or other cutting required. Photodetectors, internal LEDs, optical elements, and low-noise electronics with ambient light rejection are used to prevent atmospheric light from interfering with the sensor's data. The working is also given in Ahmed et al. [2017] and Ahmed et al. [2020].

2. LITERATURE REVIEW

Ahmed et al. [2020] discusses the use of Arduino Uno, ESP8266, Thingspeak cloud, and Arduino app to manage and "transport" data to any place of interest. In this the proposed model uses a DS18B20 body temperature sensor and Arduino Uno and ESP8266 in a master-slave setup to transfer data over the given wi-fi module.

In another paper, the author, namely Kumar et al. [2017] covers various topics of interest, such as Smartwatches, Thingspeak, Android applications, and IFTTT.The paper talks about the use of smartwatches and android application in monitoring and transmission of data utilizing Bluetooth or wi-fi to a given cloud terminal, thus uploading the data to the cloud.

Similarly Verma and Mishra [2020] shows us the integrated use of sensors such as LM-35 temperature sensors, with MAX30100, Arduino Uno, and ESP8266. LM-35, combined with a master slave combination of Arduino Uno and ESP8266 wifi module to upload data on the cloud and access it at another point.

Similarly,the usage of NodeMCU is discussed by Jayaysingh et al. [2020]. In this paper, ESP8266, PLSNSR1, and Thingspeak are integrated to make a complete detection and transmission system. The PLSNSR1 pulse sensor is used to read the pulse, gives it to ESP8266, from where the data is transferred to the cloud by the Blynk app where it may be stored, and loaded at any palace and any point required.

3. METHODOLOGY AND IMPLEMENTATION

3.1 The building blocks and structure

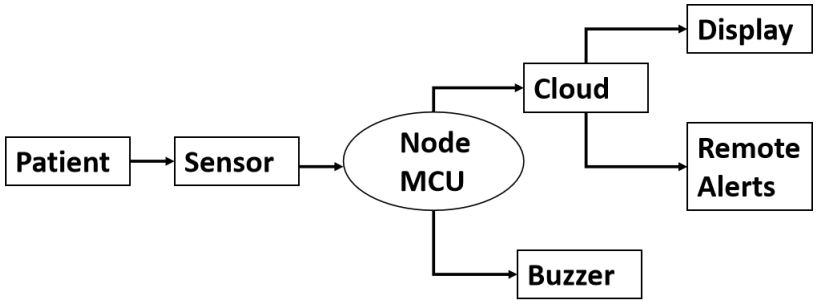


Figure 1. Block diagram of the system

The above Figure 1 shows the block diagram of the implemented system in which a remote health monitoring system is integrated with alerting mechanism. This system can be divided into three main parts.

3.1.1 *The Sensing Part:.* This part includes the system that is to be attached to the end user who is to be monitored. This part typically consists of sensing, processing and relay units. The sensors are used to measure any change of parameters in the given subject. They usually lack processing and relay systems. The sensed raw data is then sent to a microcontroller which then

processes this data and converts it into measurable or normalized scale. This data is fed to the relay system. The relay system transfers the data to the given platform of choice, i.e. cloud, any other computer or a server as shown in Kumar et al. [2017]. The relay system may be wired, like any USB cable, or it may be wireless, like WiFi. In the above block diagram, we have used MAX0102 as the primary sensor, ESP8266 as the processing unit or the microcontroller. For the relay system, we use the integrated WiFi module of the ESP8266 to transfer the data over WiFi to any other device as given in Ananth et al. [2019] and Longmore et al. [2019].

3.1.2 *The Data Management Part:.* The data sent by the microcontroller will be collected at an IoT gateway. This gateway acts as a bridge between the microcontroller and the IoT based cloud platform. The processed data is uploaded to the cloud. The data can be accessed at every place which has an internet facility. The IoT gateway used here is Blynk. Blynk is an open source platform for IoT based operations which is free of cost and provides a server based system to its users.

3.1.3 *The Alerting System:.* The model has two types of alerts available. The first one is the manual alert system, which consists of a buzzer connected to the microcontroller. The buzzer is set on when any of the parameters being monitored goes over a certain set threshold. Second one is a notification on the blynk app. The blynk app sends an alert notification whenever the parameter threshold is crossed. This alert is not dependent on the proximity to the subject being monitored when connected to the designated server.

3.2 Hardware Implementation

MAX20102, a pulse oximeter sensor which can measure pulse rate, SpO2 and body temperature with the help of onboard temperature sensor was interfaced with Node MCU ESP8266 supplying a required voltage of 3.3V - 5V. The communication was established between the MAX30102 and Node MCU through I2C communication protocol implementing the master slave configuration, described in Škraba et al. [2017]. Serial Clock (SCL) of the sensor was connected to the Serial Data (SDU) of Node MCU and SCL of Node MCU was connected to the SDA of the sensor as shown in Figure 2. Figure 3 and Figure 4 shows the facial shield with on board sensors and controller.

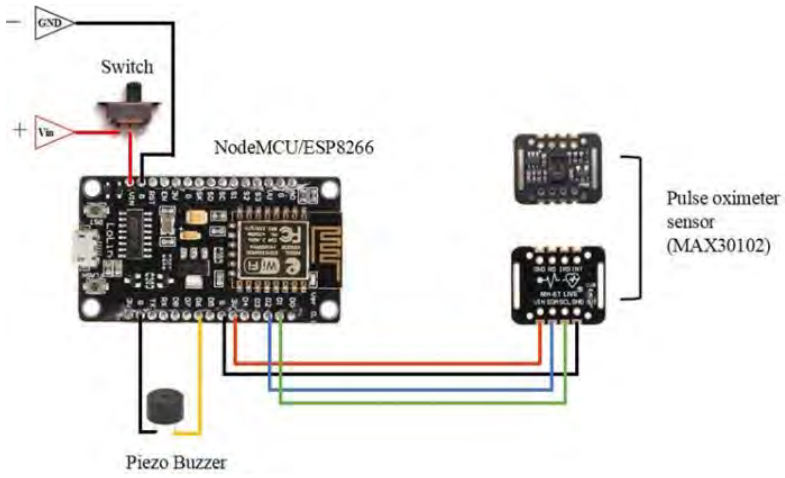


Figure 2. Circuit of remote health monitoring system

Figure 3. Model wearing a face shield

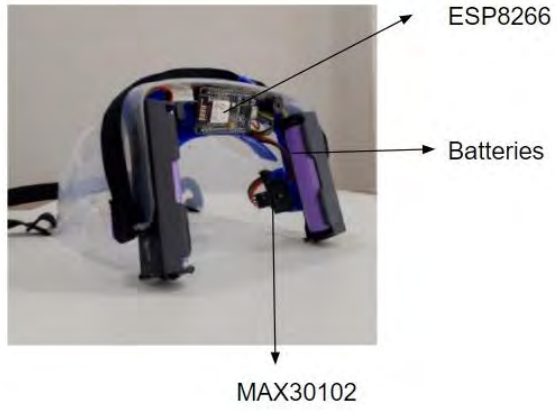


Figure 4. Developed hardware prototype of the facial shield

4. CONCLUSION AND FUTURE WORK

We have implemented the remote health monitoring system and were able to achieve good results. The model was tested for its accuracy with industry level equipment. Comparative readings are shown in the result tables I and II.

We obtained the results on the blynk app connected to the ESP8266 via the WiFi module. We implemented the remote health monitoring system and received the desired results which were displayed using blynk platform. We got the pulse rate in Beats Per Minute (BPM) and the body temperature measurement precisely which were cross checked with readings obtained by

Pulse oximeter reading in Celsius	**Health monitoring system output in Celsius**	**Error in percent**
36	35.8	0.5555
36.6	36.7	0.2732
37	37.1	0.2702
37.3	37	0.8024

Table I: Average error of body temperature in percent = 0.4757

Pulse oximeter reading in BPM	**Health monitoring system output in BPM**	**Error in percent**
60	63	5
63	64	1.5873
64	65	1.5625
64	64	0

Table II: Average error of BPM in percent = 2.0374

the model available with industry supposed to be medically tested, calibrated and certified. We also calculated errors and tolerance values for the obtained data. The tolerance was well within the permissible range with minor error. Further, we aim to increase the efficiency of the battery, to last longer, may be replace it with super capacitors.

References

Agustine, L., Muljono, I., Angka, P. R., Gunadhi, A., Lestariningsih, D., and Weliamto, W. A. 2018. Heart rate monitoring device for arrhythmia using pulse oximeter sensor based on android. In *2018 International Conference on Computer Engineering, Network and Intelligent Multimedia (CENIM)*. IEEE, pp.106–111.

Ahmed, M. F., Hasan, M. K., Shahjalal, M., Alam, M. M., and Jang, Y. M. 2017. Design and implementation of an occ-based real-time heart rate and pulse-oxygen saturation monitoring system. In *2017 International conference of Electronics, Communication and Aerospace Technology (ICECA)*. IEEE, pp.198740–198747.

Ahmed, M. F., Hasan, M. K., Shahjalal, M., Alam, M. M., and Jang, Y. M. 2020. Real time android app based respiration rate monitor. In *Design and implementation of an occ-based real-time heart rate and pulse-oxygen saturation monitoring system*. IEEE, pp.709–712.

Al-Sheikh, M. A. and Ameen, I. A. 2020. Design of mobile healthcare monitoring system using iot technology and cloud computing. In *IOP conference series: materials science and engineering*. IOP Publishing, 012113.

Ananth, S., Sathya, P., and Mohan, P. M. 2019. Smart health monitoring system through iot. In *2019 International Conference on Communication and Signal Processing (ICCSP)*. IEEE, pp.0968–0970.

Bhattacharya, R., Bandyopadhyay, N., and Kalaivani, S. 2017. Real time android app based respiration rate monitor. In *2017 International conference of Electronics, Communication and Aerospace Technology (ICECA)*. IEEE, pp.709–712.

Hassan, A. U., Salihu, Y. O., et al. 2021. Real-time monitoring of heart beat rate and spo2 based on internet of things. In *2021 International Conference on Electrical, Computer and Energy Technologies (ICECET)*. IEEE, pp.1–4.

Jayaysingh, R., David, J., Raaj, M. J. M., Daniel, D., and BlessyTelagathoti, D. 2020. Iot based patient monitoring system using nodemcu. In *2020 5th international conference on devices, circuits and systems (ICDCS)*. IEEE, pp.240–243.

Kumar, S. P., Samson, V. R. R., Sai, U. B., Rao, P. M., and Eswar, K. K. 2017. Smart health monitoring system of patient through iot. In *2017 international conference on I-SMAC (IoT in social, mobile, analytics and cloud)(I-SMAC)*. IEEE, pp.551–556.

Longmore, S. K., Jalaludin, B., Breen, P. P., and Gargiulo, G. D. 2019. Comparison of bi-wavelength and tri-wavelength photoplethysmography sensors placed on the forehead. In *2019 International Conference on Electrical Engineering Research & Practice (ICEERP)*. IEEE, pp.1–4.

Prasanth, C., Prakash, R., Rufus, E., and Alex, Z. C. 2021. Design and development of cloud based mobile health monitoring system. In *2021 Innovations in Power and Advanced Computing Technologies (i-PACT)*. IEEE, pp.1–6.

Škraba, A., Koložvari, A., Kofjač, D., Stojanović, R., Stanovov, V., and Semenkin, E. 2017. Prototype of group heart rate monitoring with nodemcu esp8266. In *2017 6th Mediterranean Conference on Embedded Computing (MECO)*. IEEE, pp.1–4.

Verma, P. and Mishra, R. 2020. Iot based smart remote health monitoring system. In *2020 International conference on electrical and electronics engineering (ICE3)*. IEEE, pp.467–470.

Mr. Suchet Nawade is an undergraduate student, currently pursuing a B.E in Electronics Engineering and Honors in AI for edge computing from Shri Ramdeobaba College of Engineering and Management, Nagpur, India. He worked as a research intern in Centre for Microsystems at Department of Electronics Engineering, RCOEM during this project. His research interests are in IoT, Machine Learning, and Big Data Computing.
E-mail: nawadesg@rknec.edu

Mr. C. Rohit is a student, currently pursuing B.E in Electronics engineering and Honors in AI and ML applications from Shri Ramdeobaba College of Engineering and Management, Nagpur, India. He cleared GATE 2022 in EC with an AIR of 6293. His research interests are in Big Data, Data Engineering, Machine Learning, and Cloud Computing. .
E-mail: rohitc@rknec.edu

Prof. Vishal R. Rathee Vishal Rathee is an Assistant Professor at the Ramdeobaba College of Engineering and Management, Nagpur. He received his Bachelor of Electronics and Telecommunications Engineering in 2002. He graduated in 2007 with a Master's degree in electronics engineering. His fields of interest are Microsystems, Microfluidics, and soft computing. More than 12 articles have been written by the International Conference/Journal. He is also a member of ISTE and ISSS.
E-mail: ratheevr@rknec.edu

A Covid Outbreak Prediction using Machine Learning

Ashish Chandak, Purshottam J Assudani, Sakshi Saklani, Amrusha Rahangdale and Achal Loya
Shri Ramdeobaba College of Engineering and Management,Nagpur

Machine learning (ML] helps with the future prediction of action and take decision. A variety of prediction techniques are used for the future prediction of risks and effectively dealing it. This work shows how ML models can predict death rates of COVID-19 patients so that we can do effective treatment and try to minimize the effect of the causes. Coronavirus 2019, COVID-19 is a member of the Coronaviridae genus. A virus without a cure causes unpredictable devastation to people's lives as well as the financial and economic systems of every nation on earth. We have taken certain features from the COVID-19 dataset to study and comprehend the future circumstance using machine learning algorithms, various prediction models are created, and their performances are calculated and assessed. We have compared machine learning algorithms viz. Random Forest and Linear Regression, Decision Tree to predict a number of cases.

Keywords: Machine learning, linear regression, random forest, decision tree.

1. INTRODUCTION

World Health Organization (WHO) defines coronavirus as a virus extended family that causes diseases due to the common cold to severe respiratory diseases which could turn out to be fatal for humans. In December 2019, Wuhan experienced an outbreak of coronavirus disease 2019 (COVID-19), which was caused by severe acute respiratory syndrome coronavirus-2. (SARS-CoV-2). As the medical management was incapable of handling the pandemic situation, hundreds of people died within a month and many were infected as the disease spread rapidly. Our goal is to the prediction of death rates using Machine Learning algorithms. This forecasting method will predict the upcoming number of COVID-19 death cases. Here we have used three standard models for forecasting including linear Regression (LR), Decision tree, and Random Forest, which will predict the number of COVID-19 death cases in the future.According to the results of the analysis, the decision tree model outperforms the random forest and linear regression models.

1.1 Signs and symptoms

Although COVID-19 symptoms vary, they commonly include fever, coughing, headaches, exhaustion, breathing difficulties, anosmia, and loss of taste. Symptoms may appear one to fourteen days after viral exposure. At least one-third of those infected have no symptoms at all. The majority (81%) of those who have symptoms that are noticeable enough to be classified as patients have mild to moderate symptoms (up to mild pneumonia), while 14% have severe symptoms (such as dyspnea, hypoxia, or more than 50% lung involvement on imaging), and 5% have critical symptoms (respiratory failure, shock, or multiorgan dysfunction).
Common symptoms of COVID-19:
- fever
- cough
- tiredness
- loss of taste or smell.

Less common symptom of COVID-19:
- throat sore
- headache

• aches and pains
• diarrhea
• a rash on the skin, or discoloration of fingers or toes
• red or irritated eyes

Serious Symptoms of COVID-19:
• shortness of breath or difficulty breathing
• loss of speech or mobility, or confusion
• chest pain.

1.2 Machine learning

Machine learning allows a software application to predict outcomes without us manually typing a program to get the desired result. Machine learning algorithms use past data to make predictions about future outcomes.

1.3 Types of Machine Learning

There are four types of machine learning which are described as follows.

1.Supervised Learning: In this type of machine learning, where algorithms are provided with a labelled dataset and define an independent variable that the algorithm should analyse for correlations. The input and output of the algorithm are both specified.

2.Unsupervised learning: It is a type of machine learning where algorithms are trained on unlabelled data. The algorithm analyses the dataset to find a relation between variables. Using data, the algorithm trains and the predictions it outputs are predetermined.

3.Semi-supervised learning: It is a type in which a model is given some labelled data as well as some unlabelled data. However, the model is free to study the data on its own and learn from it.

4.Reinforcement learning: It is a technique that is mainly used to teach a machine to complete a multi-step process for a goal that is already predefined.

In this Covid19 Prediction Model, we used a supervised Machine learning algorithm. Supervised learning requires labelled inputs (e.g., examples of what the algorithm should predict) and desired outputs (e.g., what the algorithm should produce). Supervised learning algorithms are well suited for the following tasks:

1.Binary classification: Separating data into two categories.

2.Classification: It can be difficult when there are more than two types of answers to choose from.

3.Regression modelling: is a technique used to predict continuous values.

4.Ensembling: For accurate outcomes, a combination of prediction of multiple machine learning models can be done.

2. LITERATURE REVIEW

The results of (Wang, Zheng, Li, and Zhu, 2020) the trials show that COVID-19 affects people in the age ranges of 20 to 30, 40 to 50, and 40 to 50. To comprehend the link between the dataset features, correlation matrices are constructed. For the classifiers that are developed, the feature importance is calculated. Regressors and classifiers are constructed alongside prediction tools.

The outcomes demonstrate that in terms of CoD and Accuracy, the Random Forest Regressor and Random Forest Classifier have outperformed other models.
The author in (Prakash, Imambi, Ismail, Kumar, and Pawan, 2020) seeks to offer a model for early forecasting of the COVID-19 spread. For the next 10 days, forecasts are made for the following three crucial disease-related variables:
1) The total quantity of newly confirmed instances.
2) The quantity of fatalities three) The number of recoveries. This forecasting issue has been categorized as an ML regression issue. The COVID-19 patient dataset from Johns Hopkins was used to train the learning models. The results show that the ES outperforms all other models, followed by LR and LASSO, which are good at predicting new confirmed cases, death rates, and recovery rates, while SVM does not perform well in all scenarios where predictions are made using the dataset that is currently available.
In (Rustam, Reshi, Mehmood, Ullah, On, Aslam, and Choi, 2020a) three classification techniques, namely logistic regression (LR), random forest (RF), and extreme gradient boosting, were used to analyze the data (XGB). The data were initially pre-processed using a variety of pre-processing methods. This study used supervised machine learning algorithms to investigate the role of vital signs, chronic disease, early clinical data, and demographic factors in predicting the death and survival of COVID-19 patients. The dataset has a data imbalance since the COVID-19 cases had a lower death risk. The data imbalance was corrected using the SMOTE technique. Using 10-fold cross-validation, the findings revealed that random forest outperformed the other models. The grid search technique was used to optimize the parameters. Coronavirus has spread so quickly around the world that the overall incidence of COVID-19 was rising quickly every day. It is possible to track Covid-19, forecast the expansion of the epidemic, and create plans and policies to control its spread using machine learning (ML).
An enhanced mathematical model is used in this (Tuli, Tuli, Tuli, and Gill, 2020) work to examine and forecast the spread of the disease. An enhanced model based on machine learning has been used to forecast the threat of COVID-19 in nations around the world It demonstrated that a better fit may be obtained to create a framework for prediction when fitting the Generalized Inverse Weibull distribution using iterative weighting. Active response from the government and the public can benefit from a data driven strategy with improved precision. Due to a high level of uncertainty and lack of data, many standard models have shown low accuracy for long-term prediction.
The paper (Aljameel, Khan, Aslam, Aljabri, and Alsulmi, 2021) presents a comparative analysis of machine learning and soft computing models to predict COVID-19 as an alternative to susceptible–infected– recovered and susceptible-exposed-infectious-removed models. Among a range of machine learning models investigated, two models showed promising results (i.e., multi-layered perceptron, MLP; and adaptive network-based fuzzy inference system, ANFIS). This paper further suggests that a genuine novelty in outbreak prediction can be realized by integrating machine learning and SEIR models.

3. IMPLEMENTATION

Figure 1 shows selected attribute values and Figure 2 shows data description. Dataset has a total of 159326 instances and 26 attributes out of which 7 are input variables and one is a target variable. This data consists of date-wise case reports with properties in which 'total deaths' is taken as the dependent variable and the rest as the independent variable. From total dataset 70% data has been used for training and 30% for testing. Some instances with missing values are dropped and replaced by mean values. The extracted 7 features were selected into modeling as per guidance: total_cases, new_cases_per_million, handwashing_facilities,stringency_index,cardiovasc_death_rate, diabetes_prevalence.

	Total_cases	new_casese_ per-million	Handwashi ng_facilities	Stringency _index	Cardiovasc_ death_rate	Diabetes_ prevalance
99102	908349	74.575	0.000	64.81	419.146	7.14
16646	773	96.631	0.000	50.93	139.547	13.00
74485	1371426	193.660	0.000	52.31	79.370	5.72
135681	5339992	1065.393	0.000	43.98	99.403	7.17
30258	80625	0.055	0.000	81.02	261.899	9.74
...	...	...	...	...	...	...
157557	2102	0.033	49.542	27.78	459.003	5.35
20176	59480	0.000	0.000	62.04	237.372	4.81
136653	13470	0.000	23.437	68.52	431.388	15.67
21551	248	0.000	0.000	0.00	0.000	13.67
84226	6824	2823.234	0.000	0.00	0.000	7.77

Figure 1. Selected attribute's values

	total_c ases	new_c ases	new_c ases_s mooth ed	total_ deaths	new_d eaths	new_ death s_smo othed	total_c ases_p er_milli on	new_c ases_p er_mil lion	new_c asess mooth ed_per _millio n	total_d eath_p er_milli on	...	female _smoke rs
Count	1.593250e+05	1.593250e+05	1.593250e+05	1.593250e+05	159325.000000	159325.000000	159325.000000	159325.000000	159325.000000	159325.000000	...	159325.000000
Mean	2.261768e+06	1.028383e+04	1.003228e+04	4.802570e+04	148.801054	147.917984	25249.195284	140.158673	135.376373	417.688235	...	6.784617
Std	1.363875e+07	7.666639e+04	7.269132e+04	2.705283e+05	777.902805	757.703207	42760.127992	589.596308	432.656949	718.268772	...	9.862066
Min	0.000000e+00	-7.434700e+04	-6.223000e+03	0.000000e+00	-1918.000000	-232.143000	0.000000	-13876.282000	-1936.106000	0.000000	...	0.000000
25%	1.395000e+03	0.000000e+00	4.857000e+00	2.000000e+01	0.000000	0.000000	450.489000	0.000000	1.177000	5.447000	...	0.000000
50%	2.080700e+04	6.800000e+01	8.871400e+01	3.370000e+02	1.000000	1.143000	4015.258000	9.558000	15.164000	64.722000	...	1.700000
75%	2.647240e+05	9.550000e+02	9.932860e+02	4.868000e+03	13.000000	14.143000	32644.103000	90.369000	103.777000	525.631000	...	9.700000
max	3.880400e+08	4.218944e+06	3.432553e+06	5712849e+06	18057.000000	14705.714000	471468.832000	51427.491000	15886.607000	6187.339000	...	44.000000

Figure 2. Data Description

We have selected these 7 features because if the person has some medical histories there are more chances that they will not be able to recover from the disease. If the person doesn't follow hygienic habits, then there are more chances that he will fall ill. The previous trends of the rise of the total case will also serve the purpose of the prediction.

To predict the number of cases we used supervised models that are linear regression (LR), Decision tree, and Random Forest. The learning models were trained using the patient's covid dataset from the Kaggle dataset. The Covid-19 dataset was pre-processed and divided into two subsets: the training set (70% of the records) and the testing set (30% of the records). To forecast future, the majority of ML algorithms need a large amount of data, and model performance becomes better as the size of the dataset grows. Forecasting using ML models can help decision-makers keep pandemics like COVID-19 under control. When given labelled data, a supervised learning model is used to create a prediction model. As a result, in this technique, the ML algorithm uses a dataset to train. The trained model then predicts for the given test

datasets. The models we have used are:
1. Linear Regression: Linear regression, in which one output variable is predicted using one or more input variables. A linear equation that combines the projected output (y) for a set of input values (x) and a set of input values (x) is how linear regression.
2. Random Forest: The ensemble learning technique called Random Forest uses many different decision trees. Each decision tree in a random forest makes a prediction, and the prediction that receives the most votes is taken as the result.
3. Decision Tree: A decision tree uses a tree-like structure to classify decisions and the potential outcomes and implications of those actions. Each internal node in this tree represents a test on an attribute, and each new branch is the result of the test. A decision tree's outcome will be more accurate the more nodes it contains.

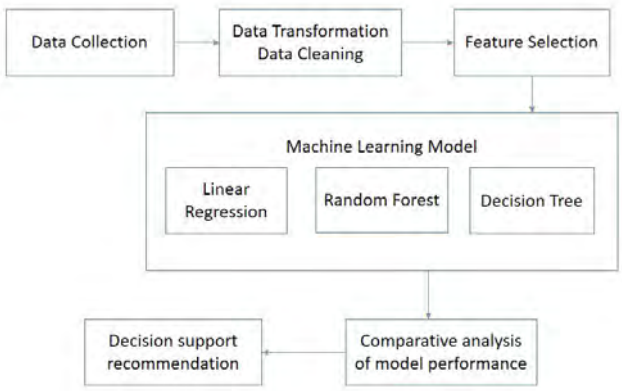


Figure 3 Methodology

A training dataset is a set of data that is used for training an ML algorithm. The dataset includes the sample output data and sets of input data that have an influence on the output. We train the model to run the input data through the algorithm and relate the processed output against the sample output. We take historical data to train a model. After training the model, we can then use it to predict the future.
Model scoring is the process that uses various scoring metrics for understanding the performance of a model and its strengths and weaknesses. Model evaluation is necessary for assessing the efficiency of a model during research phases, and for model monitoring. In model evaluation, we take a new prediction model on the new data and use it to predict the outcome. We then examine how well the model performs.
Technologies used:
1. Data science language (Python)
2. ML Techniques (Linear Regression, Random Forest Decision Tree)
3. Libraries (Python)
• pandas-data manipulation
• matplotlib - library for visualization
• NumPy - numerical python
• scikit: used for preprocessing, dimensionality reduction regression, and model selection.

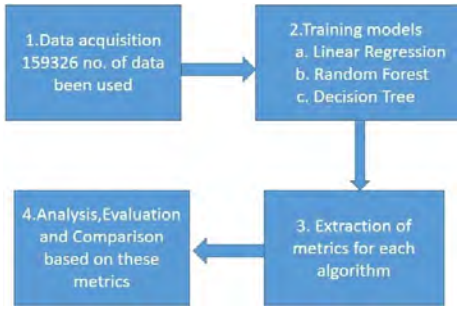


Figure 4. Flow of Work

Figure 4 shows the flow of operation first we have done data acquisition of 159326 no. of data. Then identifying dependent and independent variables is feature selection. Then divided data into training and testing. Then training model using algorithms like Linear regression, and Decision tree and calculated accuracy based on that.

Performance Analysis: We have measured the performance of random forest, linear regression, and decision tree on the basis of accuracy. Accuracy is a measure of how well a prediction system performs on a test dataset. It is easy to calculate how well a prediction model is performing. It is the ratio between predicted and true values.

4. RESULTS

The accuracy of decision tree, random forest and linear regression is calculated. The Accuracy of the Decision Tree is 97.85%, Random Forest is 95.01% and Linear Regression is 94.2%. Simulation results shows that decision tree outperformed as compared to other Models.

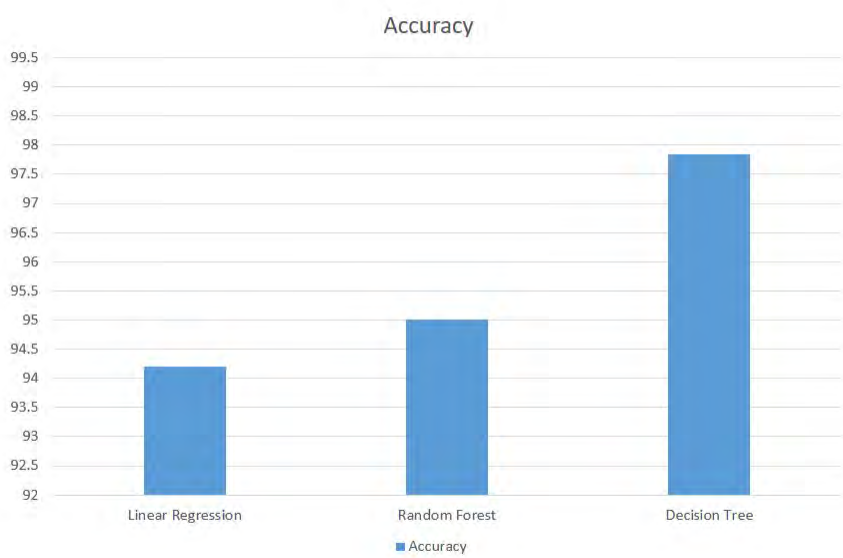


Figure 5. Accuracy Comparison

5. CONCLUSION

The COVID-19 epidemic has created a havoc on the entire planet and caused a global health disaster. The pandemic has been addressed in a number of ways. We have used supervised learning algorithms to investigate the influence of certain parameter demographic factors to estimate the death rates of the Corona patients. We have compared linear regression, random forest and decision tree. Decision trees fared better than the other models, according to the results. Thus, we conclude that decision tree has outperformed the other models

References

Aljameel, S. S., Khan, I. U., Aslam, N., Aljabri, M., and Alsulmi, E. S. 2021. Machine learning-based model to predict the disease severity and outcome in covid-19 patients. *Scientific programming 2021*.

Ardabili, S. F., Mosavi, A., Ghamisi, P., Ferdinand, F., Varkonyi-Koczy, A. R., Reuter, U., Rabczuk, T., and Atkinson, P. M. 2020. Covid-19 outbreak prediction with machine learning. *Algorithms 13,* 10, 249.

Ebrahim Abbasi-Oshaghi, Fatemeh Mirzaei, F. F. I. K. and Tayebiniaf, H. 2020. Diagnosis and treatment of coronavirus disease 2019 (covid-19): Laboratory, pcr, and chest ct imaging findings. international journal of surgery (london, england).

Kwekha-Rashid, A. S., Abduljabbar, H. N., and Alhayani, B. 2021. Coronavirus disease (covid-19) cases analysis using machine-learning applications. *Applied Nanoscience*, 1–13.

Prakash, K. B., Imambi, S. S., Ismail, M., Kumar, T. P., and Pawan, Y. 2020. Analysis, prediction and evaluation of covid-19 datasets using machine learning algorithms. *International Journal 8,* 5, 2199–2204.

Rustam, F., Reshi, A. A., Mehmood, A., Ullah, S., On, B.-W., Aslam, W., and Choi, G. S. 2020a. Covid-19 future forecasting using supervised machine learning models. *IEEE access 8*, 101489–101499.

Rustam, F., Reshi, A. A., Mehmood, A., Ullah, S., On, B.-W., Aslam, W., and Choi, G. S. 2020b. Covid-19 future forecasting using supervised machine learning models. *IEEE access 8*, 101489–101499.

Tuli, S., Tuli, S., Tuli, R., and Gill, S. S. 2020. Predicting the growth and trend of covid-19 pandemic using machine learning and cloud computing. *Internet of Things 11*, 100222.

Wang, P., Zheng, X., Li, J., and Zhu, B. 2020. Prediction of epidemic trends in covid-19 with logistic model and machine learning technics. *Chaos, Solitons & Fractals 139*, 110058.

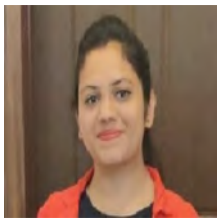
Zoabi, Y., Deri-Rozov, S., and Shomron, N. 2021. Machine learning-based prediction of covid-19 diagnosis based on symptoms. *npj digital medicine 4,* 1, 1–5.

Prof. Ashish Chandak has done her B.E from Amravati University and M.Tech (CSE) from NIT,Rourkela. He has more than 9 years of Teaching and 2.5 years of Industry experience. He is currently working as Assistant Professor in Department of Information Technology, Shri Ramdeobaba College of Engineering and Management, Nagpur. His area of Interest includes Distributed System, Web Technologies, Fog Computing and Grid Computing.
E-mail: chandakav@rknec.edu

Dr. Purshottam Assudani is working as an Assistant Professor in Department of Information Technology, Shri Ramdeobaba College of Engineering and Management, Nagpur, India. He has done Ph.D. in Computer Science and Engineering from Vellore Institute of Technology (VIT), Vellore, India. He has also completed his Bachelors and Masters in Computer Science and Engineering. He has published one Indian patent and published several papers in International Journals and conferences. He has a total teaching experience of more than 13 years and specializes in Cloud Computing, Distributed Systems and Operating Systems. He is a Certified Cloud Architect and Certified Trainer on Microsoft Azure and Amazon Web Services cloud platforms. He has delivered multiple corporate trainings on multi cloud platforms. He has also conducted online training sessions of Ms Azure at Caltech, USA. He has received a Best Paper Award in an International Conference. He has the membership of Indian Society for Technical Education (ISTE).
E-mail: assudanipj@rknec.edu

Sakshi Saklani is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.
E-mail: saklanisl@rknec.edu

Amrusha Rahangdale is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.
E-mail: rahangdaleap_1@rknec.edu



Achal Loya is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.
E-mail: loyaap@rknec.edu

Improved Salp Swarm Optimization-based Fuzzy Centroid Region Growing for Liver Tumor Segmentation and Deep Learning Oriented Classification

Suraj Patil[1,2]
[1]Research Scholar, Department of Computer Engineering SSBT's College of Engineering,KBC North Maharashtra University, Jalgaon,India
[2] Department of Computer Engineering MPSTME NMIMS University Shurpur, India
Dnyaneshwar Kirange
Department of Computer Engineering SSBT's College of Engineering, KBC North Maharashtra University, Jalgaon,India
and
Ramchand Hablani
Department of Computer Engineering, Ramdeobaba College of Engineering,Nagpur,India

Due to heterogenous shape of liver, the segmentation and classification of liver is challenging task. Therefore, Computer-Aided Diagnosis (CAD) is employed for predictive decision making for liver diagnosis. The major intuition of this paper is to detect liver cancer in a precise manner by automatic approach. The developed model initially collects the standard benchmark LiTS dataset, and image preprocessing is done by three techniques like Histogram equalization for contrast enhancement, and median filtering and Anisotropic diffusion filtering for noise removal. Further, the Adaptive thresholding is adopted to perform the liver segmentation. As a novelty, optimized Fuzzy centroid-based region growing model is proposed for tumor segmentation in liver. The main objective of this tumor segmentation model is to maximize the entropy by optimizing the fuzzy centroid and threshold of region growing using Mean Fitness-based Salp Swarm Optimization Algorithm (MF-SSA). From segmented tumor, the features like Local Directional Pattern (LDP) and Gray Level Co-occurrence Matrix (GLCM) are extracted. The extracted features are given as input to NN, and segmented tumor is given to Convolutional Neural Network (CNN). The AND bit operation to both of the outputs obtained from NN and CNN confirms the healthy and unhealthy CT images. Since the number of hidden neurons makes an effect on final classification output, the optimization of neurons is done using MF-SSA. From the experimental analysis, it is confirmed that the proposed model is better as compared with state of art results of previous study can assist radiologists in tumor diagnosis from CT scan images.

Keywords: Computer Aided Diagnosis,CT,Improved Salp Swarm Optimization, Convolutional Neural Network.

1. INTRODUCTION

The liver is a key metabolic organ in the human body, performing activities such as detoxification and digesting(Tran and Liu, 2020).It is susceptible to some diseases like hepatitis and hepatic steatosis, which leads to liver tumor and hepatic sclerosis and it is the one of the major causes that leads to death. The tumor region must be targeted for eliminating the tumor tissues and preserving the healthy tissues. For assessing and treating liver tumor, CT is one of the significant techniques that employ imaging models (Li, 2015). By using manual delineation, the segmentations of liver tumor are acquired from the radiologist experts. Though, the volumetric CT images are traced manually using slice-by-slice procedure that leads to labour-intensive and poor reproduction(Hu, 2016). For liver and tumor segmentation, several sophisticated approaches are

introduced from CT images for overcoming the constraints(G. Chartrand and Guise, 2017). Automated, interactive, and semi-automatic approaches are the sophisticated algorithms(A. Jose, 2021). In general, both the semi-automatic and interactive models need many user directions, which leads to the inefficiency of treatment and an increase in computational cost. The finest liver segmentation algorithm is CNN as its architecture learns more information that incorporate the liver shapes. During hepatic tumor segmentation, CNNs doesn't acquire the best results because it is very complex for learning the unpredictable tumor texture and shape with less amount of training data. Thus, for attaining best results in tumor segmentation and classification using fully automated models, new deep learning algorithms need to be used.

The significant contributions are

- To implement a novel liver tumor segmentation and classification using CT abdominal images by an improved MF-SSA algorithm.
- To segment liver tumor effectively using optimized fuzzy centroid-based region growing algorithm, in which the seed points of fuzzy centroid and threshold are optimized by the proposed MF-SSA for entropy maximization.
- To merge NN and CNN for providing the hybrid classifier called NN+CNN to maximize the accuracy by optimizing number of neurons in hidden layer by MF-SSA algorithm. In addition, the analysis has been performed by considering various performance measures.

Regarding paper organization, Section II provides a review of various liver tumor segmentation algorithms. Section III represents the architectural model for proposed liver tumor segmentation and classification. Section IV shows MF-SSA for improved segmentation and classification. Section V shows the experimental results. Section VI depicts the final conclusion

2. RELATED WORK

Recently discriminative approaches that include deployment of deep learning models for segmentation and classification of lesions for 2D and 3D volumetric data is introduced by (S. Almotairi, 2020; S. Piyush Kumar, 2021). (Umit Budak and Sengur, 2020), solved liver tumour classification in 2020 using cascaded CNN. Two deep EDCNN were trained to segment liver and lesion in CT images. The first CNN was used to segment the liver and second CNN segregated ROI tumor region to classify tumor has hepatic tumor. The resulting model was evaluated using 3DIRCADb dataset. The results show that the proposed approach segmented most accurately. (Maayan Frid-Adar, 218), built GANs for synthesising medical images in 2018. The presented model uses CT images of 182 liver lesions. GAN architectures generated better liver lesion ROIs and classification was done using custom CNN model. Generalizing the algorithm for medical classification helped radiologists improve detection performance. (Amita Das, 2019), proposed WGDL for delineating cancer lesions in CT liver imaging. The 225 images were used to introduce the method. The liver was divided via "marker-controlled watershed segmentation." GMM segmented the cancer-affected lesion. After tumor segmentation, texture features were extracted and sent to DNN for automatic classification.(Namatēvs, 2017; Tran and Liu, 2020), designed deep neural network that improves decision-making and clinical diagnosis by identifying early symptoms. It defines precise semantic segmentation of liver which is very challenging task due to overlapping of multiple organs in abdominal CT scan image. Each image shows different liver shapes. Which makes it hard to automate liver lesion and tumour diagnosis. Because of limited features, even typical machine learning classifiers can't solve this problem. Deep learning CNN-based architectures are developed to handle image data for feature extraction. These challenges are motivated to develop a novel method to segment and classify liver tumour using deep learning methods.

3. ARCHITECTURAL MODEL FOR PROPOSED LIVER TUMOR SEGMENTATION AND CLASSIFICATION

Liver cancer is one of the leading causes of death worldwide. Manually detecting cancer tissue is time-consuming. This work aims to automatically detect liver cancer. This paper solves the segmentation of liver tumours in CT abdominal images using a hybrid classifier framework based on Neural Network advancements (NN), as shown in Fig1. The model collects the standard benchmark LiTS dataset and pre-processes the image using Histogram equalisation for contrast enhancement, median filtering, and Anisotrophic diffusion filtering for noise removal (E. Yilmaz and Kayipmaz, 2017). Adaptive thresholding will segment the liver. As a new contribution, the optimised Fuzzy Entropy region growing model will segment the liver tumour. This tumour segmentation model optimises the region growing threshold using an improved Salp Swarm Algorithm (SSA)(Seyedali Mirjalili and MohammadMirjalili, 2016). From the tumour segmented image, LDP and GLCM will be extracted. Convolutional Neural Network will process the tumour-segmented binary image and the extracted features (CNN). The AND bit operation confirms healthy and unhealthy CT images. Enhanced SSA optimises the number of hidden neurons in NN and CNN since they affect final classification output. The proposed technology can help radiologists detect liver cancer using CT images, according to experiments.

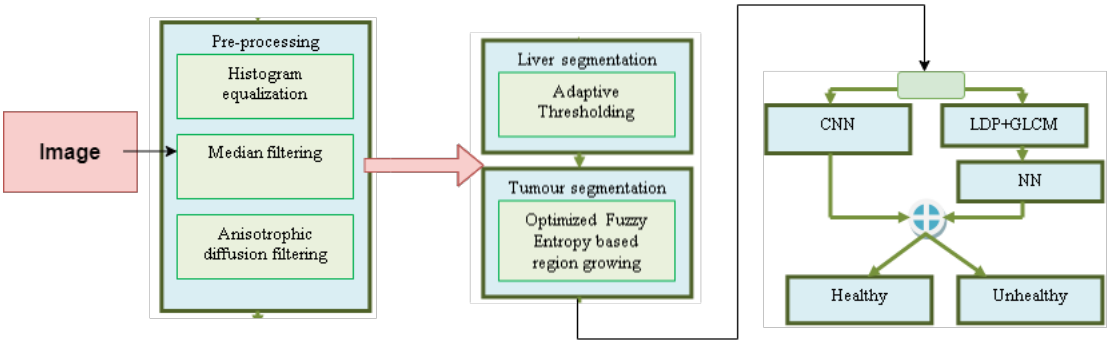


Fig.1. Proposed architecture framework for automatic liver tumor detection

3.1 SHALLOW CNN MODEL

To improve the performance of tumor classification in liver, we have designed shallow CNN model with minimum number of hidden layers to optimize classification performance.The objective of designing shallow CNN model is to minimize the information loss during training.In first convolution, input image of 224×224 with filter of size 5×5 with stride=2 is used to generate 32 feature map of size $112 \times 112 \times 32 = 401,408$ neurons. Then max polling with stride=2 is applied that reduces the feature map size to $56 \times 56 \times 32 = 100,352$ neurons. In second convolution, we used filter of size 3 and in third convolution we have used filter of size 5 with same stride=2. The main benefit of shallow model is that it captures high level and low-level features of tumor with the optimized neurons in hidden layer with help of salps swarm optimization algorithm.Finally fully connected layer feature vector is given to sigmoid function in output layer for classification.

3.2 NEURAL NETWORK MODEL

The neural network architecture(NN) is dependent on neurons and it is an interconnected classifier, which consists of nodes and weights. The strength of the inter unit connection is acquired by the adaption technique and training pattern set and also the processing ability of the network is controlled. There are input, output, and hidden layers in NN. The neural network is trained with hybrid handcrafted features such as energy,contrast,homogeneity,entropy and gradient magnitude of neighbouring pixel extracted using GLCM and LDP.

4. MEAN FITNESS-BASED SALP SWARM OPTIMIZATION FOR IMPROVED SEGMENTATION AND CLASSIFICATION

The major intuition of SSA [8] is the swarming behaviour of salps while moving and searching in the oceans. SSA [8] is based on the swarming behaviour of salps in the waters. This algorithm depicts "leader guides swarm, followers follow each other." In dimensional search space, the salps position is determined by the problem's variable count. All salp locations are kept in a 2D matrix. Swarm's target is a space food source. The Eq.(1) updates the leader's position as shown below.

$$ps_y^1 = \begin{cases} Fs_y + b_1((Ub_y - Lb_y)b_2 + Lb_y) & b_3 \geq 0 \\ Fs_y - b_1((Ub_y - Lb_y)b_2 + Lb_y) & b_3 < 0 \end{cases} \tag{1}$$

In the above equation, the location of first salp in y dimension is given by ps_y^1 , the location of food source in y^{th} dimension is denoted as Fs_y , the upper and lower limits of yth dimension is indicated by Ub_y and Lb_y. The random numbers are represented as b_1, b_2 and b_3.The term b_1 is the significant parameter in SSA as it balances exploration and exploitation defined in equation (1). The detail algorithm of Proposed MF-SSA is given in Following are the two objective contribution of proposed MF-SSA algorithm.

- The first contribution is to implement the optimized fuzzy centroid-based region growing algorithm for liver tumor segmentation using equation (2).

$$Obj_1 = \text{argmax}(\text{entropy}(ent)) \tag{2}$$

The formula for entropy is denoted in Eq. (3). Here, the number of gray levels is given by gl and the probability associated with gray level gl is denoted as pb_{gl}.

$$ent = -\sum_{gl} pb_{gl} \log(pb_{gl}) \tag{3}$$

- The other objective is to maximize the classification accuracy by performing the hidden neuron optimization in both NN and CNN .

This optimization is performed by the heuristic MF-SSA algorithm. The mathematical formulation for computing accuracy is denoted in Eq. (4). The count of hidden neurons of NN and CNN are denoted as hd_{nn} and hd_{cnn}

$$Obj_2 = \arg\max_{\{hdn_{NN}, hdn_{CNN}\}}(A) \tag{4}$$

Where

$$A = \frac{tR_{Ps} + tR_{Ne}}{tR_{Ps} + tR_{Ne} + fA_{Ps} + fA_{Ne}}$$

In the above equation, as tR_{ps} is true positive and fA_{ps} is false positive, respectively. Moreover, the true negatives and false negatives are given by tR_{ne} and fA_{ne}, respectively.

5. RESULT AND DISCUSSION

The developed liver tumor segmentation model was designed using framework with python. In order to evaluate the performance of the proposed model, the dataset named LITS was used. For experiment, maximum count of iterations was considered as 25, and the population size was initialized as 10. The analysis of the developed MF-SSA-NN+CNN was compared over existing meta-heuristic algorithms and results were analysed and shown in Fig2. From experimental results it is seen that proposed meta heuristic technique MF-SSA-NN+CNN performs best as compared to existing metaheuristics algorithm such has PSO, GWO, WOA as shown in Fig2

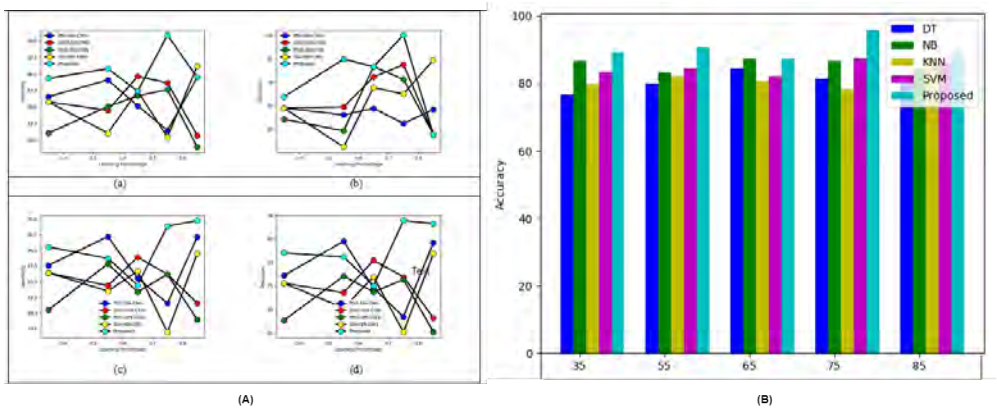


Fig.2.(A):Analysis on proposed and the meta-heuristic–based CNN for liver tumor classification concerning various performance metrics such as (a) accuracy, (b) sensitivity, (c) specificity, (d) precision
. (B) Performance of Different Classifier with Hybrid CNN model.

Fig.2.(A) shows the performance effect of the proposed meta heuristic technique MF-SSA for hyper parameter optimization of the CNN and NN models, respectively. It is seen that for different percentage learning rates, the proposed model MF-SSA-NN+CNN outperforms best in hyper parameter tuning as compared to the existing meta heuristic technique. It is seen that at learning percentage rate 35, the accuracy of implemented MF-SSA-NN+CNN is 2.8% advanced than PSO-NN+CNN,3.4% advanced than SSA-NN+CNN and 10.4% advanced than WOA-NN+CNN. Fig.2.(B) shows the accuracy of classification with an optimized MF-SSA-NN+CNN classifier with different machine learning classifiers. The output of segmented liver tumor with ground truth is shown in Fig.4. and performance parameter of proposed hybrid salp optimization algorithm is shown in Tabel1. The dice similarity score of liver segmentation for CT images A,B and C is .93, .94 and .94 respectively and for tumor it is 0.75, .86.and .88 respectively.

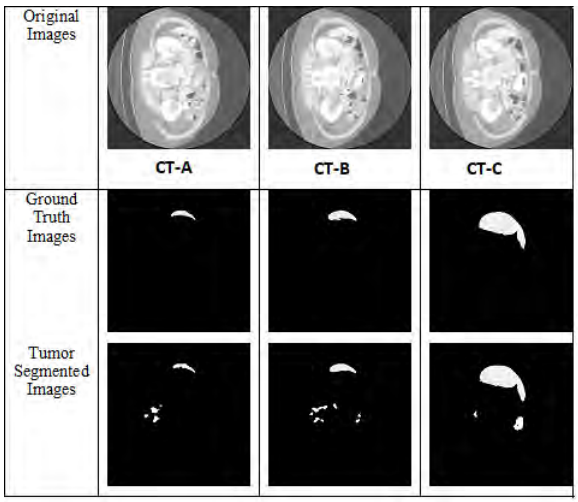


Fig.3.Liver-Tumor Segmented Image with Ground Truth Image

Performance Measures	Accuracy	Sensitivity	Specificity	Precision
PSO(M.E.H.Pedersen and A.J.Chipperfield, 2020)	0.814433	0.8125	0.815385	0.684211
GWO(Seyedali Mirjalili and MohammadMirjalili, 2014)	0.886598	0.9375	0.861538	0.769231
WOA(Seyedali Mirjalili and MohammadMirjalili, 2016)	0.876289	0.90625	0.861538	0.763158
SSA(M.E.H.Pedersen and A.J.Chipperfield, 2020)	0.804124	0.875	0.875	0.651163
Proposed -IM-SSA-NN+CNN	0.958763	1	0.938462	0.888889

Table I: Performance of Proposed method with other nature inspired algorithm

6. CONCLUSION

In this paper, a new approach for segmenting and classifying liver tumors is proposed. We used the LiTS benchmark dataset to develop the suggested model. The entropy of liver tumor segmentation was maximized by optimizing the fuzzy centroid and threshold of region growing using MF-SSA and an optimized fuzzy centroid-based region growing method. The LDP and GLCM characteristics were extracted next. The segmented tumor by proposed algorithm was given to CNN, handcrafted feature was given to NN. Here, optimization of hidden neurons was done using MF-SSA proposed algorithm. The suggested MF-SSA-NN+CNN was shown to be 12% improvement than NN, 32.8% improvement than CNN, and 2.1 percent better than NN+CNN based on the results of the trial. Hence, it is confirmed that the developed MF-SSA-NN+CNN achieved promising result in liver tumor segmentation and classification. In future attempt can be made to opimize number of hidden layers along with neurons in each layer in CNN architecture and designing of custom loss function for training deep learning models.

References

A. Jose, C. L. 2021. An automatic method for segmentation of liver lesions in computed tomography images using deep neural network. *Expert System with Application, Elsevier Vol.180.*

Amita Das, U. Rajendra Acharya, S. S. P. S. S. 2019. Deep learning based liver cancer detection using watershed transform and gaussian mixture model techniques. *Cognitive Systems Research Vol.54*, pp.165–175.

E. Yilmaz, T. K. and Kayipmaz, S. 2017. Noise removal of cbct images using an adaptive anisotropic diffusion filter. *International Conference on Telecommunications and Signal Processing (TSP), Barcelona Vol.57*, pp.650–653.

G. Chartrand, T. Cresson, R. C. A. G. A. T. and Guise, J. A. D. 2017. Liver segmentation on ct and mr using laplacian mesh optimization. *IEEE Transactions on Biomedical Engineering Vol.64,* 9.

Hu, P., W. F. P. J. L. P. . K. D. 2016. Automatic 3d liver segmentation based on deep learning and globally optimized surface evolution. *Physics in Medicine Biology Vol.61,* 24.

Li, W., J. F. . H. Q. 2015. Automatic segmentation of liver tumor in ct images with deep convolutional neural networks. *Journal of Computer and Communications Vol.3,* 11.

Maayan Frid-Adar, Idit Diamant, E. K. M. A. J. G. 218. Gan-based synthetic medical image augmentation for increased cnn performance in liver lesion classication. *Neurocomputing,.*

M.E.H.Pedersen and A.J.Chipperfield. 2020. Simplifying particle swarm optimization. *Applied Soft Computing, Vol.10,* 2, pp.618–628.

Namatēvs, I. 2017. Deep convolutional neural networks: Structure, feature extraction and training". *Information Technology and Management Science.*

S. Almotairi, G. Kareem, M. A. B. A. M. S. 2020. Liver tumor segmentation in ct scans using modified segnet. *Sensor Vol.2.0.*

S. Piyush Kumar, Z. Mohammed, H. W. T. T. T. B. 2021. Ai-driven novel approach for liver cancer screening and prediction using cascaded fully convolutional neural network. *Journal of Healthcare Engineering Vol.2022.*

Seyedali Mirjalili, Amir H.Gandomi, S. Z. S. H. and MohammadMirjalili, S. 2014. Grey wolf optimizer. *Advances in Engineering Software Vol.69*, pp.46–61.

Seyedali Mirjalili, Amir H.Gandomi, S. Z. S. H. and MohammadMirjalili, S. 2016. The whale optimization algorithm. *Advances in Engineering Software Vol.95*, pp.51–67.

Tran, S.T., C. C. N. T. L. M. and Liu. 2020. Tmd-unet: Triple-unet with multi-scale input features and dense skip connection for medical image segmentation. *Healthcare Vol.9.*

Umit Budak, Yanhui Guo, E. T. and Sengur, A. 2020. Cascaded deep convolutional encoder-decoder neural networks for efficient liver tumor segmentation. *Medical Hypotheses Vol.134.*

Suraj Patil is currently working as faculty in computer science department in MPSTME, NMIMS University, Shirpur, India. He is SAS Global certified in SAS data analytics solutions. He is pursuing Ph.D. degree from KBC, North Maharashtra University, Jalgaon, India. His research interest includes data mining, machine learning, deep learning,computer vision and advance web programming framework
E-mail: psuraj007@gmail.com

Dnyaneshwar Kirange is currently working as Associate Professor in Computer Engineering Department in SSBT's college of Engineering and Technology, Bambhori, Jalgaon, India. He is member of Board of Studies in KBC North Maharashtra University, Jalgaon, India He is executive member of IETE at Aurangabad, India. His research interest includes data mining, machine learning, deep learning, image processing and data analytics.
E-mail: dkirange@rediffmail.com

Ramchand Hablani is currently working as Associate Professor in Computer Science Engineering Department in Ramdeobaba College of Engineering and Management, Nagpur, India. He is having 27 years of teaching experience and published more 30 research articles. His research interest includes machine learning, deep learning and robotics.
E-mail: hablanir@rknec.edu

Novel approach to Create Human Faces with DCGAN for Face Recognition

Roshni Khedgaonkar, Kavita Singh and Sunny Mate
Yeshwantrao Chavan College of Engineering, Nagpur, India

Due to the remarkable data generation abilities of the generative models, many generative adversarial networks (GAN) models have been developed, and several real-world applications in computer vision and machine learning have emerged. The generative models have received significant attention in the field of unsupervised learning via this new and useful framework. In spite of GAN's outstanding performance, steady training remains a challenge. In this model, use of Deep Convolutional Generative Adversarial Networks is incorporated, Main aim is to produce human faces from unlabeled data. Face generation has a wide range of applications in image processing, entertainment, and other industries. Extensive simulation is performed on the Celera dataset. Key focus is to successfully construct human faces from the unlabeled data and random noise and achieved average loss of 1.115% and 0.5894% for generator and discriminator respectively.

Keywords: Human Faces Generation; generate man Faces using DCGAN; Generate Fake Images; Image Processing.

1. INTRODUCTION

GANs (Generative Adversarial Networks) are gaining popularity in the research community of deep learning. Computer vision, natural language processing, time series synthesis, semantic segmentation, and other disciplines have all used GANs. GANs are machine learning-based generative model compared to other models like variational autoencoders. GANs have a number of advantages in managing estimation functions, producing needed samples quickly, removing deterministic bias, and integrating data. GANs have found considerable success in computer vision domain, particularly in the field of image generation, image translation, and image completion. The two greatest ones are that they are difficult to train and difficult to analyze. Regarding being difficult to train, the generator frequently fails to learn the entire range of datasets, and attaining Nash equilibrium for the discriminator and generator during training is challenging. In terms of evaluation, the main concern is how to best assess the dissimilarity between the target pr real distribution and the generated distribution pg. Unfortunately, accurate pr estimate is impossible. As a result, obtaining accurate estimates of the relationship between pr and pg is difficult Wang et al. [2021].

Firstly, uses of a Deconvolutional Neural Networks architecture for G was DCGAN(Deep Convolutional Generative Advisory Network) Zeiler and Fergus [2014]. Deconvolution is a method for visualizing the characteristics of a CNN that has demonstrated to be effective in the visualization of Convolution Neural Networks (CNNs) Yu et al. [2015]. DCGAN makes use of the deconvolution operation for G spatial up-sampling capability, allowing for the producing of high resolution images with GANs. DCGAN's architecture differs significantly from that of the original Fully Conditional GAN (FCGAN), allowing for higher resolution modelling and more stable training. As shown in fig 1. At the beginning, DCGAN replaces any pooling layers with stride and fractional-stride convolutions for the discriminator and generator, respectively. Second, batch normalization is used by both the discriminator and the generator, which aids in the location of generated samples and real samples centering at zero, i.e., equivalent statistics for created samples and real samples. Finally, ReLU activation is applied in the generator for all layers except output, whereas LeakyReLU activation is used in the discriminator for all levels. As the generator gets gradients from the discriminator, Large-Scale Scene Understanding (LSUN) Deng

et al. [2009], ImageNets Creswell et al. [2018], has been assembled are used to train DCGANs. Generally, DCGAN is giving effective result on minimum resolution and less diversified images, because of the optimization and limit model capacity used in DCGAN. Key focus is to create faces using latent vectors or random noise. This paper is organized in the following way. Section 2 discusses the overview of GAN. Section 3 Provides a proposed methodology, a detailed description of the techniques and methods used followed by result and then discussion in section 4, and the conclusion is shown in section 5.

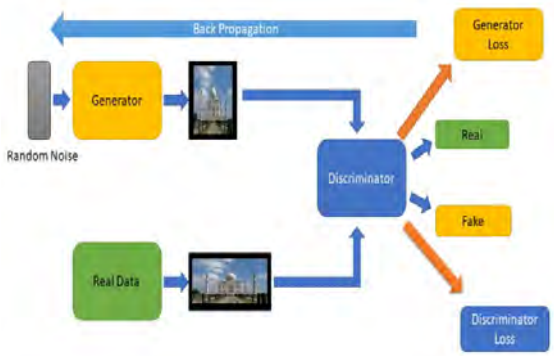


Figure 1. DCGAN working ProcessRadford et al. [2015]

2. OVERVIEW

Generative models are able to through instant action on region of image vision problems. Generative models are the traditional models where given preparing information p-data(x) from an unreadable information producing appropriation creates new examples information p-model(x) from a similar dissemination. The ultimate objective of any Generative Model is to draw comparable information tests (p-model(x) from the inclined genuine information conveyance p-data(x))Aslan et al. [2019]. GANs (Generative Adversarial Networks) are a resilient network used for unsupervised machine learning to establish a two ply min-max game, i.e., building up both players (networks) with their own goals. The generator network (G) is one participant, while the discriminator network (D) is the other (D). The first player (G) attempts to trick the second player (D) by creating exceptionally common-looking true pictures from arbitrary idle vector z, and the second player (D) improves in-recognizing genuine and produced information. Both organizations try to streamline themselves in the best possible way to achieve their individual goals because they both have goal capabilities, i.e., D needs to extend its cost worth, while G needs to limit its cost worthAslan et al. [2019].
Another category of convolutional neural organizations (CNN) called Deep Convolutional GAN (DCGAN). DCGAN was the main structure that practiced de-convolutional neural organizations (de-CNN) basic layout, which balances out GAN preparation. These systems are made up of two organizations: one acts as a CNN called the generator, while the other acts as a de-CNN called the discriminator Goodfellow et al. [2014]. A recently proposed category of design limitations remembered for CNN are:

—Remove all degrees of pooling layers with step convolutions.

—Both G and D should utilize Batch Normalization.

—Use ReLU and Leaky-ReLU in the generator and the discriminator organizations separately.

3. PROPOSED METHODOLOGY

Architecture

Deep learning(CNN) based DCGAN technique is being used in proposed approach. Because of its great accuracy, CNN are employed for picture categorization and recognition. A fully-connected layer, where all of the neurons are connected to one another and the output is processed, is produced by the CNN by using a hierarchical model. In the discriminator model, this paper defined our first convolution layer in which input to layer is an image of 3 channels (RGB channel). And after that 32 is the dimension of the convolution layer. In other words, applying 32 kernels to an input image or convolving to an input image. The filter size or convolution kernel size is 4*4. Then, used a stride of 2*2 which will move with 2 steps during the convolution process. Further, we applied batch normalization. A deep neural network is trained using the batch normalization approach, which standardizes the inputs to each layer for each mini-batch. The goal must be to keep the learning process stable and drastically cut down on the how many training iterations are needed to train deep networks. Scaling the layers output, precisely by standardizing the activations of every input variable per mini-batch, such as the activations of a previous layer's node. Then the use of 2*2 stride which will move with 2 steps during the convolution process same as before.

Further, the use of batch normalization layer, network training is fundamentally impacted by batch norm since, it renders the relevant optimization problems landscape suitably smooth. After that, defined a single completely linked layer that receives a 2048 input and gives outputs a single feature, then passed sigmoid function to output full connected layer because it has a range of values from 0 to 1. The optimal choice is sigmoid because anything only has a possibility of occurring between 0 and 1. The following stage is to distinguish between genuine misfortune and false misfortune. A Sigmoid layer and the Binary Cross Entropy (BCE) loss are combined. This adaption is more mathematically stable than using a simple Sigmoid followed by a BCE Loss. Since, the use of log-total trick for mathematical solidity by combining the activities into one layer. To distinguish the images during feedforward and backpropagation, assigned a zero to the counterfeit name and a one to the real brand. For smoothing the yield, 0.9 incentive Adam is being used for a sophisticated computation that may be used to refresh network loads iteratively based on preparation data instead of the usual stochastic angle plunge methodology. Kingma and Ba Kingma and Ba [2014] introduced Adam in the ICLR work "Adam: Adam combines the finest features of the AdaGrad and RMSProp improvement computations to create a calculation that can deal with insufficient slopes on noisy situations. Adam is a reasonably easy to construct character, and the default arrangement boundaries perform admirably in most situations. Alpha 0.0005 was utilized, which is also known as the learning rate or step size. For the first-moment estimates, we utilized beta1 is 0.1, the exponential decay rate, and beta2 is 0.99, the exponential decay rate for the second-moment estimations. The next stage is to train the whole Deep Convolution Neural Network. The training of both discriminator and generator is two-fold method. To begin, we use real photos to train our discriminator. The Celera dataset was used in this analysis. The images in this dataset span a wide range of postures and foundation issues. CelebA has a lot of variety, a lot of content, and a lot of feedback. The discriminator learns that this is how real images look by passing the real images through it. And generates a real loss for the said images Next during the first pass training random noise is passed through the generator where it generates fake images from it that are to be passed through the discriminator. The fact that these images are exactly the same size or dimensions as the discriminator input capacity is crucial. After that, the discriminator calculates the loss for these fake images, which is known as fake loss. Backpropagation is then performed by combining these real and artificial losses. It is a method for modifying the loads of a neural network based on the previous error rate. When backpropagate we update the filter and weights of the fully connected layers based on the calculated losses. It is trained by passing latent vectors or random noise through a generator from which it generates fake images which are then passed through the discriminator but

this time it generates a loss for fake images using flipped labels. The same back propagation process is then repeated to finish the training. All this training is done multiple times in the form of epochs. An epoch is essentially nothing but an iteration of the training cycle. Architecture structure of both generator and discriminator network is depicted fig 2 and fig 3 respectively.

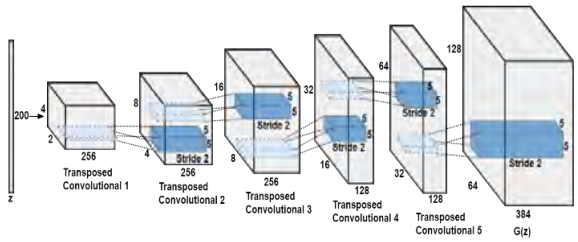


Figure 2. Architecture of Generator NetworkAslan et al. [2019]

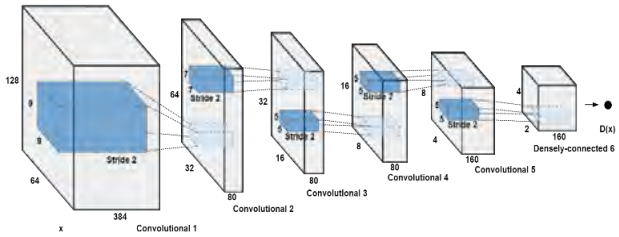


Figure 3. Architecture of Discriminator NetworkAslan et al. [2019]

4. RESULT AND DISCUSSION

For experimentation, celebA dataset is use, plotting of face landmarks for input data is shown in fig 4. Considered types of layers, output shape and their parameters of generator and discriminator which is used to generated the images using un-labelled data and discriminator compared data with original face images shown in fig 5 and fig 6. The ability to transform un-labelled data into meaningful data and their potential to generate large amounts of results is nothing but power of DCGAN. If size of dataset increases then achieves great accuracy. As approach from fig 5 and fig 6 as analyze there is increase in little accuracy when epoch reached from 30 to 80. After running 80 epochs of the network the results shown in table 1 have been gathered. Fig 7 shows the graphical representation of average loss of Generator and discriminator

The dense layer is the typical layer of a neural network with many connections. It is the most typical and often utilised layer. Based on the results of the convolutional layers, a dense layer is utilised to categorise the images. Hence, the single dot is 1 and parameters is 8193.the summary of discriminator is shown in Table2. After the discriminator works complete then alternate way generator work starts from dense layer to convolutional 2D. The output shape of Dense layer is 8192 and parameters is 827392. Then after it reshape by 8x8x128. Conv2DTranspose is a convolution operation whose kernel is learnt (just like normal conv2d operation) while training model. Hence, it given the output shape is 16x16x8. Again passed filter of 256, kernel size is 4 then generated output is 32x32x256. Same as next layer is having filter size is 512 and finally generated output size is 64x64x3."Table 3 tabulated the summary of generator.

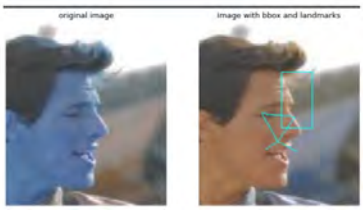


Figure 4. Image of plotting Lines on faces

Figure 5. Generated Images after 30 epoch

Figure 6. Generated Images after 40 epoch

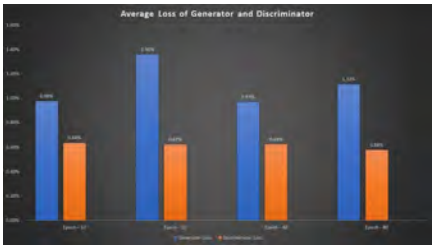


Figure 7. Graphical representation of average loss of Generator and discriminator

Epoch	Generator	Discriminator
Average Loss Epoch – 10	0.9761 %	0.6383 %
Average Loss Epoch – 20	1.3599 %	0.6244 %
Average Loss Epoch – 40	0.9685 %	0.6261 %
Average Loss Epoch – 80	1.1156 %	0.5894 %

Table I: Average and minimum Loss of Generator and Discriminator

Layer (type)	Output Shape	Param
conv2d_8 (Conv2D)	(32, 32, 64)	3136
lleaky_re_lu_12 (LeakyReLU)	(32, 32, 64)	0
conv2d_9 (Conv2D)	(16, 16, 128)	131200
leaky_re_lu_13 (LeakyReLU)	(16, 16, 128)	0
conv2d_10 (Conv2D)	(8, 8, 128)	262272
leaky_re_lu_14 (LeakyReLU)	(8, 8, 128)	0
flatten_2 (Flatten)	(8192)	0
dropout_2 (Dropout)	(8192)	0
dense_4 (Dense)	(1)	8193”

Table II: Summary of Discriminator

Layer (type)	Output Shape	Param
dense_5 (Dense)	(8192)	827392
reshape_2 (Reshape)	(8, 8, 128)	0
conv2d_transpose_6 (Conv2DTranspose)	(16, 16, 128)	262272
leaky_re_lu_15 (LeakyReLU)	(16, 16, 128)	0
conv2d_transpose_7 (Conv2DTranspose)	(32, 32, 256)	524544
leaky_re_lu_16 (LeakyReLU)	(32, 32, 256)	0
conv2d_transpose_8 (Conv2DTranspose)	(64, 64, 512)	2097664
leaky_re_lu_17 (LeakyReLU)	(64, 64, 512)	0
conv2d_11 (Conv2D)	(64, 64, 3)	38403

Table III: Summary of Generator

5. CONCLUSION AND FUTURE WORK

There are several networks present in machine learning but the use of DCGAN as a category of GAN is proposed for generation of face images. There is another category of GAN, Conditional GAN (cGAN) is to assists the discriminator in correctly classifying the input so that, it is difficult for the discriminator to complete. One of the most popular, effective, and successful types of GAN architecture is deep convolutional GAN. ConvNets (Convolutional Networks) are used to implement it rather than a multi-layered perceptron. The ConvNets use a convolutional stride and are built without max pooling which provides realistic possible images. Extensive simulation has been performed on CelebA face dataset using DCGAN, which achieved more accuracy as compared to cGAN is previous network model after that DCGAN launched. It is most useful for face generation and recognition for security purposes. Hence, the proposed approach found that DCGAN outperformed cGAN. There are many opportunities to expand the dataset using dataset as like we generated new faces by using dataset. Detect the number plate of bike so that we get the full information of that person when they do not follow the rules. If any criminal found on railway station camera can detect them as a criminal as like there are many applications used in this field.

References

Aslan, S., Güdükbay, U., Töreyin, B. U., and Cetin, A. E. 2019. Deep convolutional generative adversarial networks based flame detection in video. *arXiv preprint arXiv:1902.01824*.

Creswell, A., White, T., Dumoulin, V., Arulkumaran, K., Sengupta, B., and Bharath, A. A. 2018. Generative adversarial networks: An overview. *IEEE signal processing magazine 35,* 1, 53–65.

Deng, J., Dong, W., Socher, R., Li, L.-J., Li, K., and Fei-Fei, L. 2009. Imagenet: A large-scale hierarchical image database. In *2009 IEEE conference on computer vision and pattern recognition*. Ieee, 248–255.

Goodfellow, I. J., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., Courville, A., and Bengio, Y. 2014. Generative adversarial networks.

Kingma, D. P. and Ba, J. 2014. Adam: A method for stochastic optimization. *arXiv preprint arXiv:1412.6980*.

Radford, A., Metz, L., and Chintala, S. 2015. Unsupervised representation learning with deep convolutional generative adversarial networks. *arXiv preprint arXiv:1511.06434*.

Wang, Z., She, Q., and Ward, T. E. 2021. Generative adversarial networks in computer vision: A survey and taxonomy. *ACM Computing Surveys (CSUR) 54,* 2, 1–38.

Yu, F., Seff, A., Zhang, Y., Song, S., Funkhouser, T., and Xiao, J. 2015. Lsun: Construction of a large-scale image dataset using deep learning with humans in the loop. *arXiv preprint arXiv:1506.03365*.

Zeiler, M. D. and Fergus, R. 2014. Visualizing and understanding convolutional networks. In *European conference on computer vision*. Springer, 818–833.

Roshni Khedgaonkar received her B.E. degree in computer science & engineering from Anjuman College of Engineering and Technology, Nagpur in 2008. She is M.Tech. in Computer Science and Engineering from Yashvantrao Chavhan College of Engineering,Nagpur in 2012 and working as an Assistant professor in Yashvantrao Chavan College of Engineering, Nagpur. Her research interests are Image processing, Pattern recognition and Machine learning.
E-mail: rskhedgaonkar@ycce.edu

Dr. Kavita R Singh received the B.E degree in Computer Technology in 2000 from RGCERT, Nagpur University, Nagpur, India, and the Mtech. Degree in Computer Science and Engineering from Birla Institute of Technology, Ranchi, India, in 2007, and the Ph. D. degree in Computer Science from the Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, Gujarat, India. She is currently Associate Professor in Computer Technology Department, Yeshwantrao Chavan College of Engineering, Wanadongri, and Nagpur, India. Her current research interests include the area of Data structures, Database, Rough sets, Image Processing, Machine Learning, Pattern Recognition and Near Sets.
E-mail: singhkavita19@gmail.com

Mr. Sunny Mate received the B.E degree in Computer Science and Engineering, Nagpur University, Nagpur, India, and the Mtech. Degree in Computer Science and Engineering from Yashvantrao Chavhan College of Engineering, Nagpur
E-mail: sunnymate@gmail.com

Ensembled Approach to Heterogeneous Data Streams

Lalit Agrawal and Dattatraya Adane
Shri Ramdeobaba College of Engineering and Management, Nagpur, India

Principal component analysis-based decision tree forest (PDTF) can improve the variety in base classifiers while generating the forest of decision trees. All the trees in the forest have a very low correlation. In this research work, an algorithm is proposed to select the important features from the original data by applying them to the PDTF algorithm and then the selected features are used with long and short-term memory (LSTM) networks for improving the classification accuracy of heterogeneous data streams. This reduces the load on the active classification system and improves the per record classification time. In addition to thirty-five different datasets, Indian National stock exchange data feeds are used for experimentation. This real-time data feed is used as a base for calculating the values of twenty-five technical indicators. Technical indicators statistically forecast the market movement. Since the movement of stock is not only governed by its past values and it simply cannot be predicted with technical indicators alone. Therefore, heterogeneous data related to various domains that could probably impact the performance of the market is also considered. This approach is evaluated against the benchmark methods against a total of thirty-five datasets and livestock feeds and from the results, it is evident that this approach is better than previously used approaches.

Keywords: LSTM, Random forest, PDTF, Classification, Heterogeneous data streams, NIFTY prediction.

1. INTRODUCTION

A decision tree proposed by Charbuty and Abdulazeez [2021] is a data structure used to recursively divide the independent variables in the dataset into smaller functions. At each node of the tree, a selective function is applied to transfer appropriate data in the tree hierarchy. Each node of a tree provides a basis for a different forecasting function. The decision tree was developed using the statistical theory but it has now evolved as one of the most widely used data structures in the field of data science and artificial intelligence. It has various advantages like being simple to understand and easy to implement.

Another way to completely augment the power of decision trees is to create a forest of trees as mentioned by Rokach [2016]. As the name implies, the forest consists of many decision trees with different predictive functions and forecasting abilities. Outputs generated by all the individual trees are considered while providing the final prediction using the forest method. This neutralizes the errors made by individual trees during the decision-making and improves the accuracy of the final output. The advantages of the forest method are harnessed by various researchers in solving problems related to various domains.

Stock market prediction is a popular problem statement in the field of machine learning. This domain is particularly imperative since it is straight away related to the economic growth of the country. It is very difficult to predict the future trend of the market as it is highly volatile and depends on numerous factors. Two popular hypotheses related to this domain are it is not possible to predict the future prices of the sock as it not only depends upon the past prices and technical indicators. Another one is with proper use of historical data and an appropriate model it is possible to predict future stock prices with high precision. Researchers were trying to predict the market movement for the last few decades but with the innovations in powerful machine learning tools and algorithms, predictions are getting better. Dargan et al. [2020] presented a comprehensive work associated with deep learning methodologies and their applications in various domains. Various machine learning techniques for time-series data analysis of stock

price movement are mentioned by Parray et al. [2020]. Stock market prediction based upon the principal component analysis is mentioned by Waqar et al. [2017]. An innovative method for stock price estimation by the gradient boosting machine learning procedure is offered in Nabi et al. [2020]. A model based on a convolutional neural network (CNN) for predicting the future trend of the stock market with better accuracy is presented by Mehtab and Sen [2020]. Various machine learning and deep learning methods have been applied to the stock market domain for predicting the future value of the stock.

PDTF proposed by Agrawal and Adane [2021] improves the diversity in each decision tree while generating the forest. For improving diversity, principal component analysis (PCA) based transformation techniques are applied. Their experimentation shows that the PDTF model performs better than the normal random forest technique at the same time it lags in performance with the linear regression methods. To make this approach more suitable for improving the classification accuracy of heterogeneous data streams in real-time the two drawbacks of this approach need to be focused on. The first problem is that it takes more time in processing as the algorithm needs to make PCA-based transformations for improving the diversity measure in the base classifiers. The second problem is that the trees are not constructed using the original features. Instead, the transformed features are used in the construction of the forest. In this case, if a user wants to study the features of the trees then the linear correlation between the features must be identified and which makes it difficult to understand.

The rest of the paper is organized as follows: In section 2 proposed work is discussed. The research methodology is discussed in section 3. The next section 4 is dedicated to the results and discussion and the last section 5 presents the conclusion and future work.

2. PROPOSED WORK

In this manuscript, a new method is projected for improving classification accuracy by combining the PDTF and LSTM algorithms. The rotation decision tree forest constructs the tree with high accuracy and combination. This upsurges the variety and the subsequent trees in the forest will have very little correlation. The idea behind this approach is to create a passive structure by extracting the set of most important features from the PDTF algorithm that are contributing to the majority of the decision-making and providing this new and reduced information to the LSTM model as the new training data.

Experiments are carried out in this work to test the proposed algorithm against various benchmark datasets. We consider that it is possible for machine learning and deep learning models to learn from past instances and predict future instances with high accuracy. In our earlier work as mentioned in Agrawal and Adane [2021], a PDTF approach is presented for predicting the value of NIFTY. To validate our hypothesis, the PDTF approach is further modified and combined with LSTM to further improve the classification accuracy.

LSTM is a special type of Recurrent neural network specialized in the learning of long-term dependencies. It detects or mines the pattern from the infinite time series data that is getting generated and identifies the long-term dependencies and helps in identifying the correlation between the various entities. Due to large numbers of input factors affecting the decision-making trends, it becomes very important to identify the most important features leaving those who do not contribute significantly or even at times responsible for reducing the accuracy of the decision-making process.

The working of the improved PDTF algorithm is shown below:

Input:

'N' – Number of data streams

'F' – Size of the forest

'Ti' – Total available trees where i = 1. . . .F

'L' - List of features used for training

'A' – List of the accuracy of trees in F

Output: Concluding the Forecast
Step 1: For all N create a forest 'F' of decision trees as per the PDTF algorithm
F ← T1,T2,T3,. . . ,Tn
Step 2: For all Ti belongs to F, Compute feature importance score $\delta(Li)$
$\pi Li \leftarrow \delta(Li) > Threashold(k), k = 1, \ldots, Ln$
$Step3 : LSTM \leftarrow \{Li\}$
$Step4 : Output : Finalprediction$

The improved PDTF model works in two stages where the first part is dedicated to identifying the most important feature from the total available features and supplying those selected features to the next LSTM layer as input for getting the final trend of the stock market. During the tree generation phase, trees are generated with the help of the PDTF algorithm which internally uses PCA based transformations resulting in high diversified trees. For selecting the trees contributing more to the decision process, the feature importance score of all the input features is calculated and features above threshold (k) are provided to the next level for further processing.

The proposed framework is based on the concept mentioned by Charbuty and Abdulazeez [2021]. It alleviates the shortcomings mentioned above by ensuring that the application vendor can better track performance of the deployed application in the run-time environment for an individual customer (s) spanning over different time periods of software development and upgradation. Thus, the proposed invention ensures continuous and comprehensive performance monitoring for real-time regression analysis.

3. RESEARCH METHODOLOGY

This research work evaluates the performance of the proposed algorithm over thirty-five benchmark datasets by comparing it with various standard algorithms. Also, the NIFTY prediction accuracy is analyzed.

3.1 Data

For evaluating the proposed Improved PDTF algorithm, thirty-five datasets are downloaded from the UCI repository of machine learning databases. The details of these datasets are mentioned in Table 1.

4. PERFORMANCE

The foremost purpose of this experimentation is to compare the performance of the Improved PDTF algorithm with various algorithms over various benchmark datasets. Also, to appraise the performance of the Improved PDTF algorithm in the prediction of the NIFTY trend and compare it with other procedures. After examining the values from Table 2, it is that compares the performance of four algorithms namely LSTM, Random forest, PDTF and Improved PDTF methods it is observed that the improved PDTF method has provided better results for most of the datasets under consideration.

The accuracy of LSTM, Random forest, PDTF and Improved PDTF algorithms against various datasets are mentioned in Table.2. All the values mentioned are averaged over 10 executions. In Table 3, a comparative performance matrix is presented where each value is of the form Vij which represents the number of times the method in a row (i) has performed better than the method mentioned in column (j). For example, V32 represents that PDTF has given better accuracy than random forest in 30 datasets out of 36.

The first row represents how LSTM has performed over the other three algorithms on these 36 datasets. LSTM has given better values than Random forest, PDTF and I-PDTF in 31,15 and 17 of the datasets respectively. The second row represents how Random forest has performed better than LSTM, PDTF and I-PDTF 5, 6 and 4 times respectively. The third row shows that PDTF has performed better than LSTM, Random forest and I-PDTF in 20, 30 and 17 datasets

Datasets	Objects	Features	Class
Balance scale	625	4	3
QSAR Biodegradation	1055	41	2
Breast cancer Wisconsin (Diagnostic)	699	9	2
Breast Tissue	106	9	6
Car Evaluation	1728	6	4
Climate Model Simulation Crashes	540	18	2
Ecoli	336	7	8
Hepatitis	155	19	2
Hill Valley(with noise)	1212	100	2
Hill Valley(without noise)	1212	100	2
Iris	150	4	3
Letter Recognition	20000	16	26
Libras Movement	360	90	25
Lymphography	298	18	4
Musk (version1)	497	167	2
Nursery	12960	8	5
Ozone Level Detection	2536	72	2
Page blocks	5473	10	5
Parkinsons	195	22	2
Planning relax	182	12	2
Seeds	210	7	3
Soybean(large)	683	35	19
Spect-heart	267	22	2
Splice	3190	59	2
Steel plates Faults	1941	27	7
Statlog(heart)	270	13	2
Statlog(vehicle silhouettes)	846	18	4
Vertebral column (2C)	310	6	2
Vertebral column (3C)	310	6	3
Waveform(version1)	5000	21	3
Waveform(version2)	5000	40	3
Wine	178	13	3
Wine quality(red)	1599	11	6
Wine quality(white)	4898	11	7
Yeast	1484	8	10

Table I: Dataset Description

and the fourth row indicates that I-PDTF has performed better in 19, 32 and 19 datasets than LSTM, Random forest and PDTF respectively.

The accuracy of LSTM, Random forest, PDTF and Improved PDTF over the NIFTY is 85.67, 85.64, 89.56 and 90.23. Initially, the experimentation is started by applying the PDTF algorithm to various available datasets using a 10-fold cross-validation method. From the results, it is inferred that the values do not vary at large. This is a clear indication of the absence of issues like overfitting and underfitting.

The subsequent set of experimentations was supported using the Improved PDTF algorithm. It is a two-step process. In the first step, the forest is created with the PDTF algorithm. The feature importance of the input features is calculated and the best features are considered as input to the next LSTM layer.

Experimentations were conducted to predict the NIFTY using an LSTM algorithm. This procedure is very good at performance with time-series data like the stock market. NIFTY prediction is also done using a random forest algorithm. The same, 10-fold cross-validation method is applied. Experimentations were conducted for a varied number of trees to match the performance of PDTF.

The 10-fold cross-validation method is good in neutralizing inconsistencies and providing better accuracy. Various algorithms used in this research are evaluated by this method. Type-I and

Datasets	**LSTM**	**Random Forest**	**PDTF**	**I-PDTF**
Balance scale	87.13	84.27	88.70	88.34
QSAR Biodegradation	84.77	83.93	84.89	84.81
Breast cancer Wisconsin (Diagnostic)	95.09	94.57	94.83	95.26
Breast Tissue	75.10	71.19	74.36	74.00
Car Evaluation	95.13	94.08	95.37	95.41
Climate Model Simulation Crashes	90.15	91.26	91.18	96.05
Ecoli	86.39	85.24	86.83	85.42
Hepatitis	83.61	83.44	83.79	83.97
Hill Valley(with noise)	87.62	53.61	82.47	86.75
Hill Valley(without noise)	97.47	53.76	97.84	97.96
Iris	93.79	92.98	93.69	93.72
Letter Recognition	94.65	94.21	94.82	94.78
Libras Movement	85.11	79.75	82.01	83.48
Lymphography	97.13	96.37	96.53	97.00
Musk (version1)	98.59	98.76	97.27	97.80
Nifty Prediction	85.67	85.64	89.56	90.23
Nursery	98.64	98.54	98.76	98.72
Ozone Level Detection	96.21	95.97	96.21	96.15
Page blocks	96.90	96.82	96.95	96.92
Parkinsons	92.77	91.87	91.11	92.23
Planning relax	71.73	71.44	69.41	70.69
Seeds	91.87	91.21	91.94	91.92
Soybean(large)	94.22	93.36	94.97	94.92
Spect-heart	78.49	75.29	78.62	78.84
Splice	90.24	94.06	92.34	94.01
Steel plates Faults	75.62	76.11	75.19	76.09
Statlog(heart)	82.53	81.86	82.38	82.21
Statlog(vehicle silhouettes)	80.67	76.45	81.34	80.23
Vertebral column (2C)	86.39	85.09	86.09	86.04
Vertebral column (3C)	85.79	84.77	85.35	85.13
Waveform(version1)	85.20	83.91	84.90	85.30
Waveform(version2)	85.27	83.52	84.86	85.20
Wine	97.11	97.20	98.87	98.19
Wine quality(red)	70.80	70.48	71.08	71.28
Wine quality(white)	68.24	67.01	68.39	68.19
Yeast	64.38	63.08	64.47	64.19

Table II: Accuracies of LSTM, Random forest, PDTF and i-PDTF over various datasets

Method	**LSTM**	**Random Forest**	**PDTF**	**I-PDTF**
LSTM	0	31	15	17
Random Forest	5	0	6	4
PDTF	20	30	0	17
I-PDTF	19	32	19	0

Table III: Performance Matrix

Type-II errors are considered for all the algorithms implemented in this study as mentioned in Table 4. A type-I error signifies the false positive output and a type-II error signifies the false-negative output. The error percentage for the Improved PDTF algorithm is close to 10%, the lowest among the methods under consideration.

The Improved PDTF algorithm performs better mainly because of two reasons than the other algorithms mentioned in the above study. The first one is to select the improved behaviour of splitting non-leaf nodes while building the decision tree forest and the second is to select the most relevant features only for the decision-making LSTM layer. This increases the diversity and the

	PDTF	I-PDTF	LSTM	Random Forest
Type I Error (alpha)	10.38	9.82	15.77	16.48
Type II Error (beta)	10.8	10.26	16.08	16.89

Table IV: Error Percentage

resulting trees in the forest will have very little correlation.

5. CONCLUSION AND FUTURE WORK

A new "Improved PDTF" procedure is projected and tested on various datasets for classification accuracy mentioned in this paper. Also, a relative study is offered using diverse machine learning algorithms such as a decision tree based on principle components, LSTM and random forest for forecasting the movement of an index. The precision of the projected procedure is remarkably good. After examining the forecast results, it is found that the Improved PDTF algorithm has an average accuracy of 86.22%.

By observing the values mentioned in table 4, we can state that the I-PDTF has the lowest error rate as compared to other methods. The I-PDTF algorithm is robust and it can handle the non-linear data and dynamic price movement very effectively. The accuracy of the proposed algorithm is also evaluated on 35 heterogeneous data streams. This algorithm has outperformed the other methods as can be seen in the confusion matrix.

In the further development of the model, a few more data sources could be added like annual reports for evaluating the detailed performance of the company. News plays an important role in deriving user sentiment which greatly affects the performance of the market. Some news has a long time impact and some news has a very short impact. Identifying the type of news and appropriate weight assignment can further improve the accuracy. In line with this research work, the combination of deep learning methods with the finance domain can be explored.

References

Agrawal, L. and Adane, D. 2021. Improved decision tree model for prediction in equity market using heterogeneous data. *IETE Journal of Research*, 1–10.

Charbuty, B. and Abdulazeez, A. 2021. Classification based on decision tree algorithm for machine learning. *Journal of Applied Science and Technology Trends 2,* 01, 20–28.

Dargan, S., Kumar, M., Ayyagari, M. R., and Kumar, G. 2020. A survey of deep learning and its applications: a new paradigm to machine learning. *Archives of Computational Methods in Engineering 27,* 4, 1071–1092.

Mehtab, S. and Sen, J. 2020. Stock price prediction using convolutional neural networks on a multivariate timeseries. *arXiv preprint arXiv:2001.09769*.

Nabi, R. M., Soran Ab M, S., and Harron, H. 2020. A novel approach for stock price prediction using gradient boosting machine with feature engineering (gbm-wfe). *Kurdistan Journal of Applied Research 5,* 1, 28–48.

Parray, I. R., Khurana, S. S., Kumar, M., and Altalbe, A. A. 2020. Time series data analysis of stock price movement using machine learning techniques. *Soft Computing 24,* 21, 16509–16517.

Rokach, L. 2016. Decision forest: Twenty years of research. *Information Fusion 27*, 111–125.

Waqar, M., Dawood, H., Guo, P., Shahnawaz, M. B., and Ghazanfar, M. A. 2017. Prediction of stock market by principal component analysis. In *2017 13th International Conference on Computational Intelligence and Security (CIS)*. IEEE, 599–602.

Mr. Lalit S. Agrawal received his B. E. Degree in Information technology from Shri Ramdeobaba College of Engineering and Management, Nagpur, India in 2008 and Post-graduate degree from Birla Institute of Technology and Science in 2013. He is currently pursuing a Ph D degree in the Department of Computer Science and Engineering, Shri Ramdeobaba College of Engineering and Management, Nagpur. His areas of interest include the Internet of Things and data analytics. He has published various papers in reputed journals.
E-mail: agrawalls@rknec.edu

Dr. Dattatraya S. Adane is M.Tech in Computer Science and Engineering from IIT Guwahati and received his PhD in Computer Science and Engineering from VNIT, Nagpur. He is currently working as Professor in, Information Technology Department, Shri Ramdeobaba College of Engineering and Management, Nagpur (M.S.), India. He has over 28 years of experience in Teaching and Research with over 50 publications in reputed journals to his credit. His areas of interest are Information and Network Security, Internet of Things and Data Analytics. Adane is also a life member of ISTE and the Institution of Engineers, India.
E-mail: adaneds@rknec.edu

Design and Development of a system for corrosion detection using Image Segmentation algorithms

Praful Sonarkar, Gaurav Patil and Pranav Chalasani
Shri Ramdeobaba College Of Engineering and Management

Corrosion, the natural and irreversible process that converts refined metal into a more chemically stable form such as oxide, hydroxide, carbonate. Ultimately the purity of metal goes down and it will cause failure in Welding, bindings in an industry. Accidents due to mechanical loss of metallic bridges, cars, aircraft, etc may cause damage to not only metal but the human digestive tract, eyes, skin, respiratory tract. The manual checking on these metals for corrosion detection is time-consuming. Hence this study builds the Design and Development of a system for Corrosion detection using the image segmentation algorithm U-Net. Dataset creation is first and foremost, a crucial step whenever we go for applying machine learning for any new task. During this experiment, the dataset was generated by capturing images from surrounding various devices and combining datasets from various online sources consisting of rusted metal. This approach obtains a good predictive result with an intersection over union score of 0.6160, and a Jaccard loss of 1.1356 for rust detection. In this paper, we proposed the automated technique by which we can be able to detect rust on metal.

Keywords: Deep Learning, Image Segmentation, Corrosion Detection, U-Net

1. INTRODUCTION

Corrosion is a circumstance having a process of chemical and electrochemical reaction (Czichos, Saito, and Smith, 2011). One of the reasons for reducing durability is because of the corrosion only and atmospheric corrosion may impact transportation, energy, and other domains and for the same, the maintenance costs are too high for manual checking (Veleva, Mexico, and Kane, 2003). There are various types of corrosion such as Uniform, Galvanic, Crevice, Pitting, Fill form, Pack Rust. The uniform corrosion observes when the continuous shifting of anodes and cathodes region on the metal surface is in contact with electrolyte. The Galvanic mostly occurs when the two metals are connected electrically where active metals will become anode in a galvanic cell and its corrosion will be increased. The Crevice occurs in microenvironments such as under washers, insulation material, gaskets, clamps, etc. Pitting is an extremely local attack after a certain duration it directly holes the metal. The Fill form observes microscopic, defects in the coating. Pack Rust occurs in an open environment of the atmosphere such as in place of bridges (Lesto, Kusumo, Kristanto, and Prasetia, 2022). Rusting is an electrochemical process by which the exchange of electrons takes place. In simple words the slow process of deterioration of materials due to the reaction with our surrounding environment (B, Pranav, Raj, and C V, 2014). Deep Learning has become the most widely used computational approach in the Machine Learning field. Deep Learning has grown fast in the past few years and its application can be found in various domains. It has shown outstanding results as has even beaten the human performance (Alzubaidi, Zhang, Humaidi, Al-Dujaili, Duan, Al-Shamma, Santamaría, Fadhel, Al-Amidie, and Farhan, 2021). Various Computer Vision applications in the industry have automated the human process. Reducing the workload, time, and cost of application (Li and Zhang, 2020). Object Detection, Object Segmentation, Object tracking, etc. are used in industry to perform the task more efficiently (Deng, Xuan, Wang, Li, Yao, and Wang, 2020) (Kumar, Zhang, and Lyu, 2020) (Liu, Ouyang, Wang, Fieguth, Chen, Liu, and Pietikäinen, 2020) (Sharma, Singh, and Khurana, 2016). In Image Segmentation, the object in the image is separate from the rest

of the image. Various image Segmentation techniques are available to efficiently segment objects for the rest of the image (Bhanu and Lee, 1994).

It is evident that the frequency of failure mechanisms of corrosion in all the forms such as general, pitting, etc. in gaps, stress corrosion cracking, corrosion fatigue dominates over 42%. This process is time-dependent so, all metals deteriorate with an age, such as weapon systems, aircraft, storage tanks, machinery, bridges, ships, storage tanks, etc. are all concerned not only with ownership costs but also with safety, reliability, and operability perspective (Petrovic, 2016). It is estimated that the annual cost, of $300 billion for the United States of America, of which $13 billion is for aircraft systems alone and $3billion is for military aircraft systems (Agarwala, Reed, and Ahmad, 2000). Thus, there is a need to automate the task of corrosion detection.

2. LITERATURE SURVEY

In this work (Srivastava, Ji, and Singh, 2021), Deep learning UNet-8layers architecture was used for image-based corrosion detection. 400 images were trained to analyse and classify the corroded region in the images. In the research (Wang, MA, and Ye, 2020), the author proposed a crack detection method using I-UNet over the time consuming and labours method. To extract different scales of image features and conduct multi scale feature fusion, a method like "inception" is used. Authors in the paper (Le Dinh, Son, and Hassan, 2020), presented a comparative study of E-Net, U-Net, FCN for rust detection in images.

3. PROPOSED APPROACH

Corrosion Detection from an image is an image segmentation task. Among the various corrosion detection technique in this paper, the author has proposed the design and development of desktop software for Corrosion segmentation using the U-Net algorithm. The U-Net algorithm is efficient and requires very few labelled images to learn to compare to other algorithms. The algorithm takes an image as an input and predicts the segmentation of rust in this experiment.

4. DATASET

The dataset consists of 253 RGB images from the heterogeneous source like various types of cell phone cameras, DSLR, online resources, etc., which consist of an image of corrosion on metal surf/ace as shown in Fig. 1

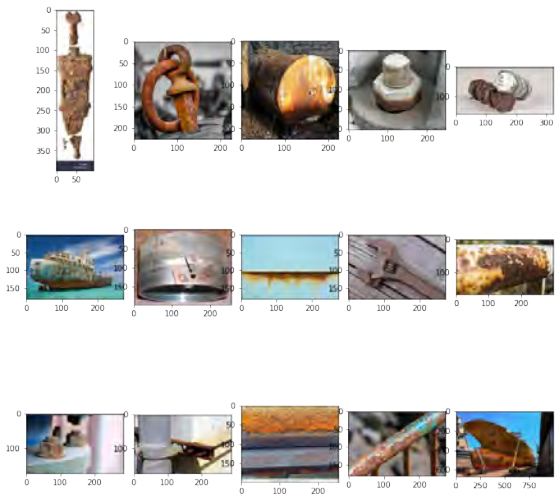


fig.1 Sample Images from Dataset

This image varies in terms of dimension, corrosion type, the landscape of environment such as river, land, etc, illumination, etc. The dataset consists of an image with various resolutions, therefore, all the images in the dataset were converted into a unified dimension of 512x512. For Image Segmentation, the input consists of the original image and a mask of it which represent the corrosion area. All the images were annotated to create a mask consisting of corrosion location as shown in Fig. 2

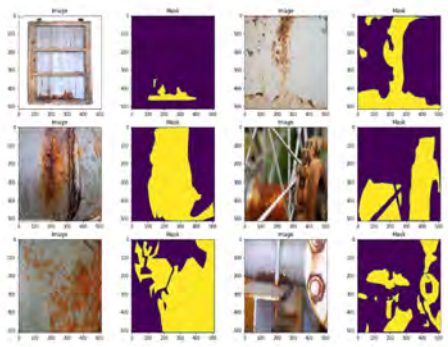


fig.2 Resized Images and Their Respective Labels

The dataset was then separated into training and validation with a ratio of 80:20. The training dataset consists of 203 image and their masks. and validation dataset consists of 51 image and their masks.

5. PROPOSED SYSTEM

In Fig 3. depict the steps involve for the system building. Preprocessing step involves the conversion of dataset of various dimension to fix dimension of 512x512. Under the model build, the dataset is split into train and validation set. The train model makes use of training set to learn the weights and validation set for checking the prediction and evaluation. The weights of trained model are saved. In the system, the user input the image and it get resize to 512x512 image. The saved weights are used to predict the rust in the image. The algorithm detects the corrosion in the image and displays the segmented image containing corrosion.

6. MODEL TRAINING

The U-Net algorithm is trained over the dataset to detect the rust. Python language and Tkinter library was used for the design and development of software application. TensorFlow deep learning framework for building U-Net algorithm.

6.1 Training

The corrosion detection was done using the U-Net image segmentation algorithm. The image segmentation model was trained with 204 images with a shape of (512x512x3) each and masked of shape (512x512x1) each. The model makes use of ResNet34 as a backbone. The 512x512x3 was the input shape of the model with 1 class to predict and sigmoid activation function at the last layer. The architecture diagram of the image segmentation model is shown in Fig 4.

6.2 Evaluation

At the 100th epoch, the training Jaccard loss and validation Jaccard loss obtain was 0.1409 and 1.1356 respectively, training iou score and validation iou score obtained was 0.9136 and 0.6160

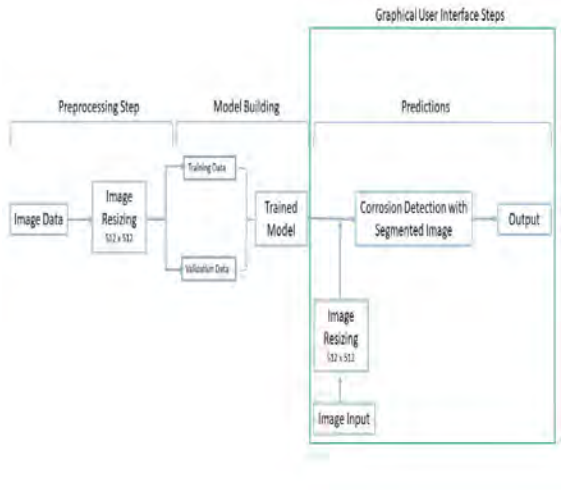


fig.3 Model Architecture

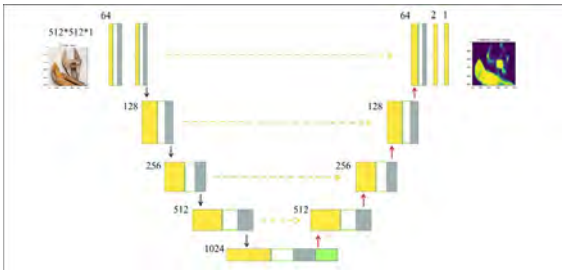


fig.4 U-Net Architecture

respectively. The history of training and validation loss per epoch is represented in graphical format as shown in Fig 5. The history of training and validation iou score per epoch is represented in graphical format as shown in Fig 6.

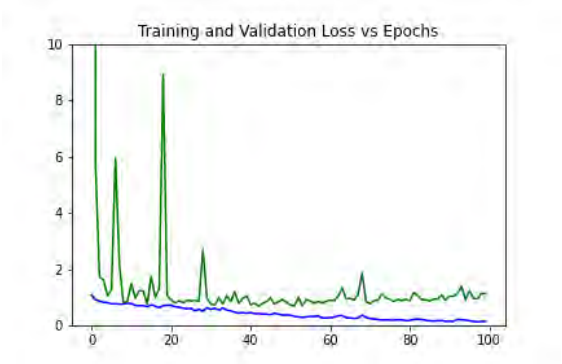


fig.5 Loss History

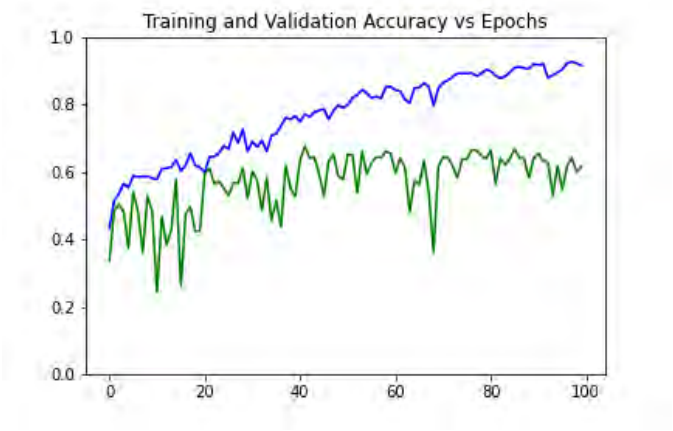


fig.6 Accuracy History

6.3 Prediction

Fig 7. Represents the image, their ground truth i.e., the location where corrosion exists and predicted mask i.e., the location where corrosion is predicted using this approach.

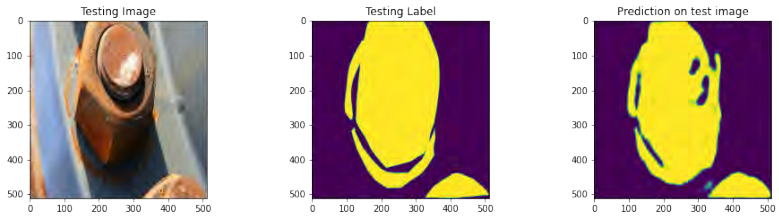


fig.7 Comparison of Original Image Ground Truth and its Predicted Label

7. DEPLOYMENT AND RESULTS

The model build can be deployed in desktop software, websites, and can be embedded in hardware like CCTV cameras to give real-time solution for rust detection in various workplaces. The desktop software deployment of this algorithm is shown in Fig 8 and Fig 9.

fig.8 GUI

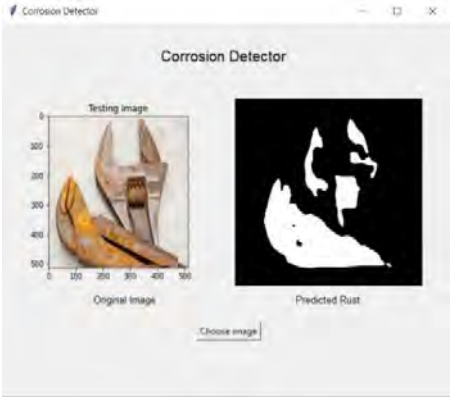


fig.9 GUI Depicting Original Image and Predicted Label

8. CONCLUSION

In this paper, we build a desktop software application for rust detection based on deep learning U-Net algorithm. We train the model on 203 images and 51 images were used for validation. The model was able to detect the rust in the image. The algorithm classifies the corrosion in the image at the pixel level. In future work, different algorithms like Mask-RCNN, etc. and large datasets would be used to experiment which we believe will increase the accuracy of the model

References

Agarwala, V., Reed, P., and Ahmad, S. 2000. Corrosion detection and monitoring - a review.

Alzubaidi, L., Zhang, J., Humaidi, A., Al-Dujaili, A., Duan, Y., Al-Shamma, O., Santamaría, J., Fadhel, M., Al-Amidie, M., and Farhan, L. 2021. Review of deep learning: concepts, cnn architectures, challenges, applications, future directions. *Journal of Big Data 8*.

B, S., Pranav, K., Raj, K., and C V, J. 2014. Rust prevention in structural establishments using cathodic protection technique driven by an mppt based solar charge controller.

Bhanu, B. and Lee, S. 1994. *Image segmentation Techniques*. 15–24.

Czichos, H., Saito, T., and Smith, L. 2011. *Springer Handbook of Metrology and Testing*. Vol. 2.

Deng, J., Xuan, X., Wang, W., Li, Z., Yao, H., and Wang, Z. 2020. A review of research on object detection based on deep learning. *Journal of Physics: Conference Series 1684*, 012028.

Kumar, A., Zhang, J., and Lyu, H. 2020. Object detection in real time based on improved single shot multi-box detector algorithm. *EURASIP Journal on Wireless Communications and Networking 2020*.

Le Dinh, D., Son, N., and Hassan, M. 2020. Deep learning in semantic segmentation of rust in images.

Lesto, A., Kusumo, P., Kristanto, D., and Prasetia, A. 2022. Corrosion management technology for analyzing and solving of corrosion problems in geothermal field.

Li, Y. and Zhang, Y. 2020. Application research of computer vision technology in automation. 374–377.

Liu, L., Ouyang, W., Wang, X., Fieguth, P., Chen, J., Liu, X., and Pietikäinen, M. 2020. Deep learning for generic object detection: A survey. *International Journal of Computer Vision 128*.

Petrovic, Z. 2016. Catastrophes caused by corrosion. *Vojnotehnicki glasnik 64*, 1048–1064.

Sharma, A., Singh, P., and Khurana, P. 2016. Analytical review on object segmentation and recognition. 524–530.

Srivastava, A., Ji, G., and Singh, R. 2021. Application of deep-learning architecture for image analysis based corrosion detection. 1–5.

Veleva, L., Mexico, Y., and Kane, R. 2003. *Atmospheric Corrosion*.

Wang, L., MA, X.-h., and Ye, Y. 2020. Computer vision-based road crack detection using an improved i-unet convolutional networks. 539–543.

Praful Sonarkar has been working as Assistant Professor in Computer Science and Engineering/AI/IT since last 5 years. his research interst includes machine learning and computer vision. currently author is carrying out research work in area of developing models and methods for effciently detection and segmentation of corrosion.
E-mail: sonarkarpb@rknec.edu

Gaurav Patil is a student perceiving BTech in Artificial Intelligence from GH Raisoni college of Engineering, Nagpur. He has previously experience on working in various industries and research internship and wrote 5+ research paper and 2 filed patents. His area of research are applied Machine learning,computer vision and Natural language processing,etc.
E-mail: gauravpatil22301@gmail.com

Pranav Chalasani is a student perceiving BTech in Artificial Intelligence from GH Raisoni college of Engineering, Nagpur. He has good leadership skill and technical knowledge. His area of research are applied Machine learning and computer vision.
E-mail: pranavchalasani612@gmail.com

Robust Image Encryption Scheme for Biometric Finger Print Images using Bit Planes, DWT and Cubic Map

Gouri Morankar
Department of Electronics Engineering, Shri Ramdeobaba College of Engineering and Management, Nagpur, India.

UIDAI employs biometric finger print system to generate omnipresent identity card for Indian citizens. Biometric finger print images are therefore accepted by all Banks and Government offices to established identity of the person. Furthermore lots of private organizations employ biometric finger print system to record attendance and personal information of its employees. Consequently these biometric finger print images are stored and transmitted widely enhancing risk of misusing user personal information and cybercrimes. In this paper, robust image encryption scheme for biometric finger print images is proposed through bit planes; cubic map and DWT. The complete encryption or decryption process can be decomposed into three methods. Firstly each 8-bit biometric image is separated into 8 bit planes corresponding to each bit. Secondly DWT is applied that further encrypts the image in frequency domain by manipulating LL subbands through cubic map. Finally inverse DWT (IDWT) converts each image into spatial domain which is synthesis to from a single 8-bit encrypted image. The robustness of the proposed encryption scheme is measured through entropy, correlation coefficient, number of pixel change rate (NPCR) and unified average change intensity (UACI). Furthermore the proposed encryption scheme is also tested successfully for compression and noise attacks.

Keywords: Encryption, Cubic map, Attacks, Robustness.

1. INTRODUCTION

Due to tremendous advancement in digital technology and internet of things (IoT), information security has been a demanding area of interest for engineers and scientist. Bulk of information is transmitted and received for domestic as well as industrial applications over the internet which poses a higher security thread. UIDAI employs biometric finger print system to generate omnipresent identity card for Indian citizens. Biometric finger print images are therefore accepted by all Banks and Government offices to established identity of the person. Furthermore lots of private organizations employ biometric finger print system to record attendance and personal information of its employees. Consequently these biometric finger print images are stored and transmitted widely enhancing risk of misusing user personal information and cybercrimes. Biometric finger print images have higher redundancy and correlation as compared with natural images, textual information and data A. Nagar et. al. Conventional encryption schemes such as Advanced Encryption Standard (AES) and Data Encryption Standard (DES) are not advisable B. Murugan et. al. Additionally significant use of fingerprint images in several critical applications demands higher security, authenticity, confidentiality and integrity. B. Norouzi et. al. developing encryption scheme for fingerprint image data essentially needs several nonlinear and transform based schemes. Y. Zhang et. al. described chaos based encryption schemes have demonstrated better results in terms of complexity in generating random sequences as compared with transform and compressive sensing techniques. Chaotic systems can efficiently generate more random sequences through initial and state variables. Smaller change in these values can provide significant change in the random sequences that generates entirely different encrypted images H. Wen et. al. Mostly secure encryption schemes are based on confusion and diffusion methods. The confusion means scrambling the pixel in row and column wise and diffusion means

manipulating the pixel value through logical transformation. The performance of the encryption schemes depends upon the manipulation of pixel value at smallest level. Since in digital image processing the smallest level is bit, therefore bit level encryption may produce better encrypted image A. Shaque et. al. Several techniques based on spatial and frequency domain are demonstrated for encryption. Spatial domain uses conventional cryptosystems whereas frequency domain applies transform based methods. Elliptic curve cryptography (ECC) that uses public key generated through random sequences is extremely time consuming due to several rounds S. Toughi et. al. Chaotic maps through several functions such as logistic, sine, gauss, etc are demonstrated but didn't work in mapping issues. Further homomorphic cryptosystem along with Ant lion Optimization (ALO) was demonstrated to achieve higher security and reduced time consuming K. Shankar et. al. Genetic algorithm was also tried to generate several cipher images H. Nematzadeh et. al. It is utmost necessary to leverage the features of biometric fingerprint images to develop efficient encryption scheme C. Li et. al. and S. Chatterjee et. al. In this paper, robust image encryption scheme for biometric finger print images is proposed through bit planes, cubic map and DWT. The complete encryption or decryption process can be decomposed into three methods. Firstly each 8-bit biometric image is separated into 8 bit planes corresponding to each bit. Secondly DWT is applied that further encrypts the image in frequency domain by manipulating LL subbands through cubic map. Finally inverse DWT (IDWT) converts each image into spatial domain which is synthesis to from a single 8-bit encrypted image. The robustness of the proposed encryption scheme is measured through entropy, correlation coefficient, NPCR and UACI. Furthermore the proposed encryption scheme is also tested successfully for compression and noise attacks. The paper is organized as follows, section 1 introduces to several encryption schemes with its pros and cons, proposed encryption / decryption scheme is explained in section 2, experimental results on several biometric fingerprint images are demonstrated with measured parameters in section 3 and finally summarized in section 4.

2. PROPOSED ROBUST IMAGE ENCRYPTION SCHEME

The complete three steps robust image encryption scheme for biometric fingerprint image is detailed in this section. The process of encryption through mathematical and logical expression is as follows. The process of decryption is exactly opposite of encryption.

2.1 Encryption Algorithm

2.1.1 . Select an 8-bit gray scale biometric fingerprint image I of size P x Q where P and Q are number of rows and columns in the image respectively.

2.1.2 . Extract 8 bit planes from the input biometric fingerprint image. The extraction process of each bit can be represented as

$$I_{pq} = \sum_{n} (I_{pq}^{n} * 2^{n}) \tag{1}$$

where n = 0 to 7 represents the extracted bit plane image of size P x Q and bit plane position respectively.

2.1.3 . Generate two random vectors (kr and kc) through cubic logistic map using initial and state variables suitably using equation (2).

$$K_{n+1} = \alpha K_n (1 - K_n)(2 + K_n) \tag{2}$$

where alpha and kn are two variables whose different initial values may generate different chaotic maps. However all the initial values are not suitable for generating random sequences since it generates constant values in some intervals. Therefore it is essential to select appropriate interval that demonstrates random behaviour. The initial values may be selected in the range mentioned in equation (3) and (4) that generates random sequences in the range (0,1) further converted to

integer numbers equation (5).

$$\alpha = (0, 1) \tag{3}$$

$$K_n = (1.4, 1.6) \tag{4}$$

$$K_n = (floor(K_n * 255))modp \tag{5}$$

2.1.4 . DWT is applied on the extracted bit planes that generate four frequency subbands (LL, LH, HL, HH) for every bit plane. Thus 32 frequency subbands are obtained in which only eight LL subbands are encrypted since it contents highest information as compared with other LH, HL, HH subbands. Horizontal permutation is computed by clockwise shifting the ath column of the LL subband image to jth column where j is obtained through random number kn. Vertical permutation is computed by anticlockwise shifting the ath row of the LL subband image to jth row where j is obtained through random number kn. Also two separate random numbers can be obtained through cubic logistic map with different seed values for horizontal and vertical permutation.

2.1.5 . IDWT is applied on the encrypted bit planes containing four frequency subbands (LLe, LH, HL, HH) for every bit plane. Thus 8 bit plane encrypted images are obtained with real pixel values.

2.1.6 . Combined the 8 bit planes with their respective positions to reconstruct an 8-bit encrypted biometric fingerprint image Ien(p,q).

2.1.7 . Finally we apply grey level diffusion through two XOR operations given as

$$I_{e_n}^{1} = BITXOR(I_{en}(x, y), K_n^h(x, y)) \tag{6}$$

$$I_{e_n}^{2} = BITXOR(I_{e_n}^{1}(x, y), K_n^v(x, y)) \tag{7}$$

The encryption process stops here, however the encryption process can be iterated n number of times if desired to obtain enhance security for biometric finger print image. The proposed encryption scheme is suitable for grey scale and binary images.

3. SIMULATION RESULTS

Performance of the proposed robust image encryption algorithm through bit planes; cubic map and discrete wavelet transform (DWT) is evaluated using entropy, correlation coefficient, NPCR and UACI. All the simulations were done using MATLAB R2014a on i5 processor at 2.4 GHz and 4GB RAM.

3.1 Visual Inspection

Several biometric fingerprint images were applied for evaluation of the proposed encryption algorithm. figure 1 demonstrates the input biometric fingerprint images along with its encrypted image and entropy values, it is clearly demonstrated that no visual similarity is observed between the two images. Table 1 contents the obtained values of encryption performance measuring parameters UACI and NPCR.

Finger Print Image	NPCR	UACI
1	99.61	27.94
2	99.67	28.44
3	99.56	28.3

Table I: Encryption Parameters

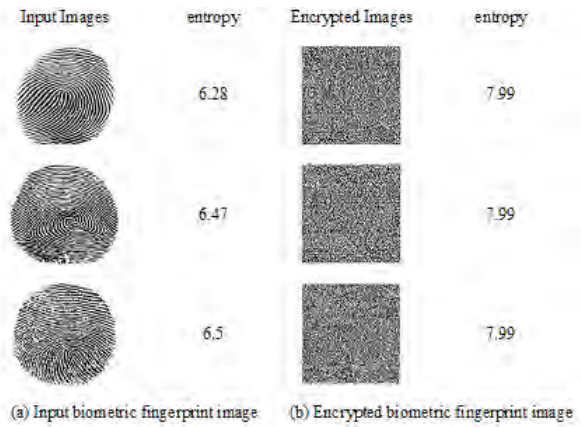


Figure 1. Visual inspection for input biometric fingerprint image and its encrypted version

3.2 Noise Attack

Salt pepper noise of the density in the range of 0.1, 0.9 was introduce in the encrypted biometric fingerprint images. Then these salt pepper noise introduced encrypted images were applied for evaluation of decryption algorithm. Figure 2 demonstrates the obtained biometric fingerprint images after decryption of noisy encrypted image that clearly demonstrates the robustness of the algorithm. Table II enlists the correlation coefficient obtained after decrypted image.

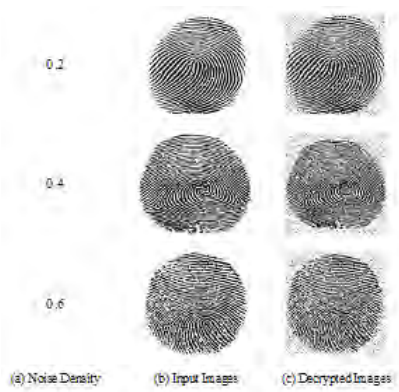


Figure 2. Decrypted image after impulse noise attack at several noise density

Finger Print Image	Noise Attack	Compression Attack
1	0.88	0.91
2	0.93	0.95
3	0.91	0.94

Table II: Correlation Coefficients for Noise and Compression Attack

3.3 Compression Attack

Compression is one of the important tasks during storage and transmission of information since it reduces the size of the image. Therefore it is at most necessary to assess the consequence of compression on the encryption / decryption algorithm. The encrypted image was compressed using JPEG format, decompressed and decrypted. It was found that compression and decompression

unaffected the encryption / decryption process. Figure 3 shows the biometric fingerprint images obtained after described process and table II enlists the correlation coefficient clearly indicating robustness of the algorithm.

Figure 3. Decrypted image after compression JPEG attack

4. CONCLUSION

In this paper, robust image encryption scheme for biometric finger print images is proposed through bit planes; cubic map and DWT. The complete encryption or decryption process can be decomposed into three methods. Firstly each 8-bit biometric image is divided into 8 bit planes corresponding to each bit. Secondly DWT is applied that further encrypts the image in frequency domain by manipulating LL subbands through cubic map. Finally IDWT converts each image into spatial domain which is synthesis to from a single 8-bit encrypted image. The robustness of the proposed encryption scheme is measured through entropy, correlation coefficient, NPCR and UACI. Furthermore the proposed encryption scheme is also tested successfully for compression and noise attacks. The values of NPCR and UACI indicate the suitability of algorithm for biometric fingerprint images. The entropy of encrypted image is 7.99 that distribute the grey values uniformly over the range of (0, 255). The proposed encryption algorithm can be further evaluated on medical images.

References

Chatterjee, S., Roy, S., Das, A. K., Chattopadhyay, S., Kumar, N., and Vasilakos, A. V.

Li, C., Xie, T., Liu, Q., and Chen, G.

Murugan, B., Gounden, A., and Gounder, N. 2016. Image encryption scheme based on blockbased confusion and multiple levels of diffusion. *IET Computer Vision Vol.10,* No.6, pp.593 – 602.

Nagar, A., Nandakumar, K., and Jain, A. K. 2012. Multibiometric cryptosystems based on feature-level fusion. *IEEE Transactions on Information Forensics and Security Vol.7,* No.1, pp.255 – 268.

Nematzadeh, H., Enayatifar, R., Motameni, H., Guimarães, F. G., and Coelho, V. N. 2018. Medical image encryption using a hybrid model of modified genetic algorithm and coupled map lattices. *Optical Lasers Engineering Vol.110*, pp.24 – 32.

Norouzi, B., Seyedzadeh, S. M., Mirzakuchaki, S., and Mosavi, M. R. 2015. A novel image encryption based on row-column, masking and main diffusion processes with hyper chaos. *Springer Multimedia Tools and Applications Vol.74,* No.3, pp. 781 – 811.

Shankar, K. and Lakshmanaprabu, S. K. 2018. Optimal key based homomorphic encryption for color image security aid of ant lion optimization algorithm. *International Journal of Engineering and Technology Vol.7,* No.9, pp. 22 – 27.

Shaque, A. and Shahid, J. 2018. Novel image encryption cryptosystem based on binary bit planes extraction and multiple chaotic maps. *European Physical Journal Plus Vol.133,* No.8, pp.331.

Toughi, S., Fathi, M. H., and Sekhavat, Y. A. 2017. An image encryption scheme based on elliptic curve pseudo random and advanced encryption system. *Signal Processing Vol.141*, pp.217 – 227.

Wen, H. and Yu, S. 2019. Cryptanalysis of an image encryption cryptosystem based on binary bit planes extraction and multiple chaotic maps. *European Physical Journal Plus Vol.134,* No.7, pp.337.

Zhang, Y., Zhang, L. Y., Zhou, J., Liu, L., Chen, F., and He, X. 2016. A review of compressive sensing in information security field. *IEEE Access Vol.4*, pp.2507 – 2519.

Gouri Morankar is working as Assistant Professor in the Department of Electronics Engineering Shri Ramdeobaba College of Engineering Management, Nagpur, India. She received Ph. D. in Electronics Engineering from RTMN University, Nagpur, India and Post-Graduation M. E. in Electronics Engineering from SRTM University Nanded, India. Her research interest includes FPGA implementation of signal and image processing algorithms, deep learning algorithms and techniques. She has published many papers in national / international conferences and journals of repute and has two patents to her credit.
E-mail: morankarg@rknec.edu

Lost + Found: The Lost Angel Investigator

Harsh Shrirame, Student, Department of Computer Science and Engineering
Bhavesh Kewalramani, Student, Department of Computer Science and Engineering
Daksh Kothari, Student, Department of Computer Science and Engineering
Darshan Jawandhiya, Student, Department of Computer Science and Engineering
and
Rina Damdoo, Assistant Professor, Department of Computer Science and Engineering,
Shri Ramdeobaba College of Engineering and Management, Nagpur ,Maharashtra, India

Each year, a large number of youngsters are found missing in India. Among them, a large number of cases are never solved due to various difficulties faced by the police ranging from heavy paperwork to lacking technology. Therefore, one of this work's key goals is to provide an application that may assist people whose children have been missing and rescued by the public. This will also reduce the time required to find the missing child to reunite the child with their loved ones as soon as possible. The pictures of child victims can be uploaded by the citizens along with landmarks, to our web app. The photographs will be matched to the missing child's registered photographs if existing in the database. A deep neural network model is trained to locate the lost youngster using a facial picture uploaded by the citizens. Multi-Tasking CNN (MTCNN), the most efficient DNN technique for image-based apps, is used for facial Identification. The images were passed through an augmentation layer to get images of different orientations, brightness, and contrast, which were used ahead to train the EfficientNetB0 model. This model is then used to recognize faces in photographs. Using the MTCNN model for facial recognition with EfficientNetB0 and developing it yields a deep learning model that is free from all types of distortion. The model's training accuracy is 96.66 percent and its testing accuracy is 76.81 percent, implying that there is approximately 77 percent possibility of finding a match for the missing kid. It was evaluated using 25 Child classes. Each Child class has around 15 to 20 images. These images are taken with different backgrounds and real-time settings so that model will work even when noise is present in the image.

Keywords: Deep Learning Model, Face Detection, Face Recognition, MTCNN, EfficientNetB0.

1. INTRODUCTION

Each country's most valuable asset is its children. Each year, a significant number of youngsters go lost due to a variety of factors such as kidnapping, desertion, trafficking, and lost youngsters. Traditional procedure involves notifying the police about missing children. The police filed an FIR and begin their search which is a very time-consuming and tedious process. For a variety of circumstances, a kid lost in one location may be located in another region or state. Even if a child is located, identifying him or her from the reported missing instances is challenging as there is no properly maintained easy-to-use common database. This project describes a structure and methods for designing an assistance tool and webpage specialized in locating missing kids. The objective of our project is

- A architecture and technique for developing missing children tracing software.
- A common database where every report is maintained.
- Encouraging people to give back to society by helping find missing children by capturing the images of children in suspicious settings and uploading them on our webpage.
- Depreciating the chock-a-block in the police system by providing them a hassle-free technology.
- Terminating the glut of Venal Practices from the system reduces the undue advantage given to the privileged.
- Promoting Digitalization/Automation.

Our project includes an automated search for the picture provided by the citizen among missing kid case photographs. These assist officials in searching for the youngster. Whenever a kid is found, the image taken at the time is matched to the photograph provided by the authority/guardian when the kid went missing. Sometimes the child's facial look can also alter according to variations. The image taken by the citizen might be of low quality because it was taken from a faraway position without the child's awareness. All of these restrictions are taken into account while designing a deep learning framework. Compared to other technologies such as iris or fingerprint recognition systems, the proposed method is simple, inexpensive, and trustworthy.

2. LITERATURE REVIEW

The work by Singh et al. [2022] discuss face recognition which was employed as a search method. In the event of a missing person, the person's guardian can upload the photo, which will subsequently be saved in the database. The database will then be checked by their system's facial recognition model for a match of that person. Pupala et al. [2021] discuss that their system has mainly based on the FaceNet technique for facial feature recognition and extraction as well as C-GAN technique for facial ageing. Singh and Jasmine [2019] and Satle et al. [2016] employ the KLT method, the Viola-Jones technique for face detection (which uses a Haar cascade classifier to detect human faces, but the camera constantly detects faces with each frame), and the PCA algorithm for feature selection. To match the geometrical features of the human face, we combine a model. The study by Kasar et al. [2016] provides an overview of face detection experiments and systems that use various ANN techniques and algorithms. Their research study also analyses the performance of various ANN approaches and algorithms in addition to the strengths and weaknesses of these literature studies and systems. Another research team of Chandran et al. [2018] and Sai et al. [2022] have used technique to obtain facial descriptors from photos using the VGG-Face model. In contrast to normal deep learning applications, the trained classification algorithm conducts kid identification in the approach, which employs the neural network just as a high dimensional extractor. Experiments conducted by Boyko et al. [2018] and Ayyappan and Matilda [2020] proposed the development of a full recognition system and the scientific underpinnings of facial recognition were discussed. The fundamental tenets of facial recognition software are established. The productivity of the Dlib and OpenCV libraries was compared in terms of implementation time and the total number of times the utilised algorithms were iterated. They offer a system that can correctly detect many faces, which is important for swiftly looking for suspects because the calculation time is relatively short. It generates a unique pattern for each face and compares it to other photos in the collection. Wang et al. [2020] present attentive feature distillation and selection (AFDS), which dynamically selects the key features to transfer while also adjusting the level of transfer learning regularization. A research team of Kaipeng Zhang et al. [2016] employ an architecture that is a pipelined structure consisting of three levels of precisely developed deep neural networks to predict facial and landmarks placement from basic to high level. Their method surpasses other algorithms on the tough FDDB and WIDER FACE facial identification benchmarks, as well as the AFLW facial alignment test, while preserving actual performance level. Tan and Le [2019] thoroughly investigated the framework scalability and observed that balancing network length, breadth, and quality can boost results. They illustrated the efficiency of this approach for scaling ResNet and MobileNets and employed neural architecture to advance much further to explore for ways to build a new foundation network in order to develop the EfficientNets family of models

3. PROPOSED WORK

3.1 Workflow of the Lost Angel Investigator

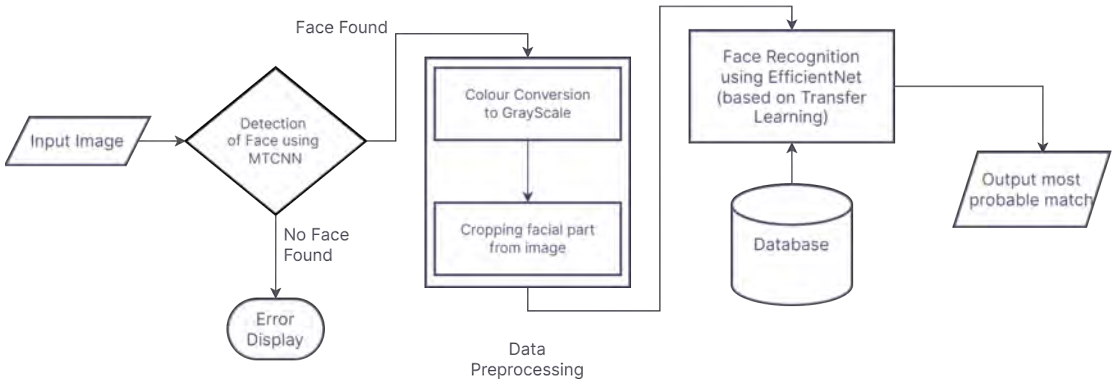


Figure 1: Workflow of the Lost Angel Investigator

3.2 Dataset

The dataset of 25 children was created by collecting the images from relatives and friends obtaining 15 to 20 images of each child. These images were taken from different angles, varying the amount of real-world ground and capturing devices to stimulate the real world. These images were later used to train the deep-learning model.

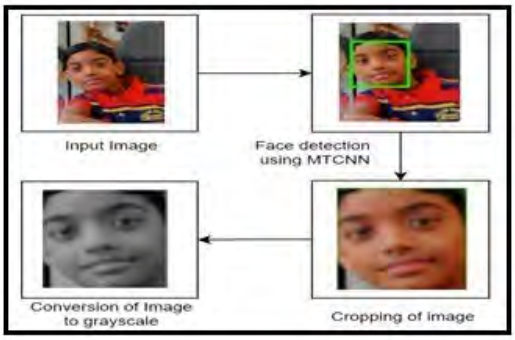
Figure 2 (i) Figure 2 (ii)

Figure 2: (i) Images of the subject from the dataset used to train the model, (ii) Face detection using MTCNN

3.3 MTCNN Model

Face detection and recognition are the two phases of a lost angel investigator. Lots of ways have been used to implement these phases. The MTCNN is used for face detection. This method is quicker than viola jones's and recognizes faces with varying sizes, illumination, and rotations. In the MTCNN model, first, the image is scaled many times to detect faces of various sizes. The P-network (proposal) then searches pictures, conducting initial detection. It has a low detection threshold and hence identifies numerous false positives, even after NMS (non-maximum suppression), but does so on design. The recommended areas (which contain many false positives) are sent into the second network, the R-network (refine), which, as the name implies, filters detections (also using NMS) to produce very accurate bounding boxes. The O-network (output) conducts the final refining of the bounding boxes in the final step. Not only are faces recognized in this manner, but bounding boxes are also incredibly accurate and exact. Detecting facial landmarks, such as the eyes, nose, and corners of the mouth is an optional function of MTCNN.

It is nearly free because they are utilized for facial detection in the process, which is an added benefit if one requires those.



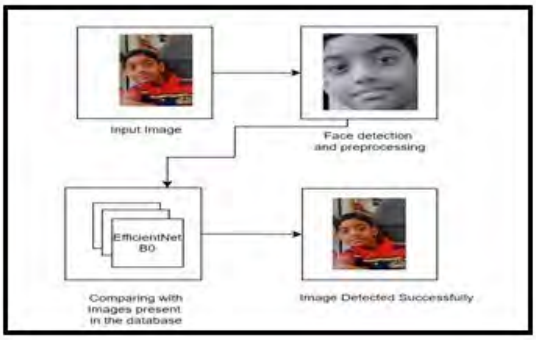


Figure 3 (i) Figure 3 (ii)

Figure - 3: (i) Face Detection using MTCNN and Pre-processing, (ii) Workflow of the Recognition Phase

3.4 Data Pre-processing

After the face has been detected successfully, the image is converted to grayscale and the facial part is cropped. The image is passed ahead for face recognition and verification. This cropping is done using the OpenCV library in python. The coordinates received from the MTCNN face detector are used to get the coordinates of the facial part in that specific image and are further cropped in a rectangular shape. This cropped image is then converted to grayscale. This is done to normalize all the images concerning the color. This conversion is again done using OpenCV python.

3.5 Face Recognition

Predictions are made using the transfer learning model based on EfficientNet-B0. The first layer in this model has a data augmentation layer, followed by an EfficientNetB0 model with a removed topmost layer. Then comes a GlobalAveragePooling2D layer, accompanied by a dense output layer. Initially, layers of EfficientNetB0 are not allowed to train with this data. While training, the input images will be passed through the data augmentation layer, which includes augmenting the images with random flipping, rotation, height, width, brightness, and contrast. For every image in the training dataset, 6 augmented images with 1 original image are passed to the model. All these images are given as input to the EfficientNetB0 model which is followed by a globalaveragepooling2d layer to get summarized weights. Finally, A dense layer is applied to each picture to categorize it into one of the pre-defined classes. Next, to fine-tune this model, only the top 5 layers from the base EfficientNet-B0 model are allowed to train on our data, by lowering the learning constant to 1e-4 we ensure that we get the advantage of this model concerning the data we provided. This model is stored in JSON format and the weights are stored in h5 format. These two files are used in our Django Web application to make predictions. The pre-predictions image is passed in this model to make a prediction and find the matching child class.

4. SIMULATION RESULTS

The accuracy of the conventional Face Recognition algorithm Eigen face is 60%. For face identification and recognition, we employed MTCNN and EfficientNet-B0 deep learning models. Both methods were simple to put into action. This approach achieved an accuracy of 76.81%. It was discovered that during the recognition phase of the process, the photographs needed to be educated for the machine to learn about the facial traits of the provided individual. The testing accuracy of the model rises as the frequency of epochs grows, as seen in Figure 4 (i). The testing loss of the model reduces as the frequency of epochs increases, as seen in Figure 4 (ii). The increase in the frequency of epochs after fine-tuning enhances the overall testing accuracy

of the model, as seen in Figure 4 (iii). Figure 4 (iv) demonstrates that after fine-tuning, the total testing loss of the model reduces as the frequency of epochs increases. The formula used for loss calculation is Categorical Cross Entropy. The calculation of the above loss is done using the given formula.

$$Loss = -\sum_{i=1}^{outputsize} \left(E_i . log \hat{E}_i \right)$$

Here Ê is the considered i-th numeric attribute present in the model output and Ei is the target value, and the output size is the frequency of numeric attributes in the output of the model.

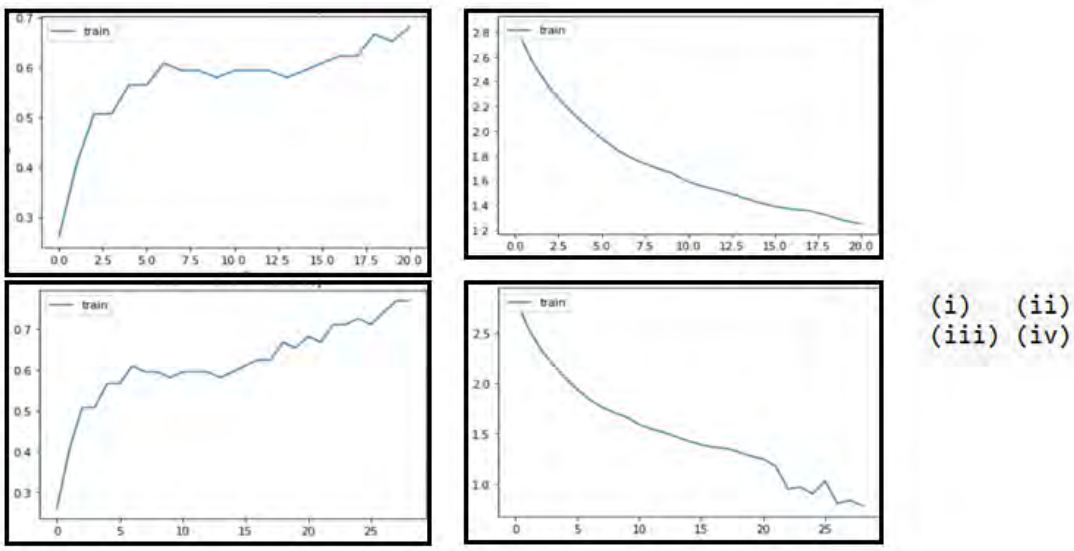


Figure 4: (i) Model Testing Accuracy Graph For 21 Epochs (Before Fine Tuning), (ii) Model Testing Loss Graph For 21 Epochs (Before Fine Tuning), (iii) Model Testing Accuracy Graph for 28 Epochs (After Fine Tuning), (iv) Model Testing Loss Graph For 28 Epochs (After Fine Tuning)

Epochs	**Training Accuracy**	**Testing Accuracy**	**Training Loss**	**Testing Loss**
21	0.8967	0.6812	0.8065	1.2503
28	0.9666	0.7681	0.1613	0.7849

Table I: Training Accuracy , Testing Accuracy, Training Loss for 21 Epochs (Before Fine Tuning) and 28 Epochs (After Fine Tuning)

Table 1 shows the Training Accuracy, Training Loss, Testing Accuracy, and Testing Loss. We can see a significant improvement in the accuracy after the model was fine-tuned. Fine Tuning resulted in decreasing loss thus improving the accuracy from 68.12% to 76.81%. A callback function was set to terminate training when no improvement in training loss was found which terminated the regular training at 21 epochs and after fine-tuning at 28 epochs. Training loss was reduced at a certain level improving the training and testing accuracy.

5. CONCLUSION

Face recognition technique using a deep learning model EfficientNetB0 has been used to make predictions on the uploaded image to find the nearest match possible. Using our model, one can get the search results in minutes, thus reducing the time required for the tedious manual process to follow and helping in improving the lost children detection process. The proposed model achieved a testing accuracy of 76.81% even when trained only on 423 images. However, this model may be improved by training it on additional photos and eliminating as much background

noise from the images as feasible. Our proposal will result in a system assisting police and parents in finding missing children effectively and this initiative will aid in the promotion of digitization in the police sector to provide a database for officers from multi-states. The dataset created by us using the images of relatives and friends is quite helpful for future studies. This model can act as a basis for testing different noise reduction techniques. For security purposes, this web app can be integrated with Aadhar authentication.

References

Ayyappan, S. and Matilda, S. 2020. Criminals and missing children identification using face recognition and web scrapping. *International Conference on System, Computation, Automation, Networking (ICSCAN). IEEE*.

Boyko, N., Basystiuk, O., and Shakhovska, N. 2018. Performance evaluation and comparison of software for face recognition, based on dlib and opencv library. *2nd International Conference on Datastream Mining and Processing*.

Chandran, P. S., Byju, N. B., Deepak, R. U., Nishakumari, K. N., Devanand, P., and Sasi, P. M. 2018. Missing children identification using deep learning and multiclass svm. *IEEE Recent Advances in Intelligent Computational Systems (RAICS)..*

Kasar, M., Bhattacharyya, D., and hoon Kim, T. 2016. Face recognition using neural network: a review. *International Journal of Security and Its Applications..*

Pupala, A., Mokal, S., Pandit, N., and Bharne, S. 2021. Identification of lost children using face aging with conditional gan. *ITM Web of Conferences..*

Sai, P. N. H., Kiran, V. S., Rohith, K., and RajeswaraRao, D. 2022. Identification of missing person using convolutional neural networks. *IEEE International Conference on Sustainable Computing and Data Communication Systems (ICSCDS)..*

Satle, R., Poojary, V., Abraham, J., and Wakode, M. S. 2016. Missing children identification using face recognition system. *International Journal of Advanced Engineering and Innovative Technology (IJAEIT)..*

Singh, M. K., Verma, P., Singh, A. S., and K, A. 2022. Implementation of machine learning and knn algorithm for finding missing person. *IEEE 2nd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)..*

Singh, S. and Jasmine, G. 2019. Face recognition system. *International Journal of Engineering Research and Technology (IJERT)..*

Tan, M. and Le, Q. 2019. Efficientnet: Rethinking model scaling for convolutional neural networks. *Proceedings of the 36th International Conference on Machine Learning, PMLR..*

Wang, K., Gao, X., Zhao, Y., Li, X., Dou, D., and Xu, C.-Z. 2020. Pay attention to features, transfer learn faster cnns. *International Conference on Learning Representation (ICLR)..*

Zhang, K., Zhang, Z., Li, Z., and Qiao, Y. 2016. Joint face detection and alignment using multitask cascaded convolutional networks. *IEEE Signal Processing Letters..*

Harsh Shrirame is a student of Shri Ramdeobaba College of Engineering and Management and is currently pursuing his bachelor's degree in Computer Science and Engineering. His research interests include Computer Vision and Image Processing.
E-mail: shriramehm@rknec.edu

Bhavesh Kewalramani is a student of Shri Ramdeobaba College of Engineering and Management and is currently pursuing his bachelor's degree in Computer Science and Engineering. His research interests include Computer vision and Image Processing.
E-mail: kewalramanibb@rknec.edu

Daksh Kothari is a student of Shri Ramdeobaba College of Engineering and Management and is currently pursuing his bachelor's degree in Computer Science and Engineering. His research interests include Computer vision and Image Processing.
E-mail: kotharidh@rknec.edu

Darshan Jawandhiya is a student of Shri Ramdeobaba College of Engineering and Management and is currently pursuing his bachelor's degree in Computer Science and Engineering. His research interests include Computer vision and Image Processing.
E-mail: jawandhiyadp@rknec.edu

Rina Damdoo Rina Damdoo received the Masters in Technology in Computer Science and Engineering from Nagpur University in 2012. She is pursuing PhD from VNIT, Nagpur. Currently she is serving as Assistant Professor at Shri Ramdeobaba College of Engineering and Management, Nagpur. Her research interest includes, Image and Video Processing in the domain of Sentiment Analysis. Her ongoing work is in the domain Affective Computing, and Sign Languages.
E-mail: damdoor@rknec.edu

Automatic Adaptive Filtering Technique for Removal of Impulse Noise using Gabor Filter

Swati Rane, Department of Electronics and Telecommunication Engineering, SIES Graduate School of Technology, Nerul, Navi Mumbai, India.
Research Scholar, Department of Electronics and Communication, Visvesvaraya Technological University, India.
L. K. Ragha, Principal, Terna Engineering College, Navi Mumbai, India.
Siddalingappagouda Biradar, Department of Electronics and Communication Engineering, Dayananda Sagar Academy of Technology Management, Bangalore, India.

Tremendous development in Internet of Things (IoT) and mobile devices lead to several images pooled on social media websites and communicated through networking channels. These images are mostly corrupted with impulse noises due to hot pixels generated in the camera sensors and communication channels. Adaptive mean filter technique removes impulse noise at low density but is unsuccessful as noise density increases and computationally expensive. In this paper, automatic adaptive filtering technique for removal of impulse (salt and pepper) noise is demonstrated. The proposed algorithm consists of impulse noise detection and noise removal modules. An automatic impulse noise detection module is based on mean and variance technique that selects the noisy pixels among the entire image. The noise removal module is based on replacement of noisy pixel through mean and edge direction using Gabor filter. The proposed technique demonstrated better robustness compared with existing techniques.

Keywords: Adaptive filter, Impulse noise, Edge detection, Gabor filter, Noise removal.

1. INTRODUCTION

Incredible use of digital technology through personal assisted devices such as mobile phones and tabs is witness since last few years. These personal assisted devices are equipped with high resolution cameras that generate impulse. Images captured using these cameras is affected with impulse (salt and pepper) noise that requires processing to improve the quality of the image. Therefore it is mandatory to have effective impulse noise removal technique that also further enhances the quality of the image. Standard median filters have been extensively employed due to its low computational complexity, better performance and effective noise removal. These standard median filters are improved by several researchers to achieve better performance that includes fast and efficient median filter, adaptive median filter, adaptive soft switching median filter, adaptive fuzzy median switching filter, adaptive weighted mean filter, etc. All these methods depend upon the assumption that the images are corrupted with impulse noise and do not employ noise detection techniques nor preserves the details such as texture, edges and contrast in the image. Gabor filters have demonstrated multiresolution approach that represents texture and edges in an image with better magnitude through its multiple orientation and scale. These filters are mostly employed to derive texture features from images or region of interest in the images for segmentation applications. A complex sinusoid signal is modulated using Gaussian envelop to obtain a Gabor function. The 2D Gabor function can be represented using equation (1) where sigmax and sigmay are standard deviations and w is frequency of the sinusoid.

$$g(x,y) = \frac{1}{2\pi\sigma x\sigma y} e^{\frac{-1}{2}(\frac{x^2}{\sigma x^2}+\frac{y^2}{\sigma y^2})+2\pi j w_x} \tag{1}$$

Let g(x,y) be the mother Gabor function which forms the basic functional building block. The similar filter coefficients can be obtained for multiple scale a greater than one and orientations theta = 2pi/N, using equations (2), (3) and (4).

$$g_{mn}(x,y) = a^{-m} g_{mn}(x',y') \tag{2}$$

$$x' = a^{-m}(xcos\theta + ysin\theta) \tag{3}$$

$$y' = a^{-m}(-xsin\theta + ycos\theta) \tag{4}$$

Let I (x, y) represents gray scale distribution in an image, the convolution operation of the image I together with a Gabor kernel gmn is given in equation (5) where s and t are the filter mask size variables.

$$G_{mn}(x,y) = \sum_s \sum_t I(x-s, y-t) g'_{mn}(s,t) \tag{5}$$

Application of Gabor filter at several orientation results in extraction of fine edges in the image. Gabor filter is designed to extract edges at four different orientations which correspond to 0, 45, 90 and 135 degree depicted in figure 1. In this paper, automatic adaptive filtering technique for

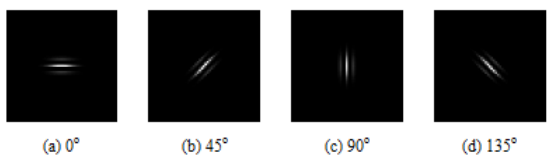


Figure 1. Gabor filter with edge orientation at 0, 45, 90 and 135 degree

removal of impulse (salt and pepper) noise is demonstrated. The proposed algorithm consists of impulse noise detection and noise removal modules. An automatic impulse noise detection module is based on mean and variance technique that selects the noisy pixels among the entire image. The noise removal module is based on replacement of noisy pixel through mean and edge direction using Gabor filter. Several experiments are performed to establish the effectiveness of the proposed technique using signal to noise ratio (SNR), mean absolute error (MBE) and image enhancement factor (IEF) parameters. The proposed technique has demonstrated better robustness as compared with existing techniques. The paper is organized as follows mathematical model for Gabor filter is illustrated in introduction, related work is briefed in section 2, proposed algorithm through mean and edge direction using Gabor filter is explained in section 3, experimental results are discussed in section 4 and finally concluded.

2. RELATED WORK

Several filters have been proposed by researchers to eliminate impulse (salt and pepper) noise using techniques based on statistical methods, morphology, adaptive techniques, Fourier and wavelet transforms, interpolation methods and fuzzy logic. Standard median filters have been extensively employed due to its low computational complexity, better performance and effective noise removal. “Standard median filter” Z. Wang et. al., “switching median filters” H. Talebi et.al., “adaptive median filter”, and “adaptive centre weighted median filter” T. Chen et. al., are implemented and found to be effective in removal of low density impulse noise. An adaptive switching median filter varies the centre weights to define general operators. It assists in impulse detection by analysing filter outputs and current pixel. Thus the value switches between median filter output and current pixel and have delivered better performance at low density noise. In T. Bai et. al. automatic removal and detection of impulse noises is demonstrated using Newton–Thiele filter. Detection of noise is accomplished through local mean and variance whereas noise pixels are removed using Newton–Thiele filter rational interpolation. The technique does

not require variable window size and is robust. A "new algorithm to remove high-density salt and pepper noise using modified sheer sorting method" is proposed. The modified sheer sorting algorithm successfully reduces the time required to compute median which increases the efficiency of the system. It is also demonstrated that the algorithm removes noise and preserves the fine edges in the image. However these techniques are ineffective in removal of high density noise and detonate the quality of the image. In A. Majid et. al. genetic algorithm based estimation was demonstrated to search noisy pixels and replace with derived values. Yet another technique in H. H. Chou et. al. particle swarm optimization technique is proposed for noise removal. Cardinal B-splines is applied to determine the corrupted pixel through selecting four neighbour noise free pixels using an adjustable window size. Most of these methods depend upon the assumption that the images are corrupted with impulse noise and do not employ noise detection technique S. Rane et. al. Moreover most of the filters employ variable window size to adjust to the level of noise density in median filtering. It is desired to develop algorithm that detects noise in the beginning and employs effective noise removal technique that preserves the details such as texture, edges and contrast in the image.

3. PROPOSED AUTOMATIC ADAPTIVE FILTERING TECHNIQUE

The removal of impulse (salt and pepper) noise is accomplished in three step process. It includes noise pixel detection followed with replacement of noisy pixel with adaptive mean filtering technique in variable window size. Finally replacement of noisy pixel with application of four orientation edge detection technique using Gabor filter. The proposed block diagram of automatic adaptive filtering technique that restores edges using Gabor filter is depicted in figure 2. Further it is also expressed in literatures that mean filtering technique have demonstrated bet-

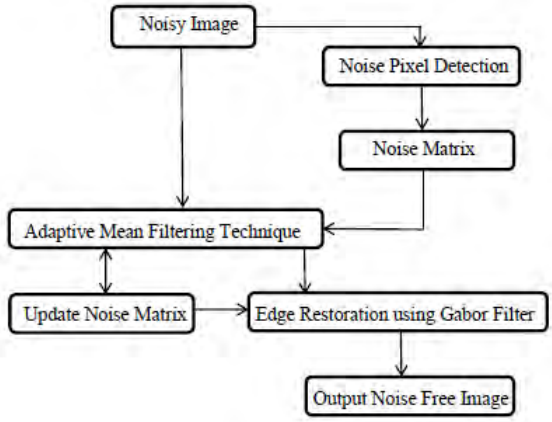


Figure 2. Block diagram of automatic adaptive filtering technique

ter performance as compared with median filtering. Therefore adaptive mean filtering through variable window size is adopted to initially reinstate the noisy pixel in an image. The noise detection technique generates noise matrix that is applied to determine noise free pixels in the neighbourhood of the noisy pixels. Initially a window size of 3 X 3 is selected around the noisy pixels. If the number of noise free pixels is greater than the half of the total size, mean of noise free pixels is assigned to noisy pixel. The adaptive mean filtering process is depicted in figure 3. Once the mean of the noise free pixels is assigned to all the illegible noisy pixels, the noise matrix is updated and further processed through Gabor filter. Gabor filter is applied to extract edges at four different orientations which correspond to 0, 45, 90 and 135 degree centred on the updated noisy pixels. Thus it is desired to determine the edge direction for the preselected window size

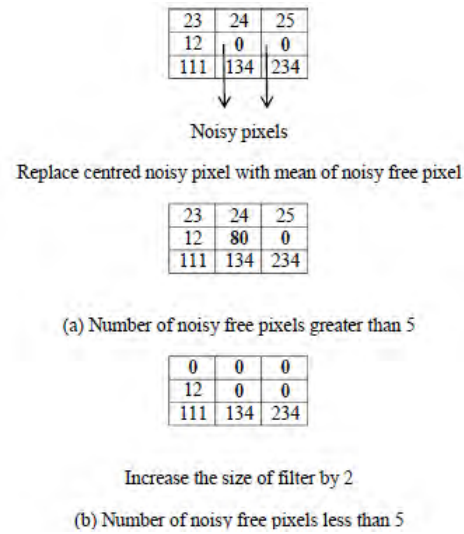


Figure 3. Noisy pixel replacement process through adaptive mean filtering technique

using equation (6) where I(x,y) represents image and Ø = 0, 45, 90 and 135 degree.

$$If_\theta(x,y) = \sum_s \sum_t I(x-s, y-t) g_\theta(s,t) \tag{6}$$

IfØ (x,y) represents filter image corresponding to the edge directions Ø = 0, 45, 90 and 135 degree. Further to assured the correct edge directions, canny edge C(x,y) detection algorithm is applied on the processed image wherein the illegible noisy pixels are updated in step 1.

$$If_c(x,y) = \sum_s \sum_t I(x-s, y-t) C(s,t) \tag{7}$$

After completing the process of filtering through Gabor filter and canny detection algorithm, the norm Nf the filtered image with window size 3 X 3 is calculated using equation (8) for each edge directions Ø = 0, 45, 90 and 135 degree.

$$N_f = \sum_s \sum_t If_\theta * If_c \tag{8}$$

Hereafter selecting the highest norm Nf for the particular edge direction, wherein the Gabor filter orientation matches the edge direction, the pixel value is further updated with mean of the directional pixels. Thus it preserves the texture and edges in the image. If above condition is unsatisfied i.e. noisy free pixels are less than the half of the total filter size, the corresponding noisy pixel remains unchanged for further step wherein the window size is increased by 2 i.e. 5 X 5 and the process is repeated. The complete process is repeated till the final window size of 9 X 9 is achieved.

4. EXPERIMENTAL RESULTS DISCUSSION

Qualitative and quantitative performance of the proposed automatic adaptive filtering technique through edge orientated Gabor filter is demonstrated in this section. To establish the advantage of the proposed algorithm several images based on entropy values are selected and grouped. The image with greater details such as textures and edges endures higher entropy. The set of images obtained from UC-Berkeley dataset with their corresponding entropy is depicted in figure 4 for illustration. Several experiments are performed to establish the effectiveness of the proposed technique using signal to noise ratio (SNR), mean absolute error (MAE), image enhancement factor (IEF) and structural similarity (SSIM) parameters. Performance parameters PSNR, MAE,

IEF SSIM were calculated for all the sets of the images by varying the impulse (salt and pepper) noise density from 0.1 to 0.6 tabulated in table 1. The restored images after the application of the proposed algorithm are depicted in figure 5.

Figure 4. Set of input images with their corresponding entropy

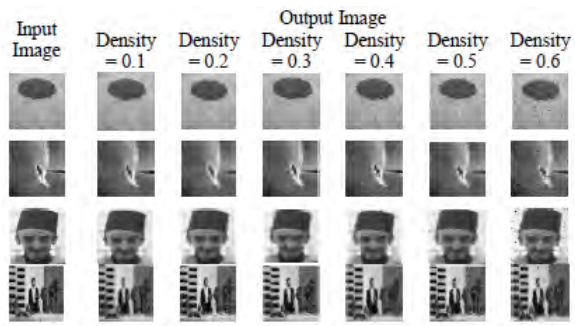


Figure 5. Restored images at several noise densities entropy

Group	Density	PSNR (dB)	MAE	IEF	SSIM
1	0.2	35.32	0.78	59.97	0.91
1	0.4	32.50	1.51	64.33	0.84
1	0.6	32.11	2.12	89.10	0.66
2	0.2	34.50	0.73	103.08	0.94
2	0.4	31.43	1.51	100.04	0.89
2	0.6	30.54	2.13	121.57	0.69
3	0.2	33.39	0.83	67.59	0.94
3	0.4	30.17	1.69	65.54	0.89
3	0.6	28.16	2.61	63.52	0.71
4	0.2	26.97	2.24	18.76	0.91
4	0.4	24.34	4.30	20.17	0.82
4	0.6	22.67	6.31	21.42	0.68

Table I: Performance Parameters

The image does not contain any visual defects for the noise density 0.1 to 0.5 hereafter the noise pixels for noise density greater than 0.5 are clearly visible. Also for the noise density 0.1 to 0.5 algorithms successfully restores the textures or edges shown in figure 6. However the algorithm is unsuitable to remove higher noise densities also window size greater than 9 X 9 severely distorts and degrades the quality of the image. Hence it is observed that an algorithm without application of variable window size is desired to restore images at higher densities. Table 2 represents the comparison with other techniques and clearly indicates that the proposed algorithm significantly improves the quality and structural similarity of the images upto noise density 0.6.

Figure 6. Restored textures and edges in an image

Noise Density	**0.2**	**0.4**	**0.6**	**0.2**	**0.4**	**0.6**
Techniques	PSNR			SSIM		
Median Filter	25.95	18.15	12.03	0.80	0.43	0.11
ASWMF	30.86	27.83	25.62	0.93	0.86	0.77
EDSMF V. Anitha et. al.	33.06	30.87	27.37	-	-	-
AMFT S. Rane et. al.	31.24	24.06	27.35	-	-	-
Proposed	32.54	29.61	28.37	0.925	0.86	0.685

Table II: Average PSNR and SSIM values for UC-Berkeley dataset

5. CONCLUSION

In this paper, automatic adaptive filtering technique for removal of impulse (salt and pepper) noise is demonstrated. The proposed algorithm consists of impulse noise detection and noise removal modules. An automatic impulse noise detection module is based on mean and variance technique that selects the noisy pixels among the entire image. The noise removal module is based on replacement of noisy pixel through mean and edge direction using Gabor filter. Several experiments are performed to establish the effectiveness of the proposed technique using SNR, MBE and IEF parameters. The image does not contain any visual defects for the noise density 0.1 to 0.5 hereafter the noise pixels for noise density greater than 0.5 are clearly visible. Also for the noise density 0.1 to 0.5 algorithms successfully restores the textures or edges. However the algorithm is unsuitable to remove higher noise densities also window size greater than 9 X 9 severely distorts and degrades the quality of the image. Hence it is observed that an algorithm without application of variable window size is desired to restore images at higher densities. The proposed technique has demonstrated better robustness as compared with existing techniques.

References

Anitha and Radha, V. 2012. Enhanced switching median filter for denoising in 2d patterned textile images. *Elsevier Procedia Engineering Vol.38*, pp.3362–3372.

Bai, T. and Tan, J. 2015. Automatic detection and removal of high density impulse noises. *IET Image Processing Vol.9,* No.2, pp.162–172.

Chen, T.and Wu, H. R. 2001. Adaptive impulse detection using center-weighted median filters. *IEEE Signal Processing Letters Vol.8*, pp.1–3.

Chou, H.-H.and Hsu, L.-Y. H. H.-T. 2013. Turbulent-pso-based fuzzy image filter with no-reference measures for high-density impulse noise. *IEEE Transaction on Cybernetics Vol.43,* No.1, pp.296–307.

Majid, A.and Lee, C. H. M. M. T. C. T. S. 2012. Impulse noise filtering based on noise-free pixels using genetic programming. *Knowledge Information System Vol.32,* No.3, pp.505–526.

Rane, S. and Ragha, L. 2020. Adaptive mean filter technique for removal of high density salt and pepper (impulse) noise. In *Applied Computer Vision and Image Processing.* Springer, 290–299.

Talebi, H. and Milanfar, P. 2014. Global image denoising. *IEEE Transaction Image Processing Vol.23,* No.2, pp.755–768.

Wang, Z. and Zhang, D. 1999. Progressive switching median filter for the removal of impulse noise from highly corrupted images. *IEEE Transaction on Circuits Systems II: Analog Digital Signal Processing Vol.46,* No.1, pp.78–80.

Swati Rane is Assistant Professor at SIES Graduate School of Technology, Navi Mumbai affiliated to Mumbai University. She is pursuing Ph.D. from Visvesvaraya Technological University (VTU), Belagaum, Karnataka. She has received ME (E&TC) from Pune University. Her research interests include image processing machine learning.
E-mail: swati.rane@siesgst.ac.in

Dr. L. K. Ragha is a Senior Professor and has been working as Principal at Terna Engineering College, Nerul, Navi Mumbai, India. . He received his Ph.D. Degree in Electronics Engineering from University of Mumbai. He was a research scholar at BARC, Mumbai from 2007 to 2011 for his research study on "Technological, Environmental and Biological aspects of Microwave and communication fields". His primary research interest is Microwave bio effects and numerical simulation of radiating systems. His other areas of research interest are speech processing, Noise reduction technics, Internet of Things, etc. He has 36 years of experience and served in many Institutions at various capacities. He has published more than 40 research papers in national and international journals and conferences.
E-mail: lkragha@gmail.com

Dr. Siddalingappagouda Biradar is currently working as an Associate Professor in the Department of Electronics and Communication Engineering, Dayananda Sagar Academy of Technology and Management Bangalore. He earned his BE [Electronics & Communication Engg.] from B.L.D.E.A's Dr. P.G Halakatti College of Engineering & Technology, Vijaypura in 2007, M.Tech[DC&N] from KLS Gogte Institute of Technology, Belagavi in 2011 and Ph.D from Visvesvaraya Technological University(VTU) Belagavi in 2019, respectively. He has published more than 20 research articles in International Conference Proceedings and Journals, awarded with best paper. He is a professional member of IEEE and a life member of the INSC, IFERP, IMAPS, IETE and ISTE. He has 2 Indian patents, 2 CopyRight and 1 Australian Patent. His current research interests include Network Automation, 3G/4G-LTE, 5G Technologies, Mobile Ad hoc Networks, Wireless Sensor Networks related to quality of service and performance analysis.
E-mail: s.biradar-ece@dsatm.edu.in

A Machine Learning approach for Fake News Detection

Prof. Wani H. Bisen, Anuragini Paunikar, Bharat Thakur, Anushka Garg and Khushbu Nangliya
Shri Ramdeobaba College of Engineering and Management, Nagpur, Maharashtra, India

A vital role is played by the media in the circulation of public information about the happenings. A fast spread of information using social media and social networks or websites is possible due to the quick development of the internet. With no worry about the reliability of the information, the misinformation is spread via social websites or networks and reaches multiple users. It is a very big challenge for society to deal with the spread of misinformation. The present research interest is the analysis of instinctive credibility of the news articles. For linguistic modeling, LSTM (Long Short-Term Memory), RNN (Recurrent Neural Network), etc. are widely utilized deep learning models. This paper presents a Bidirectional LSTM (BiLSTM) based sequential model for the detection of fake news. The proposed model uses word embeddings for the representation of words in high dimensional vector format. These word embeddings and Bidirectional LSTM tries to incorporate more semantic information of the content than that of RNN and unidirectional LSTM. 3 different publicly available datasets from Kaggle dataset repository are combined together for training, testing and validation of the proposed model. Along with this, the performance of different word embeddings is analyzed in this paper.

Keywords: Natural Language Processing (NLP), Bidirectional Long Short-term Memory (BiLSTM), Global Vectors for word representation (GloVe), word embeddings.

1. INTRODUCTION

In this digital world, it is very common for people to read news from news articles available online or via social media networks such as WhatsApp, Facebook, Twitter, etc. Not each one of them is reliable. There is a wide spread of hoaxes. Fake news is misleading, provides wrong information, wrong perception. It can be created by modification of the existing news articles, adding some misleading information or adding photos, videos to the existing news article. This misinformation can lead to various problems in the sectors like health, sports, politics as well as science. Spread of misinformation on Whatsapp is one such occurrence that led to mob lynching across India in 2018. This resulted in harmful attacks among the people and created a severe condition in the country that led WhatsApp to limit forward messaging features for up to five people at a time in India, which was implemented globally afterwards. Recently, misleading information in regards to novel coronavirus was circulated widely across the world. There is a need for a mechanism which will aid the user to determine whether a news article is fake or real. We have described a bidirectional LSTM based sequential model for the classification of news as real or fake. Four different word embeddings - glove.6B.300d, glove.840B.300d, google pre-trained word vectors and gensim custom word2vec model are used and the comparison of the performance of these four different word embeddings with our model is analyzed to find the best fit for our model.

2. RELATED WORK

Narayan et al. [2021] proposed a model that uses a hybrid of DNN (Deep Neural Network) and stacked LSTM (Long Short-Term Memory) for fake news identification. They used two different datasets which were retrieved from Kaggle dataset repository. The authors applied the machine learning model on both the text attribute and the combination of title and text attribute. They used word embeddings of Glove 300d for representation of words in high dimensional vector format. They performed 3 different evaluations. The first evaluation is done on the model which was the hybrid of DNN and stacked LSTM applied only on the text attribute. The second evaluation

is performed on same previous model but this time it was applied on the combination of title and text attribute. The third evaluation is done on the Convolutional Neural Network (CNN) model which is applied only on the text attribute. Out of these evaluations they found that model which was the hybrid of DNN and stacked LSTM gave better performance than others. This model gave the accuracy of 91.16% on Fake or Real dataset (Kaggle) and 97.05% accuracy on Fake News dataset (Kaggle).

Yesugade et al. [2021] proposed a model based on LSTM, NLP and word embeddings. They used one hot representation as the embedding techniques for their proposed model. Various techniques like stop word removal, one hot representation, padding, tokenization, have been used in order to get better results. The authors proposed the sequential model containing the following layers – the embedding layer, the LSTM layer with 100 neurons and then the dense layer with sigmoid activation function. They used Adam optimizer for adaptive estimations. Their proposed model gave the accuracy - 91.05%

Agarwal et al. [2020] proposed a model which is combination of CNN and RNN architecture with word embeddings of Glove 100d. The model is formed by combining the layers of RNN and CNN. Their proposed model provided accuracy - 94.71 %. Jain et al. [2019] came up with a model having three main modules namely- Aggregator, News authenticator and News suggestion/ Recommendation System. They combined Naïve Bayes classifier, Support Vector Machines. Their model gave the accuracy of 93.50%.

3. PROPOSED MODEL

Outline of the proposed methodology in this paper is demonstrated in Figure 1. It focuses on various steps involved starting from processing the dataset till finding the accuracy of the proposed model.

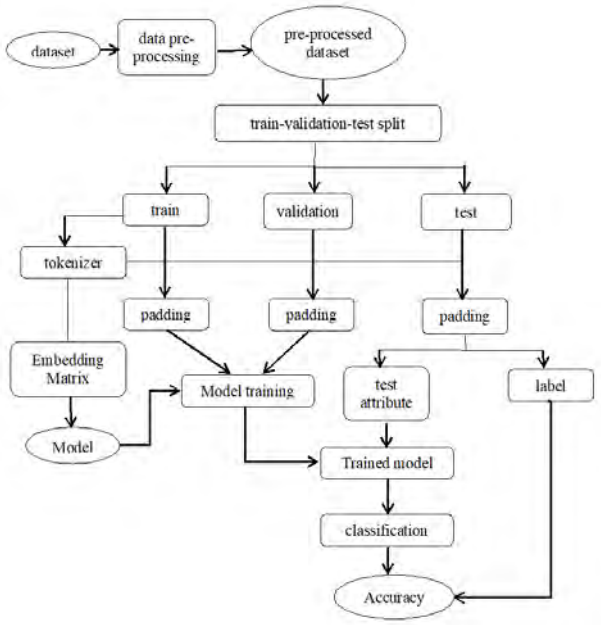


Figure 1. Outline of Proposed Methodology

3.1 Dataset used

For this study, three datasets have been retrieved from the "Kaggle" dataset repository. The first dataset is Fake news dataset. It consists a total of 25403 instances out of which 20203 instances were for training and 5200 instances were for testing. The second dataset is Fake and real news dataset. A total of 44898 instances were collected after preprocessing, out of which 23481 instances were labelled as fake and 21417 instances were labelled as real. The third dataset is fake/real-news-source-dataset-self-prepared. A total of 56386 instances were collected after preprocessing with approximate 50% instances being fake news instances and remaining being real news instances. The instances from these three datasets are combined together by dropping the NA values and a total of 1,26,499 instances were formed. The text of title and text columns of each instance were concatenated together for getting the final dataset.

3.2 Data Preprocessing

Before training the model, the data needs to be pre-processed. This is because the textual data consists of various extraneous characters and unwanted information that does not add to the context of the textual data. For preprocessing of data we performed - removal of punctuations, conversion of text into lowercase, removal of stop words and lemmatizatino.

3.3 Train Validation Test Split

After data is pre-processed, the entire combined dataset of 126499 instances is split into 3 parts for training, testing and validation. Table 1. gives the split distribution information.

Split Type	**%split**	**No. of Instances**
Train	60 %	75899
Validation	20 %	25300
Test	20 %	25300

Table I: Train validation test split distribution

3.4 Tokenization and Padding

The tokenizer object is created which is fitted on the corpus of the training data. After this, the tokenizer is applied on training, validation and testing data to convert the input word sequences into the integer sequences. After this, padding is applied on them. The corpus length is irregular among the instances in the dataset. For example: 250, 500, 1000, etc. This leads to irregular shape of the input matrix. The input matrix which is provided to the model for training and evaluation should be a square matrix where each row is having same length or entries. In order to ensure this, padding is done.

3.5 Word Embeddings

Word embedding is used to represent the word in high dimensional denser vector of floating-point values. They are responsible for extracting features from input text data, which is then provided as input to machine learning model. Other NLP techniques like TF-IDF, Bag of Words, Count Vectorizer depends on the word count in the sentence but are not capable of saving the semantic information of the text. But contradiction to this, word embeddings try to preserve the semantic information of the textual data. Following word embedding techniques are used for our model.

(1) **GloVe** - Global Vectors for word Representation is used to retrieve the vector representation for words. It was proposed by Stanford in 2014 by Pennington et al. [2014]. It makes use of unsupervised learning and is trained on various huge corpuses. It is quite popular for representation of words in the form of vector. Following two pre-trained word vectors are used in this thesis.

(a) **glove.6B.300d** – This word embedding is trained on corpuses like Wikipedia 2014 and Gigaword 5. It has 6B tokens, along with 400k vocab, which is uncased. It is represented as 300 dimensional vectors.
(b) **glove.840B.300d** - It is trained on Common Crawl corpus. It is represented as 300 dimensional vectors. It has 840B tokens, along with 2.2M vocab, which is cased.

(2) **Word2vec** - This embedding technique was published in 2013 by google. It is used to represent the words in high dimensional vector space. Two main learning algorithms are used for training this model – CBOW and skip gram. Following two versions of word2vec were used in this thesis in addition to that of GloVe.
(a) **Google pre-trained word vectors** – This word embedding is trained on corpus of Google News dataset. This google news dataset is having around 100 billion words. The pre-trained vectors consists of 3 million words which is represented as 300 dimensional vectors.
(b) **Word2vec (genism)** - This module of genism uses the same algorithms of CBOW and skip gram and is not pre-trained and is trained on runtime. Instead of using the pre-trained vectors we can also train the word2vec model on runtime on local corpus in the dataset that we are using. This is customized word2vec model.

3.6 Proposed Model

Figure 2 demonstrates arrangement of the layers added in our proposed model.

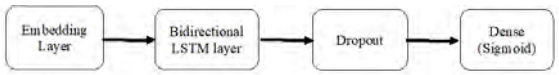


Figure 2. Workflow diagram of bidirectional LSTM

(1) **Embedding layer**
The embedding matrix obtained from the pre-trained word vectors or customized word2vec model is given as input to this layer. Being the first hidden layer of the (any) neural network, it deals with textual data in our model. This layer is responsible for passing the information about whatever this layer has learnt about the input data to the subsequent layers. It gives the high dimensional dense representation of the vocabulary retrieved from the tokenizer.

(2) **Bidirectional LSTM layer**
This layer consists of a Bidirectional LSTM model with 300 neurons. Bidirectional LSTM has the capability to recognize the patterns.

(3) **Dropout layer**
A dropout of 0.2 is added to the sequential model. This dropout layer is important in order to deal with the issue of model overfitting / underfitting.

(4) **Dense layer**
In order to minimize the dimension of the layer, the dense layer is added. Dimension of this layer is 1 i.e., it consists of 1 neuron and it uses sigmoid as its activation function.

Our proposed model is compiled with binary cross entropy loss function. This function calculates the cross-entropy loss between the classes that are predicted and the true classes. The optimizer used for compiling this model is RMSprop. The reason for selecting RMSprop as an optimizer for our model is discussed in the results and discussion section of this paper.

4. RESULTS

For better performance we performed an analysis on the two padding techniques and different optimizers. From Figure 3, it is clearly visible that we got highest accuracy for the pre padding technique at epoch 7. Similarly, out of the three optimizer Adam, Nadam, RMSProp that are widely used optimizers for neural networks, our model gives highest accuracy for RMSProp optimizer which can be seen from Figure 4. Figure 5 summarizes the validation accuracies recorded during each epoch for the bidirectional LSTM based sequential model with same architecture but different word embeddings provided to the embedding layer of the model. Each model is trained for up to 10 epochs. From Figure 5, it is clearly evident that the bidirectional LSTM based sequential model with embedding matrix created by word2vec genism on local corpus i.e., custom word2vec model achieved highest validation accuracy at epoch 5.

Table II summarizes the performance evaluation results of proposed model with different embedding techniques on testing dataset. The model with pre-trained glove word vectors having 6B tokens achieved 96.74% accuracy while for 840 B tokens it was 96.57%. For word2vec embeddings, the pre-trained google word vectors gave 96.47% accuracy while the custom word2vec word embedding model which was trained on local corpus that is training dataset gave the highest accuracy – 97.07%. Also, the loss that was recorded for this custom word2vec was the lowest of all.

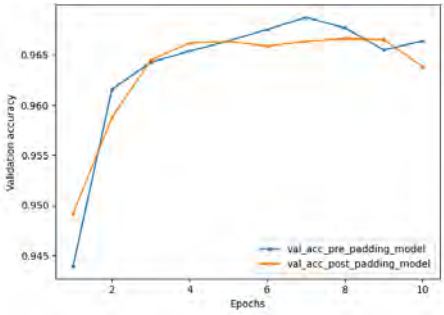


Figure 3. Comparison of validation accuracies of the two padding techniques

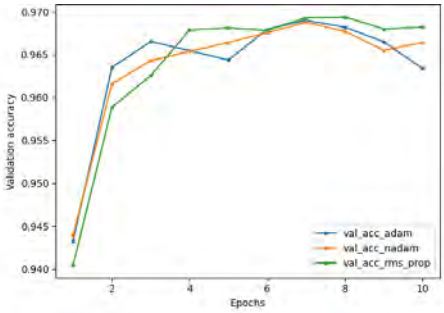


Figure 4. Comparison of validation accuracies of of different optimizers

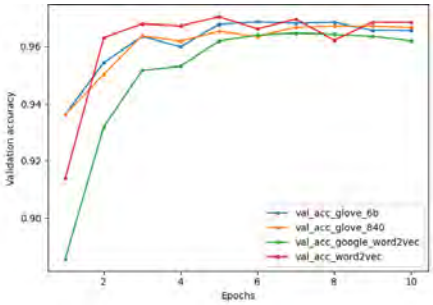


Figure 5. Comparison of validation accuracies of different embedding techniques.

5. CONCLUSION AND FUTURE WORK

News is an important part of our day-to-day life. Various open-source platforms are available on the internet for spreading the news. It is essential to build a mechanism that can identify the fake news to minimize the spread of hoaxes. We compared various word embedding techniques.

Word Embedding	Accuracy	Precision	Recall	F1-Score	loss
GloVe 6B	0.96739	0.96929	0.95871	0.96363	0.10733
GloVe 840B	0.96569	0.96847	0.95605	0.96191	0.13601
Google word2vec (pre-trained)	0.96470	0.96212	0.96037	0.96092	0.09974
Word2vec (custom)	0.97067	0.96414	0.97173	0.96766	0.09611

Table II: Performance evaluation of bidirectional LSTM based sequential model with different word embeddings

A crucial role is played by the embedding layer in this model. Bidirectional LSTM is better than LSTM in terms of incorporating semantics of the content. But bidirectional LSTM is computationally more expensive than ordinary LSTM. From the analysis that we have done, we figured out that the use of Bidirectional LSTM with the word2vec embedding technique gave better performance than the other embedding techniques with 97.07% accuracy. Our proposed model is effective due to the use of bidirectional LSTM and word embeddings as it incorporates more semantic information about the content.

The results achieved can be further increased by augmenting and increasing the training dataset in order to incorporate more patterns. Currently our model is working on textual data but it can also be extended for other datasets that contain media like images, videos, etc. This paper has its major focus on the binary classification (real / fake) of the content of the news. However, this can be further extended for classifying the news into multiple classes. Studies can be further extended to explore some of the advanced machine learning and NLP techniques like use of ensemble methods, BERT, etc.

References

Agarwal, A., Mittal, M., Pathak, A., and Goyal, L. M. 2020. Fake news detection using a blend of neural networks: An application of deep learning. In *SN Computer Science*. Springer Nature, https://doi.org/10.1007/s42979-020-00165-4.

Bahad, P., Saxena, P., and Kamal, R. 2019. Fake news detection using bi-directional lstm-recurrent neural network. In *Procedia Computer Science Volume 165*, P. Nithyanandam, R. Parvathi, R. Kannan, and A. N. Khan, Eds. IEEE, https://doi.org/10.1016/j.procs.2020.01.072, 74–82.

Bharadwaj, P. and Shao, Z. 2019. Fake news detection with semantic features and text mining. *International Journal on Natural Language Computing (IJNLC) Vol.08,* No.03.

Jain, A., Shakya, A., Khatter, H., and Gupta, A. 2019. A smart system for fake news detection using machine learning. In *International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT)*. IEEE, 10.1109/ICICT46931.2019.8977659, pp. 1–4.

Kong, S. H., Tan, L. M., Gan, K. H., and Samsudin, N. H. 2020. Fake news detection using deep learning. In *IEEE 10th Symposium on Computer Applications Industrial Electronics (ISCAIE)*. IEEE, 10.1109/ISCAIE47305.2020.9108841, pp. 102–107.

Narayan, U., Kumar, A., and Kumar, K. 2021. Fake news detection using hybrid of deep neural network and stacked lstm. In *2021 3rd International Conference on Advances in Computing, Communication Control and Networking (ICAC3N)*. IEEE, 10.1109/ICAC3N53548.2021.9725519, pp. 385–390.

Pennington, J., Socher, R., and Manning, C. 2014. GloVe: Global vectors for word representation. In *Proceedings of the 2014 Conference on Empirical Methods in Natural Language Processing (EMNLP)*. Association for Computational Linguistics, Doha, Qatar, 1532–1543.

Yesugade, T., Kokate, S., Patil, S., Varma, R., and Pawar, S. 2021. Fake news detection using lstm. *Certified Journal International Research Journal of Engineering and Technology (IRJET) Vol.08,* No.04.

Prof. Wani H. Bisen is the Assistant Professor in Ramdeobaba College of Engineering and Management, Nagpur, 440013 besides pursuing Ph.D from RCOEM, Nagpur. Her research interest is Natural Language Processing. Prior to joining RCOEM, Nagpur she has worked in VJTI, Matunga, Mumbai as an Assistant PRofessor for 2 Years. She has teaching experience of 5 Years. She has published 3 Research Papers (1 Socpus, 1 International Journal, 1 National Conference). She has received Best Paper Award in the National Conference in 2016 held in GHRIETW, Nagpur.
E-mail: bisenwh@rknec.edu

Anuragini Paunikar is a final year student at Shri Ramdeobaba college of Engineering and Management, Nagpur. She is pursuing her Bachelor's of Engineering degree in Computer science and Engineering. Her research interests include Machine learning, Deep learning and Image processing.
E-mail: paunikarar@rknec.edu

Bharat Thakur is a final year student at Shri Ramdeobaba college of Engineering and Management, Nagpur pursuing his Bachelor's degree in Computer science and Engineering. His research interests include Machine learning, Deep learning and Image processing.
E-mail: thakurba@rknec.edu

Anushka Garg is a final year student at Shri Ramdeobaba college of Engineering and Management, Nagpur. She is pursuing her Bachelor's of Engineering degree in Computer science and Engineering. Her research interests include Machine learning, Deep learning and Image processing
E-mail: gargav@rknec.edu

Khushbu Nangliya is a final year student at Shri Ramdeobaba college of Engineering and Management, Nagpur. She is pursuing her Bachelor's of Engineering degree in Computer science and Engineering. Her research interests include Machine learning, Deep learning and Image processing
E-mail: nangaliyakm@rknec.edu

Employing Biomedical Signals as a Means of Biometric Identification

Janmejay Rathi, Henay Lakhwani, Nachiket Kulkarni, Somya Ramani and Vasundhara Rathod,
Shri Ramdeobaba College of Engineering and Management, Nagpur, India.

In modern society, different identification and verification methods are being used, and everyone finds that security is a top concern. Traditional methods like passwords and hardware tokens may be lost or stolen, resulting in identification failure. Therefore, we require reliable and robust human recognition techniques. Using electroencephalography (EEG), person identification systems can be robust, anti-spoof, and efficient. This paper aims to develop an efficient deep-learning model for person identification using EEG signals. We proposed a deep learning model using a 1D Convolutional Neural Network (CNN) and stacked Long Short-Term Memory (LSTM) separately. The effective dataset DEAP was used for evaluating the proposed method. The proposed models were trained on the first 10 seconds of EEG data (60 seconds long) and tested on random 10 seconds of data from the remaining part of the data. The results indicate that stacked LSTM slightly outperformed 1D CNN with up to 99.97% accuracy with just eight data channels (out of 64 channels) and 15 subjects. The comparative analysis between parameters like the number of channels used, the length of data used for training and testing, and the number of subjects indicates that stacked LSTM outperforms 1D CNN as RNNs can remember certain features of time-series data better than CNN.

Keywords: Electroencephalogram (EEG), Electrocardiogram (ECG), Electromyography (EMG), Biometrics, Anti-spoof, Convolutional Neural Network (CNN), Recurrent Neural Network (RNN), Long Short Term Memory (LSTM), Gated Recurrent Unit (GRU), Deep Learning, Neural Networks.

1. INTRODUCTION

In modern society, different identification and verification methods are being used, and everyone finds that security is a top concern. Traditional methods like passwords and hardware tokens may be lost or stolen, resulting in identification failure. Therefore, we require reliable and robust human recognition techniques. We will use biometric authentication technology as other security measures are open to breaches. Biometrics provides increased assurance of a person's identity and is hard to replicate. It is a type of security process that verifies the identity of a user via their biological attributes such as fingerprints, faces, iris, and voices. DNA, and genes. However, ECG/EEG/EMG signals are the most reliable of all these traits. The others are prone to spoofing attacks, i.e., someone can falsify the data, which can be quickly taken/stolen without a person's consent, but EEG signals would make it difficult to do so.

Human identification has been in huge demand today, specifically for security-related purposes. The traditional identification methods are not secured as they could be mimicked or reconstructed. So, there is an urgent need for some high-security system, which our paper gives a solution to. It considers EEG signals as an identification method. These are highly secure and unique signals. They are hard to imitate as they measure an individual's brain-related activities/tasks.

The main objective of this paper is to study EEG signals for making an efficient biometric identification system, analyze and classify these biomedical signals based on different numbers of channels used for training and testing, and compare the proposed models, which are a 1D CNN and a stacked LSTM.

The method used to train and test the models might help us understand the real-life feasibility of the project since the EEG signals are unique every second we live. The method and model used can be implemented using low-cost equipment, will be robust, and anti-spoof.

2. BACKGROUND AND RELATED WORK

Electroencephalography (EEG) is a method of recording an electrogram of the electric activity at the scalp level. EEG is mostly used to detect epilepsy, which generates abnormalities in EEG data. As anatomical imaging tools like magnetic resonance imaging (MRI) and computed tomography (CT) emerged, EEG's use as a primary method of investigation for tumors, strokes, and other localized brain issues has diminished. In Fan et al. [2021], a personal identification system was proposed in this paper using resting state EEG. Dataset used was the PhysioNet dataset and had resting state EEG signals. Also, the sliding window protocol was used for the preprocessing and augmentation of these signals. The results stated that the sliding window performed better than the fixed window. Different sliding window schemes were used. This system has the advantages of low computational complexity and rapid deployment using market-available low-cost EEG sensors. In Wilaiprasitporn et al. [2019] proposed a model in which CNNs and RNNs were both combined. The proposed GRU model outperformed the previously worked SVM and LSTM approaches and gave an accuracy of 99.90% mean CRR with 32 and 99.17% CRR with five electrodes. Also, the SVM approach improves significantly when focused on specific EEG frequency bands like theta (4–8 Hz) and alpha (8–15 Hz). In Rehman et al. [2019]they used a hybridization approach of different features and RBF-NN, i.e., Radial basis Function Neural network. Three hybrid features were extracted from these signals, i.e., wavelet entropy, entropy, and ARIMA coefficients, and passed to RBF-NN for person identification.

3. PROPOSED MODEL ARCHITECTURE

We have used the 1D-CNN and Stacked LSTM machine learning models on the EEG dataset to predict the person. In Convolutional Neural Network (CNN), we have used the 1-D CNN model because it can learn and extract features from the data sequences and knows how to map those internal features to different subjects. They have a strong ability for EEG signal feature extraction and learning from it.

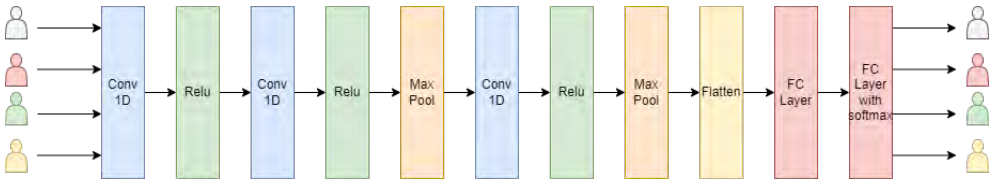


Figure 1. Proposed CNN model with 3 Conv1D layers

Long short-term memory (LSTM) is an RNN architecture of deep learning, and the most powerful tool to learn from sequential data and time series data is a particular case of that. LSTM is also able to memorize and recognize previously scanned sequential data. Here the proposed model is stacked LSTM where we have used two layers of LSTM. At every time step of an LSTM, if the input is already the result from an LSTM layer (or a feedforward layer), then the current LSTM layer can create a more complex feature representation of the existing data input.

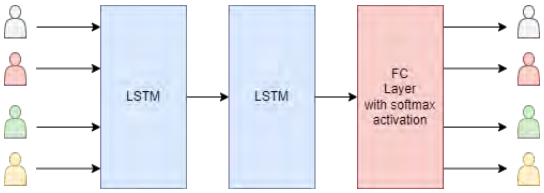


Figure 2. Proposed Stacked LSTM model with 2 LSTM layers

4. METHODOLOGY

4.1 Dataset

The data of Goldberger et al. [2000], Schalk et al. [2004] of EEG Motor Movement/Imagery Dataset consists of over 1500 one-minute and two-minute EEG recordings, obtained from 109 volunteers.

From this dataset, we have trained our model using the baseline data of the subject when his eyes are open. To maintain the data's original information and to gain the most insight into EEG properties, filtering operations are not performed on the data. The sampling rate of the data is 160 Hz i.e. in each second the data has 160 points plotted and thus the size of the numpy array will be 64 x 9600 for 1 minute of data (160 x 60 = 9600) and since there are 64 channels in EEG machine. In figure 3, you can visualize how the EEG data looks when plotted for an interval of 10 sec by using a 64 channel EEG device for a particular person.

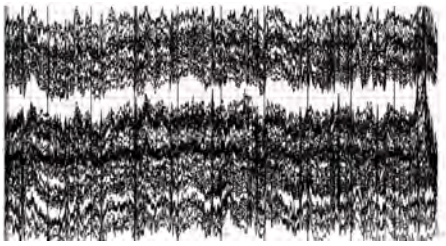


Figure 3. EEG data for 10 sec of a subject with 64 channels

4.2 Proposed Methodology

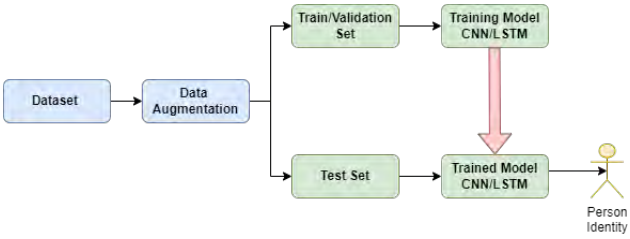


Figure 4. Proposed Methodology

4.2.1 *Data Preprocessing.*

First, the resting state EEG data used here are converted from .edf files to .npz files using python MNE and NumPy libraries to train the model upon EEG signals. After this conversion, we get a NumPy array of a subject of size 64x9600 since the data comprises 64 EEG channels and, since the EEG signal is 1 minute long, i.e. 60 seconds with a sampling frequency of 160 Hz, which gives us a total of 9600 data points. Further, no pre-processing was done on the data to preserve its original information and to learn EEG features as much as possible.

4.2.2 *Train-Validation-Test Split.*

For training and testing, the first 1.5 seconds (250 data points per subject) of data and the first 10 seconds (1600 data points per subject) out of 60 seconds separately are used to see whether it gives a significant difference. And since the aim is to make the model efficient and robust, these timeframes out of 60 seconds are chosen since training the model on whole data will take high computation power and time to get trained.

While dividing the dataset into train, validation and test sets, the number of channels and upon what channels the model has to be trained is also selected. For training and validation sets, first, the data's 1.5 seconds (250 data points per subject) and the first 10 seconds (1600 data points per subject) out of 60 seconds separately are selected and divided into train and validation sets with a 70:30 ratio randomly.

For test sets, 1.5 seconds (250 data points per subject) of data and the 10 seconds (1600 data points per subject) out of 60 seconds separately are randomly picked for each subject and form a test set for the accuracy and efficiency of the proposed model.

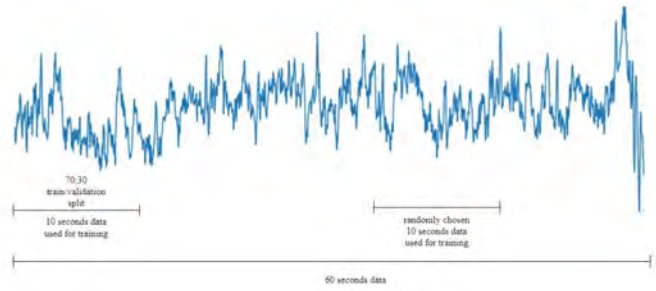


Figure 5. Dataset Split (Train/Validation/Test Split)

4.2.3 *Model Training and Testing.*

The proposed models are trained on various sets of channels including 6, 8, and 14 channels (marked in figure 6.) upon 1.5 seconds (250 data points per subject) of data and the first 10 seconds (1600 data points per subject) out of 60 seconds separately. Also, the proposed model is trained on different numbers of subjects i.e. 15 and 100 subjects. In figure 6, the channels marked with the red circles are 6 useful channels, channels marked with the green circles are 8 useful channels and together the red and green channels account for the 14 most useful channels out of 64. The channels which are not marked are not used.

Following are the models upon which the proposed model is trained and tested: [15 subjects, 6 channels, and 250 data points (1.5 sec)], [15 subjects, 8 channels, and 250 data points (1.5 sec)], [15 subjects, 14 channels, and 250 data points (1.5 sec)], [15 subjects, 6 channels, and 1600 data points (10 sec)], [15 subjects, 8 channels, and 1600 data points (10 sec)], [15 subjects, 14 channels, and 1600 data points (10 sec)], [100 subjects, 8 channels, and 250 data points (1.5 sec)], [100 subjects, 8 channels, and 1600 data points (10 sec)].

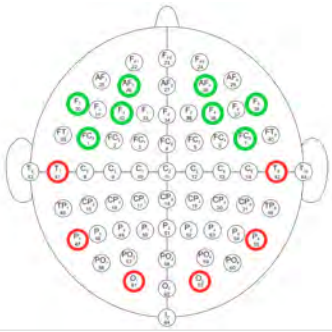
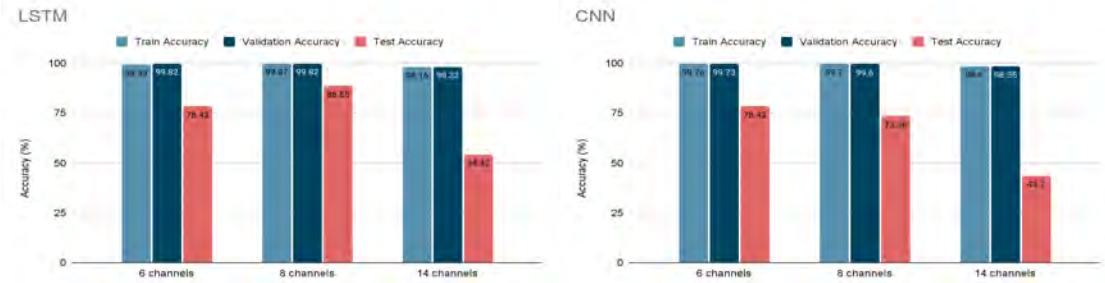


Figure 6. Position of electrodes on the scalp with their corresponding channels

5. RESULT AND DISCUSSION

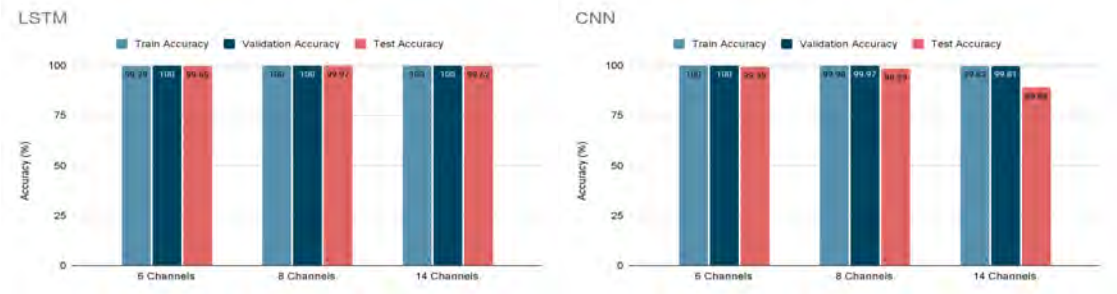
5.1 Results and Accuracy

Figure 8. shows the graph for the accuracy of 15 subjects and 1600 data points per subject (10 seconds) and its comparison between different channels used. Figure 9 shows the graph for the accuracy of 100 subjects on 250 and 1600 data points per subject and with 8 channels.



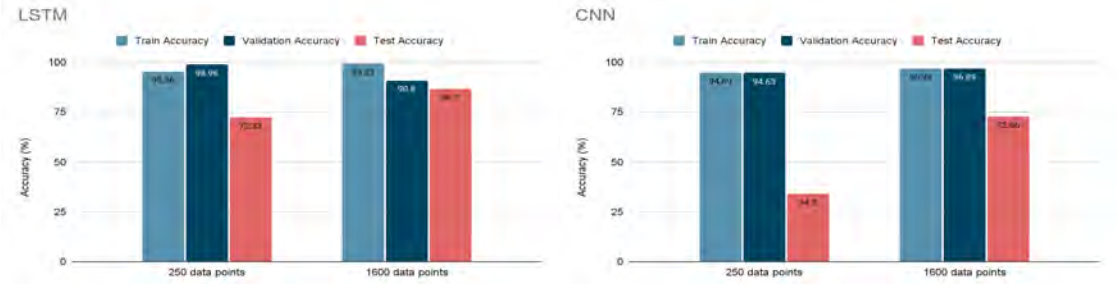
(a) LSTM (b) CNN

Figure 7. Graph for accuracy of models with 6, 8, and 14 channels on 15 subjects and 250 data points



(a) LSTM (b) CNN

Figure 8. Graph for accuracy of models with 6, 8, and 14 channels on 15 subjects and 1600 data points



(a) LSTM (b) CNN

Figure 9. Graph for accuracy of models with 6, 8, and 14 channels on 15 subjects and 1600 data points

5.2 Discussion

The results of the proposed 1D-CNN and Stacked LSTM based authentication system are compared with some of the state-of-the-art EEG-based authentication systems. Fraschini et al. [2014] used the Physionet EEG motor Movement/Imagery dataset for evaluating the performance of the proposed biometric system and proposed the use of eigenvector centrality of EEG signals as features to distinguish different subjects. They achieved an accuracy of 92.60% and EER of 4.40% with 12-second EEG signals for feature extraction. Similarly, Arnau-Gonzalez et al. [2017] and Mao et al. [2017] also proposed the use of CNN for user authentication, achieved accuracies of 94.01% and 97.00% using DREAMER and BCIT Experiment Baseline Driving EEG datasets respectively. In addition to these models, there is one more model proposed by Sun et al. [2019] in which CNN authentication system was applied to the Physionet EEG dataset and accuracy was 98.87%. Our proposed model outperforms other previous approaches as it gave an accuracy of 99.35% with CNN which required only 6 EEG channels and 99.97% with LSTM which required only 8 channels.

6. CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

One of the high-level security developments today is employing EEG signals as biometric identification. In today's world, we regularly see that biometric identification methods such as fingerprints, face recognition, iris scanning techniques, and other techniques can be falsified easily and are an excellent threat in terms of security. Using EEG signals in biometric identification guarantees that they cannot be forged or predicted. As a result, the proposed model is highly efficient and uses comparatively less computational power than the existing research. For 15 subjects, we achieved 99.97% test accuracy using the LSTM model and 99.35% with the CNN model

with 10 seconds of data for each subject and using just eight channels, which is remarkable. For 100 subjects, we achieved 86.7% test accuracy using the LSTM model and 72.67% test accuracy using the CNN model with 10 seconds of data for each subject and using just eight channels.

6.2 Future Scope

The possible work that can be done in future includes training and testing on more extensive data with more number of subject, implementing transfer learning between 1D-CNN and stacked LSTM for better performance, implementing it with the real-time EEG data for a real-life biometric identification system and achieving increased security level.

References

Arnau-Gonzalez, P., Katsigiannis, S., Ramzan, N., Tolson, D., and Arevalillo-Herrez, M. 2017. Es1d: A deep network for eeg-based subject identification. In *2017 IEEE 17th International Conference on Bioinformatics and Bioengineering (BIBE)*. IEEE, 81–85.

Fan, Y., Shi, X., and Li, Q. 2021. Cnn-based personal identification system using resting state electroencephalography. *Computational Intelligence and Neuroscience 2021*.

Fraschini, M., Hillebrand, A., Demuru, M., Didaci, L., and Marcialis, G. L. 2014. An eeg-based biometric system using eigenvector centrality in resting state brain networks. *IEEE Signal Processing Letters 22,* 6, 666–670.

Goldberger, A. L., Amaral, L. A., Glass, L., Hausdorff, J. M., Ivanov, P. C., Mark, R. G., Mietus, J. E., Moody, G. B., Peng, C.-K., and Stanley, H. E. 2000. Physiobank, physiotoolkit, and physionet: components of a new research resource for complex physiologic signals. *circulation 101,* 23, e215–e220.

Mao, Z., Yao, W. X., and Huang, Y. 2017. Eeg-based biometric identification with deep learning. In *2017 8th International IEEE/EMBS Conference on Neural Engineering (NER)*. IEEE, 609–612.

Rehman, U. u., Kamal, K., Iqbal, J., and Sheikh, M. F. 2019. Biometric identification through ecg signal using a hybridized approach. In *Proceedings of the 2019 5th International Conference on Computing and Artificial Intelligence*. 226–230.

Schalk, G., McFarland, D. J., Hinterberger, T., Birbaumer, N., and Wolpaw, J. R. 2004. Bci2000: a general-purpose brain-computer interface (bci) system. *IEEE Transactions on biomedical engineering 51,* 6, 1034–1043.

Sun, Y., Lo, F. P.-W., and Lo, B. 2019. Eeg-based user identification system using 1d-convolutional long short-term memory neural networks. *Expert Systems with Applications 125*, 259–267.

Wilaiprasitporn, T., Ditthapron, A., Matchaparn, K., Tongbuasirilai, T., Banluesombatkul, N., and Chuangsuwanich, E. 2019. Affective eeg-based person identification using the deep learning approach. *IEEE Transactions on Cognitive and Developmental Systems 12,* 3, 486–496.

Janmejay Rathi is a Final Year student at Shri Ramdeobaba College of Engineering and Management, pursuing Bachelors of Engineering in Computer Science and Engineering. With a fascination for robotics, drones, and automated technology since high school, he delved into many robotics-related subjects, such as Artificial Intelligence and Machine Learning. He continued to learn as much as possible about Data Science, ML, and AI, by exhaustively pursuing numerous avenues like projects, competitions, research papers, and internships, leading his team on many occasions. The crowning jewels of his extracurricular activities were getting selected for the Amazon ML Summer School 2022, winning the 3rd position in the "Nasa Space Settlement Contest" conducted by NASA, and winning the 1st position in the drone competition. He plans to pursue a Master's degree in his field of interest, thus being surrounded by like-minded people and gaining more strong technical skills.
E-mail: rathiju@rknec.edu

Henay Lakhwani is a student in the 4th year of his undergraduate degree of B.E. in Computer Science and Engineering pursuing from Shri Ramdeobaba College of Engineering and Management, Nagpur. He is fascinated and passionate about technology, and during his first year of college, he found and explored the concept of machine learning. He continued to learn as much as possible about machine learning and data science by pursuing works like projects, competitions, and internships, leading his team on many occasions. He led a team of 4 students for an ML project in his 6th semester on "Employing biomedical signals as a means of biometric identification". Apart from this, he is a terrific designer, leading various tech and design communities in their city. He wants to work in the tech industry and wants to keep learning and exploring his interests.
E-mail: lakhwanihp@rknec.edu

Nachiket Kulkarni is a Final Year student at Shri Ramdeobaba College of Engineering and Management, pursuing Bachelors of Engineering in Computer Science and Engineering. His interest includes working on projects involving machine learning, deep learning, and artificial intelligence. He has completed his Internship as a web developer at Prima-Think Technologies Pvt. Ltd. He has been an active member of Nautanki The Drama Club and has worked for various events. His career objective is to work in a renowned IT company and strive for excellence by continuously growing in his domain and wants to learn new things.
E-mail: kulkarninp@rknec.edu.

Somya Ramani is a final year student at Shri Ramdeobaba College of Engineering and Management, pursuing Bachelors of Engineering in Computer Science and Engineering. Her interest includes working on projects involving machine learning and artificial intelligence. Besides this, she has worked on developing various websites as Front end developer. She has completed her internship as a React Developer under the guidance of Mr. Cyril Thomas. She was also a Technical Content Writer Intern at Gyaani Buddy for few months. She was a semi-finalist in a hackathon named Toycathon. She has been an active member of ACM and has worked for various events. Her career objective is to work in a renowned IT company and strive for excellence by continuously learning and growing in her domain.
E-mail: ramanism@rknec.edu

Vasundhara Rathod received her M.Tech. degree from VJTI, Mumbai, India, and Ph.D. degree from the Indian Institute of Information Technology, Nagpur, India. She is currently an Assistant Professor with the Department of Computer Science and Engineering, Ramdeobaba College of Engineering and Management, Nagpur, India. She has 8 years of academic experience. She has co-authored a number of research articles in various journals, conferences, and book chapters and has 1 published patent. Her research interests include bio-medical signal processing and machine learning.
E-mail: rathodv1@rknec.edu

Detection of Cloud Cover in Satellite Imagery Using Semantic Segmentation

Sanay Jaju, Mohit Sahu, Akshat Surana, Kanak Mishra, Aarti Karandikar
and
Dr. Avinash Agrawal
Shri Ramdeobaba College of Engineering and Management, Nagpur, M.S., India

Accurate detection of cloud cover is an important task in the field of Remote Sensing of the environment. Currently, a lot of development is going on in this field by using various methods. Some of the methods apply concepts of machine learning (ML) whereas some apply deep learning. Since the accuracy of ML being lower than deep learning, the latter is preferred. This paper also uses the method of deep learning to detect cloud cover using images of satellite. This paper proposes a modified U-Net based deep learning model for cloud cover detection in satellite images. The model proposed is not as accurate as the original model, but it compensates for it by reducing the time for learning. The accuracy of the model came out to be 89.73%.

Keywords: Semantic Segmentation, Cloud Detection, Satellite Image, Object Detection, Deep Learning

1. INTRODUCTION

Satellites generate lots of images each second from very high above the earth. Images are of different wavelength coverage for e.g., red color band image, blue color band Image, green color band image, Near Infrared (NIR) image, etc. The clouds in the images sensed remotely form a barrier for major portion of water bodies, land and many other atmospheric conditions according to Wang et al. [2019]. Also in Long et al. [2015], the authors have mentioned the hindrance clouds create by reducing the usefulness of the satellite images for studying the land, water bodies and forests, thereby creating a problem in monitoring the land underneath. Hence to detect the clouds in the satellite images is an important task and it is the step before it is processed in order to be used for the applications in remote sensing. With advancements in the technology of remote sensing, many satellites with data of high resolution are obtained. These images are used to do various kinds of analysis like assessment of crops, studying the marine activities, monitoring of land cover and other fields according to Francis et al. [2019]. Due to the presence of clouds in the images, there is hindrance to the aforementioned studies. Algorithms for cloud detection cannot compared on the basis of theory due to the different ad hoc techniques and even different characteristics and hence this has been a never stopping and advancing field of research as discussed in Frantz et al. [2018], Qiu et al. [2019], Diakogiannis et al. [2020], Zupanc [2017], Zhu and Woodcock [2014].

2. RELATED WORKS

In the field of remote sensing, many researchers have presented various models on various datasets that are available from different satellites like Landsat, Sentinel, and others. In Wang et al. [2019], they have proposed a model for the detection and removal of cloud and the shadows on the basis of simulated TOA radiance fields. They have detected clouds and its shadow and also were able to remove it. They use a simple way for removing clouds, which helps in showing the effectiveness of the proposed model. Their method of simple spectral threshold is an effective method offered in the detection of cloud and is known to be reliable and most popular approach. Clouds are hard to distinguish between ice and snow because of the temperatures being comparable in thermal

bands.
In Hagolle et al. [2017], the authors did comparison between various cloud detection model and algorithms from a viewpoint which was regional. They took the importance of monitoring of land changes in the Amazon Rainforest and hence picked the images of that region from Sentinel-2 MSI. The algorithms and methods for cloud detection they took were: Fmask [Diakogiannis et al. [2020]], MAJA [Zupanc [2017]], S2cloudless [Baetens et al. [2019]] and Sen2Cor 2.8 [Frantz et al. [2018]]. The approach in Baetens et al. [2019] is object-based annotation of image pixels and their respective class labels, that is, the algorithm is extracting the characteristic features from the objects, either whole or partial, that is existing in the images such as trees, cars or corners of buildings and assigning each pixel with the vector of probabilities of the class. In the field of research of computer vision, there are available many literatures which have covered up various modules which are used in convolutional neural networks that are based on the idea of "per object classification". Also, after the modelling of residual networks (He et al. [2015]), the training of the deeper neural networks was possible, which avoided the issues of vanishing gradients or exploding gradients to a great extent. The use of models based on residual networks have been done in Jaju and Chandak [2022].

3. METHOD AND MATERIAL

In this model we have used the already available U-Net Model and tuned it to cater our needs. We altered the model in order to enhance the output accuracy, lesser loss percentage, and a better Jaccard coefficient.

3.1 Semantic Segmentation

Semantic Segmentation is a method in computer vision that is used for identifying and labelling of image pixels for differentiating the different image regions. It is referred mostly to be image classification in remote sensing problems and when non-RGB images are semantically segmented, the applications can be seen in land cover classification, in urban planning or even in vegetation classification. There is a lot of study on going in computer vision and remote sensing, related to semantic segmentation as in Kemker et al. [2018], Laliberte et al. [2011]. According to Hua et al. [2022], semantic segmentation is one of the fundamental, out of the currently available technology, visual task which has not stopped attracting a lot of attention among the researchers of remote sensing and it has proved that it is advantageous in different tasks like traffic monitoring. Authors of Xu et al. [2021] defined it as an end-to-end image segmentation method that helps in predicting the pixel-level label map directly from the network. Also, the extraction of features in the network is done by a backbone that plays a chief role in the task of segmentation since the performance of the backbone affect the segmentation head and the "encoder" directly [Tian et al. [2019]]. The basic semantic segmentation here is carried out using the U-Net model. It is a semantic segmentation convolutional neural network model that has 2 phases: contraction and expansion.

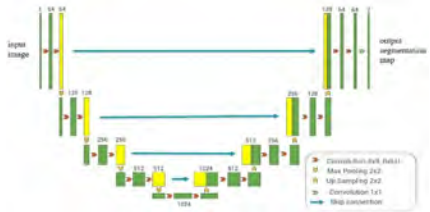


Figure 1. This is the U-Net architecture [Guo et al. [2020]]. The boxes in green and yellow are for the indication of the multi-channel feature maps, the down yellow arrows are for the max pooling which was used for dimension reduction, the up yellow arrows are for up-sampling which is used for retaining the original dimension and the right red arrows are for the indication of the 3*3 convolution used for extraction of features.

3.2 Model

We used U-Net; a model designed for semantic segmentation. The main motive behind using this model is to use the features that we extract and concatenate them to form the image again. This model was It uses a encode-decoder segmentation method which is symmetric in nature. In the contraction phase or the encoder, the input layer takes the input height, width and number of channels of the input image. The architecture of the basic U-Net model is shown in Figure 1. The left and the right half respectively represent the encoding and decoding paths.

3.3 Data Set

We used the dataset available in the Microsoft AI for Earth competition under the task named, "On Cloud N: Cloud Cover Detection Challenge". The challenge was to detect cloud in the images given in the dataset. The dataset contains images in four formats – the three individual colour bands RGB and a fourth NIR (Near InfraRed). The total number of images and the respective labels is 11748 each. The images are from the Sentinel-2 satellite which is stored as Geo-Tiffs [Zhu et al. [2017]]. Some of the images from the data set can be seen in Figure 2.

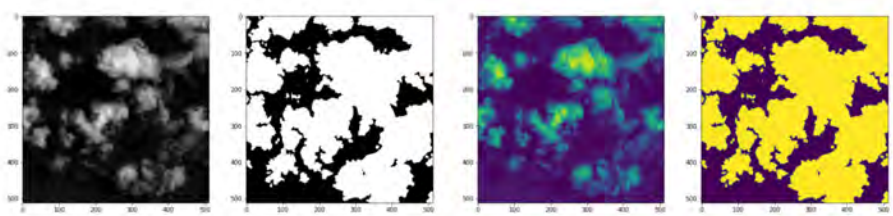


Figure 2. This is an example from the dataset that we have used. The first two images the black and white format of the image from the dataset with the left image being the actual image and the right image being the corresponding label. The third and fourth images are the RGB representation.

3.4 Jaccard Coeffiecient

We started with pixel accuracy, one of the best ways to test the accuracy in classification tasks. The formula requires four attributes, namely, True Positive (TP), True Negative (TN), False Positive (FP) and False Negative (FN). The formula is:

$$accuracy = \frac{\#TP + \#TN}{\#TP + \#TN + \#FP + \#FN} \tag{1}$$

However, as our task was binary semantic segmentation the pixel accuracy measure is not considered to be the best measure because there will always be one class that will be present in the majority, this class in our case is black pixels. So even if the model returns a completely black image the accuracy of the model will be really high. Hence Equation (1) could not be used. Instead, Jaccard Coefficient or IoU (Intersection over Union) can be used. It is a simple metric for measuring the model prediction. This metric uses predicted value and the actual value. The intersection of the predicted value and the actual value is divided by the union of the predicted value and the actual value. The formula for finding the same is as follow:

$$IoU = \frac{|A \cap B|}{|A \cup B|} \tag{2}$$

Where A is predicted pixels and B is actual pixels. A more precise formula, in the terms of TP, FN, and FP is expressed as

$$IoU = \frac{\#TP}{\#TP + \#FP + \#FN} \tag{3}$$

Since, Jaccard coefficient is closely connected to precision and recall both, hence it can calculate the likeliness between any two sets images.

3.5 Experiment Results

In the specified approach, we changed the model to take image input size as 512px*512px rather than the original 572px*572px and also the images are grayscale. The padding is specified as "same" so as to retain the size of the image. This is accomplished when the stride is 1. Padding "same" means we will be adding extra zeroes to the image so that more importance can be given to the edges. We have added the dropout layer to the U-Net model in between the 2 convolution layers in the down sampling or encoder phase. This process is repeated for all the 4 blocks as well as the last block before expansion that does not have the max pooling layer. The dropout layer is used to overcome the problem of overfitting (a condition in which the model gets used to the training dataset and is unable to give accurate results on the unseen or testing dataset). The dropout layers randomly remove a specified amount of neurons to lower down the computation cost of the model. The same dropout layers are added in the up sampling or the decoder phase. Also, the dropout helps in avoiding overfitting problem in the model.

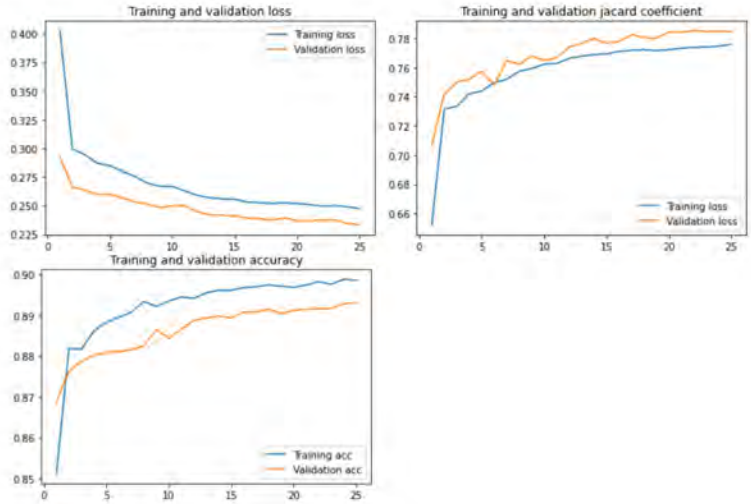


Figure 3. The top-left image is of the graph plotted for the calculated loss, the top-right image is of the graph plotted for the metric, Jaccard Coefficient and the bottom-left image is the graph plotted for accuracy.

4. CONCLUSION

Detection of cloud is a vital step for use of satellite imagery for further studies. It is just like the data pre-processing for images captured by satellite. The advancement in artificial intelligence has given rise to methods of deep learning in computer vision, image segmentation and object detection. In this paper, we have reworked the model and modified it so that we can retain a large portion of the values while keeping it low cost on the training setup. We worked with only

a 4GB VRAM graphics for the training, validation and prediction of this model. We also only used about 14GB of RAM or CPU, so that it could all be done on a laptop which has both the capabilities fulfilled. Also, we ran this code on Google Colab that one can use by logging into their accounts, and it also works fine enough while training the images. We also used Jaccard Coefficient as a metric for measurement other than training and validation accuracy and also the loss parameter was calculated which has been compiled in the figure. As the graphs show the values, we got accuracy while training as 89.73%, accuracy while validating as 88.69%, loss while training as 24.43%, loss while validating as 23.60% and the Jaccard coefficient as 78.43% in validation. All the values have been compiled in table I.

Table I: The values of Accuracy, Loss and Jaccard Coefficient

	Loss	**Accuracy**	**Jaccard Coefficient**
Training	24.43	89.73	77.79
Validation	23.60	88.69	78.43
Testing	27.37	88.76	80.55

References

Baetens, L., Desjardins, C., and Hagolle, O. 2019. Validation of copernicus sentinel-2 cloud masks obtained from maja, sen2cor, and fmask processors using reference cloud masks generated with a supervised active learning procedure. *Remote Sensing 11,* 4.

Diakogiannis, F. I., Waldner, F., Caccetta, P., and Wu, C. 2020. Resunet-a: A deep learning framework for semantic segmentation of remotely sensed data. *ISPRS Journal of Photogrammetry and Remote Sensing 162*, 94–114.

Francis, A., Sidiropoulos, P., and Muller, J.-P. 2019. Cloudfcn: Accurate and robust cloud detection for satellite imagery with deep learning. *Remote Sensing 11,* 19.

Frantz, D., Hass, E., Uhl, A., Stoffels, J., and Hill, J. 2018. Improvement of the fmask algorithm for sentinel-2 images: Separating clouds from bright surfaces based on parallax effects. *Remote Sensing of Environment 215*, 471–481.

Guo, Y., Cao, X., Liu, B., and Gao, M. 2020. Cloud detection for satellite imagery using attention-based u-net convolutional neural network. *Symmetry 12,* 6.

Hagolle, O., Huc, M., Desjardins, C., Auer, S., and Richter, R. 2017. Maja algorithm theoretical basis document. cnes, cesbio & dlr report ref maja-tn-wp2-030 issue 1.0.

He, K., Zhang, X., Ren, S., and Sun, J. 2015. Spatial pyramid pooling in deep convolutional networks for visual recognition. *IEEE Transactions on Pattern Analysis and Machine Intelligence 37,* 9, 1904–1916.

Hua, Y., Marcos, D., Mou, L., Zhu, X. X., and Tuia, D. 2022. Semantic segmentation of remote sensing images with sparse annotations. *IEEE Geoscience and Remote Sensing Letters 19*, 1–5.

Jaju, S. and Chandak, M. 2022. A transfer learning model based on resnet-50 for flower detection. *2022 International Conference on Applied Artificial Intelligence and Computing (ICAAIC)*, 307–311.

Kemker, R., Salvaggio, C., and Kanan, C. 2018. Algorithms for semantic segmentation of multispectral remote sensing imagery using deep learning. *ISPRS Journal of Photogrammetry and Remote Sensing 145*, 60–77. Deep Learning RS Data.

Laliberte, A. S., Goforth, M. A., Steele, C. M., and Rango, A. 2011. Multispectral remote sensing from unmanned aircraft: Image processing workflows and applications for rangeland environments. *Remote Sensing 3,* 11, 2529–2551.

Long, J., Shelhamer, E., and Darrell, T. 2015. Fully convolutional networks for semantic segmentation. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR).*

Qiu, S., Zhu, Z., and He, B. 2019. Fmask 4.0: Improved cloud and cloud shadow detection in landsats 4–8 and sentinel-2 imagery. *Remote Sensing of Environment 231*, 111205.

Tian, Z., He, T., Shen, C., and Yan, Y. 2019. Decoders matter for semantic segmentation: Data-dependent decoding enables flexible feature aggregation. *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*.

Wang, T., Shi, J., Letu, H., Ma, Y., Li, X., and Zheng, Y. 2019. Detection and removal of clouds and associated shadows in satellite imagery based on simulated radiance fields. *Journal of Geophysical Research: Atmospheres 124,* 13, 7207–7225.

Xu, Z., Zhang, W., Zhang, T., and Li, J. 2021. Hrcnet: High-resolution context extraction network for semantic segmentation of remote sensing images. *Remote Sensing 13,* 1.

Zhu, X. X., Tuia, D., Mou, L., Xia, G.-S., Zhang, L., Xu, F., and Fraundorfer, F. 2017. Deep learning in remote sensing: A comprehensive review and list of resources. *IEEE Geoscience and Remote Sensing Magazine 5,* 4, 8–36.

Zhu, Z. and Woodcock, C. E. 2014. Automated cloud, cloud shadow, and snow detection in multitemporal landsat data: An algorithm designed specifically for monitoring land cover change. *Remote Sensing of Environment 152*, 217–234.

Zupanc, A. 2017. Improving cloud detection with machine learning. *Accessed: Oct 10*, 2019.

Sanay Jaju is a student in his final year in Computer Science and Engineering department, Shri Ramdeobaba College of Engineering and Management, Nagpur, India.
E-mail: jajuss@rknec.edu

Mohit Sahu is a student in his final year in Computer Science and Engineering department, Shri Ramdeobaba College of Engineering and Management, Nagpur, India.
E-mail: sahums1@rknec.edu

Akshat Surana is a student in his final year in Computer Science and Engineering department, Shri Ramdeobaba College of Engineering and Management, Nagpur, India.
E-mail: suranaaa@rknec.edu

Kanak Mishra is a student in her final year in Computer Science and Engineering department, Shri Ramdeobaba College of Engineering and Management, Nagpur, India.
E-mail: mishrak@rknec.edu

Prof. Aarti Manish Karandikar is an Assistant Professor in department of Computer Science and Engineering, Shri Ramdeobaba College of Engineering and Management, Nagpur, India. She has completed her B.E. and M.Tech in Computer Science and Engineering and is also pursuing her Ph.D. She has a teaching experience of over 18 years. Her subject of specializations are Data Warehousing and Mining and Data Science.
E-mail: karandikara@rknec.edu

Dr. Avinash Agrawal is, at the time of writing this paper, the Head of Department, Computer Science and Engineering, Shri Ramdeobaba College of Engineering and Management, Nagpur, India. He has completed his B.E. and M.Tech in Computer Science and Engineering and also has been awarded with Ph.D. He has a teaching experience of over 24 years. His subject specializations are Information Retrieval, NLP, Pattern Recognition Compiling for High Performance Architecture, Language Processors, Artificial Intelligence, Theoretical Computation, Mobile Application Design.
E-mail: agrawalaj@rknec.edu

Computerized System to Audit and Sharing Feature of Medical Life History

Bhagyashree Hambarde and Priya Parkhi
Shri Ramdeobaba College of Engineering and Management, Nagpur

Rapid technological evolve brings grate changes. As technology advances it replaces the old way of working or doing things. With the electronic format of paper work, efforts of organizations are greatly reduces. But it give rise to new problems i.e. how to store, access and update the records. As the data is available online, it may affect data's privacy and security. A health care domain greatly advances with new innovations. The documents can be saved easily and access everywhere. A patient and organization can effectively use this system to access his medical records, medical history and currently prescribe medicines. It gives patient as well as his family to easily access the data, sharing of medical reports and use of signed prescription at pharmacy anytime anywhere. The data should be available but need to take care of data security and privacy. The patient must be the owner of data. Using blockchain technology, data will be available in decentralized manner. Using digitize signature the authentication of data can be verified. With the use of cryptography, data will be secure. While consensuses algorithm used for the reliability in a network. The system provides privacy using privacy agreement storage. Only with the permission from the patient or authorized person the data can be used. Owner will be able to see, who is using his data and for what purpose. The system will be efficient to handle the data electronically as well as effective to confidentiality, authenticity and patient-centric.

Keywords: Blockchain, data security, data privacy.

1. INTRODUCTION

1.1 Traditional Health Care System

Now days, everyone pays attention to the health. It is accomplished it with regular health checkup. As technology evolved, humans also exposed to new diseases. Patients are eager to take second opinion for their treatment before taking decision. When a patient visits the hospital, a record(Akhter, Sakib, Nawal, Alsufyani, khan, and Bourouis, 2022) is generated. When, this patient visit another doctor or to another hospital, a new record created. Patient finds it difficulty to maintain records. System does come to online mode but it restricts its approach for particular hospital only. Various hospital uses centralized computer system where a patient gets registered(Tith, Lee, Suzuki, Wijesundara, Taira, Takashi, and Nagaaki, 2019). Whenever the patient goes to same doctor, the doctor can see his/her information. But if the patient goes to another hospital or to the different doctor then a new document file will be provided to a patient which has the same or may be little different record. In traditional system, there is no exchange of information. When a information is access between different service providers it help the patient as well as a doctor to check medical history and provide proper solution to a problem.

As hospitals become centralized system, (snehal, 2021; Shaikh, 2021)the complete data of a patient is maintained with a single server. Here data can not be exchanged or misuse of data can happen. The system will become a threat when large amount of data is handled. This leads to migration from centralized system to distributed system. To develop a solution to overcome above barriers, the system should be robust, provides interoperability, easy and fastest access to data for authorized person only.

1.2 Electronic Health Record

A digital version of patient's medical record is electronic health record. It is real time system where patient's information is easily available and quickly accessible after authorized login only.

These records contain basic information of patient, his medical history, emergency contact, his doctor information and health service provider's information. This system increasingly used between service providers. Using this record, information can be exchange between different service providers, which helps patient as well as care providers to efficiently diagnose and proper medical treatment. While exchanging information, patient still concern for (Khandar and Thaokar, 2021; Hussien and Salman, 2021)security and privacy. While using the system in correct way, results in better patient experience and reliable history report to give current treatment.

Electronic health record may contain the data related to the patient like age, gender, name, address, Aadhar card, emergency contact, any allergies (basic information). These records may contain the MRI, CT scan reports, blood reports, etc. Before the current treatment, previous treatment can be analyzed.

The system will be created and managed by authorized person in a digital format who can view and update the provided information. The system will share the information among all the stakeholders(M, 2022), which give better heath care service all the time. With the help of blockchain technology, secure and robust health care system is efficiently used.

1.3 Blockchain Technology

A creative way to communicate with internet is blockchain technology. It offers features like transparency using openness of internet, security using cryptography(Bakhtawar, Abdul, Chinmay, Jamel, Saira, and Muhammad, 2021), privacy using authentication, huge storage using on-site or off-site database, immutability using blockchain.

It started with Bitcoin, which is virtual currency. It allows the transaction without disturbance (Adane, Kabra, Banode, and M, 2021) of any third part. This technology is widely used in various domains, because of its enumerable features. Blockchain can be used in supply chain management, banking sector, automotive, business, e-voting system, e-ration card, different organization where data is at most important, etc.

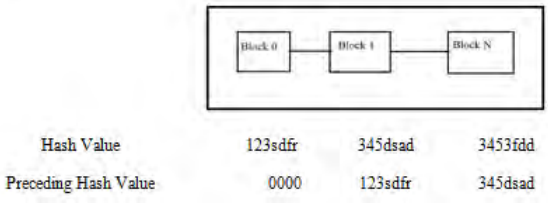


Figure 1. Blockchain with Block 0

The blockchain contains series of block which has connected to each other. Each block contains block number(G, 2021), nounce (random value), digital signature, preceding hash and current hash value. The hash value is unique. It generates depend on data. A small change to the data, the hash value will be changed.The first block is called as Block 0 or Genesis block. It contains its own hash value(Gamal, Barakat, and Rezk, 2021), and preceding hash value will be 0.

1.4 Inter-Planetary File System

A new peer to peer hypermedia protocol is interplanetary file system. It is used to store every updated version of blocks in blockchain in decentralized manner. A distributed hash table is used to give access to decentralized storage. It helps the system to get good performance and scalability(emerson, josé cláudio, Abdelhakim, and josé neuman, 2020). These node stores object at local storage, which provides file and folder to data. To know the network address of other peer, every node maintains a distributed hash table. Interplanetary file system uses content-based addressing.

This decentralized system uses Ethereum platform which runs the smart contract. Ethereum (abdur rahman, hossain, islam, nabil a. Alrajeh, and muhammad, 2020) virtual machine uses to run smart contracts. It is a distributed network made up of Ethereum modes. In this network, user can use the node, run the apps the stop the node as well and use the smart contract. User need to pay cryptocurrency i.t. ether coins to use this computing power. Smart contract are the terms, which are automatically executed when certain conditions are met.

2. MOTIVATION

The information is a sensitive, which related to the user. Anyone should not be able to access the data. If anyone can access this information, leads to loss to user.

It's been difficult for a patient to maintain health record, which contains different types and formats of reports. Patient has to maintain a file from a particular doctor. If he wants to visit another doctor, he needs to maintain another file. The reports which are generated while treatment and to share these reports to another health care provider. A system where health care provider can view and upload the reports will result to quickly helping the patient. The security and confidentiality for the data, must be maintain on network. Data ownership, this process achieves the control of data over network.

3. AIM AND OBJECTIVE

3.1 Aim

A system, for all the users to work in user friendly environment with availability, authentication, privacy, interoperability and security.

3.2 Objective

1 To understand and analyze the working of Blockchain and Permission Blockchain technology. 2 To gain confidentiality of data by user authentication using permission Blockchain Technology. 3 To achieve transparency, security and interoperability of data by the use of Permission Blockchain Technology. 4 To provide ownership of data using Blockchain Technology.

4. LITERATURE SURVEY

Blockchain works independently of any third party or authentication server. It happens as it kept encrypted decentralized ledger user in peer-to-peer network. After updating the transaction other nodes can notice the changed and then can validate the transaction. Only after validation(Khandar and Thaokar, 2021) the transaction can be added to the block and will be a part of a block. The inter-planetary file system is used to store data in a distributed database, which play important role in blockchain network. Usharani et. al.(usharani Chelladurai and Pandian, 2021) uses blockchain to create a health care electronic system, which records and shares patient information. The registration process done by admin. Using user-is and password, a patient can view and update his information. In this paper, transparency is maintained at all levels but with no control over data flow.

Vinodhini et. Al(Mani, Saleh, and Khalaf, 2021) has proposed a system where First node serve as a admin/hospital organization, the second one is for validating the transaction and third node is for stakeholder (patient). This activity performs using smart contract(Agrawal, Singh, and kokardekar, 2021) where a particular event occurs if satisfying condition met. System did not explain sharing of information. Shadab et. al.(Reegu, Salwani, Hakami, Kariem, and Alam, 2021; Shuaib, Shadab, Alam, and Nasir, 2021) presents a system with all stakeholders/service provider who can efficiently exchange the information. As information can be exchange,but did not explain how to implement it.

5. PROPOSED METHODOLOGY

The blockchain technology is used in healthcare sector to remove the isolation of medical facility. Using cryptography the privacy of patient is maintained where as using authentication the owner of data will be the patient itself.

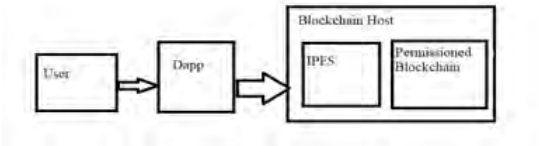


Figure 2. Proposed System

In system there are different stakeholders. This stakeholders will communicate through distributed application to blockchain host. The blockchain host will work with the help of Inter-Planetary File System (IPFS) and Permissioned blockchain. System provides a pair of keys for secure storage of data. System also provide the privacy agreement storage for ownership of data to a patient. In figure 3, stakeholders of electronic health record are presented.

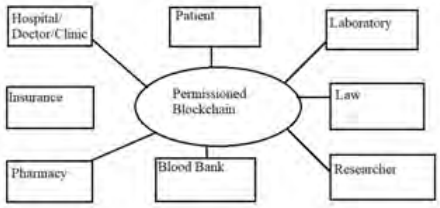


Figure 3. Stakeholders of Electronic Health Record

All stakeholders i.e. patient, hospital, blood bank, laboratory, Law, Insurance need to register on permissioned Blockchain. As they register they will get a unique ID with a stakeholder certificate. In permission blockchain, membership service provider uses to issuing and validation certificate and user authentication. At this stage, all stakeholder will get membership certificate, unique ID and a pair of key(Public key and private key). Using these key, will be encrypted and uploaded in database. When a stakeholder want to view the data,first he need to use his credential to authenticate himself on network. And then using a key he can decrpt data for further use.

The data will be saved on on-site and off-site data. Using data access control the data accessing permission will be given. Using asymmetric cryptography the data can securely shared between different stakeholders.

6. IMPLEMENTATION

The data of the patient will be in two forms on-chain and off chain data. On on-chain data a patient can save his basic information. With basic data, the hash code of off-chain data is also included. The off-chain data consist of reports of a patient. A report may be MRI, CT scan, Blood test, etc. Only required data will be viewed as per request. If a stakeholder wants to see the history of records, he can request the patient. After the grand access of health record, a stakeholder can view the data. A patient needs to access the grant or deny permission to access the data by other stakeholders. It ensures the privacy and security of health record. On Dapp,

a patient has access control preferences. Other stakeholders can request the patient to grant or deny the access request.

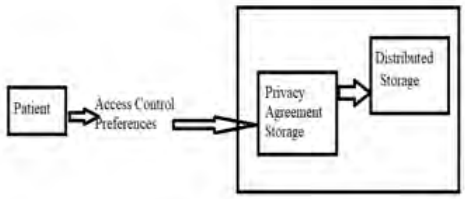


Figure 5. Data and Access control of a patient

The asymmetric key cryptography is used to upload and share the data. In this algorithm, the public key is used to encrypt the data and upload on the database. When a stakeholder ask for the data patients need to grant the permission. The permission also contains unique id of requester. Ex. A doctor ask for data permission. After permission is granted (Pgrant) using stakeholders private key (Dpvkey) the data can be decrypt. In this way only authenticate person can see the data securely. The privacy of patient is maintained.

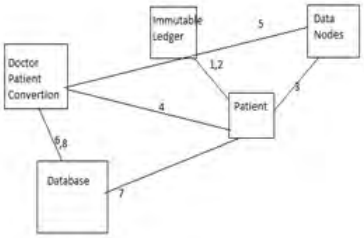


Figure 6. Cryptography used to perform data transaction

7. RESULT

The research is still going on to improve the efficiency of blockchain architecture for health care domain. For security purpose properties are observed that data integrity, non-authorized access of data, data interoperability.

Because of unchangeable transaction feature of blockchain, the on-site record has data integrity. While for off-site data is divided into directory and medical reports. Using authentication, the malicious node will not be able to leak the data. As system is able to gain the trust, the data can share between different stakeholders. The system is reliable, secure using blockchain technology.

8. CONCLUSION

The system helps to improve the tradition medical record keeping to digital version. This architecture provides security while accessing data at every level, transparency is maintained between different stakeholders, authentication before accessing any data. It helps to gain trustworthiness of a patient to access the system more easily and efficiently without any concern. The system saves data which can act as evidence while claiming any legal prospect. The blockchain with smart contracts provides the traceable system to act as evidence. Using off chain database, the accessing of data is done in no time. The exchange of information between different hospitals/doctors is done with the help of keys and authentication. The patient is the owner of its data, when he gave permission before anyone can access the data.

References

abdur rahman, M., hossain, islam, nabil a. Alrajeh, and muhammad. 2020. Secure and provenance enhanced internet of health things framework: a blockchain managed federated learning approach. *Special section on lightweight security and provenance For internet of health things Vol.8*, pp.205071 – 205087.

Adane, Kabra, Banode, and M, A. 2021. Cancer risk analysis using machine learning. *International Journal of Next-Generation Computing Vol.12*, pp.28–33.

Agrawal, Singh, and kokardekar. 2021. Hyperledger healthchain: Patient-centric ipfs-based storage of healthrecords. *Blockchain Based Electronic Healthcare Solution and Security Vol.10*, pp.1–23.

Akhter, K. T., Sakib, S., Nawal, Alsufyani, khan, and Bourouis. 2022. Electronic health record monitoring system and data security using blockchain technology. *Security and Communication Networks Vol.22,* No.15, pp.1.

Bakhtawar, A., Abdul, Chinmay, Jamel, Saira, and Muhammad. 2021. Blockchain and anfis empowered iomt application for privacy preserved contact tracing in covid-19 pandemic. *Pers Ubiquitous Computing Vol.17*, pp.1–17.

emerson, A., josé cláudio, Abdelhakim, and josé neuman. 2020. Preserving privacy in mobile health systems using non-interactive zero-knowledge proof and blockchain. *IEEE ACCESS Vol.8*, pp.204441–20458.

G, M. 2021. Medical image enhancement through dual tree complex wavelet transform and multi-resolution gabor filter. *International Journal of Next-Generation Computing Vol.12*, pp.254–261.

Gamal, A., Barakat, S., and Rezk, A. 2021. Standardized electronic health record data modeling and persistence: A comparative review. *Journal of Biomedical Informatics Vol.12*, pp.1–10.

Hussien, H. and Salman, S. 2021. Blockchain technology in the healthcare industry: Trends and opportunities. *Journal of Industrial Information Integration Vol.22*, pp.1–23.

Khandar and Thaokar. 2021. Identification of covid-19 with chest x-ray images using deep learning. *International Journal of Next-Generation Computing Vol.28*, pp.821–839.

M, P. 2022. Multi class skin diseases classification based on dermoscopic skin images using deep learning. *International Journal of Next-Generation Computing Vol.13*, pp.11–22.

Mani, V., Saleh, and Khalaf, O. 2021. Hyperledger healthchain: Patient-centric ipfs-based storage of healthrecords. *Blockchain Based Electronic Healthcare Solution and Security Vol.10*, pp.1–23.

Reegu, F., Salwani, Hakami, Kariem, and Alam. 2021. Towards trustworthiness of electronic health record system using blockchain. *Annals of Romanian Society for Cell Biology Vol.25*, pp.2425–2434.

Shaikh, T. A. 2021. An intelligent healthcare system for automated alzheimer's disease prediction and personalized care. *International Journal of Next-Generation Computing - Special Issue Vol.12*, pp.240–253.

Shuaib, M., Shadab, Alam, and Nasir. 2021. Compliance with hipaa and gdp in blockchain-based electronic health record. *Materials Today: Proceedings Vol.*, pp.

snehal, L. 2021. A worldwide application to control covid-19 by remote management of patient records accessed by an internet of things. *International Journal of Next-Generation Computing Vol.12*, pp.636–644.

Tith, D., Lee, Suzuki, Wijesundara, Taira, Takashi, and Nagaaki. 2019. Application of blockchain to maintaining patient records in electronic health record for enhanced privacy, scalability, and availability. *The Korean Society of Medical Informatics Vol.26*, pp.3–12.

usharani Chelladurai and Pandian, S. 2021. A novel blockchain based electronic health record automation system for healthcare. *Journal of Ambient Intelligence and Humanized Computing Vol.13*, pp.693–703.

Bhagyashree Hambarde is the Assistant Professor at the Shri Ramdeobaba College of Engineering and Management, Nagpur at the Dept. of Computer Science and Engineering. She has work experience of 6 years. Prof. Hambarde pursued her engineering BE(IT) and M.Tech (CSE) from Amravati University. She is pursing her PhD from IIIT, Nagpur, India. She has the membership of International Association of Engineers (IAENG). Her research interests are in Blockchain Technology, Machine Learning.
E-mail: hambardeb@rknec.edu

Priya Parkhi received her BE(Computer Technology) and MTech(Computer Science and Engineering) degree from Nagpur University,India in 2011 and 2015 respectively. She is currently pursuing the Ph.D. degree in computer science and Technology at Oriental University Indore .She is the Assistant Professor at the Shri Ramdeobaba College of Engineering and Management, Nagpur at the Dept. of Computer Science and Engineering.She has work experience of 6 years.Her research interests include Machine Learning,Deep learning.
E-mail: parkhip@rknec.edu

Outage Probability and Capacity Analysis for NOMA based 5G and B5G Cellular Communication

Mrunmayi Kinhikar, Aditi Agrawal, Dolly Tiwari, Ishant Kohad, Prasheel Thakre and Sanjay Pokle
Shri Ramdeobaba College Of Engineering And Management, Nagpur, Maharashtra, India

This study presents a non-orthogonal multiple access (NOMA) solution for 5G that unifies communication between macro-cells via the S-R NOMA link and communication between small cells via the R-D NOMA link. S-R NOMA is used to decode own signal by respective relay. Separate studies of outage performance in S-R and R-D connections may formerly be used to get an accurate definition of system outage likelihood. Our mathematical analysis is supported by simulation findings, which indicate that NOMA-assisted relaying systems outperform Orthogonal Multiple Access systems in terms of lower outage probability and better cumulative capacities (OMA).

Keywords: NOMA, Collaborative NOMA Assisted Relaying (CNAR), Outage Probability, 5G, relaying

1. INTRODUCTION

Non-Orthogonal Multiple Access (NOMA) has been identified as a critical multiple access technology in fifth-generation (5G) wireless networks for high connectivity, better spectrum use, lower bandwidth, increased connection, network capacity, and fairness. Significant advantages of NOMA include improved data rates, increased spectrum efficiency, expanded network capacity, and broader connection Liu and Wang [2016]. By integrating Superposition Coding (SC) at the transmitter with Successive Interference Cancellation (SIC) at the receiver, NOMA techniques improve spectral efficiency Tang et al. [2018].

In order to serve more numerous NOMA users in a bandwidth-efficient situation, NOMA exhibits a wonderful approach by assigning radio resources (i.e., time, frequency, and code) under various power levels Singh and Bansal [2020]. Determining the efficacy of outages in relation to power distribution coefficients at the source and relay, as well as the ideal values of these coefficients for different transmit signal-to-noise ratio (SNR). The effectiveness of the related system outage was evaluated, as well as a proposed relay selection strategy based on the highest quick SNR.

An essential technology for wireless networks is cooperative relaying strategy (CRS), which increases system capacity, combats fading, and enhances service coverage. One of the most prominent fields of research is cooperative NOMA (C-NOMA). C-NOMA is further divided into two categories: uplink C-NOMA and downlink C-NOMA depending on how the data is transmitted Kader et al. [2019]. The results of CRS-NOMA reveal that, for high signal-to-noise ratios (SNR), it can achieve greater sum capacity than standard decode-and-forward, but that it comes up short for low SNR's Kader et al. [2019].

High-quality information transfer to a considerable number of users on territory is necessary in future satellite communication systems. NOMA scheme is generating a lot of interest and is arising as a potential technology for fifth generation (5G) networks because of its ability to service numerous users at once and provide excellent resource efficiency Yan et al. [2018].

The characteristics of the outage capacity and disruption that NOMA users encounter in fading channels, however, has not been specifically studied. Due to the fading properties of channels, source information sent across wireless networks, such as audio and video, experiences distortion Kumar et al. [2021]. When compared to standard Orthogonal Multiple Access, NOMA can pro-

vide a low outage probability and a high sum rate (OMA) Liu and Wang [2016]. The asymptotic behaviors of the considered system were reviewed for the high SNR regime, indicating that cooperative NOMA leads to a better cooperative OMA gain in coding without sacrificing variety order. In case of outage achievable rate gain also OMA lacks behind NOMA Thakre and Pokle [2022].

CNAR strategy for 5G that integrates communication between macro-cells via the S-R NOMA connection and communication between micro-cells via the R-D NOMA link is proposed in this work. Several research on the efficacy of NOMA-aided relaying systems have been conducted. Studies the capabilities of the decode-and-forward(DF) relaying system and proposes an unsuccessful power-distribution strategy In addition, the dynamical sum rate and outage probability formulae for NOMA downlink collaborative networks are provided. However, the focus of this research is on the decreased half-duplex relaying mode, in which the SNR of the cell-edge user is dependent on connections between the BS and the relay.

As we advocate for our full-duplex relaying mode CNAR technology, we evaluate the system's performance as follows. To begin, we determine that an outage occurs when the intended rate for a certain message is not fulfilled by the feasible rate for that message. Outage performance is better when the relay is closer to the indirect link user and the relay's transmit power is substantially lower than the BS's transmit power Liang et al. [2017]. By reducing the outage probability of a system failure, we increase the ideal power allocation strategy to ensure the data rate Liu and Wang [2016].

1.1 Outage probability analysis:

- ✓ The outage probability of a transmission channel is a term used in information theory to describe the probability that a specific data rate won't be maintained due to changing channel circumstances.
- ✓ The probability that the rate of data will fall below the necessary threshold data rate is the basis for the outage probability.

2. SYSTEM MODEL

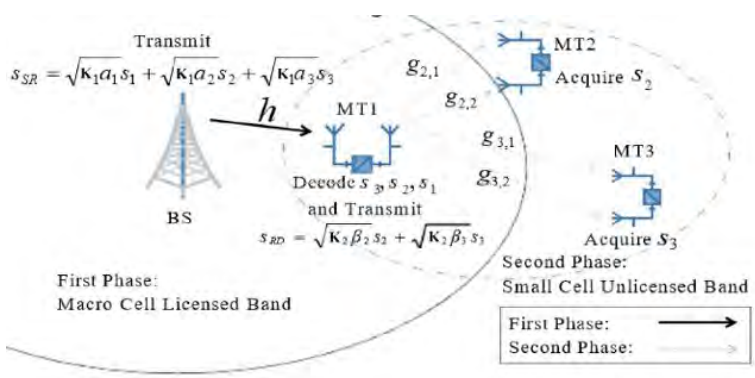


Figure 1. CNAR system model

In Figure 1, we take into consideration a CNAR communication system. Assume that the base station (BS) is in charge of three mobile terminals (MT's), and that MT1 is the one that is closest to the BS. The cell-edge users i.e. MT2 and MT3 cannot get high-quality service by BS, due to the distances between them. In order to establish connections between BS and MT2 and MT3, MT1 is used as a relay. Thus, there are two periods for the BS to assist the trio of MT's. As a

NOMA signal to be sent, BS overlays three signal information to MT1 at the time of first phase, also known as the S-R phase; at the receiver of MT1 all information or messages are decoded.

MT1 transmits information to MT2, MT3 in R-D phase (second), and superimposes them on another NOMA signal with altered power. MT2, MT3, in turn, receive signals and gather individual messages. Let's suppose that each MT has two antennas. Full-duplex mode is used by MT1 to maximize throughput. It uses one antenna to receive the NOMA signals from the BS while using the other antenna to broadcast the decoded messages to MT2, MT3, in the last time slot. To minimize interference, the initial stage of communication, known as macro-cell communication, occurs on an approved frequency, while the second stage, known as small-cell communication, occurs on an illegal frequency Liu and Wang [2016].

The BS explicitly overlays all three messages as a NOMA signal in the initial stage

$$s_{SR} = \sqrt{K_1\alpha_1}s_1 + \sqrt{K_1\alpha_2}s_2 + \sqrt{K_1\alpha_3}s_3 \tag{1}$$

then sends it to MT1. MT1, MT2, and MT3 are the recipients of messages s_1, s_2 and s_3, respectively. K_1 denotes the power transmitted by any one BS which is allocated to group of all three MT's. $\alpha_1, \alpha_{2,}\alpha_3$ denotes the ratios of power distribution for s_1, s_2 and s_3, following the power order constraint of $\alpha_1+\alpha_2+\alpha_3 = 1$. Thus, received signal at MT1 is

$$y_1 = hS_{SR} + n_1 = \sqrt{K_1\alpha_1}hs_1 + \sqrt{K_1\alpha_2}hs_2 + \sqrt{K_1\alpha_3}hs_3 + n_1 \tag{2}$$

where n1 $\sim CN(0, N)$represents the additive white Gaussian noise (AWGN) at receiving antenna of MT1 and h $\sim CN(0, \sigma_1^2)$ is the Rayleigh channel coefficient of BS-MT1. MT1 uses SIC to decode all messages after receiving s_{SR}. In order to decode s_3, it specifically considers s_1, s_2 and n_1 as noise. After that, it decodes s_2 and s_1 subsequently in the same manner by eliminating s_3. If we fix the targeted rate as R_0 associated to every message as the service quality threshold, the equivalent target SNR equals $\gamma_0 = 2^{R_0} - 1$. It is necessary to satisfy each of the following equations in order to reach the desired SNR:

$$\begin{aligned} SNR_{3,1} &= \frac{\alpha_3\rho_1|h|^2}{(1-\alpha_3)\rho_1|h|^2+1} \geq \gamma_0 \\ SNR_{2,1} &= \frac{\alpha_2\rho_1|h|^2}{(\alpha_1)\rho_1|h|^2+1} \geq \gamma_0 \\ SNR_{1,1} &= \alpha_1\rho_1|h|^2 \geq \gamma_0 \end{aligned} \tag{3}$$

Where $SNR_{n,1}$ is denoting the (PSNR) which is Post processing SNR for the n-th message at MT1 and $\rho_1 \triangleq \frac{K_1}{N}$ stands for BS transmission. Furthermore, the possible rate associated with s_1 is

$$C_1 = log_2(1 + \alpha_1\rho_1|h|^2) \tag{4}$$

and for second phase, MT1 sends the NOMA signal s_{RD} by superimposing s_2 and s_3 and it can be given as s_{RD}= $\sqrt{K_2\beta_2}s_2 + \sqrt{K_2\beta_3}s_3$ to MT2 and MT3. The transmission power for MT1 is denoted as K_2 . And β_2 & β_3 denotes ratio of power distribution for s_2 & s_3 respectively, wherein $\beta_2 + \beta_3 = 1$. As of MT2 and MT3 have two receiving antennas, the signals they receive are

$$\begin{aligned} y_2 &= g_2 s_{RD} + n_2 \\ y_3 &= g_3 s_D + n_3 \end{aligned} \tag{5}$$

Whereas $g_2 = [g_{2,1}, g_{2,2}]^T$, $n_2 = [n_{2,1}, n_{2,2}]^T$ and $g_3 = [g_{3,1}, g_{3,2}]^T$, $n_3 = [n_{3,1}, n_{3,2}]^T$. Where $g_{2,1}$,$g_{2,2} \sim CN(0, \sigma_2^2)$ represents the Rayleigh channel coefficient for the AWGN from the single transmit antennas of MT1 to the double antenna of MT2 with AWGN $n_{2,1}$,$n_{2,2} \sim CN(0, N)$ and $g_{3,1}$,$g_{3,2} \sim CN(0, \sigma_3^2)$ which shows the Rayleigh channel coefficient with the accompanying AWGN from MT1's single antenna to MT3's double antenna, with AWGN $n_{3,1}$,$n_{3,2} \sim CN(0, N)$ Liu and Wang [2016].

We should recognize NOMA for far as well as the near users during each time period, so that SIC can be used at a nearby user. Assuming, At MT2, MT3, and MT4, MRC which is maximum ratio combining is being used. For these, the combined channel gains are $||g_2||_2^2$ and $||g_3||_2^2$ respectively. Hence, when $||g_2||_2^2 > ||g_3||_2^2$ with a power ratio for near users $\beta_N = \beta_2$, MT2 is classified as a near user and $\beta_F = \beta_3$ for MT3 for far user; if not then, their statuses are swapped with $\beta_N = \beta_3$, $\beta_F = \beta_2$. Using each message's targeted rate R_0, the situations to get the desired SNR, both far users and nearby users are:

$$\begin{aligned} SNR_{F,2} &= \frac{\beta_F \min(||g_2||_2^2, ||g_3||_2^2)\rho_2}{\beta_N \min(||g_2||_2^2, ||g_3||_2^2)\rho_2 + 1} \geq \gamma_0 \\ SNR_{N,2} &= \beta_N \max(||g_2||_2^2, ||g_3||_2^2)\rho_2 \geq \gamma_0 \end{aligned} \tag{6}$$

While PSNR at far users is represented by $SNR_{F,2}$ and $SNR_{N,2}$ is the near-user PSNR and MT1 transmit SNR of $\rho_2 \triangleq \frac{K_2}{N}$. In reality, MT1 links the first and second transmission phases by acting as a DF relay. Because of DF's end-to-end data rate, the weakest connection, the achievable target, dominates relaying rate corresponding to s_2 and s_3 is

$$C_2 = log_2(1 + \min(SNR_{2,1}, SNR_{2,2})) \tag{7}$$

$$mC_3 = log_2(1 + \min(SNR_{3,1}, SNR_{3,2})) \tag{8}$$

Where in the $SNR_{2,2}$ and $SNR_{3,2}$ are representing the PSNR at MT2 and MT3, respectively.

3. NUMERICAL RESULTS

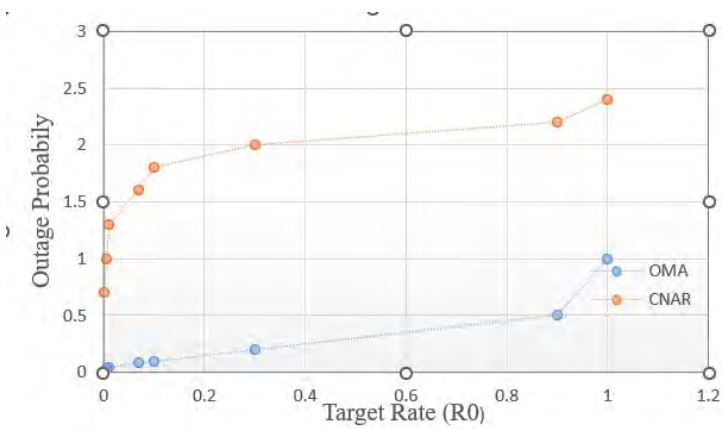


Figure 2. Outage probability in relation to target rate R_0 when $\rho_2 = 9$ dB

In Figure 2, when $\rho_2 = 9$ dB and ρ_1=14 dB is considered, it shows the outage probability in relation to target rate R_0. The simulation results show that the theoretical analysis is accurate. Here, it can be observed that the system's target rate is directly proportional to the outage probability. For different R_0 values, the probability of outage for CNAR based system is much lower as compared to OMA system.

In Figure 3, when R_0=2, and ρ_1=14 dB, ρ_2 vs outage probability is plotted. Observation of this graph shows that the probability of an outage is reducing as the value of ρ_2 is raised. Means the outage probability is inversely proportional to ρ_2. In this case, the OMA-based system has a substantially higher outage probability than the CNAR system does.

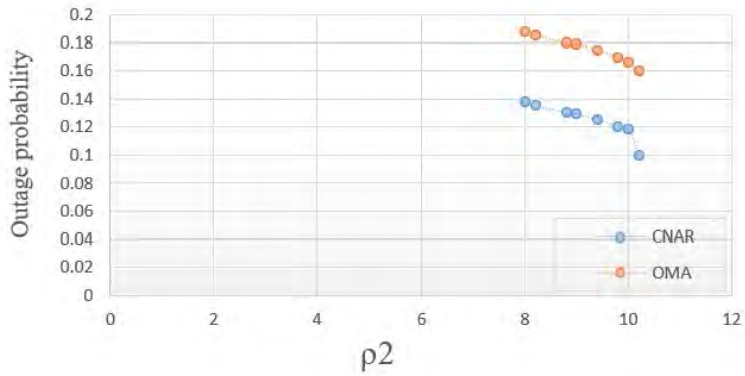


Figure 3. The probability of an outage in relation with ρ_2 SNR of MT1, when R_0=2

4. CONCLUSION AND FUTURE WORK

This research analyzes a CNAR system's probability of outage performance. Examining the characteristics of outage in the R-D and S-R lines individually, we can properly quantify the system outage probability and, as a result, define system performance. Graphs illustrate that the system's result rate is closely proportional to the chance of an outage. As we can see, the chance of a system outage is exactly proportional to the system's result rate. This means that the probability of an outage is inversely proportional to ρ_2. Theoretical findings are complemented by numerical data, which show that our relaying system beats OMA in relation of outages and capacity after helped by NOMA. Future researches will also look towards hybrid downlink-uplink NOMA for multi-output and multi-input systems.

References

Kader, M. F., Uddin, M. B., Islam, S. R., and Shin, S. Y. 2019. Capacity and outage analysis of a dual-hop decode-and-forward relay-aided noma scheme. *Digital Signal Processing 88*, 138–148.

Kumar, I., Mishra, M. K., and Mishra, R. K. 2021. Performance analysis of noma downlink for next-generation 5g network with statistical channel state information. *Ingénierie des Systèmes d'Information 26,* 4.

Liang, X., Wu, Y., Ng, D. W. K., Zuo, Y., Jin, S., and Zhu, H. 2017. Outage performance for cooperative noma transmission with an af relay. *IEEE Communications Letters 21,* 11, 2428–2431.

Liu, X. and Wang, X. 2016. Outage probability and capacity analysis of the collaborative noma assisted relaying system in 5g. In *2016 IEEE/CIC international conference on communications in China (ICCC)*. IEEE, 1–5.

Singh, S. and Bansal, M. 2020. Outage analysis of noma-based cooperative relay systems with imperfect sic. *Physical Communication 43*, 101219.

Tang, Z., Wang, J., Wang, J., and Song, J. 2018. On the achievable rate region of noma under outage probability constraints. *IEEE Communications Letters 23,* 2, 370–373.

Thakre, P. N. and Pokle, S. B. 2022. A survey on power allocation in pd-noma for 5g wireless communication systems. In *2022 10th International Conference on Emerging Trends in Engineering and Technology-Signal and Information Processing (ICETET-SIP-22)*. IEEE, 1–5.

Yan, X., Xiao, H., Wang, C.-X., and An, K. 2018. Outage performance of noma-based hybrid satellite-terrestrial relay networks. *IEEE Wireless Communications Letters 7,* 4, 538–541.

Ms Mrunmayi Kinhikar is pursuing 3rd year B.Tech. in the department of Electronics and communication Engineering, at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: kinhikarmr@rknec.edu

Ms Aditi Agrawal is pursuing 3rd year B.Tech. in the department of Electronics and communication Engineering, at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: agrawalam_3@rknec.edu

Ms Dolly Tiwari has received Diploma in Electronics and Telecommunication from Govt. Polytechnic Nagpur in 2018. She has an industrial work experience in the field of Calibration. Currently she is pursuing 3rd year B.Tech. in the department of Electronics and communication Engineering, at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: tiwaridr1@rknec.edu

Mr Ishant Kohad is pursuing 3rd year B.Tech. in the department of Electronics and communication Engineering, at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: kohadit@rknec.edu

Mr Prasheel N Thakre has received Bachelor's degree in Electronics Engineering from RTM Nagpur University in 2010. He has done M.Tech. in Electronics Engineering from Shri Guru Gobind Singhji Institute of Engineering and Technology, Nanded University in 2013. Presently he is pursuing Ph. D. from Shri Ramdeobaba College of Engineering and Management, RTM Nagpur University, under the fellowship of Visvesvaraya PhD Scheme for Electronics IT. His research area includes Non-Orthogonal Multiple Access (NOMA) for 5G Wireless Communication Systems and Wireless channel Estimation Algorithms. Presently he is working as Assistant Professor in Electronics Communication Engineering Department, Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: thakrepn2@rknec.edu

Dr. Sanjay B Pokle has received Bachelor's degree in Electronics and Telecommunication Engineering from Govt. College of Engineering Pune, Pune University in 1993. He has done M.Tech. in Electronics Engineering and Ph. D. in Electronics from Visvesvaraya National Institute of Technology Nagpur. His research area includes designing aspects of MIMO-OFDM Wireless Communication Systems and Wireless channel Estimation Algorithms. He has published 74 research papers in the reputed national and international Journals and presented papers in the reputed national and international conferences. This includes 06 SCI indexed and 04 Scopus indexed publications. He has guided several projects in the area of signal processing, Digital image processing, Artificial intelligence etc. at post-graduation level and graduate level. He has delivered many Expert lectures in reputed Engineering institutions and also worked as judge in many national level technical competitions. He is approved supervisor for Ph. D. under R.T.M. Nagpur University, Nagpur. 07 candidates has been awarded Ph.D., and 01is pursuing Ph.D. under his guidance. He is member of technical societies like ISTE and IEEE. He has total 26 years of experience which includes 3 years industry and 23 years of teaching experience. He worked as Head of department for 10 years. Presently he is working as Professor in Electronics Communication Engineering Department, Shri Ramdeobaba College of Engineering and Management, Nagpur. Also, he is appointed as Chairman, Board of Studies Electronics Engineering by RTM Nagpur University, Nagpur.
E-mail: poklesb@rknec.edu

Covid Security System Using IOT Monitoring System

Chandrakant Mohadikar[1], *Rakshit Najbile*[1], *Vivek Kaushik*[1], *Yash Konghe*[1], *Dr.Deepak Khushalani*[2], *Dr.Pankaj Joshi*[3].
1 : *Student, ElectronicsAndCommunicationEngineeringDepartment.*
2 : *Faculty, Electronics And Communication Engineering Department.*
3 : *Faculty, ElectronicsEngineeringDepartment.*
1, 2 &3 : *Shri Ramdeobaba College Of Engineering And Management*

Covid Security System is a non-contact sanitizer dispenser, that also monitors vital parameters such as temperature, heart rate, and spo2 sensors based on Internet of Things (IOT) data collection and processing. This device is vital in workplaces like hospitals, colleges, and many more. The system that has the capability to record human body temperature based on contactless mechanism efficiently with pandemic situation has looked up to usage of infrared thermometers. In this paper via our research we realize the human body temperature fast non-contact by utilizing infrared thermometer (MLX90614) along with a pulse oximeter using a pulse sensor (MAX30100) to measure the heart rate in real-time. Parameter like the oxygen level of the user is also rendered and stored on our designed IOT processing framework which can provide alerts both online or offline based on previous maintained records. In this research we have recorded parameters of the sample space comprising of 500 users. The main aspect of the research is the cost affectability where is the system can be easily interfaced with any existing framework of workplaces.

Keywords: Embedded System, Internet of Things (IOT), COVID, Human Parameters Monitoring, Infrared thermometer (MLX90614), Pulse sensor (MAX30100)

1. INTRODUCTION

The world has changed its priority and life style with the worldwide spread Coronavirus (COVID-19) has lead to pandemic where the major concern has boiled down to human life and health care facilities at workplaces [1]. The surrounding environment that cant be controlled at workplace depends on various parameters that can be catastrophic if not monitored. Some vital parameters that important when we are talking about healthcare are that revolve around temperature, heart rate, oxygen flow in terms of Spo2 and bacterial or viral spread disinfection with frequent hand sanitization. The change in services have constantly evolved during pandemic where in the first step of security or monitoring has been hand sanitization which are disbursed or sprayed using squirting machines or vaporizers. The second step is that of temperature endurances of body to depict presence of fever as the primary symptom and to provide this service one requires cost effective integration of contactless measurement. The measurement should be in the system integrated so that human resources can be saved or rendered in this modern atomized world et al. [2021b]. Further incorporation of monitoring the human parameters of heart rate and oxygen levels is also the need of the hour so that symptom recordings and analysis can provide Covid spread precautions at the primal face et al. [2021a].

In the proposed project the above mention functionality had been provided at one place, an ultrasonic sensor is used to automate sanitization machine. When the sensor detects the user's hand then it will dispense the sanitizer et al. [2021c]. A non-contact temperature measurement functionality is proposed in this project which works on Stefan-Boltzmann Law MLX90614 [] by measuring the radiation reflected by an object in presence of infra red. A pulse sensor for example

MAX30100 out of many available in market comprises of pulse oximetry and heart- rate monitor sensor solution. This solution is because of two IR modules having analog signal processing to detect pulse parameters of a human body MAX30010 []LCD [] The proposed device is having an IOT provision so that data can be transmitted over internet for record keeping and easy future access.

2. BLOCK DIAGRAM AND FUNCTIONAL DESCRIPTION

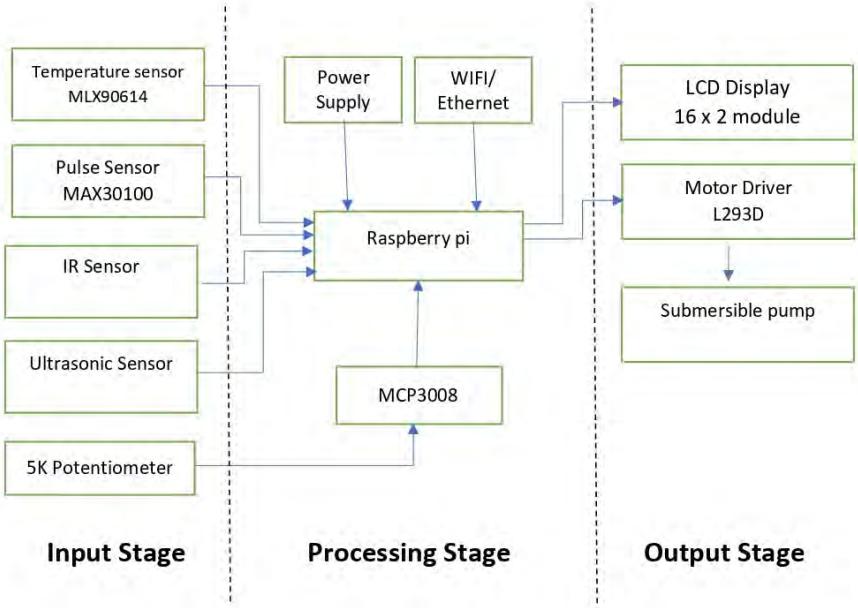


Figure 1: Covid System Block Diagram

The project consists of three stages, which are divided into input, processing, and output stage:

Input stage: This stage is responsible for getting input from user which is combinations of sensors that provide samples to the processing phase et al. [2022]HC-SR04 []Sensor []Module []PDB18 []p. foundation []guide [].

Processing stage: Processing stage: The power of Raspberry PI microcontroller is utilized so as to provide an cloud based interface as well as offline processing interface p. foundation []guide []Wikipedia []. The data collected from the various sensors can be stored in an excel file and provide some primary processing output to the user or it can be sent on a remote server for data analysis and visualization which require network access. The use of a ADC is desired so as to provide analog to digital conversions based from the input stage to the processing stage to Digital converter MCP3008 []. Attendance monitoring system could also be integrated to this for having regression analysis as per the requirements of monitoring but then the cost effective of the solution could be hampered hence not processed in this research at this level.

Output stage: The processing stage provides a step by step guidance to the user starting from sanitizer spraying to the recording of human parameters with the help of motors and display devices L293D []Pump [].

The block schematic can be better analyzed/understood with simulation as in figure 2 below.

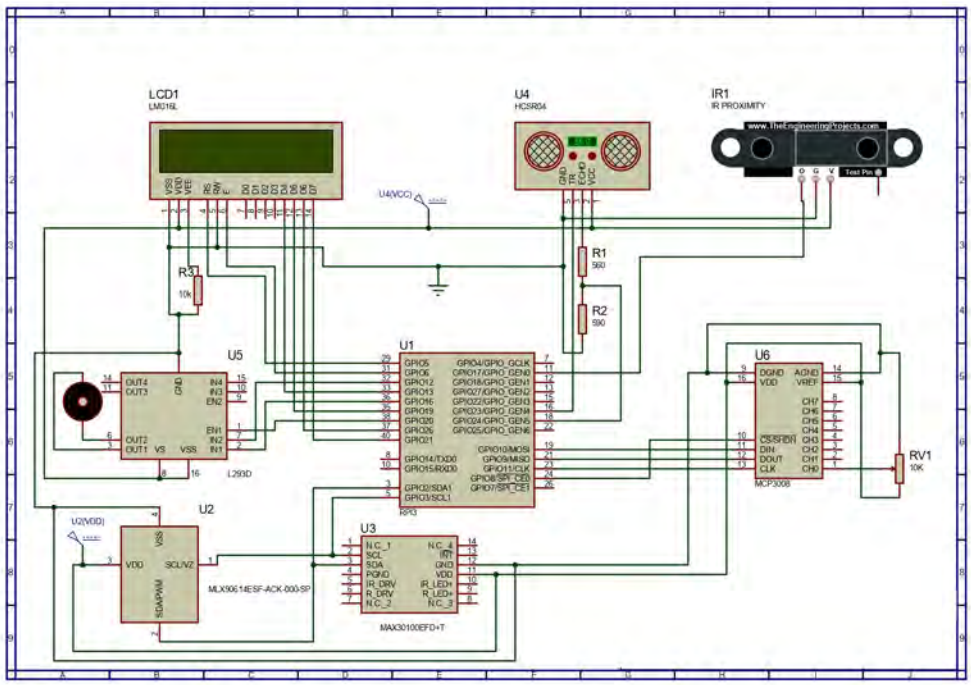


Figure 2. Circuit Diagram

Circuit diagram is essential to understand the working of the system which is covered below as step by step guide.

Step 1: On powering the system it displays the welcome message on the LCD screen. Automatic sanitizer dispensing starts when the user's hand place within the range 5-20 cm of the ultrasonic sensor HC-SR04 [].

Step 2: When the ultrasonic sensor senses the hand, it will activate the submersible pump, which sprays the sanitizer on the forehand through a small duct. The sensor is powered by the raspberry pi HC-SR04 []Wikipedia [].

Step 3: When someone places his hand for sanitization at the same time its temperature vitals are recorded and displayed on the LCD screen. The temperature detecting device consists of an MLX-90614 sensor that can instantly monitor the surface temperature without having contact with a person's skin MLX90614 [].

Step 4: Users can check Heart rate and Spo2 level by keeping their finger on the dedicated section provided. The user needs to wait after placing the finger, it takes 30 sec to analyze and once the input sample is recorded the result of heart rate and Spo2 is displayed MAX30010 [].

Step 5: In system processing as well as data transmission over network for further visualization, record keeping and analysis.

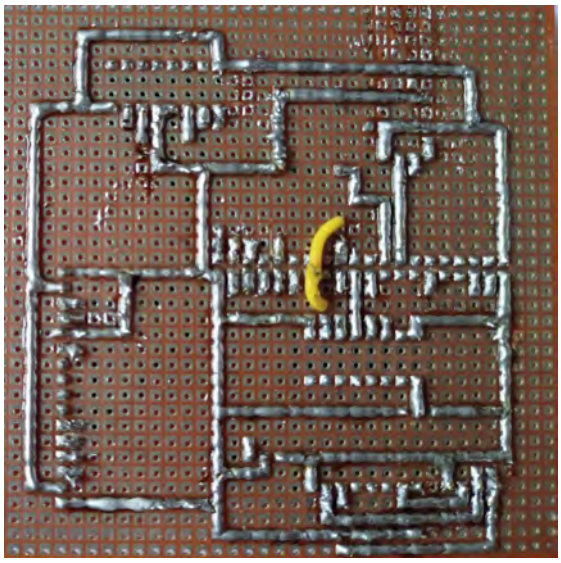


Figure 3.a: Back of PCB

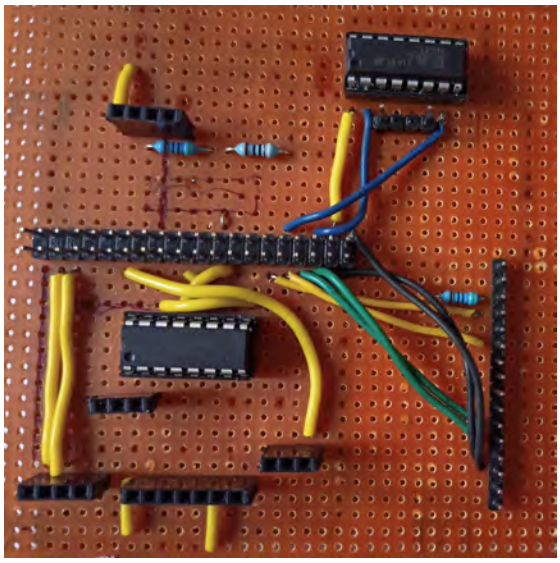


Figure 3.b: Front of PCB

Figure 4.a: Side internal view of the system

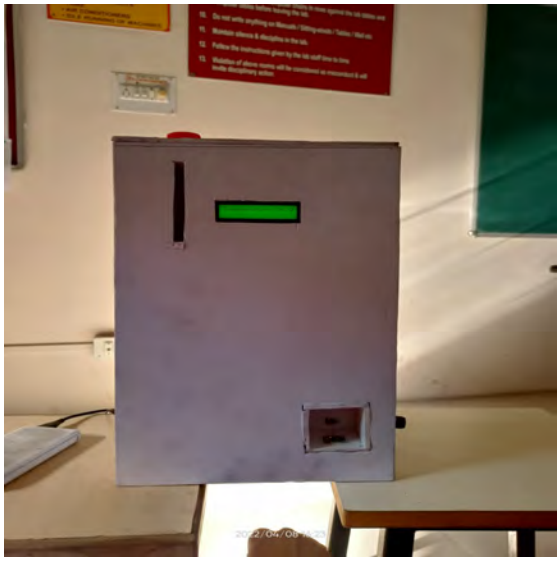


Figure 4.b: Front view of the system

3. IMPLEMENTATON

The simulated circuit is realized in with the use of a PCB as shown in figure 3 for integration with the modules to provide a complete system as shown in figure 4 below.

4. IOT MONITIORING AND VISUALIZATION

Programming of the sensor and raspberry pi microcontroller was done using the python language using different libraries such as MLX906142 (temperature sensor), MAX30100 (Spo2 and heart rate sensor), MCP3008 (ADC), time for generating time delay, Adafruit_charlcd for displaying messages on LCD, SMBus for serial communication, openpyxl to read and write into excel, os to use functions of the operating system, RPi. GPIO is used to provide basic interaction with GPIO.By using the openpyxl library data automatically gets added and if the functioning of the device stops still data don't get lost. Visualization of the data recording can be seen as in figure 5 below.

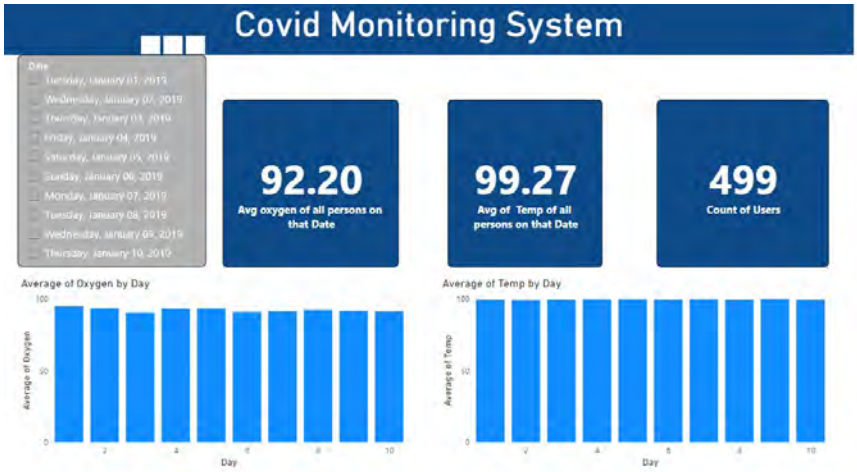


Figure 5 a. Summarized Data sample of 50 user

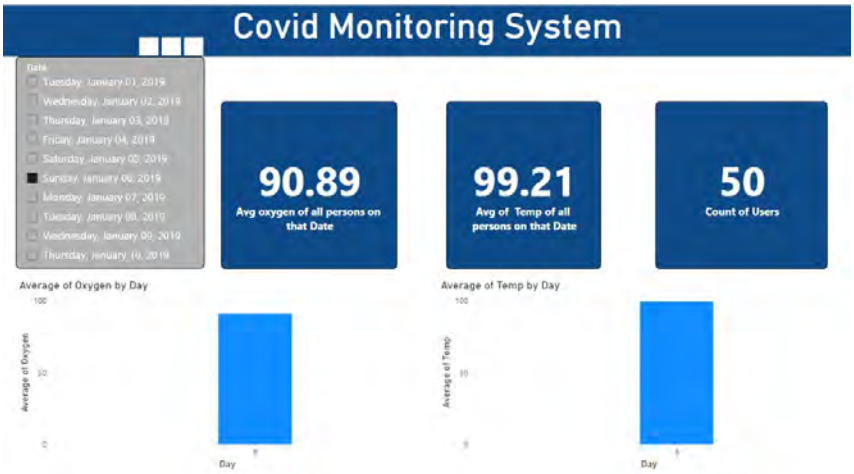


Figure 5 b. Summarized Data sample of 500 user

5. CONCLUSION AND RESULTS

The results were observed closely for all the cases such as sanitizing, contactless temperature measurement, measuring Spo2, and heart rate. The results show the accurate working of the

system based on contactless aim which is very cost effective as compared to buying various traditional methods that require a human interface a various levels. Currently sampling of just 500 users is done over a span of 3 months. Further testing of system can be provided when the system is integrated on the workplace interface. Further more in near future if facial and finger print input stages are provided then database validation system based on AADHAR can provide tremendous incubation stages of the project.

References

ET AL., A.-H. 2021a. Opportunities and challenges for the building monitoring systems in the age-pandemic of covid-19: Review and prospects. *Innovative Infrastructure Solutions Vol.6(2)*, pp.1–10.

ET AL., J. A. T. 2021b. A monitoring system for evaluation of covid-19 infection risk. *In Journal of Physics: Conference Series Vol.2069,* No.1.

ET AL., K. P. R. 2022. Design and development of low-cost humanoid robot with thermal temperature scanner for covid-19 virus preliminary identification. In *International Journal.* Vol. Vol.9(13).

ET AL., S. R. 2021c. Contactless human body temperature measurement and sanitization. In *International Journal of Advanced Research in Science, Communication and Technology (IJARSCT).* pune, India.

GUIDE, F. Flashing the compute module emmc.

HC-SR04. Datasheet.

L293D. Datasheet.

LCD, H. Datasheet.

MAX30010. Datasheet.

MLX90614. Datasheet.

MODULE, I. S. https://www.electroduino.com/what-is-ir-sensor-module-how-ir-sensor-module-works.

P. FOUNDATION, R. Getting started with raspberry pi.

PDB18. Datasheet.

PUMP, D. .-. V. M. M. S. W. https://robu.in/product/dc-3-6-v-mini-micro-submersible-water-pump/.

SENSOR, I. P. Datasheet.

TO DIGITAL CONVERTER MCP3008, . B. A. Datasheet.

WIKIPEDIA. Raspberry pi.

Chandrakant Mohadikar is final year student of department of electronics and communication department, Shri Ramdeobaba college of engineering and management, nagpur maharashtra. Shri Ramdeobaba College of Engineering and Management envisages the institute par excellence, providing world class technical and management education. Under his bachelors program he has done various projects under the guidance of Dr. Deepak Khushalani. During the curriculum progress of third year he carried out his minor project where he found out his core interest lies in the domain of embedded system design and internet of things.
E-mail: mohadikarchandu123@gmail.com

Rakshit Najbile is final year student of department of electronics and communication department, Shri Ramdeobaba college of engineering and management, nagpur maharashtra. Shri Ramdeobaba College of Engineering and Management envisages the institute par excellence, providing world class technical and management education. Under his bachelors program he has done various projects under the guidance of Dr. Deepak Khushalani. During the curriculum progress of third year he carried out his minor project where he found out his core interest lies in the domain of embedded system design and internet of things.
E-mail: rakshitnajbile@gmail.com

Vivek Kaushik is final year student of department of electronics and communication department, Shri Ramdeobaba college of engineering and management, nagpur maharashtra. Shri Ramdeobaba College of Engineering and Management envisages the institute par excellence, providing world class technical and management education. Under his bachelors program he has done various projects under the guidance of Dr. Deepak Khushalani. During the curriculum progress of third year he carried out his minor project where he found out his core interest lies in the domain of embedded system design and internet of things.
E-mail: kaushikvivek121@gmail.com

Yash konghe is final year student of department of electronics and communication department, Shri Ramdeobaba college of engineering and management, nagpur maharashtra. Shri Ramdeobaba College of Engineering and Management envisages the institute par excellence, providing world class technical and management education. Under his bachelors program he has done various projects under the guidance of Dr. Deepak Khushalani. During the curriculum progress of third year he carried out his minor project where he found out his core interest lies in the domain of embedded system design and internet of things.
E-mail: yashkonghe7@gmail.com

Dr. Deepak Khushalani born in nagpur is currently working as a Assistant Professor, Department of Electronics and Communication Engineering, Shri Ramdeobaba College of Engineering and Management. He did his bachelors in electronics (2008) from USE california, masters in vlsi (2010) from Shri Ramdeobaba College of Engineering and Management and Phd in electronics (2017) from Shri Ramdeobaba College of Engineering and Management. His research interests include VLSI, MEMS and Embedded System Design for IOT systems.
E-mail: khushalanidg@rknec.edu

Dr. Pankaj Joshi born in Nagpur, India. He did his bachelors and Masters from the RTM Nagpur University. He completed his Ph.D. from VNIT Nagpur, India in 2018. Since 2009 he has been working as Assistant Professor with Ramdeobaba College of Engineering and Management Nagpur. His research interests include VLSI Signal Processing and Architectural Optimizations of DSP applications.
E-mail: joshipu@rknec.edu

Video Lecture Summarization System

Sujal Agrawal and Shubhangi Tirpude
Shri Ramdeobaba college of Engineering and Management, Nagpur, India

Video summarization is a promising approach which provides Comprehensive summary of the video by defining the informative video contents. Video lectures, video diaries, video messages on social networks and videos in various domains are dominating various forms of information exchange. As per the Cisco Visual Networking Index: Forecast and Methodology, 2016-2021, by 2019 video will account for 80% of all global Internet traffic, excluding P2P channels. Nowadays the Lecture videos are an increasingly important learning resource for education. However, the challenge of quickly finding the content of interest in a lecture video is a limitation of this system. Thus, we have developed a lightweight system which can summarize the video lecture to save time, and also easy to use for users. The implemented system is a chrome/browser extension, which works on the browser itself, and runs in the background of the lecture (Google Meet here). This extension lets the user download the whole lecture and the summary of the lecture, and also makes them uploaded on the G-drive.

Keywords: Natural Language Processing, Speech Recognition, Video Summarization, Text Summarization,Lex Rank,Chrome extension.

1. INTRODUCTION

In this busy competitive world, the students are constantly learning new things using video lectures. But sometimes, because of lack of time, it is very difficult to see the entire video lecture taking out the important contents from the lecture. The proposed system generates a PDF containing text summary of the video lectures. This involves developing a component which extract, format and produce output as close to human understanding as possible and make them more efficient. So, the system will generate a real time summary of the lecture i.e. a summary of the transcript that it will receive in the back end of the system. There are many paid third party API and software available which summarize text given to them, but the main aim is to make the system cost free, easy and light weight to use which does not require a whole other app running in background to generate the summary. Thus, we integrate it with Browser Extension or Chrome Extension, which will be activated as soon as the user gets inside a lecture (Google meet in this case).

The remainder of this paper is organized as follows. Section 2 describes an overview of previous work in Video and text summarization, followed by the proposed system of our application in Section 3. Section 4 discusses the implementation details with all the used libraries and technology stack. Section 5 shows the final results of the system in form of screenshots of the system and its final output and also concludes this paper mentioning system and performance and other deliverables.

2. LITERATURE REVIEW

The two broad approaches to text summarization are extraction and abstraction from Widyassari et al. [2022]. The Abstractive summarization, focuses on the important topics in the original document to create a general summary whereas the Extractive algorithm creates an intermediate representation by highlighting the most important information of the text to be summarized based on the representations. There are many third-party websites, software and APIs (for ex. Wordtune.com, Assembly AI, Quilbot, TLDRthis, edit Pad) available which gives the quality summary when we upload lectures for summarization. But no system is available which generates the summary of real time lectures. So we have proposed a light weight system to solve the problem.

in Srinivas et al. [2016]. proposes a system which generates a summary of the video which is in-

teresting to the user and represents the whole video. They have considered various features such as representatives, uniformity, static attention, temporal attention and quality which includes colorfulness, brightness, contrast, hue count, edge distribution for selecting key frames.Also Chadawar et al. [2021] proposes automatic text summarization of video lectures by considering key frames to recognize text. This paper gives us a good brief about different methods for achieving good accuracy.

Vimalaksha et al. [2019] designed an innovative tool which breaks the video into multiple parts based on crowd-sourcing. The tool breaks the video based on the time duration and creates new videos titled based on the subtopic. This tool takes approximately 17 sec to process a one-hour video so that all videos recorded in a single day may be processed in an hour. This reduces the length of the video by approximately 50% and saves storage space by the same amount.

Vimalaksha et al. [2018] designed an inventive software to obtain useful information from a video lecture. This is done by utilizing the content obtained by crowd sourcing, splitting the video into multiple subtopics and then transcribing the same. The tool then processes this data and extracts keywords relevant to the area of discussion. The tool organizes these key phrases so that it can be represented as a hierarchical Mind Map.

Seneviratne et al. [2020] proposed a novel video summarization technique based on tracking local features among consecutive frames. The algorithm processes the video stream directly and produces results on the fly. The achieved results are similar or better in quality than the best performing proposals.

3. PROPOSED SYSTEM

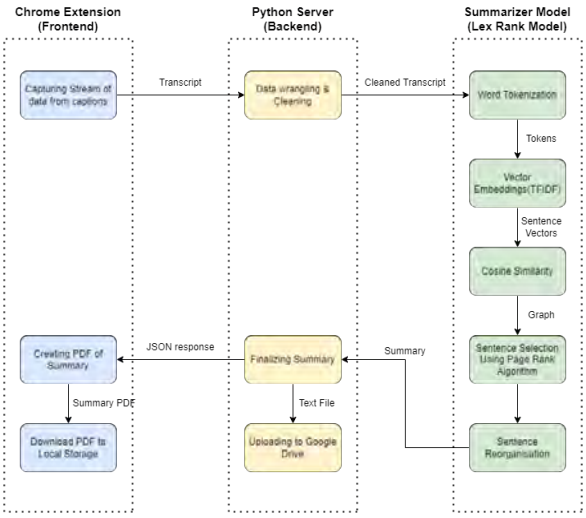


Figure 1: Proposed System Methodology

The proposed system is implemented using the Lex Rank algorithm as in Erkan and Radev [2004] which is an unsupervised graph-based approach to text summarization based on centrality scoring of sentences. The algorithm is used for computing sentence importance based on the concept of eigenvector centrality in a graph representation of sentences. This model uses a connectivity matrix based on intra-sentence cosine similarity which is used as the adjacency matrix of the graph representation of sentences. This sentence extraction majorly revolves around the set of sentences with the same indent i.e., a centroid sentence is selected which works as the mean for all other sentences in the document. Then the sentences are ranked according to their similarities.

The proposed system is divided in three swim (figure 1) lanes namely Chrome extension, Python server (back end app) and Summarise Model (Lex Rank). As the caption is turned on, a continuous stream of texts will be there as captions which will be extracted by the extension on a real time basis and will keep storing it in chrome storage. This transcript is then sent to the python flask App in the back-end, when the user triggers it. The transcript is cleaned here and further sent to the Lex Rank algorithm which will generate the summary. The Summary generated is sent back as response to the chrome extension and one copy of it will be saved to the G-Drive. The summarized response is then converted into PDF which is downloaded in the user's machine.

3.1 Why Browser Extension

We choose chrome extension as it is very light weight system to integrate with the meet web page directly. Instead of going to a third-party website, we are automating the whole task where the chrome extension gets the text transcript, and sending that document to the back-end which will generate the summary by applying the extractive algorithm. The extension will give the user two options, one to download the transcript and one to download the summary PDF of the generated text transcript in real time. Also, our aim is to make this process so that it is not interrupted by network failure, or any other technical failure.

3.2 Transcript and back-end Interaction

To get the speech to text from the online google meets lecture we use the google meet's inbuilt speech to text API and get the transcript from the meet's back-end. But the caption section of the google meet, we observed that in every 10 seconds whatever we spoke gets vanished. So, we have to extract the texts, maintain the sequence of what is being spoken in the lecture, not repeat any sentence and extract the text generated without any losses. We used JS methods to extract the data, which would be triggered by the chrome extension, when we turn on the captions.

When the text transcript will be ready to be sent to the back-end, the system will collect the response of this document and pass this to the python file which will be running in the background locally/ or hosted on the cloud. After the algorithm runs on the text document, it returns the response for download and also sends the PDF to be saved on google drive so that the whole process is automated and the user gets the summarized document in the drive folder.

3.3 The Summarization Algorithm (Lex Rank)

The lex Rank algorithm is implemented with a little modification. The text document is first tokenized and divided into tokens or sentences.The tokenized document is cleaned by removing stop words, punctuation etc. The cleaned text is now moved for stemming/lemmatization, so that we can have the actual word of the verb form of it. Next word embedding is done where we use 'TF/IDF' to transform word form into vectors so that we can apply any mathematical computation on them.The similarity between two sentences is calculated, using cosine similarity. So we have numbers associated with any of two sentences. As this is a graph-based approach, so the graph is constructed by taking sentences as nodes and cosine similarity as weight. Page Rank algorithm is then applied on this graph, where threshold is passed and this is how sentences are ranked Next, we pick top 'n' sentences to calculate or extract summary. Here the sentences may not be in semantic order, thus re-organization of sentences is done so that semantic meaning of the lecture is retained.

4. IMPLEMENTATION

Figure 2 defines the working of chrome extensions on browsers. When the caption is turned on, the lecture audio which is processed by Google API is extracted by chrome extension and is stored in chrome storage. This continues to run in the background during the lecture. Now when the download button is clicked, summary is sent to the Flask app which is at the back end server. The System then sends the transcript to the summarizing algorithm, which then generates and

sends the summary as response back to the extension. The summary is then generated in form of PDF and downloaded on the user's machine.

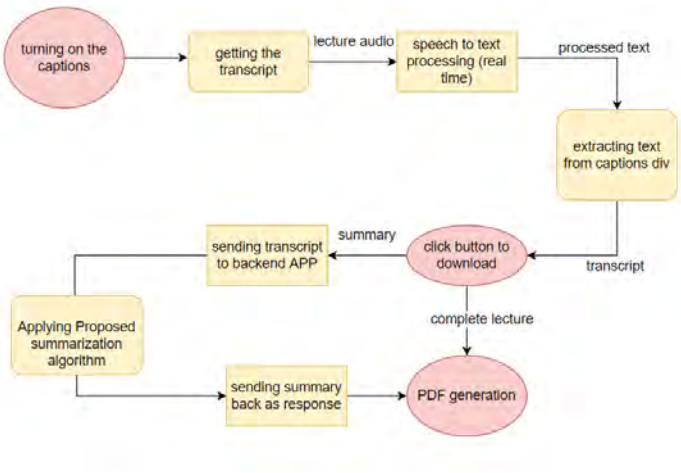


Figure 2: User Interaction and System flow

4.1 Getting the Transcript.

The text is extracted from google API and puts it in the tags of the UI in the DOM of the google meet. We have used 'MutationObserver()' which is a method in JavaScript which looks for any change in the labeled division. As soon as there is a change in that particular division, an event is triggered which returns the list of tags which have been appended i.e a change in the division. This will run every 10 sec as visibility of any processed speech is for 10 sec on the DOM. Therefore, whenever we turn on the captions, chrome extension automatically does this extraction and keeps adding the text on a real time basis.

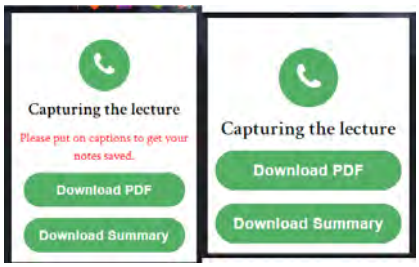


Figure 3: Captions ON/OFF features

4.2 Sending Transcript to the Flask App.

We have added a feature on the UI which tells us to turn on the captions to start recording as shown in the (figure 3-left) when OFF and (figure 3-right) when ON. When one of the two buttons is clicked as visible in figure 3, Using Another cross 'AJAX' which is Asynchronous 'JavaScript and XML', it is the use of the 'XMLHttpRequest' object to communicate with servers, in this case the backend, the transcript is sent to the Flask app which pass it to the algorithm script. The algorithm cleans, pre-process the data and then the proposed algorithm is applied on it.After summarization it is passed back as a response to the 'GET' method to the JS script.Then the summarized document is not sent for PDF creation which is then triggered to be downloaded

in users' machine and automatically uploaded to the user's personal G-Drive using the API of google-drive.

4.3 The Flask App (Back-end).

flask app could be hosted locally or on a cloud server like Heroku. This module is an abstraction layer which acts like main intermediary between front end chrome-extension module and text-summarizer module.The back end is developed using Flask Framework, in which a POST route is defined, named "/summarize". The route accepts request 'JSON' and further parses the 'JSON' into python dictionary format. The Transcript is retrieved from the request body and passed to the summarization module.Further the text-summarization module is called by passing the Transcript as the argument, which will return the summarized text of it.Finally, the summarized text will be returned as a response with status code 200 (successful).

4.4 Implementation of Algorithm

NLTK library is used for preprocessing data and cleaning the data, so series of steps have been implemented in python using various libraries such as numpy, re, math, datetime, networkx – The Data is first cleaned by removing stop words, removing punctuation using the NLTK library. Then it is tokenized, and stemming is applied so as to get the base words quickly. After this TF-IDF is calculated to convert the tokenized sentences to the vector form so that they can be computed mathematically by applying the cosine similarity between sentences. After getting a vector value between each sentence, a graph is constructed where the nodes represent sentences and edge weight is the cosine similarity. Next the PageRank algorithm is implemented using the NetworkX library of python and then finally the top threshold sentences are ranked and returned back. The Threshold can vary in accordance with the summary users want. In this algorithm we took the threshold as 0.4 which is 40% lines of the given sentences.

5. RESULTS, CONCLUSION AND FUTURE SCOPE

Figure 3 is the Basic UI of the chrome extension that the user will see when he/she will click on the chrome extension. Figure 4 is the screenshot of captions that are being put by google speech to text, which chrome extension extracts and stores in chrome storage on real time basis. This will be running till the time captions are not turned back off. Figure 5 shows the sample PDFs that are generated by the chrome extension.

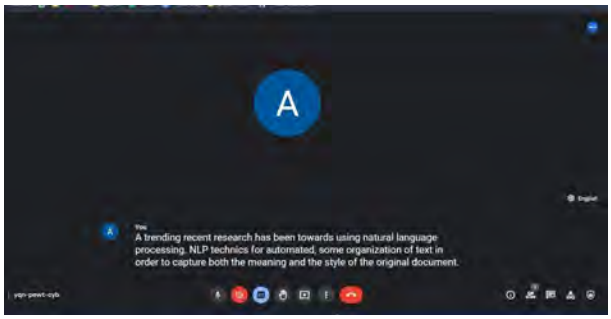


Figure 4: Google API transcribing text to speech

Figure 5: Final result document sample

5.1 Conclusion

In this paper, a novel concept was proposed of video to text summarization by providing an effortless and facile solution for creating a summary for long multimedia content using a system integrated as chrome extension. The system generates summary in 0.34 seconds for a corpus of 1000 words that is 8 minutes of speech or lecture. And considering 9000 words in a lecture of 1 hour the time taken by the algorithm is 15 seconds. Although this may vary depending on the type of text corpus that is the text that is extracted from the lecture. The proposed integrated system is robust, reliable, environment friendly and cost effective .

5.2 Future Scope

One of the features to work upon is the consideration of length of lecture in the summarization algorithm, where the context i.e., the semantic meaning can depend on the length of the lecture (here G-meet). Also, if there is network error the system will start working again but the summary can be affected as some important sentences missing can affect the efficiency. Other scope of the project is to work upon an abstractive method of text summarization as many deep learning and neural network algorithms have been proposed for a better user accepted summary. Technologies like OCR can also be integrated.

References

Chadawar, J., Deshmukh, V., Kharade, S., Shelar, T., and Bhandare, N. 2021. Lecture summarization using video processing and automatic text summarization. In *2021 International Conference on Intelligent Technologies (CONIT)*. 1–4.

Erkan, G. and Radev, D. R. 2004. Lexrank: Graph-based lexical centrality as salience in text summarization. *Journal of artificial intelligence research 22*, 457–479.

Seneviratne, I., Perera, B., Fernando, R., Siriwardana, L., and Rajapaksha, U. 2020. Student and lecturer performance enhancement system using artificial intelligence. In *2020 3rd International Conference on Intelligent Sustainable Systems (ICISS)*. 88–93.

Srinivas, M., Pai, M. M., and Pai, R. M. 2016. An improved algorithm for video summarization–a rank based approach. *Procedia Computer Science 89*, 812–819.

Vimalaksha, A., Vinay, S., and Kumar, N. S. 2019. Hierarchical mind map generation from video lectures. In *2019 IEEE Tenth International Conference on Technology for Education (T4E)*. 110–113.

Vimalaksha, A., Vinay, S., Prekash, A., and Kumar, N. S. 2018. Automated summarization of lecture videos. In *2018 IEEE Tenth International Conference on Technology for Education (T4E)*. 126–129.

Widyassari, A. P., Rustad, S., Shidik, G. F., Noersasongko, E., Syukur, A., Affandy, A., and Setiadi, D. R. I. M. 2022. Review of automatic text summarization techniques methods. *Journal of King Saud University - Computer and Information Sciences 34,* 4, 1029–1046.

Prof. Shubhangi Tirpude Mtech CSE from Amravati University. Pursuing Phd from IIIT Nagpur. She is currently working as Asst. Prof. in the department of Computer Science and Engineering, Shri Ramdeobaba College of Engineering and Management Nagpur. Her area of interest includes, Data Analysis, Machine Learning, Natural Language Processing etc.
E-mail: tirpudes@rknec.edu

Mr. Sujal Agrawal is a final year engineering student, pursuing a bachelor's degree in Computer Science and Engineering from Shri Ramdeobaba College of Engineering and Management, Nagpur from 2019 to 2023. He posses a interest in data science and related fields and made a couple of projects in the same. Other than this he has good competitive programming history on various platforms and an active participant in many such contests. One such group contest was Google Hash code 2021 where he and his group achieved global rank 443. Other than this he is into other extra co-curricular activities as well. Being an extrovert he is good with communicating with others. His recent work includes research in sentiment analysis and new system ideas in the same.
E-mail: sujalagrawal069@gmail.com

Pragmatic evaluation of privacy preservation security models targeted towards fog-based deployments

Roshan Gunwantrao Belsare and Dr. P. B. Ambhore
Government College of Engineering, Amravati, Maharashtra, India

Fog layer sits between cloud layer and edge-layer and responsible for selection of edge-nodes to process cloud tasks. Fog devices manage routers, gateways and other scheduling components, which makes them highly vulnerable to security attacks. Attackers inject malicious packets fog-server, middleware or sensing layers which causes a wide variety of attacks. These attacks include node capturing, signal jamming, node outage, authorization, selective forwarding, data disclosure etc. To remove these attacks, wide variety of solutions are proposed by researchers, which include authorization, cryptography, error correction, firewall, broadcast authentication, selective disclosure etc. Moreover, these solutions vary with respect to privacy and security quality metrics, attack prevention capabilities and deployment quality of service (QoS). Thus, testing and deployment of these solutions is time consuming, requires additional manpower for performance validation. Hence fog deployments require larger time-to-market and are costly than their corresponding cloud deployments. In order to reduce the time for testing and validation of these resilience techniques, this text reviews various fog security and privacy preservation models and discusses their nuances, advantages, limitations and future research scopes. Furthermore it also performs a detailed performance comparison between the reviewed models, which assists in selecting best possible approach for a given application scenario. This text also recommends various fusion based approaches that can be applied to existing security and privacy models in order to further improve their performance. These approaches include hybridization, selective augmentation and Q-learning based models that assist in improving efficiency of encryption, privacy preservation, while maintaining high QoS levels.

Keywords: Blockchain, privacy preservation, neural, deep learning, fuzzy, security, attacks.

1. INTRODUCTION

In the view of rising attacks on cloud deployments, fog security has recently gained a lot of momentum amongst researchers. Fog computing nodes should have low service latency, require user-defined security, and have location awareness due to their positioning on edge of the network. Due to these properties light-weight and high-efficiency security and privacy preservation models must be deployed on the fog Guo and Du [2020]. These models must include packet capturing, data cleaning, data pre-treatment, feature extraction, network packet classification, host detection and tracking, network protocol enforcement models, information analysis models, knowledge mining models, intrusion response methods, and statistical analysis methods. These models are deployed at different layers within the fog stack where fog layered architecture and its internal design components are depicted. In fog architecture, user equipment layer and network layer are the main sources of attacks. This is due to the fact that these layers are publicly available for access by any cloud user. Attacks originating from these layers include but are not limited to, authentication attack, man in the middle, insider issue attack, compromise attack, replay attack, perfect forward secrecy, key disclosure attack, and impersonation attack. Apart from this, concerns including, data integrity and secure fog data storage must also be addressed by fog security frameworks. A wide variety of performance variant models are available for addressing these concerns Tange et al. [2020], and each of them vary in terms of accuracy of attack detection, attack mitigation efficiency, response time, complexity of deployment, cost of deployment, etc. A detailed survey of these models is discussed in the next section, wherein various security issues, advantages, limitations, and nuances of fog security models are identified. This is followed by

a parametric comparison of the reviewed models in terms of various performance metrics. By referring this comparison, researchers would be able to identify the best performing security and privacy approaches for their cloud deployment. Finally, this text concludes with some interesting observations about the reviewed models, and recommends methods to improve their performance.

2. BACKGROUND AND RELATED WORK

A wide variety of security and privacy preservation models for encapsulating cloud deployments from attackers are proposed by researchers over the years. Some of these models are designed for an attack-specific scenario, while others have general purpose application capabilities. For instance, the work in Tu [2018] proposes a model for detection and mitigation of impersonation attack, wherein researchers have used Q-learning-based threshold for real-time behavior analysis. The work in M. Ma and Choo [2019] proposes such an authenticated key agreement (AKA) model without the need of bilinear node pairing. Due to its key agreement capabilities, the model supports secret communication and privacy protection against a wide variety of attacks including mutual authentication, user anonymity, perfect forward secrecy, resistance of stolen verifier attack, session key agreement, un-traceability, resistance of off-line dictionary attack, resistance of man-in-the-middle attack, resistance of known session key attack, and resistance of replay attacks. The AKA model outperforms short-time certificate uploading model (STCU) in terms of computational delay, and achieves over 91% accuracy of attack detection, which makes it suitable for real-time fog deployments. In order to design a highly scalable security model, content-awareness must be added to it. The work in Wu et al. [2019] proposes such a content-aware model, wherein different criteria for user-content classification are used in order to classify incoming requests into malicious and normal types. The model is able to achieve an accuracy of 85%, with lower delay when compared with Cache Sharing based on Bloom Filters (CSBF) which has an accuracy of 83% with higher computational delay. But the delay of this model increases exponentially w.r.t. increase in number of users, which limits its scalability. In order to reduce this delay, the work in Mourad et al. [2021] can be used, wherein researchers have proposed an adhoc approach to enable cooperative and low-latency intrusion detection. The MOMKT model is observed to have an accuracy of over 95%, with lower delay, and better energy efficiency when compared with intelligent resource-aware offloading (IRAO), and other similar models. A highly efficient and secured mutual authentication protocol (SMAP) for fog nodes is proposed in Pardeshi and Yuan [2019a], wherein researchers have used an authorization server (AS) for key-exchange. The AS model uses a pseudo random number generator (PRNG) for reducing authentication attacks via timestamp-based checking. It is able to remove these attacks with over 96% accuracy, and showcases lower delay when compared with RSA, elliptic curve cryptography (ECC), and Lightweight mutual authentication protocol (LMAP), which also have lower attack detection accuracy than SMAP. Apart from authentication, fog networks require better access control, routing security, data privacy, decentralization, heterogeneity, and location awareness. The work in Ni et al. [2018] highlights these fields, and recommends that models like edge content caching, frequent credential reconfiguration, computational offloading, aided computing, local content distribution, etc. must be applied to fog networks for improving their security and privacy performance. Even after application of these models, a wide variety of challenges must be solved while design of fog computing infrastructure. Out of these challenges, denial of service (DoS), probing, distributed DoS (DDoS), and data theft are covered by the security and trust management models (STMM) model proposed in Junejo et al. [2021]. Here, researchers have achieved data confidentiality, authentication, data integrity, and authorization using security component, while QoS optimization is performed using trust management model, which assists in selection of best possible node-to-node routing path with low delay, low energy consumption, and high packet delivery performance. The model is able to achieve 91% accuracy for detection of these attacks.In order to reduce this complexity, the work in Wang et al. [2021] can be referred, where researchers have modified the Kuhn-Munkres (KM) model, and achieved

better sustainability than the original KM model.The modified KM model is capable of reducing computational costs by 25% when compared to original KM Model when applied for resolution of coupling security issues. This modification is done during cache queuing, and during construction of mask matrix via redundancy reduction, which assists in reducing computational complexity, thereby improving deployment scalability of the model. Such models are highly compatible with other attack detection models, and can be interfaced directly into their internal computational layers. An example of such an interfacing is discussed in Wazid et al. [2019], wherein researchers have integrated Authenticated Key Management Protocol (AKM) with Real-Or-Random (ROR), and Automated Validation of Internet Security Protocols and Applications (AVISPA) security models.Due to this integration, the proposed model is able to reduce delay needed, and improve accuracy for attack detection. The AKM model showcases an accuracy of 86%, which is higher than Privacy-Preserving Dual Authentication and Key Agreement Scheme (PPDAKAS) that has an accuracy of 74.8%, and anonymous authentication scheme (AAS) that has an accuracy of 83.5% on the same attack scenarios. But the AKM model has higher computational complexity, and deployment cost when compared with PPDAKAS and AAS schemes due to multiple phases used for initialization, authentication and dynamic node addition. The work in Liu et al. [2021] proposes such a model, where researchers have utilized lightweight Boneh-Lynn-Shacham (BLS) signature method with group signature for achieving batch anonymous authentications. The model is applied to vehicular networks, but can be extended for any kind of fog-based network, where a decentralized fog node is available for intermediate signature verification. Due to use of this decentralized fog node, the proposed model is able to reduce computational complexity, and achieve moderate accuracy of attack detection between 70% to 80% depending upon network scenario. A similar outsourcing scheme is proposed in J. Zhao and Choo [2021], wherein researchers have used attribute revocation in fog-enabled e-Health networks for removing improper access control tokens from the network. In order to perform this task, a ciphertext-policy attribute-based encryption (CPABE) model is combined with fog-based access control (FAC), which assists in achieving fine-grained control over the network. The model removes attacks related to authentication and access control with 98% efficiency, and requires low delay when compared with large universe attribute-based access control (LUABAC) and fully outsourced attribute-based encryption (FOABE) models. Similar security models are proposed in Saleem et al. [2020], Du et al. [2019] wherein researchers have discussed authenticated key management (AKM), and differential privacy models (DPMs) for highly sustainable fog-data centers. Aggregation based security models are also widely used in fog networks, because they assist in reducing computational delays via batch processing of requests. The work in Lyu et al. [2018] proposes such a model, wherein researchers have used Vernam cipher or one-time pad (VCOTP) model, which is proven to be highly secure. The VCOTP model is applied to aggregate requests arriving from fog and cloud nodes, and then applied various sanitization processes in order to detect for authenticity and node failure events. The model is able to achieve an average accuracy of 83.5% for multiple attack types, which is higher than smoothed differential privacy (SDP), that has an accuracy of 61.5% on the same attack scenario. The privacy performance of this model requires improvement, which can be done via integration of crowdsourcing-based privacy preservation as suggested in Zhang et al. [2020]. Here, researchers have used key generation centers for reducing complexity of authentication and key-exchange, which can be observed from figure 1, wherein crowdsourcing server is used for securing fog nodes. Due to use of crowdsourcing, the model is able to reduce computational delay, while improving efficiency of content privacy, keyword privacy, interest privacy, security proofs, batch-based matching, and non-interactive verifications. This performance can be further improved via use of Pseudonym Scheme (PS) as proposed in Kang et al. [2018], wherein researchers have used IoV environments to incorporate context-aware pseudonym changing; reduced pseudonym management overhead, and timely pseudonym distribution amongst fog nodes. The PS model stores pseudonym data on device, and verifies it using a pseudonym pool available on fog nodes. Due to this simplistic approach, the model is able to reduce computational

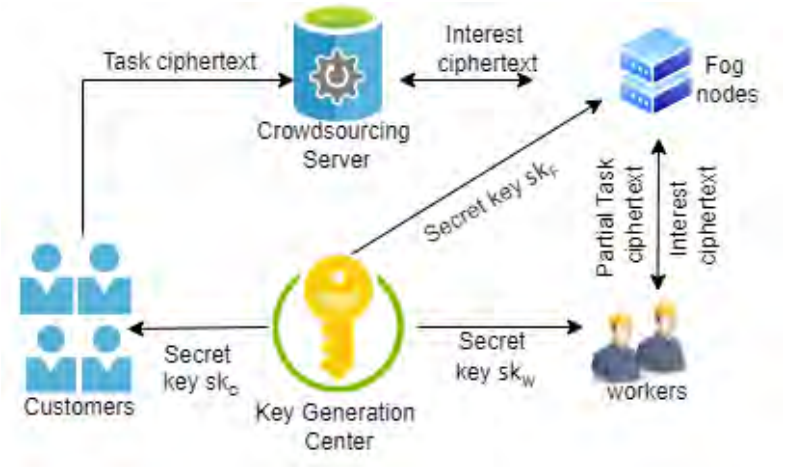


Figure 1. Use of Crowdsourcing with key generation center

delay, thereby improving overall system throughput. Privacy preservation in fog computing can also assist in improving communication efficiency via minimum re-transmissions. The work in Lu [2019] proposes a model that implements range query scheme (RQS), wherein input query is range expressed, then decomposed, and then composed in order to remove all sensitive attributes from it. This privacy preserved query is given to the network for highly effective communications. As a result of which, communication overheads are reduced, and overall communication throughput is improved. This model has low security performance, which can be improved via utilization of multiple layers of privacy preservation along with machine learning. The work in Wang et al. [2018] proposes such a model, wherein 3 layers of privacy preservation (L3PP) are used in order to store incoming data into cloud, fog, or local machine depending upon its privacy levels. An example of this system is depicted in figure 2, wherein 95% of data is stored on the cloud, 4% is stored on the fog, and remaining 1% is stored on the device locally.

All the data packets are encrypted, and diversified, such that none of the entities are able to reconstruct the data without having access to all data parts. Due to storage of data on multiple layers, this model is able to reduce spoofing, spying, and other data related attacks. But this model has data inconsistency issues, wherein one compromised node can impact the entire data storage capabilities of the network, and thus this issue must be tackled for improving overall data integrity of the network. Such a model is proposed in Yan [2021], wherein researchers have used verifiable, privacy-preserving and reliable data aggregation mechanism (ViPRAM) for improving security of mobile crowdsensing-based fog deployments. Similar privacy models are proposed in Gu et al. [2020],Pardeshi and Yuan [2019b], **?**] wherein researches have discussed use of load balancing with reputation management (LBRM), mutual authentication protocol (MAP), and access control fine grained attribute control (ACFGAC) methods for enhancing fog-device privacy. These models are able to reduce context-specific attacks with an accuracy of 74%, 85%, and 83% respectively, thus, can be used for low-scale and low-cost network deployments. Performance of these models has further scope of improvement via addition of better security methods. For instance, the work in Li et al. [2020] proposes a closed loop feedback security model, which predicts system risks before they occur. This model uses a combination of deep Boltzmann machines and Markov time-varying models in order to estimate any security risks, open interfaces, modularity issues, and compliance issues. This estimation assists in finding attacker nodes, which can perform authentication, access control, side channel attack, spoofing, and spying detection with 98.5% accuracy, which makes is useful for a wide variety of fog deployments. Similar models are proposed in Wei et al. [2018], Li et al. [2018],Rathore et al. [2018], wherein researchers have showcased use of crowdsourcing-based privacy preservation, fog computing enabled secure

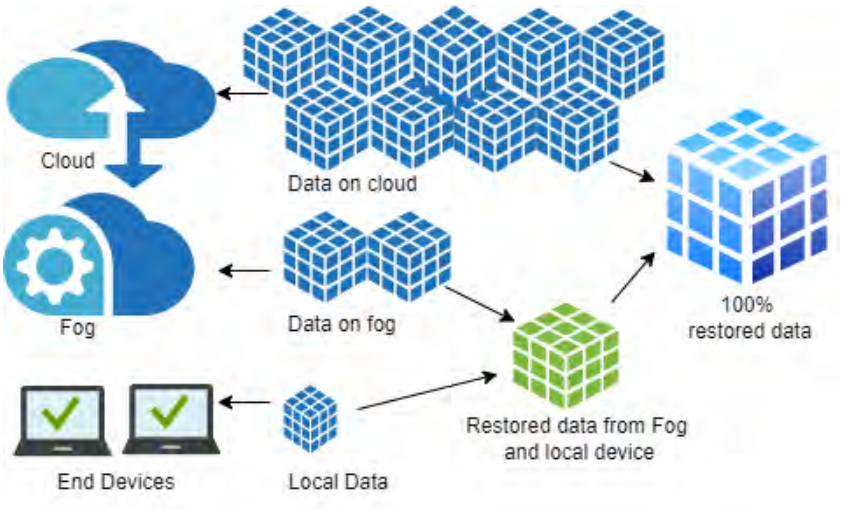


Figure 2. The 3-layer privacy preservation model

demand response (FSDR), and a soft hesitant fuzzy rough set (SHFRS) for improving system security with minimum effect on QoS performance. SHFRS model is capable of removing over 97.5% attacks from the network. Application specific fog security models are proposed in Sultana and Wahid [2019],U. U. Rehman and Lee [2021], Whaiduzzaman et al. [2021], wherein convolutional neural network based IoT based surveillance system, (CNN ISS) healthcare based personalized recommendation system (HPRS), and blockchain-based 3-layered fog IoT system (B3FIS) are proposed. These models assist in securing application specific system instances, thereby require constant tuning in order to be applicable for general purpose fog deployments. The ISS model is capable of detecting attacks with 95% efficiency, while HPRS is able to identify attack instances with 91% accuracy, and the B3FIS model is capable of identifying attacks with over 97% efficiency, thereby making them highly useful for application-specific fog deployments. In contrast to these models, general purpose fog security methods are discussed in Wen et al. [2019], P. K. Sharma and Park [2018], An et al. [2019], where researchers have proposed use of revocable access control (RAC) models, blockchain based software defined network (BSDN), and fog radio access networks with node state monitoring scheme (FRANSMS) for intrusion detection are proposed. The RAC model is used for detection of access control vulnerabilities and achieves an accuracy of 85% in detection of unwanted attacks, while BSDN and FRANSMS models are used for general purpose attack detection and prevention, and showcase an accuracy of 98.5%, and 94.3% respectively. Thus, these models are highly useful for large-scale fog deployments. The efficiency of these models must be further extended via addition of privacy preservation using crowdsensing **?**], where researchers have aimed at reducing computational complexity via addition of privacy preserving mechanisms to each mobile fog node. These improved privacy and security models are applied to application specific scenarios, like in Whaiduzzaman [2020], where researchers have used fog privacy models for tracing and preventing CoVID-19 outbreak via machine learning analytics. It does this by evaluating Automatic Risk Checkers (ARC), and Suspected User Data Uploader Node (SUDUN), and then aggregating their results via Rotational Unique Encrypted Reference Code (RUERC), in order to estimate CoVID-19 spread. The model showcases 91% accuracy of spread detection, and over 74% efficiency in reducing spread of the virus. Similarly, other healthcare applications are proposed in Wang et al. [2018], R. Saha and Lim [2019], wherein researchers have used e-Health data for privacy aware fine grained access control (PWFGAC), and data aggregation-based security rule enforcement (DASRE). These models have high level of security, and can be used for high-throughput, and high-speed medical environments. The PWFGAC model is observed to have an accuracy of 98.7%, while the DASRE

model achieves an accuracy of 96.3% for attack detection and privacy enforcement, with high computational complexity, and low end-to-end deployment delay. Thus, from this review it is observed that most of the existing models have good privacy, and attack detection performance, but vary in terms of security level, computational delay, complexity of deployment, and cost of deployment parameters. Thus, the next section evaluates parametric performance of reviewed models, and compares them in order to evaluate best fog security model for a given scenario.

3. PRAGMATIC EVALUATION

From the extensive review about various fog security and privacy preservation models, it is observed that these models are highly variant, and have different performance under different application-specific conditions. Thus, in order to estimate the best model(s) for a given application, this section evaluates the reviewed models in terms of accuracy of attack detection (A), computational complexity (CC), delay needed for privacy preservation (D), and attack scalability (AS).Pragmatic values of accuracy are directly referred from the reference documents, while computational complexity and delay needed for privacy preservation are inferred from internal architecture of the models. These values are divided into low (L), medium (M), high (H), and very high (VH) ranges, depending upon their internal implementation. Furthermore, value of

Number of attacks	Application scenarios	Scalability
<=2	<=2	L
<=4	<=3	M
<=5	<=5	H
>5	>5	VH

Table 1. Scalability rules

scalability is defined in terms of number of attacks, and number of application scenarios on which the model is tested. These values are inferred into L, M, H, and VH ranges based on the rules mentioned in table 1. Based on these observations, parametric evaluation for accuracy of attack detection (A), computational complexity (CC), delay needed for privacy preservation (D), and attack scalability (AS) can be observed from table 2 as follows. Based on this evaluation, it can be observed that PWFGAC Wang et al. [2018], Boltzmann machines Li et al. [2020], BSDN P. K. Sharma and Park [2018], FAC CPABE J. Zhao and Choo [2021], SHFRS Rathore et al. [2018], B3FIS Whaiduzzaman et al. [2021], DASRE R. Saha and Lim [2019], SMAP PRNG Pardeshi and Yuan [2019a], and AKM Saleem et al. [2020] have highest accuracy of attack detection and prevention in fog-based deployments, while, MOMKT Mourad et al. [2021], ViPRAM Yan [2021], KM Wang et al. [2021], RAC Wen et al. [2019], FSDR Li et al. [2018], BLS Liu et al. [2021], and FTD Tu [2018] have the lowest computational complexity. Thus, these models must be used for high-efficiency fog-deployments, where service rate has more priority than processing delay. Similarly, STMM Junejo et al. [2021], STCU M. Ma and Choo [2019], ViPRAM Yan [2021], BLS Liu et al. [2021], and FTD Tu [2018] have the fastest speed of deployment, thus must be used for high-speed and high-throughput cloud applications. While, the models AKA M. Ma and Choo [2019], VCOTP Lyu et al. [2018], FRANSMS An et al. [2019], L3PP Wang et al. [2018], PLS Tu [2018], Crowdsourcing Zhang et al. [2020], PS Kang et al. [2018], STMM Junejo et al. [2021], and ViPRAM Yan [2021] have higher scalability than others, and thus must be used for general purpose fog-based deployments. But from these observations it is difficult to estimate the best model for fog-security, which is highly accurate, has low complexity, low delay, and high

Method	A	CC	D	AS	Method	A	CC	D	AS	Method	A	CC	D	AS
PLS [3]	92.5	M	H	VH	BLS [12]	79	L	L	VH	ACFGAC [26]	83	M	M	M
FTD [3]	71	L	L	H	FAC CPABE [13]	98	H	H	L	Boltzmann machines	98.5	H	H	H
AKA [4]	91	H	H	VH	LUABAC [13]	91	H	M	L	FSDR [29]	79.8	L	M	H
STCU [4]	89	H	L	M	FOABE [13]	95	M	H	L	SHFRS [30]	97.5	H	M	H
FCSS [5]	85	H	VH	H	AKM [14]	95.4	M	H	H	CNN ISS [31]	95	VH	M	M
CSBF [5]	83	VH	H	M	DPM [15]	91.6	M	M	H	HPRS [32]	91	H	H	L
MOMKT [6]	95	L	M	L	VCOTP [16]	83.5	H	H	VH	B3FIS [33]	97	H	H	L
SMAP PRNG [7]	96	H	M	H	SDP [16]	61.5	VH	H	H	RAC [34]	85	L	M	M
STMM [9]	91	H	L	VH	Crowdsourcing [17]	85	M	H	VH	BSDN [35]	98.5	H	M	VH
AT [9]	85	M	M	H	PS [18]	94	VH	H	VH	FRANSMS [36]	94.3	M	H	VH
Modified KM [10]	93	M	M	VH	RQS [21]	83	H	H	M	ARC [38]	91	M	M	L
KM [10]	89	L	M	H	L3PP [22]	93.7	M	H	VH	PWFGAC [39]	98.7	M	M	L
AKM [11]	86	H	M	VH	ViPRAM [23]	94.6	L	L	VH	DASRE [40]	96.3	H	M	L
PPDKAS [11]	74.8	H	H	H	LBRM [24]	74	H	H	M					
AAS [11]	83.5	M	H	H	MAP [25]	85	M	H	M					

Table 2. Pragmatic analysis of reviewed security models

scalability. Thus, a new metric named 'algorithm rank' (AR) is evaluated using equation 1 as follows. $AR = \frac{Acc}{100} + \frac{5}{CC} + \frac{5}{D} + \frac{AS}{5}$ ...(1) This rank will assist in selecting the most accurate and scalable fog-security model with lowest possible delay, and low complexity of deployment. It is evaluated for each reviewed model, and its values are tabulated in table 3 as follows. This score

Method	AR	Method	AR	Method	AR	Method	AR	Method	AR
PLS	4.84	AT	5.43	FOABE	6.37	L3PP	4.85	CNN ISS	5.28
FTD	6.96	Modified	5.26	AKM	5.12	ViPRAM	6.95	HPRS	5.91
AKA	4.41	KM	6.31	DPM	5.50	LBRM	4.91	B3FIS	5.97
STCU	6.31	AKM	4.78	VCOTP	4.34	MAP	5.43	RAC	6.68
FCSS	4.35	PPDKAS	4.50	SDP	4.12	ACFGAC	5.83	BSDN	4.90
CSBF	4.75	AAS	5.00	Crowdsourcing	4.77	Boltzmann	4.74	FRANSMS	4.86
MOMKT	7.62	BLS	6.79	PS	4.19	FSDR	6.21	ARC	6.74
SMAP	5.13	FAC	5.98	RQS	5.00	SHFRS	5.14	PWFGAC	6.82
STMM	5.66	LUABAC	6.33	DASRE	6.38				

Table 3. Algorithmic score for each reviewed model

can also be observed from figure 3, wherein AR values for different models are plotted to better visualize their performance.

From the algorithmic score, it is observed that MOMKT Mourad et al. [2021], FTD Tu [2018], ViPRAM Yan [2021], PWFGAC Wang et al. [2018], BLS Liu et al. [2021], ARC Whaiduzzaman [2020], RAC Wen et al. [2019], DASRE R. Saha and Lim [2019], FOABE J. Zhao and Choo [2021], LUABAC J. Zhao and Choo [2021], STCU M. Ma and Choo [2019], and KM Wang et al. [2021] outperform other models, and must be used for high efficiency, and high security fog-deployments.

4. CONCLUSION AND FUTURE WORK

From this extensive review it is observed that a wide variety of models are available for securing fog deployments. These models are compared in terms of accuracy of attack detection (A), computational complexity (CC), delay needed for privacy preservation (D), and attack scalability

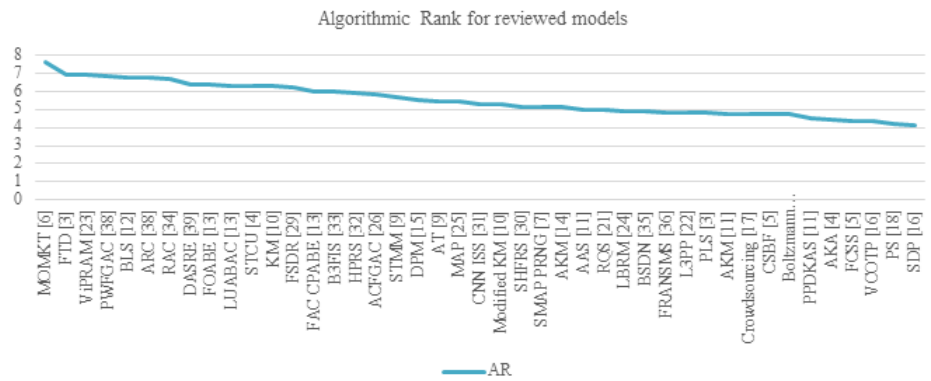


Figure 3. Algorithmic rank for different models

(AS), wherein it is observed that different models are selected for different performance terms. Thus, this text devises a novel Algorithmic Rank (AR) metric, which assists in evaluation of a singular performance metric for all the reviewed models. Observing this rank, it is concluded that MOMKT Mourad et al. [2021], FTD Tu [2018], ViPRAM Yan [2021], PWFGAC Wang et al. [2018], BLS Liu et al. [2021], ARC Whaiduzzaman [2020], RAC Wen et al. [2019], DASRE R. Saha and Lim [2019], and FOABE J. Zhao and Choo [2021] outperform other models. These models must be used for highly accurate, highly scalable, low delay, and low complexity fog-deployments, which would assist researchers and fog-designers to develop highly efficient security and privacy preservation models. In future, researchers must combine these models using fusion architectures like Genetic Algorithm (GA), particle swarm optimization (PSO), Q-learning, etc. which would assist in selection of these models based on current deployment context, thereby further improving efficiency of fog-based devices.

References

An, X., Lü, X., Yang, L., Zhou, X., and Lin, F. 2019. Node state monitoring scheme in fog radio access networks for intrusion detection. In *IEEE Access*. Vol. 7. 21879–21888,.

Du, M., Wang, K., Liu, X., Guo, S., and Zhang, Y. 2019. A differential privacy-based query model for sustainable fog data centers. *IEEE Transactions on Sustainable Computing 4,* 2, 145–155,.

Gu, K., Tang, L., Jiang, J., and Jia, W. 2020. Resource allocation scheme for community-based fog computing based on reputation mechanism. *IEEE Transactions on Computational Social Systems 7,* 5, 1246–1263,.

Guo, J. and Du, Y. 2020. Fog service in space information network: Architecture, use case, security and challenges. In *IEEE Access*. Vol. 8. 11104–11115,.

J. Zhao, P. Z. and Choo, K. K. R. 2021. An efficient access control scheme with outsourcing and attribute revocation for fog-enabled e-health. In *IEEE Access*. Vol. 9. 13789–13799,.

Junejo, A., Komninos, N., and McCann, J. 2021. A secure integrated framework for fog-assisted internet-of-things systems. *IEEE Internet of Things Journal 8,* 8, 6840–6852,.

Kang, J., Yu, R., Huang, X., and Zhang, Y. 2018. Privacy-preserved pseudonym scheme for fog computing supported internet of vehicles. *IEEE Transactions on Intelligent Transportation Systems 19,* 8, 2627–2637,.

Li, G., Wu, J., Li, J., Guan, Z., and Guo, L. 2018. Fog computing-enabled secure demand response for internet of energy against collusion attacks using consensus and ace. In *IEEE Access*. Vol. 6. 11278–11288,.

Li, Q., Tian, Y., Wu, Q., Cao, Q., Shen, H., and Long, H. 2020. A cloud-fog-edge closed-loop feedback security risk prediction method. In *IEEE Access*. Vol. 8. 29004–29020,.

Liu, X., Chen, W., Xia, Y., and Yang, C. 2021. Se-vfc: Secure and efficient outsourcing computing in vehicular fog computing. *IEEE Transactions on Network and Service Management 18,* 3, 3389–3399,.

Lu, R. 2019. A new communication-efficient privacy-preserving range query scheme in fog-enhanced iot. *IEEE Internet of Things Journal 6,* 2, 2497–2505,.

Lyu, L., Nandakumar, K., Rubinstein, B., Jin, J., Bedo, J., and Palaniswami, M. 2018. Ppfa: Privacy preserving fog-enabled aggregation in smart grid. *IEEE Transactions on Industrial Informatics 14,* 8, 3733–3744,.

M. Ma, D. He, H. W. N. K. and Choo, K. K. R. 2019. An efficient and provably secure authenticated key agreement protocol for fog-based vehicular ad-hoc networks. *IEEE Internet of Things Journal 6,* 5, 8065–8075,.

Mourad, A., Tout, H., Wahab, O., Otrok, H., and Dbouk, T. 2021. Ad hoc vehicular fog enabling cooperative low-latency intrusion detection. *IEEE Internet of Things Journal 8,* 2, 829–843,.

Ni, J., Zhang, K., Lin, X., and Shen, X. 2018. Securing fog computing for internet of things applications: Challenges and solutions. *IEEE Communications Surveys Tutorials 20,* 1, 601–628,.

P. K. Sharma, M. Y. C. and Park, J. H. 2018. A software defined fog node based distributed blockchain cloud architecture for iot. In *IEEE Access*. Vol. 6. 115–124,.

Pardeshi, M. S. and Yuan, S. M. 2019a. Smap fog/edge: A secure mutual authentication protocol for fog/edge. In *IEEE Access*. Vol. 7. 101327–101335,.

Pardeshi, M. S. and Yuan, S. M. 2019b. Smap fog/edge: A secure mutual authentication protocol for fog/edge. In *IEEE Access*. Vol. 7. 101327–101335,.

R. Saha, G. Kumar, M. K. R. R. T. and Lim, S. J. 2019. Privacy ensured ee -healthcare for fog-enhanced iot based applications. In *IEEE Access*. Vol. 7. 44536–44543,.

Rathore, S., Sharma, P., Sangaiah, A., and Park, J. 2018. A hesitant fuzzy based security approach for fog and mobile-edge computing. In *IEEE Access*. Vol. 6. 688–701,.

Saleem, M., Mahmood, K., and Kumari, S. 2020. Comments on "akm-iov: Authenticated key management protocol in fog computing-based internet of vehicles deployment". *IEEE Internet of Things Journal 7,* 5, 4671–4675,.

Sultana, T. and Wahid, K. 2019. Iot-guard: Event-driven fog-based video surveillance system for real-time security management. In *IEEE Access*. Vol. 7. 134881–134894,.

Tange, K., Donno, M., Fafoutis, X., and Dragoni, N. 2020. A systematic survey of industrial internet of things security: Requirements and fog computing opportunities. *IEEE Communications Surveys Tutorials 22,* 4, 2489–2520,.

Tu, S. 2018. Security in fog computing: A novel technique to tackle an impersonation attack. In *IEEE Access*. Vol. 6. 74993–75001,.

U. U. Rehman, S. B. P. and Lee, S. 2021. Secure health fog: A novel framework for personalized recommendations based on adaptive model tuning. In *IEEE Access*. Vol. 9. 108373–108391,.

Wang, T., Liang, Y., Tian, Y., Bhuiyan, M., Liu, A., and Asyhari, A. 2021. Solving coupling security problem for sustainable sensor-cloud systems based on fog computing. *IEEE Transactions on Sustainable Computing 6,* 1, 43–53,.

Wang, T., Zhou, J., Chen, X., Wang, G., Liu, A., and Liu, Y. 2018. A three-layer privacy preserving cloud storage scheme based on computational intelligence in fog computing. *IEEE Transactions on Emerging Topics in Computational Intelligence 2,* 1, 3–12,.

Wang, X., Wang, L., Li, Y., and Gai, K. 2018. Privacy-aware efficient fine-grained data access control in internet of medical things based fog computing. In *IEEE Access*. Vol. 6. 47657–47665,.

Wazid, M., Bagga, P., Das, A., Shetty, S., Rodrigues, J., and Park, Y. 2019. Akm-iov: Authenticated key management protocol in fog computing-based internet of vehicles

deployment. *IEEE Internet of Things Journal 6,* 5, 8804–8817,.

Wei, J., Wang, X., Li, N., Yang, G., and Mu, Y. 2018. A privacy-preserving fog computing framework for vehicular crowdsensing networks. In *IEEE Access*. Vol. 6. 43776–43784,.

Wen, M., Chen, S., Lu, R., Li, B., and Chen, S. 2019. Security and efficiency enhanced revocable access control for fog-based smart grid system. In *IEEE Access*. Vol. 7. 137968–137981,.

Whaiduzzaman, M. 2020. A privacy-preserving mobile and fog computing framework to trace and prevent covid-19 community transmission. *IEEE Journal of Biomedical and Health Informatics 24,* 12, 3564–3575,.

Whaiduzzaman, M., Mahi, M., Barros, A., Khalil, M., Fidge, C., and Buyya, R. 2021. Bfim: Performance measurement of a blockchain based hierarchical tree layered fog-iot microservice architecture. In *IEEE Access*. Vol. 9. 106655–106674,.

Wu, J., Dong, M., Ota, K., Li, J., and Guan, Z. 2019. Fcss: Fog-computing-based content-aware filtering for security services in information-centric social networks. *IEEE Transactions on Emerging Topics in Computing 7,* 4, 553–564,.

Yan, X. 2021. Verifiable, reliable, and privacy-preserving data aggregation in fog-assisted mobile crowdsensing. *IEEE Internet of Things Journal 8,* 18, 14127–14140,.

Zhang, J., Zhang, Q., and Ji, S. 2020. A fog-assisted privacy-preserving task allocation in crowdsourcing. *IEEE Internet of Things Journal 7,* 9, 8331–8342,.

Dr. P. B. Ambhore is the Assistant Professor in Information Technology department at the Government College of Engineering, Amravati, Maharashtra, India. He has vast experience of 25+ years. He has a wide range of experience in Computer and network security domains. He has over 30 published research papers in international journals/conferences. He has pursued his Engineering and PhD education at Government College of Engineering, Amravati. His research interests are in cloud computing Security and Network Security. He has worked as International Conference Organizer and Technical Committee Members for 8+ National and International Conferences. He is a member of various professional oragnizations like ISTE, ACM, Computer Society of India etc.
E-mail: pbambhore@gmail.com

Mr. Roshan G. Belsare is a Research Scholar in Government College of Engineering, Amravati, Maharashtra, (India). He has done his ME in Computer Science and Engineering from PRMIT, Badnera. . His research interests are in Computer and network Security, Software Engineering, Software Maintenance and Cloud Computing.
E-mail: roshanbelsare24@gmail.com

DIVVA: Disaster Information Verification and Validation Application Using Machine Learning

Vrushali Bongirwar, Sameer Shekhar Mishra, Atharva Bisen, Soham Mundhada, Utkarsh Singh
Shri Ramdeobaba College Of Engineering And Management Nagpur, Maharashtra, India

Social media platforms have made it possible for people and organizations to disseminate information to their peers and target markets. Even while most information is shared with the best of intentions, some people utilize social media to further their own agendas. They might publish untrue or inaccurate information in their posts. Before, during, and after disasters and emergencies, social media is rife with rumors, misinformation, and misleading information. These false rumors and information could also make individuals anxious. How to stop the spread of this incorrect information is one of the main problems that public safety authorities and organizations face. DIVVA is a system that, using some provided input text data, evaluates and validates disaster-related information. The system has two tracks: a validation track and a verification track. Verification will classify the textual input into categories related to disasters or not related to disasters. The Validation track, on the other hand, will use the official handles of government disaster relief organizations like the NDRF (National Disaster Response Force) to determine whether the event mentioned in the text data actually happened or not before classifying the disaster-related data as real or fake. Therefore, if many individuals receive erroneous information about a calamity, we can utilize our approach to determine if the information is true or false. Our results show that the Bidirectional LSTM model performs well for the tweet classification (i.e. whether the tweets are related to disaster or not) task with 84% accuracy.

Keywords: Natural Language Processing (NLP), Bidirectional Long Short Term Memory (Bi-LSTM), FuzzyWuzzy, Tweepy, Disaster, Tweets, Fake, Real, Model, Training, Model Testing, Tkinter.

1. INTRODUCTION

Social media platforms have made it possible for people and organizations to disseminate information among their peers and target audiences. Although most people share information with good intentions, some people use social media to achieve their own personal goals. How to stop or drastically minimize the dissemination of incorrect information is one of the main problems that public safety agencies and organizations face. To tackle this problem, we have built a system that allows users to submit textual data to verify and validate whether the information is accurate or not, preventing the spread of false information about disasters and mass fear. First, data cleaning was done on the dataset which involved removing the Emojis, urls, numerals, special characters, and eliminating stop words. This dataset was then used for training the Bi-Directional LSTM model. We also gathered the accurate, confirmed data from the official Twitter accounts of government organizations that provide disaster aid, such as NDMA India and NDRF (National Disaster Response Force) and SDMA (State Disaster Management Authority). These extracted tweets were stored in tweets.csv file. Using the Tkinter library the GUI for the application was made where the user can enter the text data and their text will get classified as Disaster related or non-Disaster related. Additionally, the users can see the validity percentage of their text. Validity percentage is calculated using the FuzzyWuzzy library, which uses Levenshtein Distance to calculate the differences between sequences. The user inputted text will be matched with every tweet of the tweets.csv file and the highest matched percentage will be returned to the user. Higher validity percentage means the disaster mentioned in the text has actually occurred and therefore the information which the user has entered is correct. The remainder of this paper is organized as follows. Section 2 describes an overview of previous work in tweets classification, followed by an overview of our application in Section 3. Section 4 discusses various data cleaning

and preprocessing methods, models used for Verification and Validation and the performance of our model. The results are presented in Section 5. Finally we conclude the paper in Section 6.

2. RELATED WORK

In Yun [2011] Twitter is mostly famous as a microblogging platform that enables users to communicate via brief messages called tweets. These tweets provide useful geolocation information and, in particular, time-sensitive occurrences. This study compares Google News and Twitter activity for the three disasters that occurred at the same time. This study's key finding is that emergency detection could start using microblogging services. In the research paper Nilani Algiriyage [2021], The researchers used ML and DL techniques to assess crisis-related social media messages as an autonomous activity. Their findings demonstrate the effectiveness of the Bidirectional LSTM model with Word2Vec embeddings for the tweet classification task in each of the three environments i.e. "in-disaster," "out-disaster," and "cross-disaster". Hien To [2017] Twitter and other social media are growing as platforms that help with situational awareness during emergencies. Even when there are many tweets, it can be difficult to automatically pick those that are pertinent. They suggest a straightforward yet efficient method that locates pertinent communications by matching hashtags and phrases. Jivani [2011] The aim of stemming is to reduce a word's numerous grammatical forms, such as its noun, adjective, verb, and adverb forms, to its root form, according to the study report Jivani [2011]. They have analyzed several stemming methods and looked at the many applications, advantages, and disadvantages of each. Salem [2022b] There are many different problems involving sequence data that have been solved using recurrent neural networks with different kinds of hidden units. Gated recurrent units (GRU) and minimal gated units (MGU), two of the most recent types, have both produced encouraging results on representative public datasets. They highlight the MGU RNN in this chapter and describe its induced architecture. Then, by minimizing the number of parameters in the single gate dynamic equation, they offer five slim variations that further simplify this design. Salem [2022a] Recurrent neural networks (RNN) with long short-term memory (LSTM) have been enhanced and expanded. They rely on three different gating signals that are connected by a "memory-cell" structure and replicate separate simple RNNs. Since its publication in 1997, this design has been the RNN's successful workhorse in a variety of applications. The chapter introduces the standard architecture, which contains four times as many parameters and embeds four copies of the simple Rnn. Then, five alternatives are introduced, each of which gradually lowers the number of parameters while maintaining the gating structure. The Slim LSTMs consist of these five variations. Korstanje [2021] They have discovered two types of Recurrent Neural Network cells called SimpleRNN and GRU (Gated Recurrent Unit). They'll discover a third type of cell called LSTM, for Long Short-Term Memory. Korstanje, Joos. (2021). LSTM RNNs. 10.1007/978-1-4842-7150-6_18. In this research paper Carrasco-Ochoa [2004] , the feature selection for classification of natural disaster texts through testors is presented. Testors are featured subsets such that no class confusion is introduced. Typical testors are irreducible testors. Tests were done with KNN and Naive Bayes Classifiers, results were compared against frequency threshold and information gain methods.

3. DIVVA : DISASTER INFORMATION VERIFICATION AND VALIDATION APPLICATION

In this section, we provide an overview of DIVVA, a Disaster Information Verification and Validation Application that takes texts as input which is provided by the user and our application will categorize the textual input into disaster related or non disaster related categories. If the information is found to be disaster related then application will validate whether the event mentioned in the text data has actually occurred or not with the official handles of the government disaster relief agencies and then classify the data related to disaster as real or fake and outputs it to the user. Figure 1 shows an overview of DIVVA.

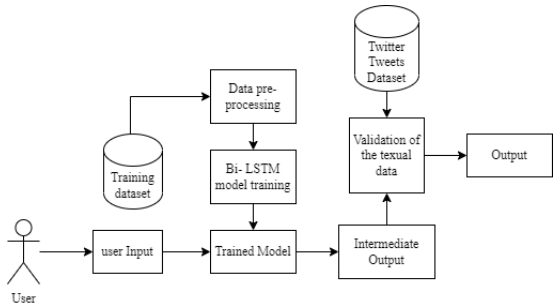


Figure 1: System Overview

4. METHODOLOGY

4.1 Data Cleaning and Preprocessing Methods

Emojis, urls, numerals, special characters, and stop words were present in the dataset which are not important data for our model. As a result, we started the cleaning process by deleting them from the dataset along with any text that had fewer than three words. After cleaning the dataset, we merged the text with the keyword and the merged column was the feature for our model. We used the built-in libraries of Python to implement the data cleaning part.

	index	id	keyword	location	text	target	word_count	clean_text	clean_keyword	keyword_text
0	0	1	ablaze	Inang Pamantasan	Progressive greetings!\n\nIn about a month students would have set their pens ablaze in The Torch Publications'... http://t.co/9FxPiXQuJt	0	17	progressive greeting month student would set pen ablaze torch publication	ablaze	ablaze progressive greeting month student would set pen ablaze torch publication
1	1	2	ablaze	Twitter Lockout in progress	Rene Ablaze & Jacinta - Secret 2k13 (Fallen Skies Edit) - Mar 30 2013 https://t.co/7MLMsUzV1Z	0	16	rene ablaze jacinta secret k fallen sky edit mar	ablaze	ablaze rene ablaze jacinta secret k fallen sky edit mar
2	2	3	ablaze	Concord, CA	@Navista7 Steve these fires out here are something else! California is a tinderbox - and this clown was setting my 'hood ablaze @News24680	1	23	navista steve fire something else california tinderbox clown setting hood ablaze news	ablaze	ablaze navista steve fire something else california tinderbox clown setting hood ablaze news
3	3	4	ablaze	Calgary, AB	#NowPlaying: Rene Ablaze & Ian Buff - Magnitude http://t.co/Av2JSjfFtc #EDM	0	11	nowplaying rene ablaze ian buff magnitude edm	ablaze	ablaze nowplaying rene ablaze ian buff magnitude edm

Table 1: A clear, formatted and uniformed dataset

4.2 Data Verification Model

The Bidirectional Long Short Term Memory Model (Bi-LSTM) enables input to move backwards or forwards in either direction. Bidirectional long-short term memory is the process of enabling any neural network to store sequence information in both directions (Bi-LSTM). We can keep track of both past and future information with this model. To make sure that our input flows in both directions for this experiment, we used a bi-directional LSTM. The flow of information from the backward and forward layers is depicted in Figure 2. BI-LSTM is typically used when activities requiring sequence to sequence are required. Speech recognition, text categorization, and forecasting models can all employ this type of network. Other layers which helps in model preprocessing included an embedding layer made with a GLOVE file, a dense layer with the activation function relu, dropout, cov1d, and input.

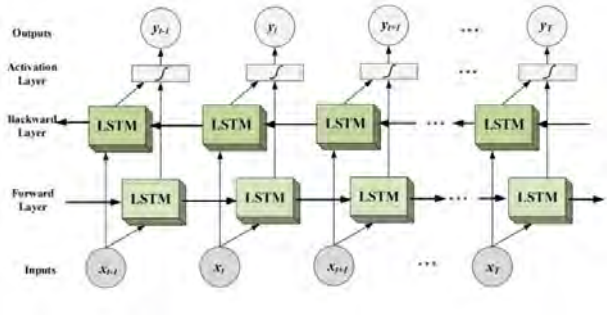


Figure 2: Bidirectional LSTM Model

4.3 Data Validation Model

We used Twitter API and Tweepy library for making the twitter tweets dataset(Validation dataset). Using the Twitter API, the majority of Twitter's features are accessible to developers. With the help of this API we extracted information about the Tweets, the tweets were extracted from the official twitter handles of disaster management agencies like NDRF (National Disaster Response Force), NDMA India (National Disaster Management Authority), and SDMA (State Disaster Management Authority). All these extracted tweets were saved into a csv file (refer Table 2). And with the help of fuzzy-wuzzy's ratio we will be calculating the maximum percentage match of the user provided tweet and the tweets present in our dataset.

	Time	User	Tweet
0	2022-05-10 15:58:09+00:00	NDRFHQ	cycloneasani update ndrf deployment te team committed across andhra pradesh dodisha estwest bengal bepreparedbesafe committedserve pmoindia hmoindia bhallaajay tatulkarwal ndmaindia pibhomeaffairs ani airnewsalerts
1	2022-05-09 17:07:16+00:00	NDRFHQ	riverrescue boy reported stranded middle dikrong river doimukh papumpare arunachal pradesh bnndrf rescue safely amid flow water pare dam disasterservicealwayseverywhere hmoindia bhallaajay atulkarwal pibhomeaffairs ani mygovarunachal
2	2022-05-04 10:36:50+00:00	NDRFHQ	dg ndrf sh atulkarwal interacts sh rajendra singh member ndmaindia dr mrutyunjay mohapatra dg indiametdept show coping disaster cyclone danger rescue ddnewslive watch telecast youtube pibhomeaffairs pibindia ani
3	2022-04-25 12:17:47+00:00	NDRFHQ	cssr ops storied const building collapse satya niketan new delhi ndrfghaziabad rescue live victim unconscious state debris cutting fallen wall ops continues hmoindia bhallaajay atulkarwal pibhomeaffairs
4	2022-04-14 03:12:30+00:00	NDRFHQ	honble pm sh narendramodi virtually interacts personnel involved ropeway rescue operation deoghar hail heroic effort coordination stakeholder watch telecast committedserve
5	2022-04-13 18:04:03+00:00	NDRFHQ	committedserve aapdasevaalwayssarvatra
6	2022-04-11 07:57:45+00:00	NDRFHQ	rescue operation underway ropeway trikut devghar jh multi agency coordination rescued people trollies ops continues disasterservicealwayseverywhere hmoindia bhallaajay ranchipib pibhomeaffairs ndrfp
7	2022-04-10 04:30:55+00:00	NDRFHQ	whenever date written struggle written result bravery solemn valourday ceremony crpfindia sh ajay kumar bhalla home secretary presented gallantry medal sh atulkarwal dg ndrf counter terrorism ops srinagar
8	2022-04-09 17:57:27+00:00	NDRFHQ	humble tribute brave crpf personnel made supreme sacrifice battle sardar post gujarat pakistani brigade attack crpf valourday
9	2022-04-08 14:05:51+00:00	NDRFHQ	conference capacity building disaster response discussion held humanitarian relief capacity building sdrfcdhg f role major stake holder emergency role ngo dm initiative best practice sdrfs ani pibindia pibhomeaffairs

Table 2: Tweets dataset extracted from the official twitter handles of disaster management agencies

4.4 Performance Evaluation

Figure 3 shows the performance of the classification model in comparison to two classes. First Quadrant of the matrix has 706 inputs, which tells the number of texts that were actually related to the disaster and our model predicted it as not related to disaster. The Fourth Quadrant has 932 inputs, which tells how many texts are really related to a disaster. Our model has a better performance on detecting target values "1" than target value "0".

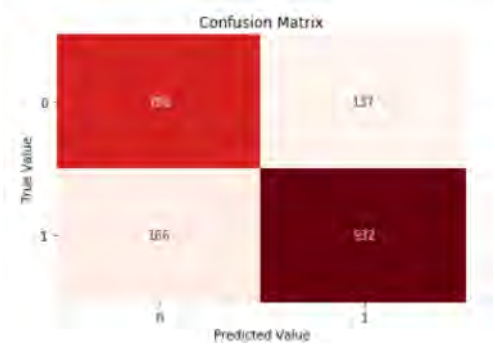


Figure 3 : Confusion Matrix

	Precision	Recall	F1-Score	Support
0	0.81	0.84	0.82	843
1	0.87	0.85	0.86	1098
Accuracy			0.84	1941
Macro avg	0.84	0.84	0.84	1941
Weighted avg	0.84	0.84	0.84	1941

Table I: Table 3 : Quality Measures

The overall accuracy of the model is 84%. For the texts which are not related to disaster, the value of precision is 0.81, recall is 0.84, f1-score is 0.82 and support is 843. For the text which are related to an accident the values for precision and recall are 0.87 and 0.85 respectively, as shown in Table 3.

5. RESULTS AND DISCUSSION

GUI for DIVVA(Disaster Information Verification and Validation Application). The figures 4 and 5 show some instances of the same. The user has to input the text in the yellow box. After pressing the validate and verify button, the application goes through the aforementioned process and gives the output on the screen in the form of 2 visual bars(and values).

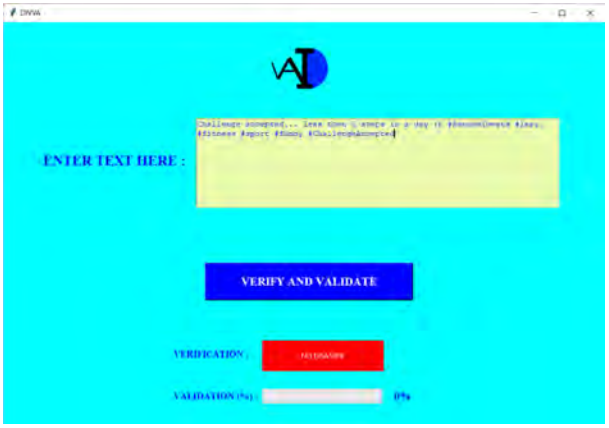


Figure 4: GUI: Disaster information not verified

Figure 5: GUI: Disaster information verified with validation match percentage

If the upper bar is red, it indicates to the user that the text doesn't relate to any disaster but may be a minor accident or some other general event. On the contrary, if it is green, the text does contain some disaster-related elements. The application doesn't move forward to the validation process, and hence the lower bar is empty. The lower bar shows the validation results. A completely white bar with 0% validation (refer Figure 4) corresponds to the text data not finding any match in our official tweets database. If the bar is partially filled with green, it indicates that the text data does partially match with some entry in our database, and the corresponding match-rate(validation accuracy) is mentioned on the right hand side of the bar. A fully filled bar indicates a 100% match (refer Figure 5).

6. CONCLUSION

The problem of spreading fake disaster news and rumors that cause panic and mayhem among the general public was examined in this article, and the text data was verified and validated with an accuracy of 84%. The technique involved preprocessing training data, feeding it to the model with the purpose to train it, and labeling each feature of the input data with either a 0 (not related to disaster) or 1 (related to disaster) classification (related to disaster). If the information was determined to be disaster-related, it was verified, and the user was informed if the text data was accurate or not as a result.

References

Carrasco-Ochoa, Jesús, M.-T. J. F. 2004. Feature selection for natural disaster texts classification using testors. *Intelligent Data Engineering and Automated Learning - IDEAL 2004, 5th International Conference, Exeter, UK, August 25-27, 2004, Proceedings*. https://www.researchgate.net/publication/221253115_Feature_Selection_for_Natural_Disaster_Texts_Classification_Using_Testors.

Hien To, Sumeet Agrawal, S. H. K. C. S. 2017. On identifying disaster-related tweets: Matching-based or learning-based? https://arxiv.org/pdf/1705.02009.pdf.

Jivani, A. 2011. A comparative study of stemming algorithms. *IJCTA*. https://www.researchgate.net/publication/284038938_A_Comparative_Study_of_Stemming_Algorithms.

Korstanje, J. 2021. Lstm rnns. https://www.researchgate.net/publication/352958930_LSTM_RNNs.

Nilani Algiriyage, Rangana Sampath, R. P. E. E. H. D. K. S. D. J. 2021. Identifying disaster-related tweets: Alarge-scale detection modelcomparison. *IS-*

CRAM 2021. https://www.researchgate.net/publication/353327105_Identifying_Disaster-related_Tweets_A_Large-Scale_Detection_Model_Comparison.

Salem, F. 2022a. Gated rnn: The long short-term memory (lstm) rnn. https://www.researchgate.net/publication/357547571_Gated_RNN_The_Long_Short-Term_Memory_LSTM_RNN.

Salem, F. 2022b. Gated rnn: The minimal gated unit (mgu) rnn. https://www.researchgate.net/publication/357540748_Gated_RNN_The_Minimal_Gated_Unit_MGU_RNN.

Yun, H. 2011. Disaster events detection using twitter data. *INTERNATIONAL JOURNAL OF KIMICS Vol. 9,* Number 1. https://koreascience.kr/article/JAKO201116450097224.pdf.

Authors

Prof. Vrushali Bongirwar, M. Tech CSE from RTMNU Nagpur, perusing Ph.D. from VNIT, Nagpur. She is currently working as Asst. Prof. in the department of Computer Science and Engineering, Shri Ramdeobaba College of Engineering and Management Nagpur. Her area of interest includes Bio-informatics, Data Analysis, Machine Learning, Natural Language Processing etc.
E-mail: bongirwarvk@rknec.edu

Mr. Sameer Shekhar Mishra is pursuing a bachelor's degree in Computer Science and Engineering from Shri Ramdeobaba College of Engineering and Management, Nagpur from 2019 to 2023. He is in the core team of Intel Student Developer Club as a web developer at Shri Ramdeobaba College Of Engineering And Management. He has worked with natural language processing, computer vision, and java/python programming. His research interests are in cloud computing, artificial intelligence, machine learning, natural language processing, computer vision etc.
E-mail: heyitzmishra@gmail.com

Mr. Atharva Bisen is a final year engineering student, pursuing a bachelor's degree in Computer Science and Engineering from Shri Ramdeobaba College of Engineering and Management, Nagpur from 2019 to 2023. His interest area includes AI, ML, and Data Science.
E-mail: bisenatharva123@gmail.com

Mr. Soham Mundhada is a final year engineering student, pursuing a bachelor's degree in Computer Science and Engineering from Shri Ramdeobaba College of Engineering and Management, Nagpur from 2019 to 2023. He is interested in and inclined towards Data Science, Machine Learning and AI and has developed many projects in the same. He has always been involved in academic, technical and extracurricular activities and competitions. He stood as one of the top five finalists of Smart India Hackathon, 2022, world's largest open innovation model. Soham has a wide range of experience in Data Processing and Data Analysis and Interpretation. His recent work domains and research interests include Natural Language Processing, Machine Learning and ETL Design.
E-mail: soham.mundhada@gmail.com

Mr. Utkarsh Singh is a final year engineering student, pursuing a bachelor's degree in Computer Science and Engineering from Shri Ramdeobaba College of Engineering and Management, Nagpur from 2019 to 2023. His research interests are in cloud computing, machine learning, natural language processing, artificial intelligence etc .
E-mail: utkarsh060902@gmail.com

An Effective Framework for design of Dataset Using Twitter

Monal R.Torney, P.G Department of CSE, Sant Gadge Baba Amravati University, Amravati(MH)
Dr K.H.Walse, Professor and Head, Department of CSE,Anuradha Engineering College, Chikhali, Dist.:Buldhana(MH)
Dr.V.M.Thakare, Professor and Head, Department of CSE, Sant Gadge Baba Amravati University, Amravati(MH)

The rapid expansion of internet usage and related services like social media and blogs has increased people level of expressiveness in day to day life. Social media platforms like Twitter and Facebook facilitate people to interact and exchange opinions about people, products, and services. As a result, a vast amount of data is available online, in form of views, tweets, messages, audio, and videos. An interface is needed to collect gain knowledge and insights from the various tweets, views, and comments. Thus we have proposed the Twitter API-based Interface, able to perform Hashtag search and extract tweets from Twitter along with the ample number of fields related to the Twitter object. Using the interface, the 55 properties of each tweet is collect which uses for further investigations. The python-based library called Tweepy is use to interact with the Twitter API. Due to the availability of real-world data, various issues related to text analysis can be address. The problems such as Sentiment Analysis, Opinion Mining, Implicit and Explicit detection, genuineness of views and Opinion Spam detection can be address using the dataset availability.

Keywords: Twitter, Tweet, Twitter API, Views, Comments, Sentiment Analysis, Genuineness of Views, Dataset.

1. INTRODUCTION

Social Media plays a pivotal role and makes people expressive in life, an essential medium to communicate, share views, opinions, and many other things (WU T, 2018). Many users share views regarding topics, products, people, and services. These comments and views share by users are vital to understanding the sentiment, opinions, and decision-making process. Social media such as Facebook, Twitter, Instagram, and many microblogging sites prefers to share their view and comments. Sentiment Analysis is a technique used to explore the sentiment involved in the text or view share by the user on social media(SHARMA S, 2019). The polarity represented in the text is positive, negative, or neutral in value. Sentiment Analysis has many research dimensions in which one can explore things and produce promising results. The user of social media shares views and comments regarding the people, products, services, and many events on platforms like Twitter, Facebook, Instagram, and many other microblogging sites. These views and comments are not always legitimate; they are often fabricate, false, and bot-generated. The need is to design a proper dataset to apply tools and techniques to detect the genuineness of view and comment share on social media. Many local datasets available on the internet are not sufficient. An interface used for collection of views, tweets and comments from social media such as Twitter. These data is stored in database which further used for analysis. The text analysis related problems such as Sentiment Analysis, Spam Detection, and Genuineness of views detection, Opinion Analysis and Explicit and Implicit Detection etc. can be considered.

2. LITERATURE REVIEW

Many researchers design and developed datasets for various problems. The dataset based on various domains such as Restaurant, Movie Reviews, Spam Reviews, Fake news and many more. In (BENVENUTO D., 2020), author design and developed dataset of COVID 19 epidemiological

trend to forecast the COVID 19 epidemic.The data was collected from various medical related website and John Hopkins University. The data were analyzed using ARIMA Model and the trend was predicted during the certain period. Logarithmic transformation was performed to evaluate the influence of seasonality on the forecast. In (KUMAR R, 2021), the author were worked to design and developed the image dataset of Pomegranate fruit of different grades. It was the attempt by author to develop the dataset for agriculture industry. This dataset is useful for the various machine vision techniques. In paper (ALHARBI A, 2019), the author used two different datasets for the experimentation to determine polarity of the text share by the users. The SemVal2016 -1 and SemVal2016-2 dataset was used and deep learning technique was used for polarity detection. The various researchers design own and already available dataset. Our aim is to design and develop a dataset of view and comments collected from social media such as Twitter. Twitter is the social media platform that provides the application programming interface such as Twitter API for extraction. Twitter API provides various objects and properties that helps to collects the abundant vital information related to the user. We have accumulate 54 such properties of users by using different object. In this paper, we have proposed a framework to design the dataset. The main contributions are summarized as follows.

—We have proposed a framework for designing and collecting datasets of views from Twitter using Twitter API.

—We have extracted the information related to the fields associated with object and publicly available fields of Twitter using the Twitter API. The Objects such as User, Twitter, Space, List, Media, and Place and their associated fields are collected.

—We have developed a Twitter interface named as Twitter Bot used to extract the views and displays on the interface.

—The Hashtag Based search technique is developed to extract the tweets from various hashtag, trends hashtags from Twitter.

—The extracted tweets from Twitter using Hashtag is stores in CSV format along with the properties of tweets.

—The various problems such as Sentiment Analysis, Opinion Analysis, Genuineness Views detection, Spam detection, and Bot detection required robust datasets to solve and analyses the performance.

3. DESIGN OF THE PROPOSED FRAMEWORK

The proposed framework consists of three operations e.g. User request and authentication, tweets extraction from Twitter, and the storage of extracted tweets as shown in Figure.1.In this framework, we have used the Twitter API V2 provided by Twitter. This API delivers the facility to users for access to twitter programmatically unique and advanced way uniquely. The Twitter API V2 is the latest version of the Twitter API used here for interaction.

4. DATA COLLECTION

Twitter API is a set of programmatic endpoints to help to extract and analyze the data from the Twitter. To build or to understand the conversation twitter API is used. The twitter API allows to engage with the Users data, Tweet data, Spaces, direct messages, Trends, media and Places. Recently Twitter released the Twitter API v2 to provide a wide variety of functionalities such as modern foundation, new and advanced features and quick on boarding to Essential access. The diversify objects are available in Twitter API v2 such as Tweets and Users. Each objects consist of its included fields.The list of the objects and the fields are given below in Table 2.

4.1 User request and Authentication

Using the user interface, the hashtag request is sent and required number of tweets to be extracted from the twitter handle. Moreover the interface can be used to get detailed information of the

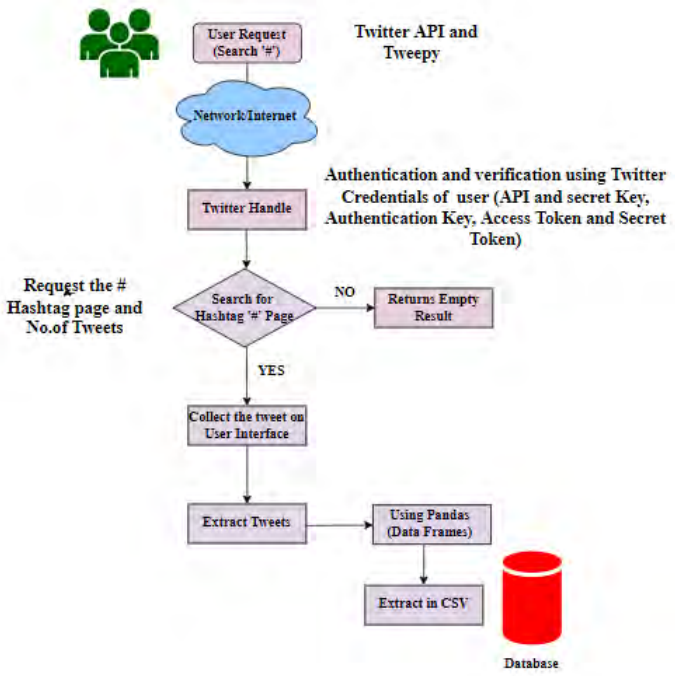


Figure.1. Framework for Tweets extraction from Twitter

users, search for the particular tweet and compare the tweets by their ids and their username. The hashtag request is sent using the credentials such as consumer key, secret key and bearer token etc. for the authentication process. For example, hashtag HDFC is the hashtag and Name of Entity may be people, product, events or organizations. The interface is able to extract the number of tweets (views) from twitter handles using Tweepy, a python library used to interact with the Twitter API. In our designed API, we can search the User related information, Search a particular hashtag e.g. HDFC is the search hashtag. Table-1 List of Fields and object associated with TwitterAPIv2 Object

The Following list consists of all the users followed on Twitter by a particular user. The Follower list consist the users following a particular user.

4.2 Tweet extraction from Twitter Handle

To bring the tweet from the Twitter Handle, the graphical user interface is designed, which is able to extract the tweets stream from the Twitter handle and place it on the front page of the interface. The tweets are extracted using the "hashtag" the name of the entity in the search box and mentioned the number of tweets to be extracted. The stream of tweets is extracted from Twitter handles in the background and shown on the interface consisting of all details mentioned the same as on the Twitter handle. In Addition to this, all the streams of tweets are extracted and stored using Pandas tool in the form of a table. The number of Tweets is extracted from the mentioned Twitter hashtag and downloaded all tweets and their respective information from the handle.

4.3 Data Storage

The stream of tweets is extracted and placed on the interface, with all the information related to tweets. Moreover, these tweets are in a raw stream in the form of an array and need to convert in another form with the help of Pandas Tool. The Pandas tool is a manipulating and data analysis

Sr.No	TwitterAPIv2 Object	Fields associated with the Object
1	Tweet	id,Text,attachments,authorid,contextannotations, conversationid,createdat,entities,geo ,inreplytouserid,lang referenced tweets, reply settings, source, withheld
2	User	id,name,username,createdat,description, entities,location,pinnedtweetid,profileimageurl, protected,public metrics,url,verified,withheld
3	Space	createdat,creatorid,createdat,hostids,lang, isticketed,inviteduserids,participantcount, scheduled start,speaker ids,started at,state,title, updated at,expansioncreatorid,host ids,inviteduserids,speakerids
4	List	createdat,description,private, follower count, member count, owner id expansions = owner id
5	Media	media keys media.fields=duration ms,height ,media key,preview image url,public metrics,type,url, width,alt text
6	Poll	pollids,poll.fields=duration minutes, end datetime,id,options,voting status
7	Place	place id,place.fields=contained within, country, country code,full name,geo,id,name,place type

Table I: List of Fields and object associated with TwitterAPIv2 Object

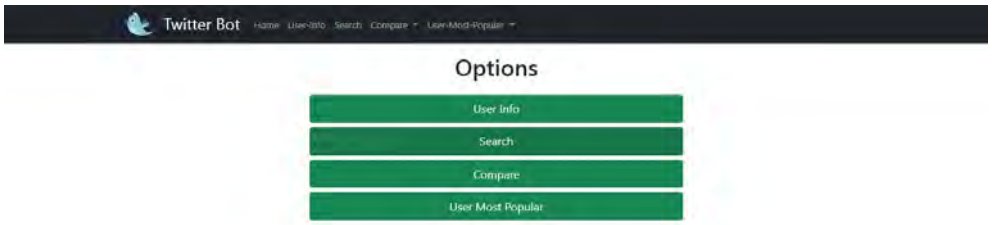


Figure 2. Twitter Interface showing different options to extract the tweets from Twitter

tool that helps store the tweet data in frames and columns. Finally, the data frames and columns of pandas are converted into the CSV file format. This CSV file is used for further processing such as text processing, sentiment analysis, genuineness views detection, spam detection, etc. Each CSV file consists of the fields of various objects such as Tweet, Users, Place, List, Media, and Poll.

The stream of data extraction from the Twitter handle and conversion in data frames has started in the background. The tweet with all related attachments is placed on the interface in the next step. The Interface is ready with the tweets and their related information. This tweet information is ready to download and is stored for further processing.

The CSV file with the Number of tweets = 100 is stored along with all the properties with respect to User-based, Tweet based, Poll based, Place, and geo-based features. The list of features collected from each tweet is as follows. Table-2 Algorithm for Tweet Extraction from Twitter

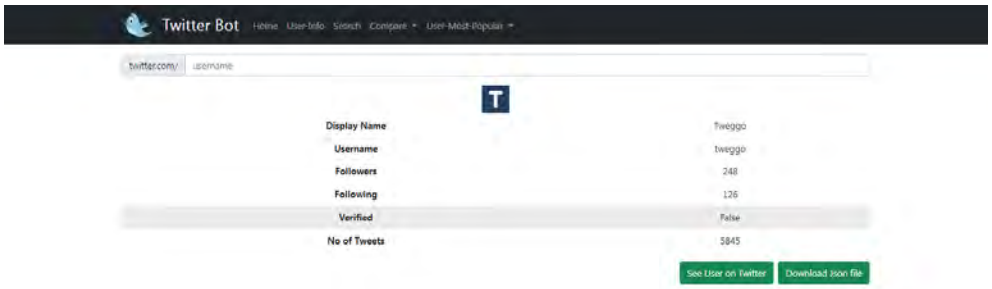


Figure 3. Interface shows details regarding the Twitter user e.g. Tweego

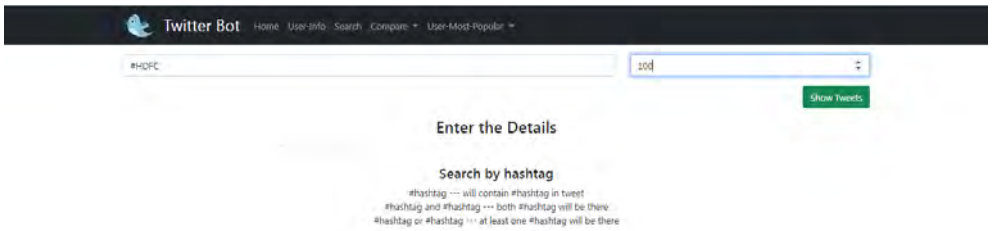


Figure 4. Interface Searches the tweets for particular Hashtag e.g. HDFC

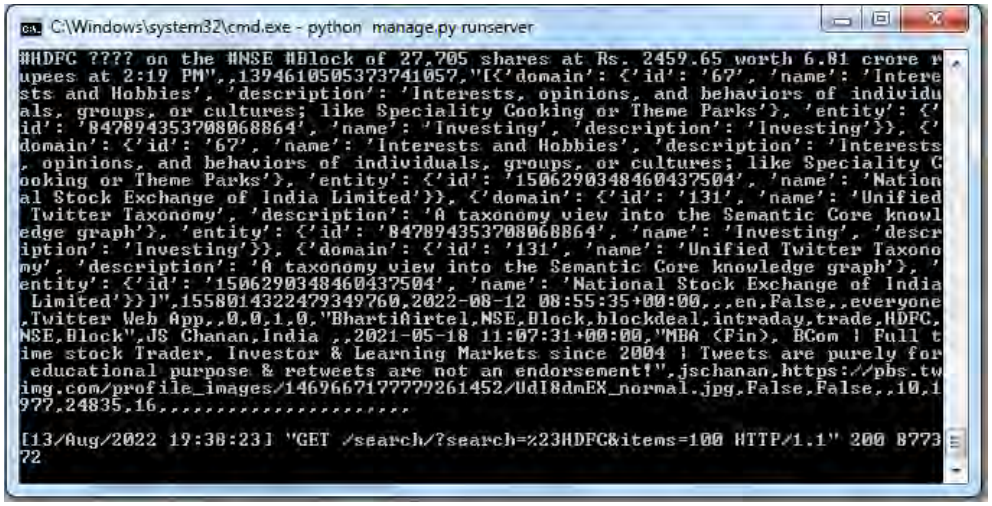


Figure 5. shows the extraction of various tweets using the particular hashtag

5. MAJOR RESEARCH FINDINGS

—Twitter Platform contains an enormous amount of data in terms of views and comments. This data is convenient for performing analysis and extracting insights.

—TwitterAPI is the application programming interface that prefers programmatically lead to

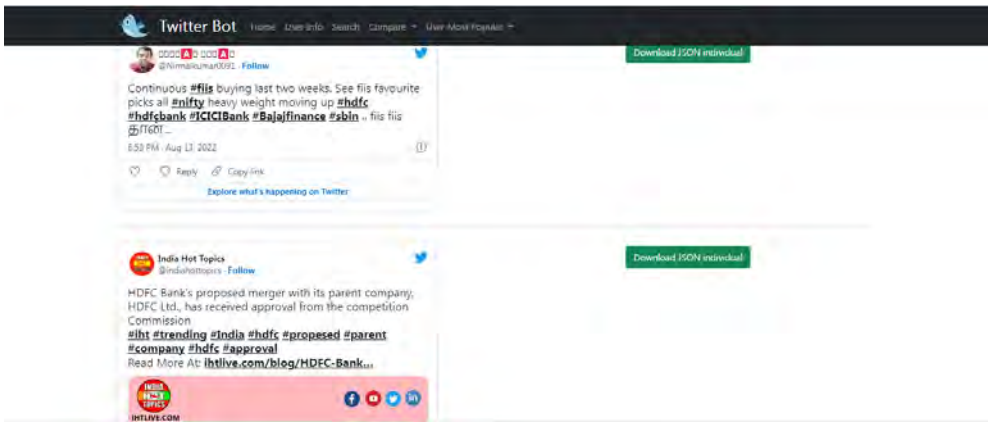
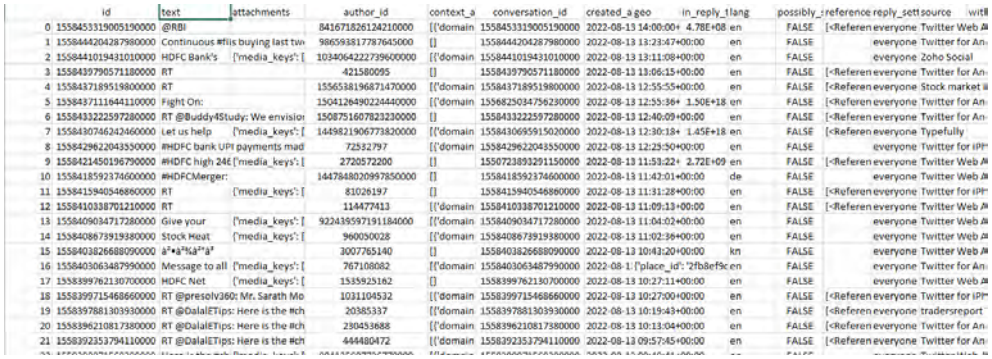


Figure 6. Interface shows the tweets extraction and its related information



	id	text	attachments	author_id	context_a	conversation_id	created_a	geo	in_reply_1	lang	possibly_	reference	reply_sett	source	witl
0	1558453319005190000	@RBI		841671826124210000	[{'domain	1558453319005190000	2022-08-13 14:00:00+		4.78E+08	en	FALSE	[<Referen	everyone	Twitter Web A	
1	1558444204287980000	Continuous #fiis buying last tw		986593817787645000	[]	1558444204287980000	2022-08-13 13:23:47+00:00			en	FALSE		everyone	Twitter for An	
2	1558441019431010000	HDFC Bank's	{'media_keys': [	1034064222739600000	[{'domain	1558441019431010000	2022-08-13 13:11:08+00:00			en	FALSE		everyone	Zoho Social	
3	1558439790571180000	RT		421580095	[]	1558439790571180000	2022-08-13 13:06:15+00:00			en	FALSE	[<Referen	everyone	Twitter for An	
4	1558437189519800000	RT		1556538196871470000	[{'domain	1558437189519800000	2022-08-13 12:55:55+00:00			en	FALSE	[<Referen	everyone	Stock market li	
5	1558437111644110000	Fight On:		1504126490224440000	[{'domain	1556825034756230000	2022-08-13 12:55:36+		1.50E+18	en	FALSE	[<Referen	everyone	Twitter for An	
6	1558433222597280000	RT @buddy4Study: We envisio		1508751607823230000	[]	1558433222597280000	2022-08-13 12:40:09+00:00			en	FALSE	[<Referen	everyone	Twitter for An	
7	1558430746242460000	Let us help	{'media_keys': [	1449821906773820000	[{'domain	1558430695915020000	2022-08-13 12:30:18+		1.45E+18	en	FALSE	[<Referen	everyone	Typefully	
8	1558429622043550000	#HDFC bank UPI payments mad		72582797	[{'domain	1558429622043550000	2022-08-13 12:25:50+00:00			en	FALSE		everyone	Twitter for iPh	
9	1558421450196790000	#HDFC high 24(	{'media_keys': [	2720572200	[]	1550723893291150000	2022-08-13 11:53:22+		2.72E+09	en	FALSE	[<Referen	everyone	Twitter Web A	
10	1558418592374600000	#HDFCMerger:		1447848020997850000	[]	1558418592374600000	2022-08-13 11:42:01+00:00			de	FALSE		everyone	Twitter Web A	
11	1558415940546860000	RT	{'media_keys': [	81026197	[]	1558415940546860000	2022-08-13 11:31:28+00:00			en	FALSE	[<Referen	everyone	Twitter for iPh	
12	1558410338701210000	RT		114477413	[{'domain	1558410338701210000	2022-08-13 11:09:13+00:00			en	FALSE	[<Referen	everyone	Twitter Web A	
13	1558409034717280000	Give your	{'media_keys': [	922435597191184000	[{'domain	1558409034717280000	2022-08-13 11:04:02+00:00			en	FALSE		everyone	Twitter Web A	
14	1558408673919380000	Stock Heat	{'media_keys': [	960050028	[{'domain	1558408673919380000	2022-08-13 11:02:36+00:00			en	FALSE		everyone	Twitter Web A	
15	1558403826688090000	à²•à²¾à²²à²		3007765140	[]	1558403826688090000	2022-08-13 10:43:20+00:00			kn	FALSE		everyone	Twitter Web A	
16	1558403063487990000	Message to all	{'media_keys': [	767108082	[{'domain	1558403063487990000	2022-08-1	{'place_id': '2fb8ef9c		en	FALSE		everyone	Twitter for An	
17	1558399762130700000	HDFC Net	{'media_keys': [	1535925162	[]	1558399762130700000	2022-08-13 10:27:11+00:00			en	FALSE		everyone	Twitter Web A	
18	1558399715468660000	RT @presolv360: Mr. Sarath Mo		1031104532	[{'domain	1558399715468660000	2022-08-13 10:27:00+00:00			en	FALSE	[<Referen	everyone	Twitter for iPh	
19	1558397881303930000	RT @DalalETips: Here is the #ch		20385337	[{'domain	1558397881303930000	2022-08-13 10:19:43+00:00			en	FALSE	[<Referen	everyone	tradersreport	
20	1558396210817380000	RT @DalalETips: Here is the #ch		230453688	[{'domain	1558396210817380000	2022-08-13 10:13:04+00:00			en	FALSE	[<Referen	everyone	Twitter for An	
21	1558392353794110000	RT @DalalETips: Here is the #ch		444480472	[{'domain	1558392353794110000	2022-08-13 09:57:45+00:00			en	FALSE	[<Referen	everyone	Twitter for An	

Figure 7. The CSV file with tweets collected from Twitter

Algorithm 1 Tweet Extraction Process	**Comments**
Inputs: Hashtag	.....Input the Hashtag
Inputs: No.of Tweets Extracted	.....No.of tweets want to extracted
Output: Hashtagname.csv	.....Output File in CSV format
1: Input string = Hashtagname n = No.of Tweets Extracted and	.....Input to the Process
2: If string = = Empty then	.....Returns nothing if Nothing
3: Stop	.....Stop the Process
4: Else	.....Else continue the Process
5: while i ¿ 0 do	.....Continue till True
6: extracted Hashtagname tweets	...extract the tweets
7: end while	.....Stop the Process
8: Extraction Tweets along mentioned fields	.....Extracted Tweets along with many Fields
9: Stored in Pandas Frame and converted in CSV	.....Store file in CSV Format

Table II: Table 2.Algorithm for Tweet Extraction Process

extract view and comments that help to solve various real-world problems.

—Hashtag-based Searching is an efficient technique to take out data in the forms of views and comments. The various information can extract using hashtag-based searching.

—Several groups of techniques and methods can be apply to datasets to get more insight into data.

RESEARCH IMPLICATIONS

The proper dataset is equally important to use techniques and methods for particular problem. The problems may require the data for processing and perform analysis to find insights. The various problem such as classification, regression etc. can be solved with the proper dataset. Our framework help to design and develop the dataset. Mainly data set consisting of views and comments extracted from Twitter. This tweets contains Meta data which is helpful to understand the insights. The various objects and its related properties are consider while extraction process those available publically. For obtaining the good classification, regression results, dataset properly process with advanced techniques. These datasets useful for Sentiment Analysis, Opinion Spam detection and explicit/ implicit detection. The secondary data is available on various data repository such as UCI and Kaggle. Many researchers use already available secondary data for experimentation. Social Media is very dynamic in nature, everyday millions of views and comments are posted and analyzed. Due to dynamic nature of social media and users writing styles changed. So it create a drift in the data and performance of the classification and other technique degrades.

CONCLUSION AND FUTURE RESEARCH WORK

The TwitterAPI is used to extract real-world views and comments from Twitter. These real-world tweets/views analyse to provide the solution to a problem. The various issues such as Sentiment Analysis, Opinion Mining, Implicit and Explicit detection, Opinion Spam detection, etc., require the dataset for analysis. The python library Tweepy employs to develop a Twitter interface and to obtain access to objects and properties from Twitter The hashtag-based searching technique is use for searching the views, comments, and stores them in the CSV dataset. The availability of real-world data from Twitter will be used to provide solution to problems and increase the performance of the classification techniques. Also, an in-depth analysis of data can give better insights. In the future, the various private matrix object and properties of TwitterAPI V2 can be used. Similarly, advanced databases can be employed for the storage of Tweets.

(Google Colab, 2022) (Twitter Developer, 2022) (Tweepy, 2022) (Twitter, 2022)

References

ALHARBI A, D. D. E. 2019. Twitter sentiment analysis with a deep neural network: an enhanced approach using user behavioral information. *Cogn Syst Res*, 50–61.

BENVENUTO D., GIOVANETTI M., V. L. A. S. . C. M. 2020. Application of the arima model on the covid-2019 epidemic dataset. *Data in Brief*, 29.

Google Colab. 2022. Colaboratory. `https://colab.research.google.com/`, Last accessed on 2022-10-30.

KUMAR R, RAJPUROHIT V, N. G. 2021. Image dataset of pomegranate fruits (punica granatum) for various machine vision applications. *Data in Brief*, 37.

SHARMA S, J. A. 2019. Cyber social media analytics and issues: A pragmatic approach for twitter sentiment analysis. *Advances in Intelligent Systems and Computing*, 924.

Tweepy. 2022. Tweepy. `https://docs.tweepy.org/en/stable/`, Last accessed on 2022-10-30.

Twitter. 2022. Twitter. `https://twitter.com/`, Last accessed on 2022-10-30.

Twitter Developer. 2022. Twitter developer website. `https://developer.twitter.com/en/docs/twitter-api/getting-started/about-twitter-apiv2-access-level`, Last accessed on 2022-10-30.

WU T, WEN S, X. Y. Z. W. 2018. Twitter spam detection: Survey of new approaches and comparative study. *Computers and Security*, 265–284.

Monal R.Torney is working as Senior Lecturer in department of Computer Engineering, Government Polytechnic Amravati(MH).He Currently pursuing the Ph.D in Computer Science and Engineering from P.G Department of Computer Science and Engineering.Prof.Torney pursued his engineering education at YCCE, Nagpur(MH) from where he has a M.Tech(CSE). His research interests are in Machine Learning,Deep Learning, Social Networks ,Natural Language Processing and Computer Security.
E-mail: monaltorney@gmail.com

Dr. K.H.Walse is Professor in Anuradha Engineering College,Chikali(MH) (India). He has completed Ph.D in computer Science and Engineering from Sant Gadge Baba Amravati University, Amravati.His research interests are Computer Security, Machine Learning ,Cloud Computing.
E-mail: kwalse1234@gmail.com

Dr. V.M.Thakare is Professor and Head in P.G. Department of Computer Science and Engineering SGBAU , Amravati(MH).(India). He has completed Ph.D from Dr.Babasaheb Ambedkar Marathwada University .He has supervised more than 30 Ph.D scholars and Publish more than 400 research papers in national , International Journal and Conferences.His research interests are Artificial Intelligence, Computer Architecture and Robotics.He worked as member of various University bodies and prestigious committee such as NACC, DRC and RRC.
E-mail: vilthakare@yahoo.co.in

Human Recognition Model Using CNN

Mridula Korde, Abhishek Joshi & Aditya Shrivastava
Shri Ramdeobaba College of Engineering and Management, Nagpur,India

Since the ever increasing demand of social platforms and social media, it is highly recommended to check age and gender of the person using social websites to avoid any age restricted content. Recognition of age and gender can be used in variety of applications majorly authentication, visual surveillance, customer care, biometrics. A convolutional neural network (CNN) is an emerging tool for image processing and human identification. In this paper, deep- convolutional neural networks (CNN) is proposed to estimate structures of human's face and hence improve performance for recognition of human's gender and age significantly. Here, we propose a less complex convolutional neural network design which can be effectively used in case of a small amount of learning data. With small learning data, the automatic age and gender recognition model is proposed here which gives better dropout rate with latest benchmark given by Adience.

Keywords: CNN, Age Identification, Gender Identification.

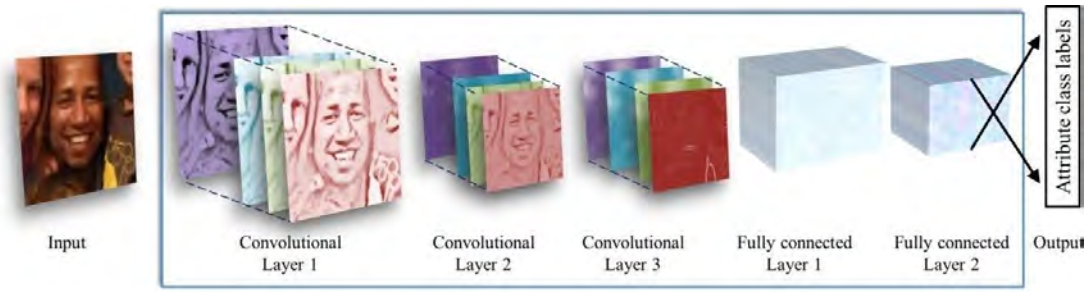
1. INTRODUCTION

With ever increase of indulgement in social platforms by younger generation; it has become risky to interact with unknown people without knowing the actual gender and age of unknown person on internet. It's a latest research topic which can be deployed in various customer areas where people interaction with unknown person is mandatory. Based on the age and gender of the person at the other end, the vocabulary can be changed. So knowing correct age and gender becomes essential. Convolutional neural network is the latest technology used to estimate age and gender. The pre-processing required in a ConvNet is less complex as compared to conventional algorithms. Also, automatic feature extraction from speech signal has been become popular field of study. Based on emotional state of the speaker from speech signal, the age and gender can be predicted. This information can be used to display advertisements and call centers by various agencies (Ito, 2018) (Levi and Hassncer, 2015). In this work, we tried to improve the efficiency of the previously existing CNN algorithms at age and gender detection (Ekmekji, 2016) (G. Antipov, 2017). Typically the face recognition is based on: capturing the image with high resolution camera, extract the features and evaluate the similarities between experimental images with trained database. Face recognition is preferred over other conventional biometric applications like finger print recognition. The advantage is simply the ease in collecting more number of features like head position, iris position, eye position etc. The accuracy of these methods increase with increase in database as well as collecting more and more facial features. Many researchers are contributing in this area as it has growing demand in various multimedia applications. Apart from image feature extraction analysis, CNN is one of the recent powerful tools to create a large training database. So recent studies have included CNN networks to obtain best estimate of face features. (Ekmekji, 2016) proposed age and gender detection model which demonstrated better dropout rate. However he has also included age and gender interdependent analysis in his further research. (G. Antipov, 2017), has analysed various estimation models like LFW, (Levi and Hassncer, 2015) has proposed increase in the layers of CNN structure overall. However all the models and research proposed earlier is primararily dependent on large database which requires longer training time, complex structure and huge memory. We have proposed a less complex CNN model which can be trained with small database and results can be benchmarked with Adience tool (Inik, Uyar, and Ülker, 2019) (Dhomne, Kumar, and Bhan, 2018) (Zhu, 2016). The paper is divided into 4 sections. Section 2 discusses about proposed CNN system. Detail

step by step experimentation and results of each step are discussed in Section 3. Results are compared with Adience benchmark in Section 4 and finally conclusion is drawn in Section 5.

2. PROPOSED AGE AND GENDER DETECTION USING CNN

Accessing personal information from social image repositories is complicated and risky task. The available data sets for estimating gender and age from real word repository is very less as compared to customized repository. Machine learning algorithms produce a concern about over fitting when we deal with small repository. Here, we have expanded our previous work, wherein we have used the interconnection between age and gender relationship to improve the overall performance.



Proposed CNN System

2.1 Network Structure

Our proposed network design includes a compact design of three convolutional layers and two fully-connected layers. Small network design is preferred here over a typical thousand class identifier network design as our task here is limited to estimate age and gender(Smith and Chen, 2018)(Nada, Alajrami, Al-Saqqa, and Abu-Naser, 2020). A convolutional network is the layer based system. Three convolutional layers are used here with two fully connected layers. Network directly processes all three color channels. Here the cropped version (227 x 227 pixels) is sent to the network. Table I shows structure of network design.

Table I: The Network Design Structure

Layer	Filter	Size	Activation
First	96	3 x 7 x 7 pixels	Rectified Linear Operator (ReLU)
Second	256	96 × 28 × 28 pixels	ReLU, Max Pooling Layer, Normalization layer
Third	384	256 × 14 × 14	ReLU, Max Pooling Layer

3. EXPERIMENTATION WITH STEP BY STEP RESULT DISCUSSION

The development platform used is the Caffe open-source framework. The processes used in convolution neural network are: Filtering, Pooling, Normalization.

3.1 Filtering

Here firstly we have lined up the features with the image patch. After lining, each image pixel is multiplied with corresponding feature pixel to finally get the summation of all multiplications. Initially we break the matrices in small pieces and compare them with the bigger one, by putting it as above and multiply the numbers present on matrices as shown in Figure 2. After multiplication, mean of all the values is taken so as to enter the mean value in the center of matrix. Remaining pixels in the matrix are filled in this manner as shown in Figure 3. After filling the whole matrices,

our filtered matrix will look like Figure 4. Multiple sets are applied to get various filter matrices as shown in Figure 5. The process of convolution of image with filter and producing heap of filtered images is called as a convolution layer.

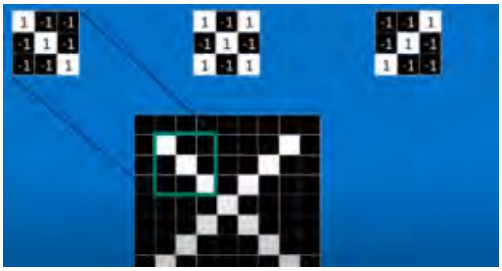


Figure 2. Filtering Step 1

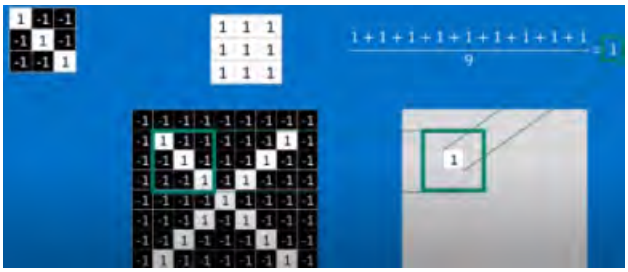


Figure 3. Filtering Step 2

Figure 4. Filtering Step 3

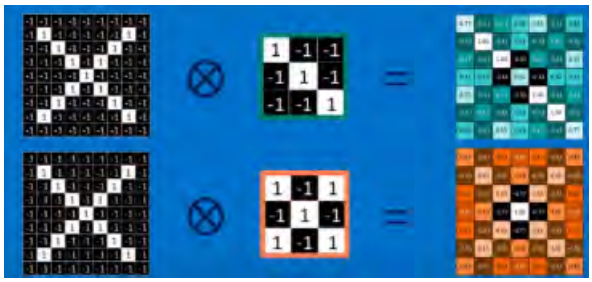


Figure 5. Filtering Step 4

3.2 Pooling

Here we have picked up a window and maximum value from each window is taken as shown in Figure 6.As shown in Figure 7, we have moved the window and filled all the maximum values in maximum pooling matrices. It helps in reducing size of matrix and the number of comparisons so as to get smaller set of filtered images.

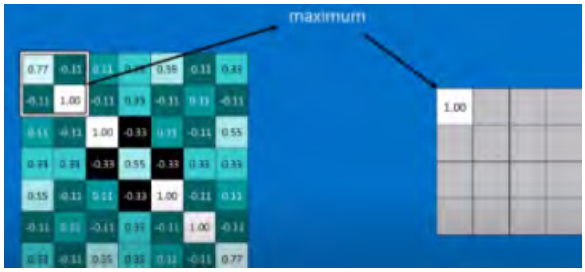


Figure 6. Pooling Step 1

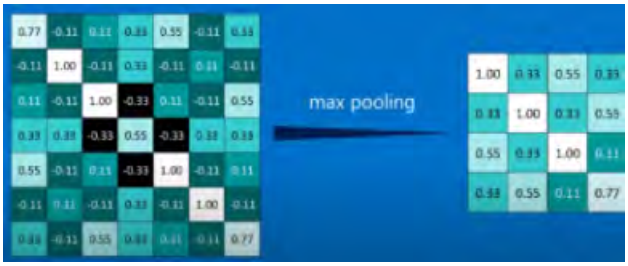


Figure 7. Pooling Step 2

3.3 Normalization:

In this step, we have to normalize matrices value tweaking each of the values just a bit. As shown in Figure 8, all negative values are made zero in the filtered matrix in order to make them normalized. Figures 9, 10 and 11 show the process of formation of single layer in CNN. We can

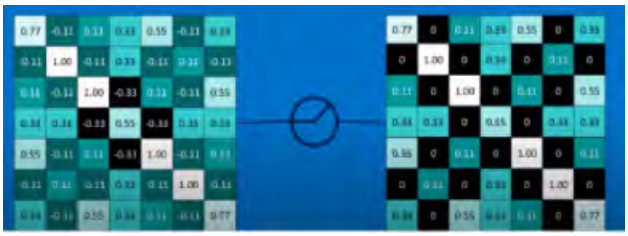


Figure 8. Normalization Step 1

apply multiple layers to reduce feature size and reduce the number of comparisons. This process is called as Deep Stacking. These layers can be repeated several times. After that every value gets a vote. Vote depends on how strongly a value predicts X or O as shown in Figure 12.

Figure 9. Normalization Step 2

Figure 10. Normalization Step 3

Figure 11. Normalization Step 4

Figure 12. Normalization Step 5

4. THE ADIENCE BENCHMARK

The Adience benchmark has been recently released to classify age and gender. These benchmarks can be used to check perfection in our network. Adience has around 36000 images stored as database. Some sample image sets are shown in figure 14. All images are classified as per the age groups shown in Table 1. We created two separate databases for training and testing. The classes for age estimation are (0- 5), (6-10), (11-15), (16-20), (21-25), (26 -30), (31-45), (46-60) and (more than 60), the gender "M" for male and "F" for female. To emphasize the correct benchmarking

Figure 13. Age and Gender Recognition

the same classes as that of Adience have been used in our model. This can be done to maintain the generality of network design as well as correct estimation of age and gender. Our experiments are based on two prediction methods to estimate age and gender of sample image. Single cropped: Here we have fed the network with the cropped face image. The cropping is from 256 x 256 to 227 × 227 near the center. Over-sampling: Here we have extracted five pixel regions, four each of the size 227 x 227. The extraction is done from corners of 256 × 256 face image. The fifth cropping is extracted from the center of the image. The findings of both techniques are compared with best benchmarks available in the literature so far. Table II shows Adience face benchmarks as per the gender and age classification. Table III shows performance of our CNN model with accuracy level. Table IV gives chances of error matrix for typically multiple class age detection. It is observed that most of the errors were due to blurred or low resolution images. Gender assessment errors were observed only for kids of age 5-6 years.

Table II: The Adience Faces Benchmark

Age	**0-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-45**	**46-60**	**Greater than 60**	**Total**
Male	2170	2105	2112	2228	2082	2147	2258	2200	19545	2228
Female	1852	1781	1992	1808	1888	1952	1962	1818	16976	1808
Both	4023	3885	4104	4037	3972	4100	4221	4021	36522	4037

Table III: The Findings of Age Estimation by Adience

Method	**Accuracy**
First Best Benchmark	84.7 ± 1.3
Second Best Benchmark	89.1 ± 0.0
Proposed (Single cropped Image)	94.3 ± 1.4
Proposed (Over-Sampled Image	90.7 ± 1.4

Table IV: The Adience Benchmark Confusion Matrix

Age	**0-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-45**	**46-60**	**Greater than 60**
0 -5	0.006	0.144	0.026	0.007	0.008	0.004	0.007	0.006	0.008
6 -10	0.012	0.577	0.162	0.025	0.121	0.013	0.012	0.011	0.006
11 - 15	0.026	0.022	0.553	0.151	0.094	0.092	0.067	0.054	0.063
15 - 20	0.004	0.018	0.082	0.238	0.136	0.105	0.056	0.048	0.027
25 - 30	0.005	0.028	0.139	0.511	0.622	0.614	0.462	0.061	0.107
38 - 45	0.066	0.008	0.022	0.659	0.626	0.648	0.394	0.076	0.122
46 - 60	0.006	0.008	0.076	0.677	0.715	0.688	0.412	0.082	0.133
More than 60	0.088	0.012	0.135	0.762	0.775	0.797	0.452	0.092	0.146

5. CONCLUSION

Regardless of the fact that numerous papers throw light on age and gender detection, most of the previous work has shown results in customized lab environment. Such settings do not adequately replicate the real world images which may be part of social media platforms and and online repositories. The huge database available on internet is difficult to process as well as takes more time for processing and training further. In this paper, we have investigated CNN deep learning algorithm to detect age and sex of human. Here CNN architecture is explored using 3 layer network structure with limited training database and accuracy close to the benchmarks. Age and gender are two crucial parameters in social interactive platforms and they are also the key attributes in many business applications as well as online customer interaction. Our research work can be used to organize customer information and purchasing history in the organizations for keeping a record of customer needs and customer data. The system will also be helpful for the government in overcoming the issues faced by the government during census.

References

Dhomne, A., Kumar, R., and Bhan, V. International Conference on Computational Intelligence and Data Science.

Ekmekji, A. Technical Report, Stanford University.

G. Antipov, M.Baccouche, J. D. *Asia-Pacific Signal and Information Processing Association Annual Summit Vol.72,* No.4.

Inik, , Uyar, K., and Ülker, E. Gender classification with a novel convolutional neural network (cnn) model and comparison with other machine learning and deep learning cnn models.

Ito, Koichi, e. a. *Asia-Pacific Signal and Information Processing Association Annual Summit Vol.63,* No.4.

Levi, G. and Hassncer, T. In *IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW).* pp.34–42.

Nada, A. M. A., Alajrami, E., Al-Saqqa, A. A., and Abu-Naser, S. S. Age and gender prediction and validation through single user images using cnn.

Smith, P. and Chen, C. In *2018 IEEE International Conference on Big Data (Big Data).* 2564–2571.

Zhu, Linnan, e. a. In *International Conference on Pattern Recognition (ICPR). IEEE.* pp.3282–3287.

Dr. Mridula Korde works as Associate Professor in Department of Electronics and Communication Engineering at Shri Ramdeobaba College of Engineering and Management, Nagpur, India. She has received her Doctorate Degree from Visvesaraya National Institute of Technology, Nagpur. She has passion of teaching with 18+ years of teaching experience in the domain of Electronics/Electronics and Communication Engineering. Her research area includes channel modeling, synchronization in wireless networks,neural networks.
E-mail: kordems@rknec.edu

Abjijeet Joshi and Aditya Shrivastava are students of Department of Electronics and Communication Engineering at Shri Ramdeobaba College of Engineering and Management, Nagpur, India.
E-mail: joshiaa@rknec.edu, shrivastavaa$_1$@$rknec.edu$

Pneumonia detection through Image Classification Using CNN

Karan Badlani, Shreya Sawal, Mohit Nilkute, Shruti Belekar and Ajinkya Nilawar
Shri Ramdeobaba College of Engineering and Management, Nagpur, Maharashtra, India

Pneumonia is a dangerous and serious lung disease. Generally, Chest Radiographs are used to detect pneumonia. This article describes a new method based on convolutional neural networks (CNN) classifiers that can identify pneumonia from a patient's X-ray. Hence, we are proposing pneumonia detection based on CNN using chest X-ray. In this paper, we analyze the existing methods of pneumonia detection and classification techniques. The performance of proposed CNN model is compared with VGG19 and ResNet50-V2. Performace evaluation is done using Precision and Recall. The proposed CNN model provides higher accuracy compared to existing CNN models.

Keywords: X-ray images, CNN, Deep Learning, VGG19, ResNet50-V2

1. INTRODUCTION

All medical professionals use x-ray pictures to diagnose diseases, making radiology one of the most significant fields in medicine. According to studies, even experienced radiologists struggle to accurately determine if something on an X-ray is an infiltration. However, the features of pneumonia can also be found in other illnesses, making the diagnosis more challenging and worsening the condition. For many people, especially in underdeveloped nations with severe pollution and inadequate medical facilities and professionals, the risk of pneumonia is quite high. Pneumonia diagnosis and treatment are made more challenging by a lack of physicians and nurses. Pneumonia requires a prompt and correct diagnosis, especially for those who live in poverty. Our objective is to create a deep learning model that can quickly determine from X-ray pictures whether a patient has pneumonia or not. (Anthimopoulos, Christodoulidis, Ebner, Christe, and Mougiakakou, 2016)
The most recent developments in computing have a broad spectrum of applications in medical imaging. For image-based analysis, Neural Networks (CNNs) have had considerable success. They may be used to divide pictures effectively. Many medical investigations, especially those utilizing photographic data, actively use CNN and Advanced Reading. They are useful for nucleus identification, abnormal diagnosis, tumor segregation, and wound separation, along with many other functions. (Bharati, Podder, and Mondal, 2020)

Three distinct CNN models were used to analyze or train the chest x-ray images from the dataset: the proposed model, the VGG19 model, and the ResNet50-V2 model. Later, these trained models are analyzed using specific criteria for comparing the feasibility of a CNN model. To verify the best CNN model for our dataset compared to others, a comparison analysis of all trained CNN models is also performed. Below Figure 1 shows the generalized use of this trained model. The highly accurate and predictive model is then turned into an API so that users can test it on their x-ray images and use it for study. In this research, we first gathered a dataset of x-ray images as input, extracted the features from that dataset, trained that dataset using a CNN model, and lastly obtained the output showing whether the image is normal or infected.

2. LITERATURE SURVEY

Rubin, J., Sanghavi et al.(2018) has their training, testing, and the validation accuracy rates are 70%, 20%, and 10% respectively and their DualNet CNN model achieved an average AUC 0.72.

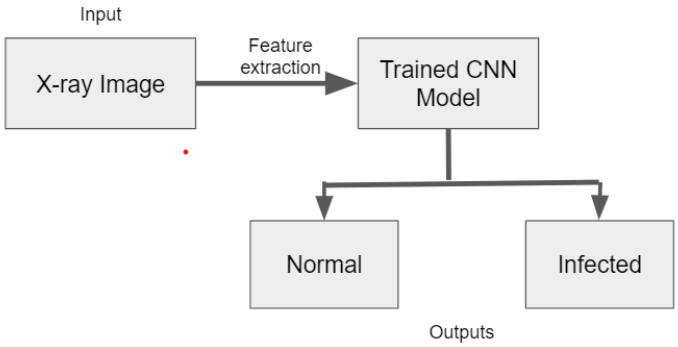


Figure 1. Generalized Block Diagram

Anthimopoulos, M. et al. (2016) describes various trends for interstitial lung diseases and its detection. Through a dataset of 14,696 images in total, they classifier gave an accuracy of 85.5% while classifying the diseases in 7 categories.

Bharati, S. et al. (2020) explains how they were able to make a Hybrid deep learning model by combining VGG, data augmentation and CNN while achieving accuracies of 69% and 69.5% for VGG19 and CNN respectively.

Rautaray, S. S. et al. (2022) describes how they downloaded a Kaggle dataset containing approximately 5,800 chest x-rays. A CNN (ConvNet) algorithm was used for detection. Contains Conv2D and Maxpooling2D layers.

Hashmi, M. F et al. (2020) learned how to fine tune the models to obtain higher training and validation accuracies with the help of Transfer Learning.(Hashmi, Katiyar, Keskar, Bokde, and Geem, 2020)

Kanmani, P et al. (2021) describe how the predictions of particular diseases are analyzed with 3 CNN models such as VGG19, Resnet50 V2 and Densenet201, and the results are detailed in terms of accuracy and loss. Resnet50V2 worked far better than the rest. They had trained with F1 score accuracies of 0.98, 0.92, and 0.97 for pneumonia, tuberculosis, and Covid, respectively.

Pandian, J. A. et al. (2021) They had proposed a CNN model which was based on the foundations of VGG neural network by training the model on a database containing 12000 images in total.(Rajasenbagam, Jeyanthi, and Pandian, 2021)

Fernando, P. et al. (2022) Including a non-medical dataset in a pool of 4 large scale datasets, they were able to obtain superiority for 9 out of 13 and 11 out of 14 labels for two main evaluation datasets.(Rammuni Silva and Fernando, 2022)

Jain, R et al. (2020) describe how they ran the chest radiography images for detection of pneumonia on a dataset available on Kaggle. The first, second, third, and fourth models consist of 1, 2, 3, and 4 convolutional layers, respectively.(Sirish Kaushik, Nayyar, Kataria, and Jain, 2020)

Zhang, R. et al. (2020), They used a dataset of chest radiographs provided by Kaggle for classification. There are a total of 5216 training images and 624 test images for his two classes, normal and pneumonia.

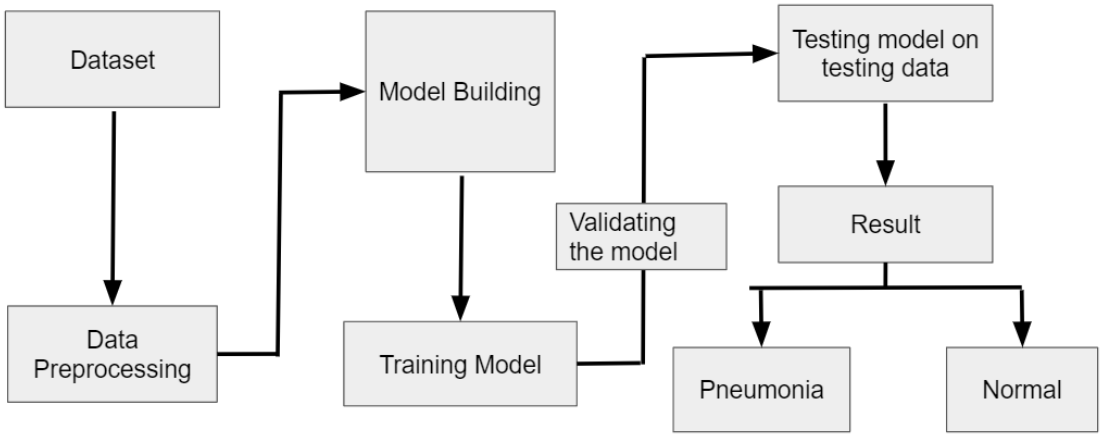


Figure 2. Block diagram for CNN model Training

3. METHODOLOGY

As shown in Figure 2 the methodology comprises the study or training of the chest x-ray images from the dataset with three different CNN models. This training is executed in different steps mainly Data-Collecting, Data preprocessing, and Training of the data to get final outputs as infected or normal cases. Later, these trained models are evaluated on the basis of certain metrics that are used to compare the feasibility of a CNN model. The comparative analysis of all the trained CNN models is also done, to verify the best CNN model for our dataset with respect to others. The CNN models we have used are VGG19, Resnet50, and our proposed CNN model. (Mangeri, OS, Puppala, and Kanmani, 2021)

3.1 Proposed CNN Model

Our CNN model uses 4 convolutional layers with Leaky ReLU as the activation function, 3 max-pooling layers, and 2 dense layers (with activation function as Leaky ReLu and Softmax). The input shape of an image for this model is 224x224x3. Adam is used as the optimizer for this model. Below Figure 3 shows the architecture of our proposed CNN model. (GM, Gourisaria, Rautaray, and Pandey, 2021)

4. PERFORMANCE ANALYSIS

For the entire dataset consisting of chest x-rays, the performances of the Resnet50 V2,VGG19 and the proposed Neural network model are studied for the metrics used in classification that include Accuracy, Loss, Confusion matrix, Precision and recall, and F1 score. (Yue, Ma, and Zhang, 2020)

The Accuracy and Loss for training as well as validation for all the three models is shown in the above Figure 4. The Resnet50 model has many ripples in the validation accuracy which makes it quite weak in predicting the outputs, whereas the VGG and proposed model shows a gradual increase in accuracy and decrease in loss (VGG having the lowest ripples). The proposed CNN model shows a systematic increase in accuracy with some ripples also, which makes sure that the model is trying its best to learn from the previous losses.

```
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 224, 224, 8)       608

leaky_re_lu (LeakyReLU)      (None, 224, 224, 8)       0

max_pooling2d (MaxPooling2D  (None, 112, 112, 8)       0
)

conv2d_1 (Conv2D)            (None, 112, 112, 8)       584

leaky_re_lu_1 (LeakyReLU)    (None, 112, 112, 8)       0

max_pooling2d_1 (MaxPooling  (None, 56, 56, 8)         0
2D)

conv2d_2 (Conv2D)            (None, 56, 56, 16)        1168

leaky_re_lu_2 (LeakyReLU)    (None, 56, 56, 16)        0

conv2d_3 (Conv2D)            (None, 56, 56, 16)        2320

leaky_re_lu_3 (LeakyReLU)    (None, 56, 56, 16)        0

max_pooling2d_2 (MaxPooling  (None, 28, 28, 16)        0
2D)

flatten (Flatten)            (None, 12544)             0

dense (Dense)                (None, 10)                125450

leaky_re_lu_4 (LeakyReLU)    (None, 10)                0

dense_1 (Dense)              (None, 2)                 22

activation (Activation)      (None, 2)                 0

=================================================================
Total params: 130,152
Trainable params: 130,152
Non-trainable params: 0
_________________________________________________________________
Found 1600 images belonging to 2 classes.
Found 316 images belonging to 2 classes.
```

Figure 3. Proposed CNN model

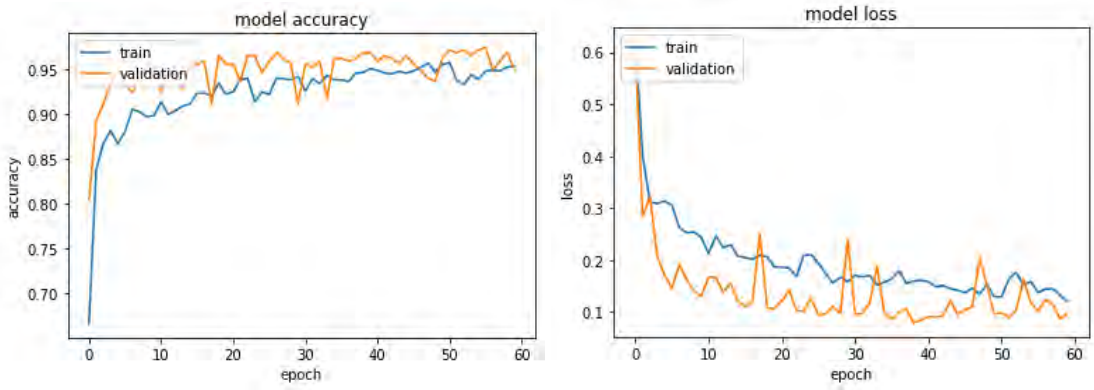


Figure 4. Training Accuracy and Loss for proposed CNN Model

$$Precision = \frac{TP}{(TP + FP)}$$

$$Recall = \frac{TP}{(TP + FN)}$$

$$F1 = \frac{2 * (precision * recall)}{(precision + recall)}$$

Table-1 Comparison with Existing models.

Model	Accuracy	Precision	Recall	F1-score
VGG19	0.710	0.635	0.985	0.772
ResNet50 V2	0.545	0.875	0.105	0.187
Proposed model	0.892	0.858	0.940	0.897

Table I: Comparison with Existing models

From the above metrics in Table No.1, the proposed CNN model has the highest accuracy of **89.2%** on testing set. Moreover, the proposed CNN model has a precision of 85.8% and a recall of 94.0%. The F1-score has a value of 89.7% for the Proposed CNN model. The accuracy and F1-score of Resnet50 are lowest due to the ripples in loss and accuracy, while the VGG19 and proposed CNN model shows significantly higher accuracy than Resnet50. VGG19 has a significant accuracy, but lags in precision which in turn lowers its F1 score. The proposed CNN model shows high precision and recall, which in turn makes a high F1 score, also it has a high area under the curve. Thus, our proposed CNN model is the best-suited model among other pre-trained models.

5. RESULT

This paper uses VGG19, ResNet50 and a proposed CNN Architecture to distinguish between infected lungs and healthy lungs. The effectiveness of the models was compared as per the classification metrics on the testing data. In addition, a confusion matrix was also computed for each model. The observations from Table No.1 showed that the Proposed CNN model is superior than rest of the models while classifying infected lungs from healthy ones, with an accuracy of 89.2%, F1-score of 89.7%, 85.8% precision, 94.0% recall, and 93.22% AUC, and can help medical professionals quickly discover infected lung. The model performs better at differentiating between normal and infected classes if the AUC is higher. For the proposed CNN model, the AUC is highest among other models with 93.22%.

6. CONCLUSION

This paper proposes a CNN model approach for automatically figuring out infected and normal patients in chest X-ray images. X-rays are powerful tools for the diagnosis and evaluation of chest-related diseases. Three CNN models were used to classify the X-ray samples. After observing the performance of all the CNN and pre-trained models, it has been concluded that the proposed CNN model differentiates well between infected and healthy images and can assist doctors in identifying cases of pneumonia. Other lung disease model characteristics can also be categorized using the approach proposed in this paper.

References

Anthimopoulos, M., Christodoulidis, S., Ebner, L., Christe, A., and Mougiakakou, S. 2016. Lung pattern classification for interstitial lung diseases using a deep convolutional neural network. *IEEE Transactions on Medical Imaging 35,* 5, 1207–1216.

Bharati, S., Podder, P., and Mondal, M. R. H. 2020. Hybrid deep learning for detecting lung diseases from x-ray images. *Informatics in Medicine Unlocked 20*, 100391.

GM, H., Gourisaria, M. K., Rautaray, S. S., and Pandey, M. 2021. Pneumonia detection using cnn through chest x-ray. *Journal of Engineering Science and Technology (JESTEC) 16,* 1, 861–876.

Hashmi, M. F., Katiyar, S., Keskar, A. G., Bokde, N. D., and Geem, Z. W. 2020. Efficient pneumonia detection in chest xray images using deep transfer learning. *Diagnostics 10,* 6, 417.

Mangeri, L., OS, G. P., Puppala, N., and Kanmani, P. 2021. Chest diseases prediction from x-ray images using cnn models: A study. *International Journal of Advanced Computer Science and Applications 12,* 10.

Rajasenbagam, T., Jeyanthi, S., and Pandian, J. A. 2021. Detection of pneumonia infection in lungs from chest x-ray images using deep convolutional neural network and content-based image retrieval techniques. *Journal of Ambient Intelligence and Humanized Computing*, 1–8.

Rammuni Silva, R. S. and Fernando, P. 2022. Effective utilization of multiple convolutional neural networks for chest x-ray classification. *SN Computer Science 3,* 6, 1–16.

Sirish Kaushik, V., Nayyar, A., Kataria, G., and Jain, R. 2020. Pneumonia detection using convolutional neural networks (cnns). In *Proceedings of First International Conference on Computing, Communications, and Cyber-Security (IC4S 2019)*, P. K. Singh, W. Pawłowski, S. Tanwar, N. Kumar, J. J. P. C. Rodrigues, and M. S. Obaidat, Eds. Springer Singapore, Singapore, 471–483.

Yue, Z., Ma, L., and Zhang, R. 2020. Comparison and validation of deep learning models for the diagnosis of pneumonia. *Computational Intelligence and Neuroscience 2020.*

Karan Rajkumar Badlani pursuing his Bachelor of Engineering (Electronics and Communication) from Shri Ramdeobaba College of Engineering and Management, Nagpur, India (2019-2023). He is interested in the field of Data Science and Machine learning. He had been a Data Analyst in a startup currently he is working as a ML Engineer.
Email: badlanikr@rknec.edu

Shreya Sawal persuing her bachelor of engineering (Electronics and communication) from Shri Ramdeobaba college of engineering and management , Nagpur, India (2019-2023). She is interested in the field of machine learning and algorithms. She has also worked as a java intern in a company and successfully completed the projects in IT and electronics domain with IOT
E-mail: sawalsm@rknec.edu

Mohit Nilkute pursuing his Bachelor of Engineering (Electronics and Communication) from Shri Ramdeobaba College of Engineering and Management, Nagpur, India (2019-2023). He is interested in the field of Robotics and Automation using Machine Learning. He has done projects in automation in IOT under an industrial expert and worked as an IT Director in leading a team of web developers in a NGO.
E-mail: nilkutemk@rknec.edu

Ms. Shruti Belekar is a final year student in the Department of Electronics and communication Engineering at Shri Ramdeobaba College of Engineering and Management, Nagpur, Maharashtra. She has experience in C, C++ Programming language and Machine Learning. She is acquainted with HTML5 and Cascading Style Sheets. She has done projects in IT domain, electronics domain with IoT. Email : belekarsm@rknec.edu
E-mail: belekarsm@rknec.edu

Prof. Ajinkya Nilawar presently working as Assistant Professor in Electronics Communication Engineering Department, Shri Ramdeobaba College of Engineering and Management, Nagpur. He has done Ph. D. in Electronics from D. B. A. M. U. Aurangabad. His research area includes Image Processing, Machine learning and Deep learning. He has published research papers in the reputed national and international Journals and presented papers in the reputed national and international conferences.
E-mail: nilawarap1@rknec.edu

ManiacNFT : An Application for NFT Marketplace

Dr. Padma Adane, Mr. Aishwarya Pardhi, Mr. Ajinkya Wadekar, Mr. Gaurav Laud, Mr. Shounik Shukla, Mr. Varad Loya
Shri Ramdeobaba College of engineering and Management, Katol Road, Nagpur
Mr. Viresh Dhawan
Data Scientist, ZS Associates

Art is mankind's treasure, yet it is often concentrated in the hands of a few. We need a better trade mechanism and technological innovation to enable fair access to artworks. A solution to the problem can be found by using the NFT technology for the trade of artwork. NFTs make the future for the creators' economy a little brighter, allowing artists to monetize their work by selling to eager collectors, while also collecting due royalties upon future resales of their works. This unique combination of blockchain with artworks provides a layer of security to the ownership of the artwork, and is restoring access to artworks for people from all regions.This research paper is about a decentralized marketplace application where one can buy and sell artworks in the form of NFTs digitally, providing the users with the facility to securely perform transactions of these NFTs that can be verified through Polygon blockchain.

Keywords: NFT, Blockchain, Security, Decentralized Marketplace Application, Polygon

1. INTRODUCTION

Art is the heritage of humans and a way for us to remember and preserve our history. In our society, the artwork is owned by a very small percentage of people. This is due to inaccessibility and lack of knowledge among the masses. In a country like India, the art industry is unorganized and there are no proper platforms to showcase the talent of artists and artisans.

There are organizations that are trying to resolve this issue by providing the ability to trade artwork online, but since they are centralized, they are vulnerable to forgery and hacking. Many organizations are trying to provide a solution for this by using technologies like blockchain and NFTs. These technologies allow more people to participate in trade without the involvement of third parties, making it more secure and accessible to them. Blockchain is used to store the information about the artwork and the ownership in a secure and decentralized way that can be verified.

This paper focuses on enabling people to engage in trade of artwork using NFTs. The idea is to build anapplication for trading art as NFTs using ERC721 contracts which provides digital artists as well as artisans with a global market platform to sell their work. The application is deployed on Polygon blockchain which is many times faster than Ethereum blockchain. Many NFT marketplaces are deployed on Polygon blockchain as it consumes less gas and is cost effective. The rest of the paper is organized as follows. In section two, we discuss blockchain, NFTs, and various marketplaces for NFTs. In section three, we discuss the implementation of the backend and frontend of our application for the marketplace followed by conclusion.

2. LITERATURE REVIEW

Blockchain technology is becoming an integral part of technology hunger fulfillment. The concept of blockchain to bitcoins, NFTs and many such applications took years of proper study and implementation. Blockchain through its NFT application became an answer to the question like, can all ordinary people afford to purchase the artworks? Even experts can't tell the difference

between real artworks from the counterfeits. Is the work of the Art maker accessible to all? Are the transactions transparent?

The Blockchain Technology's applications have already created a major impact in the financial sector courtesy of its decentralized, distributed nature and secure internet transactions in the formof cryptocurrencies and concept of smart contracts. In 2017, blockchain had a global market value exceeding 700 million dollars, as reported in a study by market analysts at Wintergreen Research. Going by their predictions, it could reach 60 billion dollars by 2024. Blockchain has the potential to completely revolutionize the creative industries like art, music, movies and theatre by its significant features like reducing third parties' dependencies, transparency to the creator and the end customer, copyright, improved traceability of creative content.Iberdola [2022]

The Blockchain technology has given birth to another buzzing concept known as NFTs or Non-Fungible Tokens which are digital tokens that represent ownership of any unique asset like art, collectibles, music, popular moments of history, even real estate. At a time, an NFT can have only one official owner in the world as it is stored and secured using Blockchain technology, which means no one can modify the ownership of an NFT which exists. The ownership can be sold to another person and only then it will be reflected on Blockchain. "Non-Fungible" means something which is unique, which is only one of its kind and which is not interchangeable.

One can buy, sell, trade, or give NFTs to anyone online, but a network of computers must verify the trade and the unique data. NFTs are secured with a unique code assigned with it for authenticity purposes. Customers or fans, especially the die-hard loyal ones, are willing to pay for the experiences and values and their icons they believe in. Brands can see this as an opportunity by creating unique assets like an exclusive special message for a person on his/her birthday, or any advertisement poster signed by its brand ambassador, collectible digital cards, memorabilia, etc. to build stronger relationships with their fanbase. The values of such assets may appreciate over time.

The blockchain has a significant potential impact on the art market. Some of its applications include: buying art with cryptocurrency, recording the provenance of artwork on the blockchain, increasing the art's accessibility and affordability, decentralizing the selling models and authorities, and creating online galleries that offer benefits like end-to-end transparency, ownership proofing, and equal opportunity for all artists, Oodles Blockchain [2021]

3. METHODOLOGY

Our application is deployed on the Polygon blockchain, which is an Ethereum scaling platform that can run smart contracts written in Solidity language. We chose polygon because of its features like scalability, higher throughput and security.

Our application consists of two parts, smart contracts that are used to update the data on blockchain and Javascript files that trigger the execution of the smart contracts. There are two smart contracts: MintNFT, for minting the NFTs, and Marketplace, for performing the operations of the marketplace. We used OpenZepplin ERC721 smart contract standard for building secure and robust smart contracts for NFTs minting and metadata storage. The basic operations of the marketplace are to mint an NFT and perform transactions for trading the NFTs.

To mint the NFTs the user logs into the metamask wallet and enters the data about the NFT such as name, description and price and uploads the file to be minted as NFT. This data and file are uploaded on the IPFS network. IPFS is a protocol and a peer to peer network that stores the files in a distributed file system, by dividing it into parts and using cryptographic hashes to find and fetch the files. The MintNFT contract is triggered which takes the uri from the IPFS network to create a NFT on the blockchain for the provided data. After the NFT is minted, a listing fee is transferred from the seller to the contract.

To trade an NFT, when the seller mints the NFT, its ownership is first transferred to the Marketplace smart contract. When a buyer buys a NFT the price of the NFT is transferred to the seller and the ownership is modified to the new buyer. After the sale is complete, the listing fee

charged earlier is transferred to the owner of the contract. Along with these, the Marketplace contracts also provides the functionality to fetch NFTs for sale, created by the user and bought by the user.
Figure 1 shows the basic flow of the working of our Marketplace application.
The MintNFT contract uses ERC721URIStorage contract from ERC721 standard to store the uri of the NFT safely. The Marketplace contract uses the reentrancy guard contract to provide prevention from reentrancy attacks.

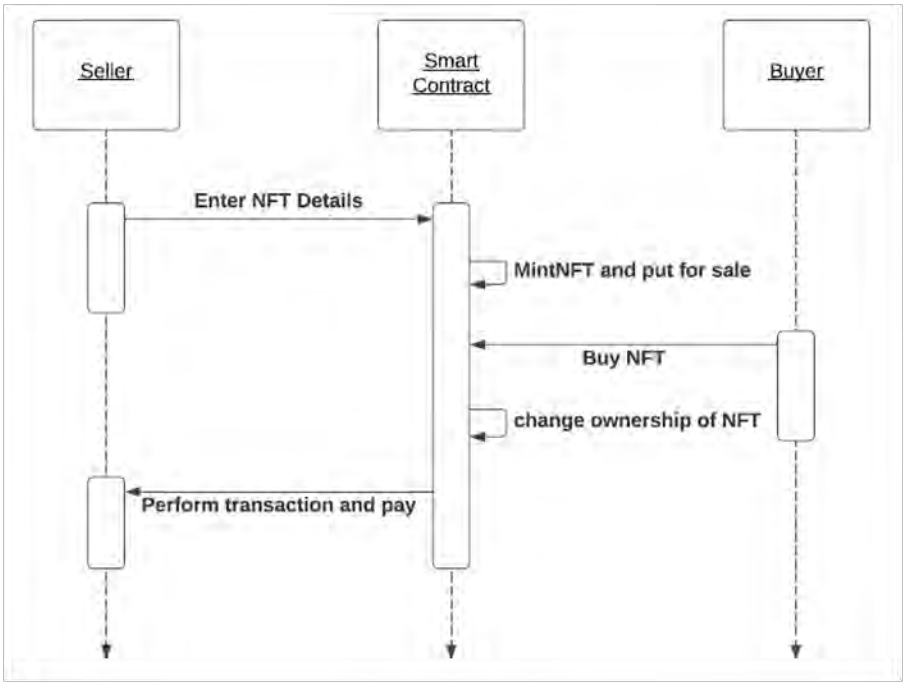


Figure 1: Sequence Diagram of the Application

There is a possibility that knowingly or unknowingly a particular contract is called which in turn calls another contract to complete the transaction. This second contract can subsequently call the first one, resulting in an infinite loop. Each call to a contract is charged to the user and such infinite loops can be expensive to the user. Thus, such issues need to be handled cautiously. For this the reentrancy guard is used to ensure the calls do not go in a loop.
Figure 2 shows the transaction occurring while buying an NFT from the marketplace page of the application.

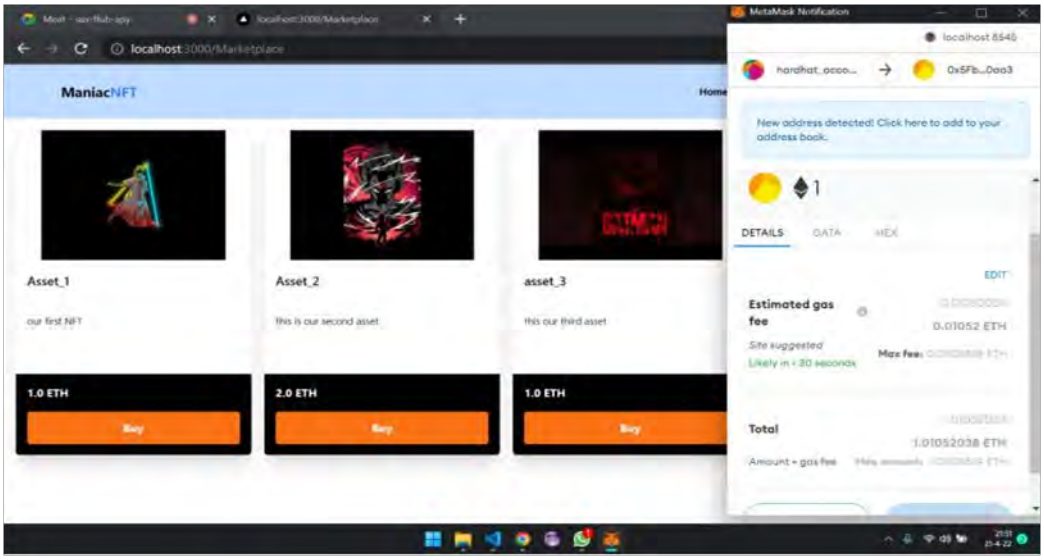


Figure 2: Transaction confirmation for buying a NFT

Figure 3 shows the creator's board which shows the NFTs that are minted by the user.

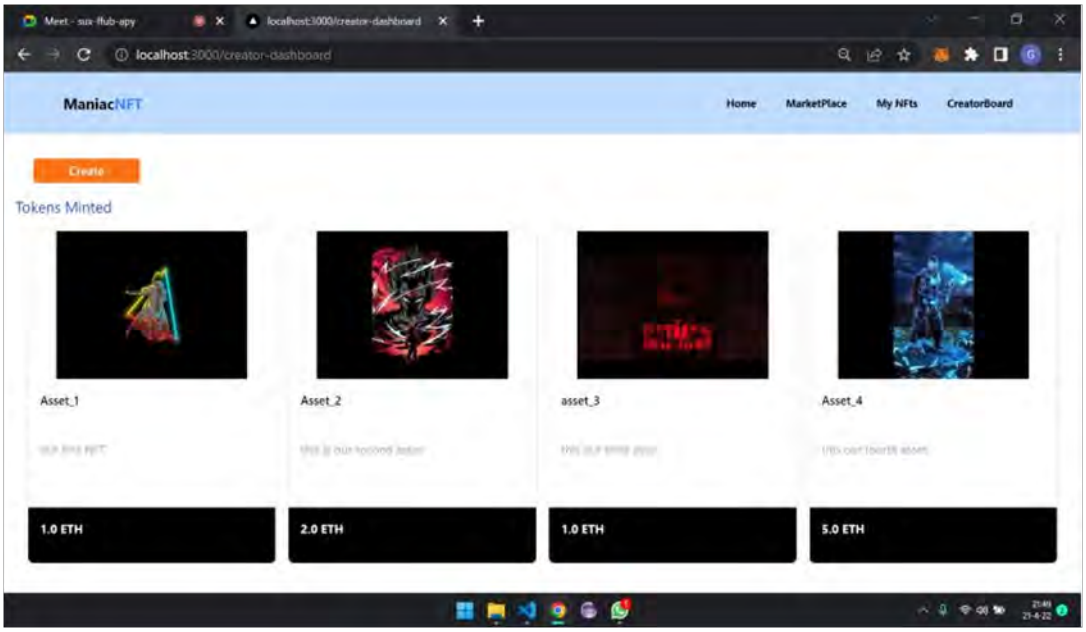


Figure 3: Creator's Dashboard Page

Figure 4 shows the minting page where the user can create their own NFTs.

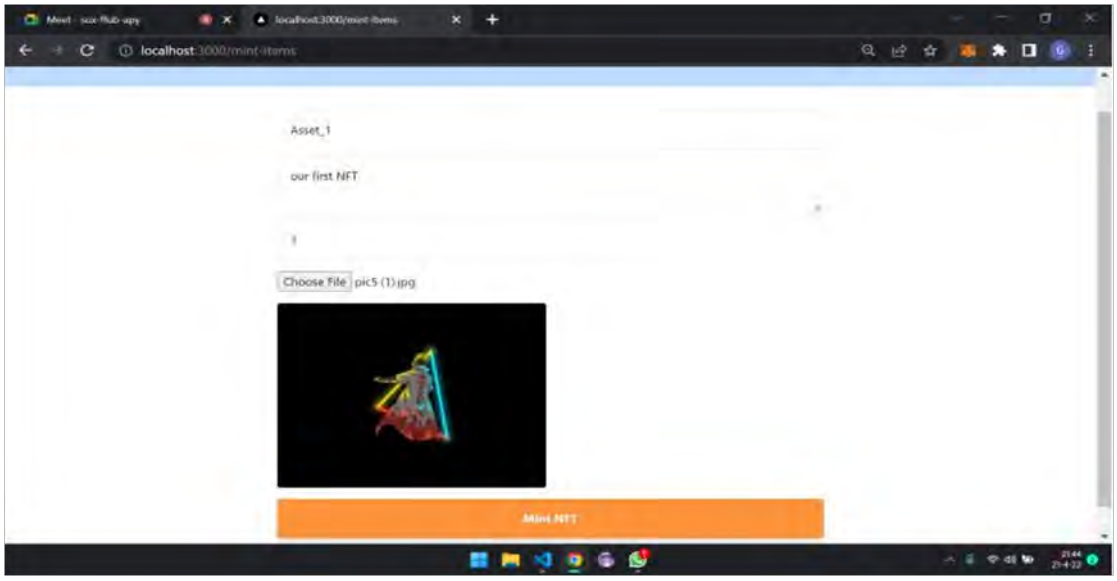


Figure 4: Minting a NFT

4. RESULT

We planned and successfully built an decentralized application that can be used to create and trade NFTs. We used the Hardhat development environment along with Openzepplin smart contract standards to write our smart contracts in Solidity. The front end work was done using the NextJS framework and tailwindCSS. We stored the files using the IPFS peer to peer network to store the files. The application has been deployed on the Polygon Mumbai Testnet.

5. CONCLUSION

Non-Fungible Tokens are a fast-growing technology in the blockchain business. In this paper, we have discussed about the various applications of NFTs and their advantages in different sectors. We have described our application, The ManiacNFT Marketplace application which has been deployed on the Polygon blockchain. Through this application, we intend to provide a platform for digital artists as well as local artisans to showcase their talent and sell their work in a secured manner. We have also described the working process and the building process for the application. We have also explained about the various features that our application offers making the life of the artisans secure and easy.

References

Iberdola – blockchain applications in the art industry. https://www.iberdrola.com/culture/blockchain-applications-in-art.

Ipfs community: Documentation of ipfs. https://docs.ipfs.tech/.

Oodles blockchain - modernising the art industry with blockchain solutions. https://blockchain.oodles.io/blog/modernizing-art-industry-blockchain-solutions/.

Openzepplin community platform: Documentation of erc721 openzepplin standard. https://docs.openzeppelin.com/contracts/4.x/erc721.

Polygon- matic whitepaper. github.com/maticnetwork/whitepaper.

Dr. Padma Adane has done her B.E and M.Tech (CSE) from Nagpur University andPh.D. (CSE) from VNIT, Nagpur. She has 25 years of Teaching and Research experienceand 4 years of Industry experience. She is currently working as Associate Professor inDepartment of Information Technology, Shri Ramdeobaba College of Engineering andManagement, Nagpur. Her area of Interest includes Information Security, OperatingSystems and Wireless Communications.
E-mail: adanep@rknec.edu

Mr. Viresh Dhawan has done his B.E. from Nagpur University. He has a total of 6 years of Industry experience and is presently working with ZS Associates as a data science consultant.In addition to his regular duties, he has contributed to and mentored a number of open source Blockchain projects carried out under Paytm's Build for India Initiative. One of his projects Ekatra.one which promotes "education for all" has been an award-winning innovation recognized by UN SDSN Youth as Top 25 solutions built for COVID response globally, and has been jointly funded by World Economic Forum & Deloitte Global under WorldClass Innovation Challenge.
E-mail: viresh.dhawan@gmail.com

Mr. Aishwarya Pardhi is a final year student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.His area of interest is Full stack and Web 3.0 development.
E-mail: pardhiar@rknec.edu

Mr. Ajinkya Wadekar is a final year student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.His area of interest is Databases and Information security.
E-mail: wadekarar_1@rknec.edu

Mr. Gaurav Laud is a final year student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.His area of interest is web developmentand web3.0 development.
E-mail: laudgj@rknec.edu

Mr. Shounik Shukla is a final year student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.His area of interest iscyberforensics.
E-mail: shuklasr_1@rknec.edu

Mr. Varad Loya is a final year student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.His area of interest is Cloud, Blockchain and front end development.
E-mail: loyavs@rknec.edu

Data Analytical Approach for Evaluating Locus of Control among Private Banks Employees

Monika R. Seth, Vinod H. Asudani, Sachin Upadhye, Satyajit S Uparkar
Shri Ramdeobaba College of Engineering and Management, Nagpur, India,

Private Banks in India, are owned by individuals or group of limited individual and not by government. Here in India, private banks represent that most of the part of equity or shares are hold by private shares holders and not by government. The locus of control is reflected in terms of the particular degree upto which the private shares holders or the bank employee's belief that they have power over their private banking events. This research study aims to find out locus of control among bank employees with special reference to private banks based on gender difference as well as two dimensions of locus of control viz. external and internal. Survey method was adopted for this study which covers four private banks within the Nagpur city. Sample size of 200 bank employees consists of bank managers, cashiers, clerks accountant were provided with an online Google form questionnaire. The questionnaire consists of seven questions related to their work, job satisfaction, colleagues clients etc. Initially Cronbach's alpha test using pilot survey on 50 pre samples of bank employees was used to determine the internal consistency of data model. As second step Explorative statistics gave the trends among the bank employees towards the seven questions. The Descriptive statistics then quantitatively describes the features from a collection of information that can reveal the influence towards the three hypotheses under consideration. Lastly the Inferential statistics based two groups of genders interpret the facts as to accept or reject the three hypotheses under consideration. The study concludes the pro and cons and the prime factors which leads towards the external and internal locus of control among the employees.

Keywords: Locus of control; Explorative statistics; Descriptive statistics; Inferential statistics.

1. INTRODUCTION

In India, private sector banks are influenced by branding on one side and on other side its workforce is the key towards the success. According to the interpretation of Arrawatai and Dixit (Arrawatai and Shailly, 2017), in this competitive world of globalization, the private banking sector is transforming due the commitment of their employees, their satisfaction and their engagement. The expected targets, the achievements, the socio economic factors etc plays an important role in setting a balance work life of the private sector employees. Hence the locus of control comes into existence. Locus of control (LOC) is a psychological concept which refers to determine the people strong believe to control the situations and experiences that can affect their lives. The locus of control can be broadly classified as internal and external locus of control. In case of internal LOC, an individual thinks that he or she makes the thing happen. The concern what one can do or can determine the own future leads towards the internal LOC. Wang and Meizhen (Wang and Lv, 2020) stated that in 1966, an American psychologist Julian B. Rotter, developed the scale for Locus of Control to measure internal LOC and external LOC. In line with this scale this research study focuses on the evaluation of the LOC among the private bank employees. Following seven parameters were considered for the evaluation process.

a) Job satisfaction
b) Promotion
c) Motivation
d) Job stress Relationship with colleague
e) Clients
f) Balance Work life

Raja and Selvakumar (Raja and K, 2019), stated that, dealing with the parameters for LOC, the demographic variables like age, gender, present position, marital status etc are used to form the hypothetical statements for the study.
Following Figure 1 determines the details of types Locus of Control.

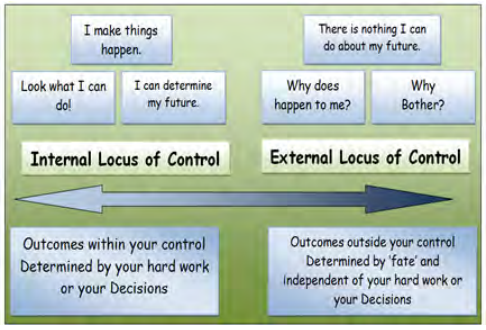


Figure 1. Types of Locus of Control

2. LITERATURE REVIEW

This section is classified in three subsections. The first section is about the present scenario of Indian private banks. Followed by the concept of Locus of control in various domains and based on demographics region, the parameters are analyzed for the fact and figures. The thirds and the last part is about the process of evaluation for the conducting the various types of statistics. Nath et al. (Nath, 2017), have reflected the status of Indian private banks. The global challenges have put these banks to upgrade themselves as to reach their customers. The study proves that due the adaptation of latest technology and the use of information technology the private sector banks have competed with the public sector bank. Annapurna and Manchala (??,) used four perspectives of Balanced Scorecard (BSC) framework to analyze the top four private sector banks. ANOVA Technique was used to interpret the results of the study. Various factors are highlights for the performance of each bank. Hafiz (Hafiz, 2018), in her exploratory design study, has analyzed various problems and challenges faced by the women employees of the banking sector. The major highlight of the paper talks about the tendency of the male co-workers towards the female staff. So, Influence of gender factor and relationship with the colleagues can be the considered for the evaluation of the locus of control. Poongavanam (S, 2013) has worked on status of LOC for the private bank employees. This study involves three types of LOC viz-internality, externality- chance and externality- powerful other. The study reveals that marital status influences internality whereas age influences externality. Mali (Mali, 2013), in his research work determined a positive correlation between the performance (in terms of employee learning capabilities) of the employees and internal LOC. He has also studied the effect of adaptation of new circumstances and job satisfaction on the LOC by the impact of the available literature review study. Poongavanam (S, 2013) extended his previous study on bankers LOC and included the public sector bank employees along with the private sector bank employees. He also focuses on the influence of LOC on officers as well as managers. Principle component analysis tool has been used to study the influence of personal variables and job orientation factor on LOC. Gangai et. al (Gangai and Vikas, 2016), focused on job satisfaction and control of reinforcement. The study determines the characteristics of internal LOC and external LOC. The strong literature review of this paper has produced the comparative study of relationship between the LOC and job satisfaction which is based on various demographic variables under consideration. Mujiatun and Ashal (Mujiatun Siti, 2017) performed their study on 65 employees of a specific bank. Their main focus was to study the influence of religious perspective on LOC. The internal LOC raised the performance of the employees due to the strong

belief in their GOD and their optimism attitude. Hans et al.(Hans, 2017) , perform their study on private college teacher of Oman for the Self efficacy, LOC and Commitment. Various statistical tests are carried out for data analytics like reliability test, descriptive analysis, correlation and regression analysis. The study reveals a strong correlation between commitment and LOC of the employee. The internal LOC was the main focused in this study. Fitra et al. (Fitra, Rasyid, and Susanti, 2018), renders their study around three major parameters LOC, Financial knowledge and decision making. The statistical analysis from Reliability test using Cronbach's alpha test till Regression analysis has been determined. The data process using SPSS is one of the highlights of this research study which helped in providing valid interpretations. Hooda and Annu (Fitra et al., 2018) have provided the latest study on LOC. They have illustrated the various factors affecting the LOC along with the advantages and disadvantages of both internal and external LOC types. This study has taken the performance of the school level teacher for analyzing the LOC. Ratnawati (Ratnawati, 2020)of Indonesia have worked on the tendency of the tax auditors and the moderating role of LOC. The non-parametric approach of Kolmogoro Smirnov test has been used for data analytics and hypothesis testing. Dhote, Uparkar and Bhave (Dhote and Bhave, 2018) have performed the data analytics using reliability test, explorative statistics, descriptive statistics and inferential statistics. They have used the data for evaluating entrepreneurial tendency of engineering graduate. One of their hypotheses contains the Locus of Control testing. Uparkar et al. (Uparkar, Asati, Sahahare, and Vaidya, 2019) has performed data modeling by pre-analyzing the data analytical steps. They have also used reliability test, graphical representation and consistency test. The study reflects the importance of preprocessing of data. Uparkar and Dhote (Uparkar Satyajit, 2020), worked on student data for their perception towards the digital banking. An online Google form was designed for data collection where every field was made compulsory to be filled by the respondent. They have used the research methodology approach for exploratory statistics and inferential statistics using chi-square test.

3. RESEARCH METHODOLOGY

The above available literature reveals the facts and figures for every keyword of the present study. The step-by-step approach towards details of the data analysis part has been explained in this section. After identifying the grey areas in the literature survey, following are the steps for the data analytical approach.

(1) **Define the problem statements in terms of Hypothetical statements** To find out locus of control among bank employees with special reference to private banks, three Hypotheses has been considered for carrying out this research study-
H1- There is no gender difference among bank employees regarding LOC.
H2- There is no difference among internal LOC in private bank employees.
H3- There is no difference among external LOC in private bank employees.

(2) **Identification of sample size, sample and scope of the study** A convenient sample size of 200 private bank employees has been finalized, which would contain 100 females and 100 male employees. Top Four private banks has been finalized viz. Axis bank, HDFC bank, ICICI bank and YES bank. The scope of study renders around the various branches of these four banks within the Nagpur city.

(3) **Preparation of Questionnaire** The Google online form is the method to collect the responses. The questionnaire is made up of two sections where each response type is been mandatory. In first section contains the demographic information of bank, present position and gender. The second section is designed for the LOC part. All the seven parameters are toggled with a pair of statements. Each of the seven parameters contains one internal LOC and another external LOC statement. The sequence these LOC may vary in each case as to avoid monotony or any biasness.
For example in the given seven parameters, following are the pattern of the two type of LOC

(1) One of the reasons why I am not satisfied with my job is because of
a) the performance appraisal criterion of the bank
b) my ability and skill sets are not at par with my present position
(2) Getting promotion depends on
a) attitude of the higher authorities
b) my working input which are upto the mark
(3) Motivation for becoming a successful employee
a) is a matter of my hard work and my correct decision every time
b) depends on good luck
(4) One of the reason for my job stress is because
a) work pressure stress given by my higher authorities
b) extreme work pressure taken by me for even a smaller thing
(5) My relation with my colleagues spoils sometimes because of
a) my nature, understanding , ignorance working attitude
b) they always have a different point of view
(6) There are certain clients who are
a) every client is good if my approach is good to them
b) not good to me, no matter how well we treat them
(7) The Balance Work life is handled smartly by me because
a) of my fate
b) I keep my personal and professional life separately
Note : In first two parameters and in fourth and seventh parameters, external LOC statements stands as first option where as in third, fifth and sixth parameter internal LOC statement is determined first. This is not even discussed with the respondents.

(4) **Method for Data Collection** Initially 250 bank employees from the mentioned 4 private banks were identified for their concern. Their mail id and contact number were noted for sending questionnaire. The gentle reminders were sending for the responses. The first 50 responses were considered for the Pilot survey. The reliability test was conducted for find the internal consistency of the Model. The data collection for 200 responses was finalized for this study.

(5) **Scoring Rules for Locus of Control** Since seven parameters consist of pair of statements, the respondent has only one choice either to choose from internal LOC or from External LOC. The following table provides the details of LOC statements.
The score varies from 0 to7 in either case. One point is given for the selection of external

Sr. No.	**Index**	**Option No.**
1	Internal LOC	1b 2b 3a 4b 5a 6a 7b
2	External LOC	1a 2a 3b 4a 5b 6b 7a

Table I: Sequence of LOC statements

LOC and no point for selecting the internal LOC. Since internal factors are tend towards biasedness. Thus, for an individual, score ranging from 0-3 indicates internal LOC, whereas the score ranging from 4-7 indicates external LOC

(6) **Data Analysis and interpretation** Following are the five steps conducted for performing the Data analysis. Based on the decision rules, fact and figure the interpretation are also determined.
(1) Pilot Survey and Reliability of Model
(2) Validity of Data and Data Pre-processing
(3) Exploratory statistics
(4) Descriptive statistics

(5) Inferential statistics
The detail analysis of these 5 steps is elaborate in next section.

(7) **Data Analysis and interpretation** To perform Data analysis various statistical test and techniques are applied. The detail elaboration of each step is as follows-

a) **Pilot Survey and Reliability of Model** Cronbach's alpha reliability test using SPSS software has been used on internal LOC as well as external LOC. Alpha range between 0 and 1where any value greater than 0.7 is acceptable, 0.8 is good and 0.9 is excellent for stating the internal consistency of the model. Based on the first 50 initial samples, following table provides the facts and figures for the two types of LOC. Interpretation: Since each

Sr. No.	Index	No. of items	Cronbach's Alpha value	Inference
1	Internal LOC	7	0.818	Good
2	External LOC	7	0.818	Good

Table II: Reliability test for LOC types

parameter is a pair of either LOC type or also the LOC type responses stand complement of each other, the Cronbach's alpha value stands same in both the cases. It can be seen that a¿0.8, the model stands enough consistent and reliable to proceed for the data collection of the remaining targeted sample size. There no need for any type of modification in the model under consideration i.e. Seven parameters stand enough for the evaluation process of LOC.

b) **Validity of Data and Data Pre-processing** The concept of online form overrules the possibilities missing entries where every question is framed as mandatory. The possibility of outliers can be handled by providing a proper task of data transformation. For performing the data analysis, the following codes were followed for data pre-processing

Sr. No.	Variable	Specification
1	Bank	1: Axis bank, 2: HDFC bank, 3: ICICI bank and 4: Yes bank
2	Present Position	1: Manager, 2: Accountant, 3: Cashier and 4: Clerk
3	Gender	1: Female and 2: Male
4	LOC response	0: False (No) and 1: True (Yes)

Table III: Data preprocessing codes

c) **: Exploratory statistics** Tabulation for sample distribution and bar charts for the trends of each parameter under both type of LOC has been used. The sample distribution of this study interpret as:
In the Nagpur region, number of female accountants and cashiers in the private banks are more as compared to the males. In case of Mangers and clerks male are more as compared to the females. Number of female and male respondents is equal for this study.
The trends for the seven parameters for both the LOC types are reflected using the bar char in the following Chart. Interpretation: Among the seven parameters, for the first six parameters External LOC is more as compared to Internal LOC except for the last parameter of Balance Work life. This shows that every employee has some or other family constraints that make an obstacle between the professional life and the personal life. Job satisfaction as well as Job stress both share highest scores in case of External LOC. An Average ratio of 55:45 within the parameters reflects that there is no wide difference among the two types of the LOCs.

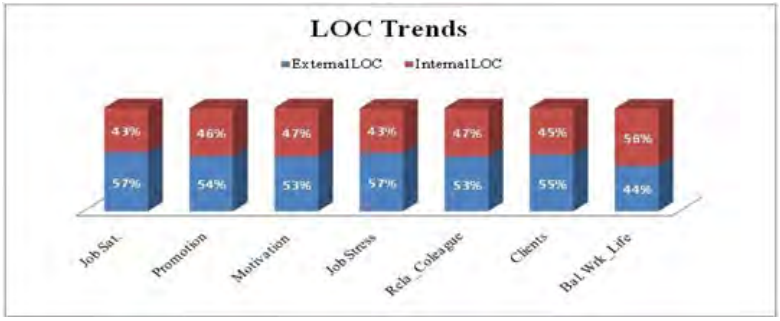


Figure 2. Chart : Initial LOC trends among the respondents

d) **Descriptive statistics** Measure of central tendencies i.e. Average, Median and Mode are used to identify the normality of the data distribution. The use of average and standard deviation are used to calculate the coefficient of variation (CV). The consistency of each type of LOC is determined by using the rule that- the low is CV value, higher is the consistency. The details analysis is given in the following Table 5.

Parameters	**Internal LOC**	**External LOC**
No. of observations	92	108
Average	1.15	4.09
Median	1	4.00
Mode	1	4.00
Std. Deviation	0.75	0.79
CV	66	19

Table IV: Details of Descriptive Analysis

Interpretation: The number of responses for external LOC factors is more than the internal LOC factors. The average, median and mode values almost coincide and hence the data is normally distributed in case of both the LOC. The Consistency among the External LOC is much more than the Internal LOC.

e) **Inferential statistics**
iThe three hypotheses are test by using the two samples Z test. In addition, the last two hypotheses based on Internal and external LOC can be tested using one way ANOVA test over the responses of 4 bank employees. The level of significance is kept at 5 percentage and the decision rule is - for any p value ¿0.05, accept the null hypothesis, otherwise reject the null hypothesis and accept the alternative hypothesis.
Consider the three hypothetical statement of the study. Since all the three statement sounds to be on the side of the Null Hypothesis, they can be statistically framed as-
H01: There is no gender difference among bank employees regarding LOC.
H02: There is no difference among internal LOC in private bank employees.
H03: There is no difference among external LOC in private bank employees.

The alternative hypotheses will reflect the tag line that-" There is some. . . . ."
First, we will use Z test for the gender difference as a whole and then on internal LOC and external LOC

Interpretation: Since all the three p values are ¿0.05, we accept the three Null hypothesis and conclude that the gender difference does not have any influence on LOC and even on the both type of LOC.

Hypo. No.	Index	Zcal	P value	Inference
H1	Overall Gender Difference	0.340	0.734	Accept H01
H2	Gender Diff, w.r.t. Internal LOC	1.106	0.272	Accept H02
H3	Gender Diff, w.r.t. External LOC	0.00	1.00	Accept H03

Table V: Specification of Z test for Gender Difference for LOC

Irrespective of the gender unbaisedness, further, for the last two hypothetical statements, we can verify by using the ANOVA test over the Four types of private banks of region.

Hypo. No.	Index	Fcal	P value	Inference
H2	Internal LOC	12.973	0.000	Reject H02
H3	External LOC	2.732	0.048	Reject H03

Table VI: Specification of ANOVA test for LOC types

Interpretation: Since both the p values are ¡0.05, we reject the two Null hypothesis (H02 and H03) and accept their respective alternative hypotheses. Hence we can conclude that-irrespective of gender difference there is the influence of Internal LOC and even the External LOC, among the bank employees of the region.

4. CONCLUSION

From interpretation of the results of the analysis, it is concluded that the locus of control among bank employees consists of two broad aspects, namely internal external. The very first Reliability test reveals that the statements under the seven parameters for both the LOC types are good enough for carrying out this study. In view of the seven parameters under consideration Job satisfaction and Job stress stands maximum in external LOC. On the other hand Balance Work life stands maximum for the internal LOC. The observation towards the external LOC is more than the internal LOC. The consistent factory is also more in case of external LOC. This shows that maximum of the bank employees are influenced by the external factors.

It is concluded that gender difference do not have significant influence on the locus of control. On the other hand among the bank employees of the region, the Internal as well External Locus of Control does matter individually. Thus, the study accepts the statement of H1-There is no gender difference among bank employees regarding LOC. Also, the gender difference does not matter in case of internal as well as external LOC, even individually. Irrespective of the gender difference, using ANOVA test, this study rejects statement H2 and conclude that there is some difference among internal LOC in private bank employees. Similarly, irrespective of the gender difference, using ANOVA test, this study also rejects statement H3 and conclude that there is some difference among external LOC in private bank employees.

It is important to note that people are not borne as internals or externals LOC. The LOC develop among the people as they grow and through their learning experience. This study deals with the status of Locus of Control among the private sector bank employees of Nagpur region. The study highlights the factor like balance work life which plays an important role in terms of internal LOC. If the employees are able to balance this factor, then every other factor like job stress, motivation, relation with the colleagues will automatically reflect their importance. In this competitive world of banking sector, the balance between the personal life and professional life of the bank employees will also lead to the factors like job satisfaction, promotion and even the approach towards the clients.

References

Arrawatai, M. A. and Shailly, D. 2017. A study of employee engagement in private sector banks of rajasthan: Assessment for organizational transformation. *International Journal of Science Technology and Management Vol. 6(5)*, pp.582–589.

Dhote, Sunita, U. S. and Bhave. 2018. Critical evaluation of entrepreneurial tendency in engineering graduates. *Helix Vol. 8(6)*, pp.4161– 4166.

Fitra, H., Rasyid, R., and Susanti, Y. 2018. The influence of locus of control and financial knowledge to employee investing decision pt. pertamina (persero) branch of padang. In *First Padang International Conference On Economics Education, Economics, Business and Management, Accounting and Entrepreneurship (PICEEBA 2018)*. Atlantis Press, 340–350.

Gangai, Khagendra, M. G. and Vikas, S. 2016. Association between locus of control and job satisfaction in employees: A critical review. *The International Journal of Indian Psychology Vol. 3(2)*, pp.55–68.

Hafiz, S. 2018. Problems and challenges faced by women in banking sector with special reference to hadoti region. *International Journal of Business and Management Invention Vol. 7(9)*, pp.78–89.

Hans, Arvind, D. A. P. A. F. C. A. S. K. P. U. A. 2017. A study on self-efficacy locus of control and commitment in select private management colleges in oman. *Amity Journal of Management Research 2,* 1, 1–9.

Mali, V. 2013. A study on locus of control and its impact on employees' performance. *International Journal of Science and Research 2,* 12, 149–151.

Mujiatun Siti, A. F. 2017. An analysis of locus of control on employee performance and in islamic perspective (case study of pt. bank syariah mandiri cfbc medan). *IOSR Journal of Humanities and Social Science 22,* 8, 91–95.

Nath, Sujit Kumar, B. S. A. G. S. 2017. Status of private sector banks in india. *International Journal of Recent Scientific Research 8(6): 8,* 6, 17532–17534.

Raja, K. and K, S. 2019. Work-life balance of employees of private sector banks in virudhunagar district. *International Journal of Management Studies 6*, 2339–2343.

Ratnawati, V. 2020. Factors affecting tax auditors' performance: the moderating role of locus of control. *Problems and Perspectives in Management 18,* 2, 36–45.

S, P. 2013. Status of locus of control among private bank employees. *International Journal of Economics, Commerce and Research 3,* 1, 119–128.

Uparkar, S. S., Asati, K. R., Sahahare, P. U., and Vaidya, N. V. 2019. Data analytics of social networking sites using game theory model. *International Journal of Engineering and AdvancedTechnology (IJEAT) 8,* 6S3.

Uparkar Satyajit, D. S. 2020. Students perception on digital banking". *Test Engineering and Management 82*, 12619–12625.

Wang, L. and Lv, M. 2020. Internal-external locus of control scale. *Encyclopedia of personality and individual differences*, 2339–2343.

Dr. Monika Ritesh Seth is expert in Psychology, Political Science, Sociology, Economics, Public Administration, Education and Business Administration. The major Achievement -Received an International Honour as the name has been enlisted in prestigious International Publication entitled, " ASIA/PACIFIC WHO'S WHO" volume XIV published in 2016 for academic achievements.
E-mail: sethmr@rknec.edu

Dr. V H Asudani is Associate Professor, Department of Humanities at Shri Ramdeobaba College of Engineering and Management, Nagpur,since last 20 years. He was conferred with "Best Teacher Writer Award" by RTM Nagpur University, Nagpur on 5th September 2015.For his contribution to the field of Literature. He received the award at the hands of Energy State Minister Mr. Chandrashekhar Bawankule Dr. V.H.Asudani was conferred with National Literary Award for his Sindhi Poetry Book " Bhun – Bhun" by National Council for The Promotion of Sindhi Language , New Delhi, in March 2015
E-mail: asudanivh@rknec.edu

Dr. Sachin Upadhye is an Assistant Professor at Computer Application Department of Shri Ramdeobaba College of Engineering and Management, Nagpur. He holds MCA, and M. Tech. Ph.D degrees in Computer Science Engineering. He is an Oracle Certified Associate, IBM Rational Certified developer and has more than 25 research paper published in National International Journals and conferences. He has 12 Years teaching experiences. He has successfully completed many certifications from NPTEL, NIT,IIT and also completed the research proposal and project.
E-mail: upadhyesd@rknec.edu

Prof. Satyajit S. Uparkar is a certified data scientist from International School of Engineering, Hyderabad. He is working as Assistant Professor in Department of Computer Application at Shri Ramdeobaba College of Engineering and Management, Nagpur, sincelast 11 years. He has bagged FIVE best paper awards in international conferences. His research contribution includes 30 research papers in various National and International Journals, one Australian Patent, in addition of two book chapters and a book on Python Programming. He is a data science consultant and has provided consultancy to the local companies of the region.
E-mail: uparkarss@rknec.edu

Using Marchenko–Pastur SVD and Linear MMSE Estimation for Reducing Image Noise

Swati Rane, Department of Electronics and Telecommunication Engineering, SIES Graduate School of Technology, Nerul, Navi Mumbai, India and Research Scholar, Department of Electronics and Communication, Visvesvaraya Technological University, India.
L. K. Ragha, Principal, Terna Engineering College, Navi Mumbai, India.
Siddalingappagouda Biradar, Department of Electronics and Communication Engineering, Dayananda Sagar Academy of Technology Management, Bangalore, India.
Vaibhav R. Pandit, Department Electronics and Telecommunication Engineering, Terna Engineering College, Navi Mumbai, India

The degradation in visual quality of images is often seen due to a variety of noise added inevitably at the time of image acquisition. Its restoration has thus become a fundamental and significant problem in image processing. Many attempts are made in recent past to efficiently denoise images. But, the best possible solution to this problem is still an open research problem. This paper validates the effectiveness of one such popular image denoising approach, where an adaptive image patch clustering is followed by the two step denoising algorithm in Principal Component Analysis (PCA) domain. First step uses Marchenko–Pastur law based hard thresholding of singular values in the singular value decomposition (SVD) domain and the second step removes remaining noise in PCA domain using Linear Minimum Mean-Squared-Error (LMMSE), a soft thresholding. The experimentation is conducted on gray-scale images corrupted by four different noise types namely speckle, salt pepper, Gaussian, and Poisson. The efficiency of image denoising is quantified in terms of popular image quality metrics peak signal-to-noise ratio (PSNR), structural similarity (SSIM), feature similarity (FSIM), and the denoising time. The comprehensive performance analysis of the denoising approach against the four noise models underlies its suitability to various applications. This certainly gives the new researchers a direction for selection of image denoising method.

Keywords: Image Denoising, Adaptive Clustering, Linear Minimum Mean-Squared-Error (LMMSE), Marchenko–Pastur Singular Value Decomposition (MP-SVD), Principal Component Analysis (PCA).

1. INTRODUCTION

Digital image noise removal is always been a challenging task. Hence several powerful and adaptive methods are developed for denoising of various types of images from decades. Images usually become noisy at the time of acquisition and transmission. Images get corrupted due to different types of noises. Specific type of image may get corrupted by a specific type of noise. The image contaminated with noise is modeled as $y = x + n$ where x and y represent the original noise free and noisy images respectively and n represents added noise. Researchers are working on developing algorithms to estimate ground truth from its noisy counterpart. Many algorithms which are spatial domain, transform domain, dictionary based, iterative, adaptive are introduced. A good image denoising algorithm is the one which not only removes noise present in the image but also is able to preserve details of the image. In the literature only few of the methods are present which are focused towards preserving the features or structures present in the image. This paper presents analysis of applications of one such method proposed by Zhao et al. which is a two stage denoising method. This method makes use of MP law and LMMSE techniques in SVD and PCA domains respectively. The remaining of the paper is organized as: Section 2 briefs the related work. The methodology of MP-SVD and LMMSE estimation approach for image denoising is presented in Section 3. Experimentation of applying denoising algorithm on images and its result analysis is addressed in Section 4. Lastly, Section 5 concludes the complete

paper.

2. RELATED WORK

To denoise a noisy image is an inverse problem. There exist many techniques for image denoising. These techniques can be classified into two categories. The first method presented by Zha et al. makes use of background information gleaned from spatial picture features such nonlocal self-similarity. The second denoising method, which includes the discrete wavelet transform, dictionary learning and principal component analysis are based on transform domain techniques. The first method is predicated on the idea that natural images have a large number of comparable pixels or patches that are either spatially close together or far apart. The nonlocal means filter, one of the many nonlocal algorithms, was first suggested by Buades et al. as a development of the bilateral filter. The non-local means filter replaces the value of a pixel of a patch by an average of pixel values of other patch which is close to the current patch in terms of the contents. The nonlocal means filter exhibits promising performance and inherits the bilateral filter's ability to preserve edges. Thaipanich et al. proposed patch-grouping techniques, such as the block matching and clustering algorithms, based on the use of nonlocal self-similarity. For picture denoising, for instance, clustering in conjunction with a patch-based Wiener filter (PLOW) is suggested by Chatterjee and Milanfar. PLOW filter takes advantage of patch redundancy present in the image. In the event of a large number of features, however, PLOW can mix several features (edges, singularities, and textures) into the same cluster because it employs K-means with a set number of clusters; as a result, some features may become undetectable after noise removal. Similar to this, several other clustering-based denoising techniques presented by Wang et al. struggle to choose the right number of clusters to effectively separate various features, which limits the use of NSS. To eliminate noise from pictures, Tomasi and Manduchi presented a non-iterative bilateral filter. By adding a Non-Local Means filter, Buade expands on this work's focus on maintaining structure in digital images. Xu et al. proposed a non-local Means filter which is exploited through patch grouping and it uses Block based NLM to estimate a patch's value based on how similar it is to other patches in the image. Only the most comparable patch numbers are chosen which helps to weed out irrelevant data. Several cutting-edge image denoising algorithms, including block matching and 3-D by Yahya et al. principal component analysis with local pixel grouping by Zhang et al. patch-based locally optimal wiener by Chatterjee and Milanfar and spatially adaptive iterative singular-value thresholding by Movchan and Shen were developed as a result of patch- or block-based image noise removal algorithms exploiting nonlocal self-similarity of images. The self-similarity property of the MR data is used by Golshan and Hasanzadeh to present a new filtering technique based on the LMMSE estimation that restores the noise-free signal.

3. METHODOLOGY

The overview of MP-SVD and LMMSE estimation approach for image denoising is presented in figure 1.

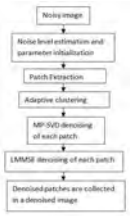


Figure 1. Methodology

3.1 Noise Level Estimation

The eigenvalues of the covariance matrix of noisy patches can be used to measure the noise level. By outlining the connection between the noise level and the matrix's PCA eigenvalue, the MP law is used to estimate the noise level of the whole image. To obtain an accurate estimate, the whole image of size a x b is divided into overlapping patches. Each patch of d x d size. All the patches are stacked together and a large matrix is constructed of size M x L, with M = d2 and L= (a − d + 1)(b − d +1). The PCA eigenvalues of noise matrix and the PCA eigenvalues of the formed large matrix are related to each other. Hence, we can gauge the intensity of noise, , based on the PCA eigenvalues of the large matrix. The steps to estimate noise level are shown in figure 2. Patches of size d x d are extracted. Then using PCA, eigenvalues are obtained for each patch. Each eigenvalue is considered individually and for each one of it, parameters like variances and difference $\sigma_{i1}^2, \sigma_{i2}^2, \delta_i$ are calculated using equation (1), (2), (3). Finally, noise estimate is computed using equation (4).

$$\sigma_{i1}^2 = E(\lambda_{xi}) \tag{1}$$

Where E(.) is the expectation and $\lambda_x i$ is the eigen value of the large matrix.

$$\sigma_{i1}^2 = \frac{\lambda_{xi+} - \lambda_{xi-}}{4\sqrt{\gamma}} \tag{2}$$

$$\Delta_i = \|\sigma_{i1}^2 - \sigma_{i1}^2\|_2^2 \tag{3}$$

Out of all the differences whichever eigenvalue gives minimum difference, that eigenvalue is set as the eigen value of the noise matrix and used for calculating the noise estimate as given in equation (4).

$$\sigma_n^2 = E(\lambda_{ni}) \tag{4}$$

Where σ_n is the noise estimate and λ_n is the eigenvalue of the noise matrix.

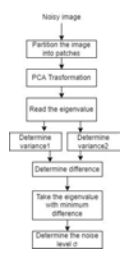


Figure 2. Estimation of noise level

3.2 Adaptive Clustering

An adaptive clustering method is used to collect patches of the image corresponding to same type of image feature or attribute utilizing the nonlocal self-similarity of the image given the level of global noise. As a result, the number of clusters should match the variety of image attributes at very small scale. As a large number of clusters need to be obtained, the adaptive clustering method makes use of divide-and-conquer technique of K-means. For the image of size p x q, the number of clusters are decided as

$$K1 = max\{\frac{pq}{(256x256)}, 4\} \tag{5}$$

Each of these clusters is re-clustered with the number of clusters given as

$$K2 = floor(\frac{L_j}{M}) \tag{6}$$

In the jth cluster matrix from the first step of clustering, L_j stands for the number of patches. Clusters corresponding to same type of image feature are merged in one cluster. To avoid being too small and sporadic clusters, merging of clusters is performed. For this the between-cluster distance of each pair of clusters is calculated and the two clusters whose distance is less than a preset threshold are merged into one cluster. If the mean vectors of the two clusters are represented by m and n, their between-cluster distance is calculated as

$$\|m - n\|_2^2 \tag{7}$$

When the cluster number does not change any more, the merging procedure is complete.

3.3 MP-SVD Denoising With Rank Estimation

The noisiest components from each cluster matrix are removed in this step. Using the already obtained noise level σ, $\lambda_{n+} = \sigma^2(1+\sqrt{\gamma})^2$ is calculated. The singular values of the cluster matrix are hard threshold to approximate a low-rank matrix from noisy data. Here the MP Law based threshold is used and given as:

$$\zeta = \sqrt{\mu\lambda_{n+}} \tag{8}$$

μ is an adjustment coefficient and should be greater than 1. The rank of the low-rank matrix in this case is determined by the quantity of singular values greater than ζ . More noisy data will be eliminated as grows, but less feature detail will be saved. Hence μ is set to 1.1.

3.4 LMMSE Denoising With Local Parameter Estimation

We obtain the signal-dominated low-rank cluster matrix for each cluster after removing the noisiest components. We derive rank transform bands in the PCA transform domain from this signal-dominated region. Instead of using global approximation to filter each PCA transform band of the signal-dominated region, local approximation is used. This is due to the finding that the PCA transform band with a signal dominance exhibits significantly greater in-band fluctuations than the band with a noise dominance. Using the LMMSE estimator, which is likewise locally applied to the patch group in a coefficient-wise manner and whose parameter is calculated through locally averaging, we eliminate the residual noise.

4. 4. EXPERIMENTATION AND RESULT ANALYSIS

This section shows the implementation and analysis of the results of the MP-SVD and LMMSE estimation method for image denoising, when applied to the dataset imagery detailed in the following subsections.

4.1 Experimental Platform

The implementation of image denoising algorithm using MP-SVD and LMMSE estimation and its further performance evaluation is carried out on an the platform detailed in Table 1.

4.2 Dataset Imagery

Four gray scale images of dimensions 256 × 256 pixels are used for the experimentation. These dataset images named Rhinoceros, Crow, Building, and Elephant are respectively displayed in figure 3.

Table I: Details of experimental setup.

Setup item	Details
Software	MATLAB R2022a
Processor	11th Gen Intel(R) Core(TM) i5-1135G7 @ 2.40 GHz
RAM	8 GB
System	Windows-10 64-bit Operating System

Figure 3. Dataset Imagery: (a) Rhinoceros, (b) Crow, (c) Building, (d) Elephant

4.3 Results

For demonstrating the performance of the image denoising method, the original dataset imagery, which is free from noise is made noisy by using four noise models correspondingly speckle, salt pepper, gaussian, and Poisson. These noisy images and the resultant denoised images obtained using MP-SVD and LMMSE estimation approach corresponding to the four noise models are respectively displayed in figure 4, 5, 6 and 7. To measure the effectiveness of image denoising, the denoised images are compared to the original noise free images and three evaluation metrics namely peak signal-to-noise ratio (PSNR), structural similarity (SSIM), and feature similarity (FSIM) are computed.

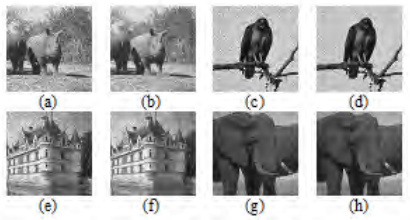


Figure 4. Experimentation for Speckle Denoising: (a) Noisy Rhinoceros, (b) Denoised Rhinoceros, (c) Noisy Crow, (d) Denoised Crow, (e) Noisy Building, (f) Denoised Building, (g) Noisy Elephant, (h) Denoised Elephant.

The obtained values of the evaluation metrics and the execution time for image denoising corresponding to four dataset images and four noise models are shown in Table 2.

4.4 Quantitative Analysis

In order to judge suitability of the image denoising method using MP-SVD and LMMSE estimation against the four noise models using the dataset imagery, it is necessary to analyze the quantified evaluation metric values. A graphical plot of obtained PSNR values as shown in Figure 8(a) will be helpful here. The desired value of PSNR is always a maximum indicating the retention of signal information despite the corruption caused by noise. From the graphical plot, it is clear that the approach is more suitable to reduce the Poisson noise. There is also a considerable reduction in Gaussian noise in the concerned image. Handling the speckle and salt pepper noise using the discussed methodology comes out to be not so efficient option. But, still it is successful to achieve higher PSNR in speckle noise reduction for Elephant image than the case of salt pepper noise. The quantification of image quality degradations in terms of perceptual metric SSIM is graphically plotted in Figure 8(b). The desired structural similarity of denoised image with original image is always as maximum as possible. From this plot also, it is clear that

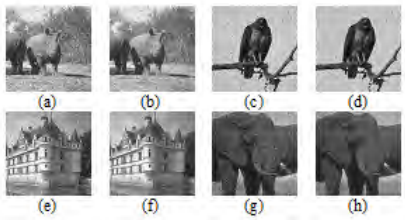


Figure 5. Experimentation for Salt Pepper Denoising: (a)Noisy Rhinoceros, (b) Denoised Rhinoceros, (c) Noisy Crow, (d) Denoised Crow, (e) Noisy Building, (f) Denoised Building, (g) Noisy Elephant, (h) Denoised Elephant.

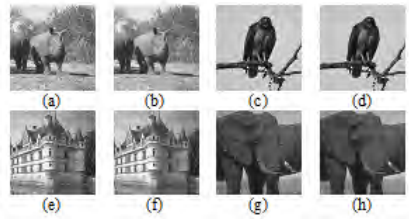


Figure 6. Experimentation for Gaussian Denoising: (a) Noisy Rhinoceros, (b) Denoised Rhinoceros, (c) Noisy Crow, (d)Denoised Crow, (e) Noisy Building, (f) Denoised Building, (g) Noisy Elephant, (h) Denoised Elephant.

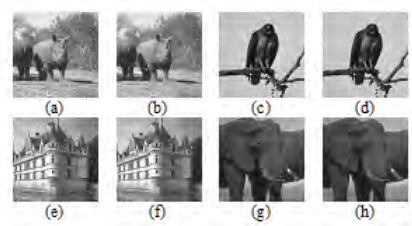


Figure 7. Experimentation for Poisson Denoising: (a) NoisyRhinoceros, (b) Denoised Rhinoceros, (c) Noisy Crow, (d)Denoised Crow, (e) Noisy Building, (f) Denoised Building, (g) Noisy Elephant, (h) Denoised Elephant.

the approach best suits to reduce the Poisson noise. Next to this, it is also efficient to reduce gaussian noise in an image to a considerable level. The performance of the discussed methodology is not consistent while handling the speckle and salt pepper noise. It seems dependent on image information variation trends in the spatial plane. In the case of Elephant image dataset, speckle noise reduction achieves higher SSIM index than in the Gaussian and salt pepper noise reduction. The feature similarity of denoised images with their original counterparts measured in terms of FSIM values is plotted in Figure 8(c). The efficiency of the image denoising algorithm also greatly depends on this metric computation. As higher the FSIM values, more efficient the denoising algorithm is. In this plot also, Poisson noise reduction has achieved overall highest FSIM values. The performances in the cases of gaussian and salt pepper noise reduction are respectively very close to Poisson denoising. Comparatively, the speckle denoising fails to retain the feature information in the resultant images. Finally, a comparison of time taken for image denoising is plotted in Figure 8(d). Despite the same computational complexity of the algorithm when applied to different images corrupted by different noise types, it is concluded that the execution time of the method does not depend on the type of noise. Speckle and salt pepper denoising using the MP-SVD and LMMSE estimation approach are found to be computationally inefficient.

Table II: Measurement of performance metrics: PSNR, SSIM, FSIM, and the execution time.

Dataset Imagery	Noise Type	PSNR	SSIM	FSIM	Time (s)
Rhinoceros	Speckle	20.8909	0.5812	0.8343	6.4411
	Salt & Pepper	20.2371	0.5359	0.8419	5.8626
	Gaussian	24.9982	0.7203	0.8767	8.4697
	Poisson	26.7270	0.7680	0.8619	6.9526
Crow	Speckle	19.5276	0.3382	0.5542	9.6125
	Salt & Pepper	19.4624	0.4131	0.7772	9.5770
	Gaussian	28.8700	0.6791	0.8164	9.3723
	Poisson	33.5271	0.9435	0.9351	20.7657
Building	Speckle	21.5728	0.5942	0.8132	6.4130
	Salt & Pepper	20.5823	0.5513	0.8515	13.0522
	Gaussian	25.8125	0.7127	0.8858	12.9120
	Poisson	28.8707	0.8565	0.8904	12.8295
Elephant	Speckle	26.8161	0.7025	0.8190	10.2185
	Salt & Pepper	20.3193	0.3704	0.7563	5.1360
	Gaussian	27.9856	0.6064	0.8483	6.4189
	Poisson	30.9993	0.7601	0.8171	7.8401

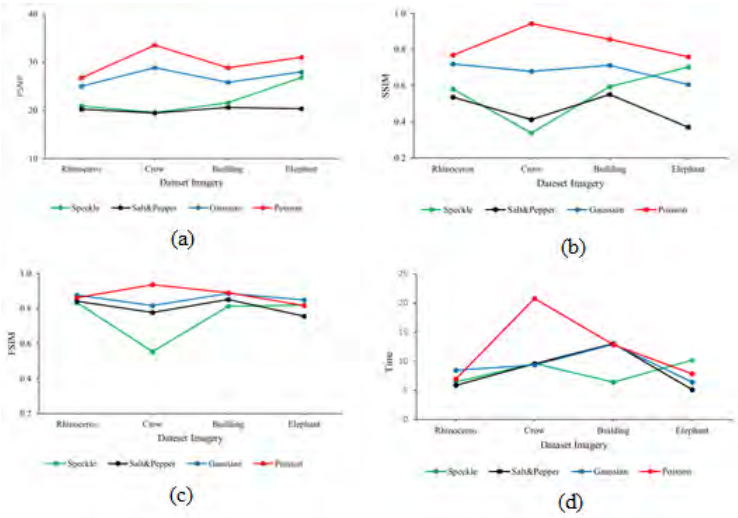


Figure 8. Comparative analysis of variation adaptive denoising approach against speckle, salt pepper, gaussian, and poisson noise models considering the measurements of (a) PSNR, (b) SSIM, (c) FSIM, and (d) the execution time

5. CONCLUSION AND FUTURE SCOPE

In this paper we have validated the effectiveness of a popular image denoising approach, where an adaptive image patch clustering is followed by the two step denoising algorithm in Principal Component Analysis (PCA) domain. First step uses Marchenko–Pastur law based hard thresholding of singular values in the singular value decomposition (SVD) domain and the second step removes remaining noise in Principal Component Analysis (PCA) domain using Linear Minimum Mean-Squared-Error (LMMSE), a soft thresholding. The experimentation is conducted on gray-scale images corrupted by four different noise types namely speckle, salt pepper, Gaussian, and Poisson. The efficiency of image denoising is quantified in terms of PSNR, SSIM, FSIM, and the

denoising time and also assessed by the visual inspection. When all the results are compared, it is observed that the method is best at reducing Poisson noise, better at reducing Gaussian noise when quality metrics and execution time are considered. Variation adaptive approach is not suitable for handling the speckle noise and salt pepper noise efficiently. Development of a more sophisticated image denoising method that can efficiently deal with variety of noise models is planned to be a future work.

References

Bartomeu, C. and Morel, J.-M. 2005. A review of image denoising algorithms, with a new one. *SIAM Journal on Multiscale Modeling and Simulation 4*.

Chatterjee, P. and Milanfar, P. 2012. Patch-based near-optimal image denoising. *IEEE Transactions on Image Processing 21,* 4, 1635–1649.

Golshan, H. M. and Hasanzadeh, R. P. 2015. An optimized lmmse based method for 3d mri denoising. *IEEE/ACM Transactions on Computational Biology and Bioinformatics 12,* 4, 861–870.

Li, P., Wang, H., and Li, X. 2021. An image denoising algorithm based on adaptive clustering and singular value decomposition. *IET Image Processing 15*.

Movchan, R. and Shen, Z. 2017. Adaptive thresholding hosvd algorithm with iterative regularization for image denoising. In *2017 IEEE International Conference on Image Processing (ICIP)*. 2991–2995.

Thaipanich, T., Oh, B. T., Wu, P.-H., and Jay Kuo, C.-C. 2010. Adaptive nonlocal means algorithm for image denoising. In *2010 Digest of Technical Papers International Conference on Consumer Electronics (ICCE)*. 417–418.

Xu, S., Zhou, Y., Xiang, H., and Li, S. 2017. Remote sensing image denoising using patch grouping-based nonlocal means algorithm. *IEEE Geoscience and Remote Sensing Letters 14,* 12, 2275–2279.

Yahya, A., Tan, J., Su, B., Hu, M., Wang, Y., Liu, K., and Hadi, A. 2020. Bm3d image denoising algorithm based on an adaptive filtering. *Multimedia Tools and Applications 79*.

Zha, Z., Yuan, X., Zhou, J., Zhu, C., and Wen, B. 2020. Image restoration via simultaneous nonlocal self-similarity priors. *IEEE Transactions on Image Processing 29*, 8561–8576.

Zhang, L., Dong, W., Zhang, D., and Shi, G. 2010. Two-stage image denoising by principal component analysis with local pixel grouping. *Pattern Recognition 43*, 1531–1549.

Zhao, W., Lv, Y., Liu, Q., and Qin, B. 2018. Detail-preserving image denoising via adaptive clustering and progressive pca thresholding. *IEEE Access 6*, 6303–6315.

Swati Rane is Assistant Professor at SIES Graduate School of Technology, Navi Mumbai affiliated to Mumbai University. She is pursuing Ph.D. from Visvesvaraya Technological University (VTU), Belagaum, Karnataka. She has received ME (E&TC) from Pune University. Her research interests include image processing machine learning.
E-mail: swati.rane@siesgst.ac.in

Dr. L. K. Ragha is a Senior Professor and has been working as Principal at Terna Engineering College, Nerul, Navi Mumbai, India. . He received his Ph.D. Degree in Electronics Engineering from University of Mumbai. He was a research scholar at BARC, Mumbai from 2007 to 2011 for his research study on "Technological, Environmental and Biological aspects of Microwave and communication fields". His primary research interest is Microwave bio effects and numerical simulation of radiating systems. His other areas of research interest are speech processing, Noise reduction technics, Internet of Things, etc. He has 36 years of experience and served in many Institutions at various capacities. He has published more than 40 research papers in national and international journals and conferences.
E-mail: lkragha@gmail.com

Dr. Siddalingappagouda Biradar is currently working as an Associate Professor in the Department of Electronics and Communication Engineering, Dayananda Sagar Academy of Technology and Management Bangalore. He earned his BE [Electronics Communication Engg.] from B.L.D.E.A's Dr. P.G Halakatti College of Engineering Technology, Vijaypura in 2007, M.Tech[DCN] from KLS Gogte Institute of Technology, Belagavi in 2011 and Ph.D from Visvesvaraya Technological University(VTU) Belagavi in 2019, respectively. He has published more than 20 research articles in International Conference Proceedings and Journals, awarded with best paper. He is a professional member of IEEE and a life member of the INSC, IFERP, IMAPS, IETE and ISTE. He has 2 Indian patents, 2 CopyRight and 1 Australian Patent. His current research interests include Network Automation, 3G/4G-LTE, 5G Technologies, Mobile Ad hoc Networks, Wireless Sensor Networks related to quality of service and performance analysis.
E-mail: s.biradar-ece@dsatm.edu.in

Dr. Vaibhav R. Pandit received B.E. (Electronics and Telecommunication Engineering), M.E. (Digital Electronics), and Ph.D. (Electronics and Telecommunication Engineering) from Sant Gadge Baba Amravati University of Maharashtra State, India in the years 2009, 2013, and 2020 respectively. His research interests include remote sensing image processing, artificial intelligence and neural networks, mobile ad hoc networks, microwave engineering, embedded systems, etc. He is professionally connected as a Life Member ISTE, Associate Member IE(India), Associate Member IETE. Currently he is working as Assistant Professor in the department of Electronics and Telecommunication Engineering at Terna Engineering College, Nerul, Navi Mumbai, Maharashtra State, India.
E-mail: vaibhavpandit111@gmail.com

Comparative Analysis of Scalability Approaches using Data Mining Methods on Health Care Datasets

Satyajit S. Uparkar and Sunit N. Dhote
Shri Ramdeobaba College of Engineering and Management, Nagpur, India
Shabana S. Pathan
St. Vincent Pallotti College of Engineering and Technology, Nagpur, India
Purushottam D. Shobhane
Symbiosis Institute of Technology, Symbiosis International Deemed University, Nagpur, India
Debasis Das
Webster University, Tashkent, Uzbekistan

The primary issue in data analysis is scalability of data mining methods. Various scaling options have been explored in prior research to overcome this problem. Several scaling strategies are explored and tested on various datasets in this research. The cascade scaling method is proposed to improve the efficacy of existing methods. The proposed method starts with gathering a huge dataset and then pre-processed. Once the dataset has undergone pre-processing, it is spitted into smaller subsets of equal size to apply a data mining strategy on each subset. The outcomes of the data mining approach on all subsets are pooled and aggregated for the final results. The accuracy of the given algorithm is used to evaluate its performance. The proposed method and existing methods are evaluated on two health care datasets: PIMA Indian Diabetes and Heart Disease. On the basis of the Data mining methods the proposed scaling approach reflects better results as compared to the existing scaling approaches. On both datasets, the proposed method is compared to previous work published by different authors in earlier studies. It was discovered that the proposed method outperformed previous research. For a few data mining methods, the proposed method achieves 100 percentage accuracy.

Keywords: Scalability, Data Mining, Health Care, Accuracy, PIMA Indian Diabetes and Heart Disease.

1. INTRODUCTION

To generate high-performance, effective, and scalable data mining algorithms, scalability is a problem that must be addressed in data mining algorithms in general. Data mining techniques may easily extract information from enormous datasets after the scalability issue has been resolved (Bondi, 2000). Due to the vast amount of data available, the majority of data mining methods are not suitable to many real-world problems. The effectiveness of data mining algorithms decreases as the problem size increases. In many circumstances, the algorithm's running time requirements are extremely high, making it impossible to use mining techniques as the problem gets bigger. This element is connected to the strategy's temporal complexity (Brain and Webb, 2002). Data mining techniques have been scaled up, as well as data reduction techniques, to solve this issue. The fact that data reduction is a data mining attempt and of itself raises questions about the scalability of this method. As a result, scaling up the data mining technique is the only way to tackle many difficulties, especially when working with very large datasets. There have been numerous attempts to create methods for scaling up current data mining technologies (Mc Manus and Kechadi, 2004). This paper discusses current scaling techniques and suggests a cascade-based strategy to address the scalability problem. The dataset is divided into subgroups using the cascade approach, and each subset is then separately examined using data mining techniques.

2. LITERATURE REVIEW

The scalability issue in data mining has provided a scope for extensive research. Tu et al. proposed using a bagging algorithm to identify heart disease warning symptoms in patients, as well as comparing the bagging algorithm's effectiveness to that of the decision tree method, which has been employed by many researchers. The ability of clinicians to diagnose cardiac disease is a critical issue, causing numerous researchers to concentrate on the development of intelligent medical decision support systems (Tu, Shin, and Shin, 2009). Srinivas et al. investigated how a significant amount of healthcare data may be processed using classification-based data mining techniques including Rule-based, Decision Tree, Nave Bayes, and Artificial Neural Network. The healthcare business has amassed massive volumes of data, which is sadly not being "mined" for hidden information. The end results is about the forecast based on likelihood of individuals developing heart disease based on medical characteristics. It enables considerable knowledge to be established, such as patterns and correlations between medical factors connected to heart disease (Srinivas, Rani, and Govrdhan, 2010). Glorot researched the problem of "domain adaptation" for sentiment classifiers, which occurs when a system is trained on labeled reviews from one source domain but then used on another. They proposed an unsupervised deep learning strategy that trained to extract a meaningful representation for each review. On a benchmark consisting of reviews of four different categories of Amazon products, sentiment classifiers trained with this high-level feature representation clearly outperformed state-of-the-art approaches. Furthermore, this strategy scales effectively, allowing them to execute domain adaptation on a larger industrial-strength dataset of 22 domains with success (Glorot, Bordes, and Bengio, 2011). Totad et al. reviewed the issues and showed the parallel and distributed data mining research that is now underway. The parallel processing adaptability of some key data mining methods, such as decision trees, finding of frequent patterns, clustering, and so on, is also reviewed, as well as recent research work linked to parallel processing of the algorithms (Totad, Geeta, Prasanna, Santhosh, and Reddy, 2010). In recent studies, D Shah and et. al, applied various supervised machine learning algorithms on Heart Disease data det. The standard procedure included data preprocessing in which out of 76 attributes only 14 attributes are considered for predicting the probability of a person having heart disease. KNN approach provided the best results as compared to the other supervised algorithms (Lane, 2000). Lilhore and et. al extended the previous study on heart disease using isolation forest approach and machine learning algorithm. Their aim was to protect the heart patients from any critical circumstance (Shah and Patel, 2020). Chang V and et. al., worked on PIMA India Diabetes data set using innovative concept of Internet of Medical Things (IoMT) and Machine learning. The results found that Naïve Bayes and Random forest algorithms provide better results on the basis of various performance parameters (Ramesh, Lilhore, Poongodi, Simaiya, Kaur, and Hamdi, 2022). Das and et.al has used the machine learning to study various alternatives applied on computer algorithms which automatically improves the end results. The variation in SVM has been used on various data sets and examined the performance metric (Chang, Bailey, Xu, and Sun, 2022). Satyajit S. Uparkar and Ujwal A. Lanjewar proposed cascade scaling approach using the scalable data mining algorithms applicable for stationary as well as non stationary data sets(Das, Goje, Uparkar, Upadhye, and Upasani, 2021; Uparkar and Lanjewar, 2022).

3. PROPOSED METHODOLOGY

Based on the cascade scaling approach, the proposed system begins with the collection of data. The steps from preprocessing to the performance evaluation for accuracy parameter are given in the following figure. From the Kaggle Datasets repository both Heart Disease and PIMA India Diabetes has been used for this research study.

Flow chart

Fig 2 depicts the proposed method's flow chart. The collecting of data is the first step in the procedure.

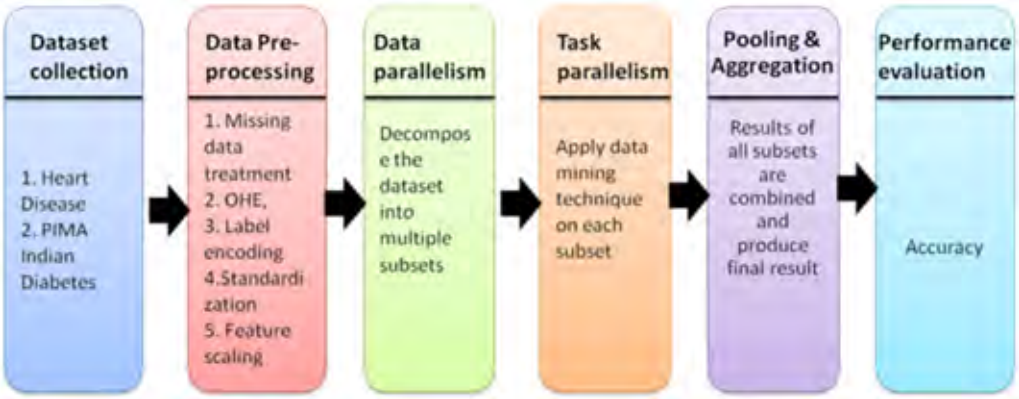


Figure 1. Proposed cascade scalable approach

Following the collection of data, pre-processing techniques are used to get clean data for future analysis. If missing data is found in the dataset, multiple approaches to missing data treatment are used. Divide the dataset into subsets of equal size. The value of the number of subsets, denoted as "n," is identified for better performance. The number of subsets should never exceed n. Eq.1 is used to get the maximum value of n. If the number of subsets is greater than n, over fitting may occur; thus, reduce subset division to avoid over fitting.

$$n = \text{math.sqrt (len (dataset))} \qquad (1)$$

After checking for over fitting, divide the dataset into n-subsets for training and testing segments. Apply the same data mining strategy to every subgroup and independently calculate the results. Combine and aggregate the results from each subgroup to get a final output for performance metrics of accuracy. Performance comparisons between the suggested scaling strategy and non-scaling data mining techniques are made. At last, determine which data mining technique compared to the suggested scaling strategy worked the best.

4. RESULTS AND DISCUSSIONS

A comparison of existing approaches with the proposed method for various data mining methods is discussed in this section. As an initial lab study various rations of training and testing were performed. Among all the ratios of 80:20 provided the consistent results. For the PIMA dataset, Table 1 illustrates the performance evaluation of existing and suggested scaling approaches using decision trees, SVM, logistic regression, random forest, KNN, and Naive Bayes.

Scaling Algorithm	**Decision Tree**	**Random Forest**	**SVM**	**Logistic Regression**	**K-NN**	**Naive BayesN**
MinMax	0.714286	0.785714	0.798701	0.772727	0.798701	0.772727
StandardScaling	0.681818	0.792208	0.805195	0.779221	0.805195	0.772727
MaxAbsScaling	0.681818	0.798701	0.792208	0.772727	0.798701	0.772727
RobustScaling	0.662338	0.785714	0.779221	0.779221	0.746753	0.772727
Normalization	0.642857	0.694805	0.616883	0.623377	0.701299	0.597403
Proposed Cascade Method	100	100	0.9935	100	0.974	100

Table I: Comparative analysis of Accuracy parameter on PIMA dataset

On KNN and SVM, the min max scaling, standard scaling, and maximum absolute scaling methods provided the best accuracy. Random forest technique accuracy is highest with robust scaling, while KNN accuracy is best with normalization scaling.On all of the data mining

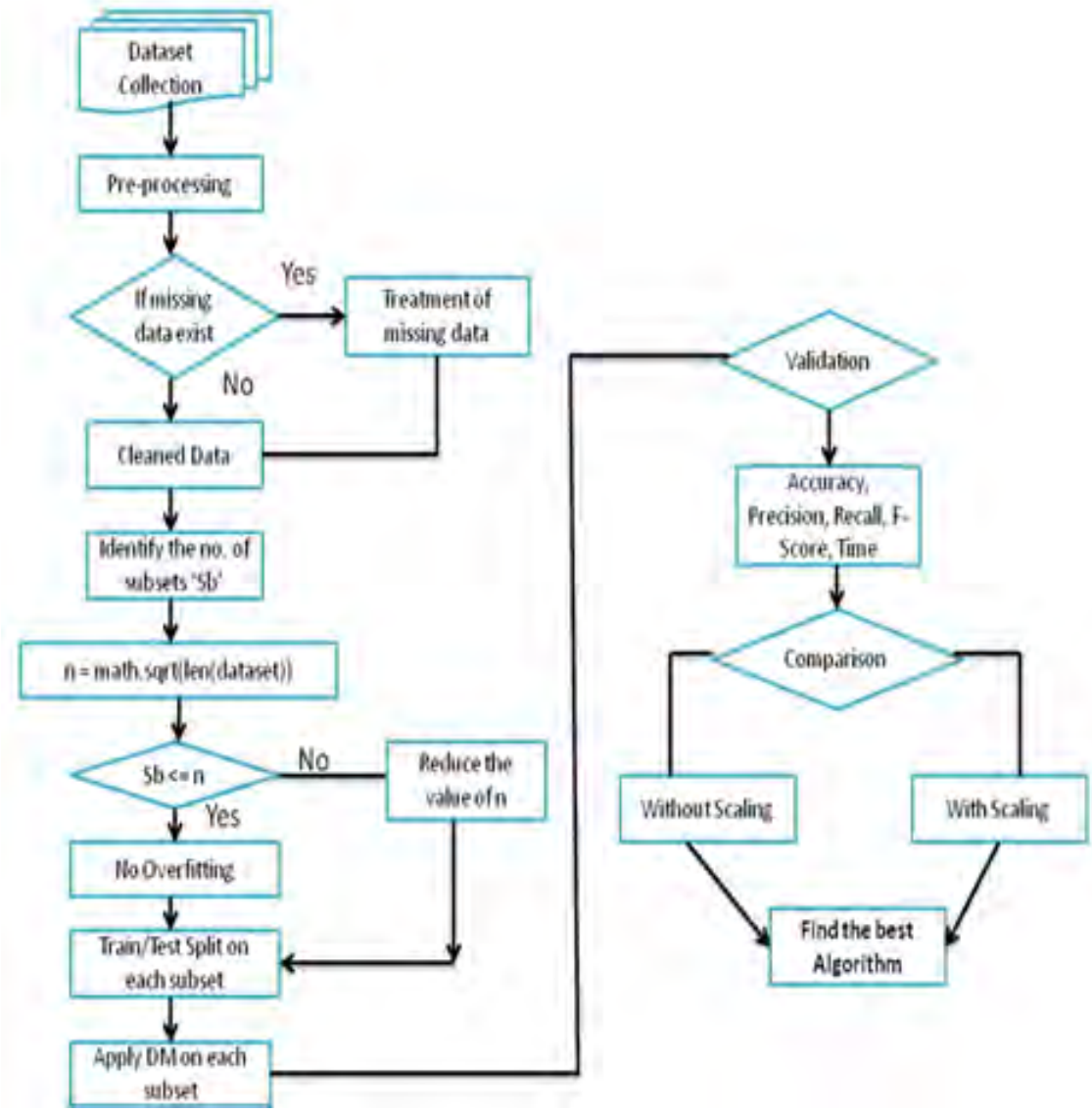


Figure 2. Flowchart of Proposed Cascade Approach

approaches presented, the proposed cascade method produced the best results. The proposed cascade technique was found to have 100 percentage accuracy on decision trees, random forests, logistic regression, and Navie Bayes, which is significantly higher than existing scaling methods. The proposed method for KNN and SVM gave accuracy of 97.4 percentage and 99.3 percentage, respectively, which is greater than existing scaling methods.

For the Heart disease dataset, Table 2 illustrates the performance evaluation of existing and suggested scaling approaches using decision trees, SVM, logistic regression, random forest, KNN, and Naive Bayes. On random forest and Naive Bayes approaches, the min max scaling, standard scaling, and maximum absolute scaling methods provided the best accuracy. KNN technique accuracy is highest with robust scaling, while Baive Bayes accuracy is best with normalization scaling.On all of the data mining approaches presented, the proposed cascade method produced the best results. The proposed cascade technique was found to have 100 percentage accuracy on

Scaling Algorithm	Decision Tree	Random Forest	SVM	Logistic Regression	K-NN	Naive BayesN
MinMax	0.704918	0.770492	0.721311	0.754098	0.754098	0.770492
StandardScaling	0.704918	0.770492	0.754098	0.737705	0.754098	0.770492
MaxAbsScaling	0.721311	0.770492	0.721311	0.754098	0.737705	0.770492
RobustScaling	0.672131	0.770492	0.786885	0.754098	0.803279	0.770492
Normalization	0.672131	0.721311	0.57377	0.606557	0.655738	0.786885
Proposed Cascade Method	100	100	100	100	0.8852	100

Table II: Comparative analysis of Accuracy parameter on on Heart Disease dataset

decision trees, random forests, logistic regression, Navie Bayes and SVM which is significantly higher than existing scaling methods. The proposed approach for KNN yielded an accuracy of 88.52 percentage , which is higher than existing scaling methods, although there is still scope for further improvement. Further, on both datasets, the proposed cascade scaling method was compared to previous published work. On the Heart illness dataset, Table 3 compares the proposed technique to Ahsan et al. 2021 (Das et al., 2021). Ahsan et al. employed known scaling methods and obtained good results, however the suggested method gave 100 percentage correct results on decision tree, random forest, Adaboost, SVM, and Navie Bayes with the exception of KNN, which offered 88.52 percentage accuracy. On existing work, the proposed technique worked amazingly.

Authors	Decision Tree	Random Forest	AdaBoost	SVM	Logistic Regression	K-NN	Naive Bayes
Ahsan et al. 2021 [14]	98	98	93	92	84	87	83
Proposed Cascade Method	100	100	100	100	100	88.52	100

Table III: Comparison of Accuracy parameter for proposed method with recent published using Heart Disease dataset

For both datasets, Table 4 shows a comparison of the proposed cascade scaling approach with Liliya A. 2021 (Demidova, 2021) on SVM and KNN. Liliya A. fared better on SVM than KNN for the heart disease dataset, however both SVM and KNN performed identically on the PIMA dataset. When compared to KNN, the suggested approach outperformed SVM on both datasets. On published work, the cascade technique performed much better.

Authors	Heart Disease Dataset (SVM)	Heart Disease Dataset (K-NN)	PIMA Dataset (SVM)	PIMA Dataset (K-NN)
Liliya A. 2021 [15]	96	86.7	86.4	87
Proposed Cascade Method	100	88.52	99.35	97.4

Table IV: Comparison of Accuracy parameter for proposed method with recent published using Heart Disease dataset

5. CONCLUSION

In this paper, cascade scaling method is proposed for different data mining methods. Existing scaling methods are also discussed and experimented for making performance comparisons with proposed method. Heart disease and PIMA Indian diabetes dataset are used for experimentation and accuracy is used as evaluation measure. The proposed cascade technique was found to have 100 percentage accuracy for heart disease dataset on decision trees, random forests, logistic regression, and Navie Bayes, which is significantly higher than existing scaling methods.

The proposed method for KNN and SVM gave accuracy of 97.4 percentage and 99.3 percentage, respectively, which is greater than existing scaling methods. On PIMA dataset, the proposed cascade technique was found to have 100 percentage accuracy on decision trees, random forests, logistic regression, Navie Bayes and SVM which is significantly higher than existing scaling methods. The proposed approach for KNN yielded an accuracy of 88.52 percentage, which is higher than existing scaling methods, although there is still scope for further improvement.The suggested cascade scaling method was also compared to previous published work on both datasets, where the cascade technique performed exceptionally well. Thus this research study can help the medical domain to prepare them for proper line of treatment in a scalable perception.

References

Bondi, A. B. 2000. Characteristics of scalability and their impact on performance. In *Proceedings of the 2nd international workshop on Software and performance*. 195–203.

Brain, D. and Webb, G. I. 2002. The need for low bias algorithms in classification learning from large data sets. In *European Conference on Principles of Data Mining and Knowledge Discovery*. Springer, 62–73.

Chang, V., Bailey, J., Xu, Q. A., and Sun, Z. 2022. Pima indians diabetes mellitus classification based on machine learning (ml) algorithms. *Neural Computing and Applications*, 1–17.

Das, D., Goje, N., Uparkar, S., Upadhye, S., and Upasani, M. 2021. Performance analysis of support vector machine algorithms. *International Journal of Next-Generation Computing 12,* 5.

Demidova, L. A. 2021. Two-stage hybrid data classifiers based on svm and knn algorithms. *Symmetry 13,* 4, 615.

Glorot, X., Bordes, A., and Bengio, Y. 2011. Domain adaptation for large-scale sentiment classification: A deep learning approach. In *ICML*.

Lane, H. 2000. Technology regression and verification acceptance method. US Patent No: 6,269,457.

Mc Manus, A. and Kechadi, M.-T. 2004. Scalability issue in mining large data sets. *WIT Transactions on Information and Communication Technologies 33*.

Ramesh, T., Lilhore, U. K., Poongodi, M., Simaiya, S., Kaur, A., and Hamdi, M. 2022. Predictive analysis of heart diseases with machine learning approaches. *Malaysian Journal of Computer Science*, 132–148.

Shah, D. and Patel, S. 2020. Santosh, and k. bharti,". *Heart Disease Prediction using Machine Learning Techniques 1*, 345.

Srinivas, K., Rani, B. K., and Govrdhan, A. 2010. Applications of data mining techniques in healthcare and prediction of heart attacks. *International Journal on Computer Science and Engineering (IJCSE) 2,* 02, 250–255.

Totad, S. G., Geeta, R., Prasanna, C. R., Santhosh, N. K., and Reddy, P. 2010. Scaling data mining algorithms to large and distributed datasets. *Intl J Database Manag Syst 2,* 2, 26–35.

Tu, M. C., Shin, D., and Shin, D. 2009. Effective diagnosis of heart disease through bagging approach. In *2009 2nd international conference on biomedical engineering and informatics*. IEEE, 1–4.

Uparkar, S. S. and Lanjewar, U. A. 2022. Analysis of a cascade scaling algorithm using data mining methods. In *2022 IEEE World Conference on Applied Intelligence and Computing (AIC)*. IEEE, 708–713.

Prof. Satyajit S. Uparkar is a certified data scientist from International School of Engineering, Hyderabad. He is working as Assistant Professor in Department of Computer Application at Shri Ramdeobaba College of Engineering and Management, Nagpur, since last 12 years. He has bagged FIVE best paper awards in international conferences. His research contribution includes 30 research papers in various National and International Journals, one Australian Patent, in addition of two book chapters and a book on Python Programming. He is a data science consultant and has provided consultancy to the local companies of the region.
E-mail: uparkarss@rknec.edu

Dr. Sunita N. Dhote Assistant Professor in the Department of Management Technology, Shri Ramdeobaba College of Engineering and Management, Nagpur, Maharashtra, India. She is Chairperson of Women Empowerment Cell of the college. Her research interests include Entrepreneurship, Finance and Women Empowerment. He published more than 5 research articles in international journals, and Conferences. She has written a book on Marketing Management. She is a Asia Book of Record Holder for Longest Distance Cycling. She holds a Guiness Book of Records in "The most people in a single mountain runat Satara Hill Half Marathon at Satara, Maharashtra, India, on 17 September.
E-mail: dhotesn@rknec.edu

Prof. Shabana S. Pathan is Assistant Professor in Information Technology Department at St. Vincent Palotti College of Engineering Technology, Nagpur. she has more than 15 Yrs of teaching experience. her research contribution includes more than 12 research paper published in National and International Journals.
E-mail: spathan@stvincentngp.edu.in

Dr. P.D. Shobhane is Assistant Professor in Mathematics Department at Symbiosis Institute of Technology, Symbiosis International Deemed University, Nagpur. He has more than 30 Yrs of teaching experience. His research contribution includes more than 8 research paper published in National and International Journals. He is authors of 4 books in Mathematics.
E-mail: pds267@gmail.com

Dr. Debasis Das is a Professor at the Computer Science Department, Webster University, Tashkent, Uzbekistan. He has more than fourteen years of experience in teaching and conducting research. Dr. Das has published a large number of research articles in reputed national / international web of SCI, ESCI, Scopus Indexed; UGC listed peer reviewed journals and also presented a large number of research articles in national and international conferences. His area of interest includes number system, cryptography, data compression, mobile technology, big data, IoT etc. He has written eight National and two international books as a Text Book and related to his research work. He has been invited as an Advisory Member/ Guest Speaker/ Chief Guest/ Resource Person/ Judge in various academic events. He worked as reviewer of CRC Press, Taylor and Francis Publication. He is an active member of Board of Computer Application, RTM Nagpur University and IETE, IAENG, IRED, Eurasia Research, ICSES and many more.
E-mail: debasisdas@webster.edu

Identification of Source Camera by Amalgamation of PRNU and Noise Print Using Dimensionality Expansive Residual Network

Somesh Telang, Khushalsingh Dilipsingh Bharadwaj, Shubham Anjankar and Richa R. Khandelwal
Department of Electronics Engineering, Shri Ramdeobaba College of Engineering and Management, Nagpur, India

It might be challenging in the field of image forensics to identify the source camera of a picture. This research proposes a noise adaptable convolutional neural network-based technique for camera identification. For camera identification, the suggested solution combines Photo Response Non-Uniformity (PRNU) noise and Noiseprint. Three parallel dimensionality expanded residual networks with convolutional layers of kernel size 1x1 were put together for enhanced feature extraction. The experiment mentioned above uses pictures from the "Vision Dataset" as its subject matter. The experimental findings demonstrate the effectiveness of the suggested methodology in identifying the source camera at the brand, model, and device levels. When two of the three networks were fed with PRNU and one with noiseprint, the best performance was obtained.

Keywords: PRNU, Noiseprint, Convolutional Neural Networks, Vision Dataset, Source Camera Identification, Dimensionality Expansive Residual Networks.

1. INTRODUCTION

Digital photos are frequently employed in current high-tech era thanks to the availability of numerous digital camera models. Every day, businesses create better and more sophisticated digital cameras that are also reasonably priced for customers to purchase. Due to the ease with which photos can now be altered, falsified, and used for illegal activities, law enforcement agencies' investigations may be negatively impacted by these fraudulent images. Therefore, identifying the source camera can aid in pinpointing the origin of an image and point an investigation in the right path. There are numerous methods for determining the source camera, one of them is to use the Exchange image file format (EXIF) Kee et al. [2011] Cameras collect metadata that includes details about the camera model, the author, the date and time, and the type of file. However, the header data and encoded information can be easily changed by software or a user. Another similar signal that is put into the image is the digital watermark Wolthusen [2001]. Although it is a fantastic tool to recognise source cameras, the majority of cameras lack a watermark. Images that have been altered, resized, or compressed when being converted from one file format to another lose their watermark and become unreadable. This method is weak because of these flaws. Bayram Bayram et al. [2005] classified and found the evidence of interpolation operation using two ways. The employment of an expectation-maximization algorithm, which analyses the correlation between each pixel's value and its neighbour, has been backed by the first method. The second strategy is based on the examination of pixel-to-pixel variations. The employment of partial second-order derivative correlation Hong Cao and Kot [2009] models and eigen algorithms Milani et al. [2014] for evaluating images with different Color Filter Array (CFA) interpolation allows for the detection of both intrachannel and cross-channel demosaicing correlation. The author previously proposed a different method for source camera identification using sensor pattern noise in Luka et al. [2006]. Another approach was suggested by the author in Chan et al. [2013] and is based on a confidence map and weighted correlation with pixel reliability. The author in Gisolf et al. [2013] suggested a straightforward noise removal approach based on the variation for speedier noise extraction without sacrificing accuracy. In Akshatha et al. [2016], the SFS feature

extraction approach was used to obtain higher-order wavelet statistics. A multiclass SVM classifier was used to extract higher-order statistics from the image after it had been denoised and then decomposed using the Haar wavelet technique. This technique was also a modified version of the sensor pattern noise approach for camera identification using Photo Response Non-Uniformity (PRNU) noise. Another method was put out by the author in Wang et al. [2009] and relied on a combination of 135-dimensional wavelet coefficient co-occurrence features and 216-dimensional higher-order wavelets. The main goal of this study is to combine PRNU noise and noiseprint as fundamental features for reliable camera classification over a wide range of camera models, hence maximising the effectiveness of convolutional neural networks (CNN). In order to improve categorization, the suggested network—which takes both PRNU and noiseprint as inputs—is then further processed as features. The remaining sections of the paper are divided into the following groups: section 2, which describes related work; section 3, which discusses the proposed methodology; section 4, which describes the experimental setup; section 5, which presents the analysis of the results; and section 6, which includes a conclusion and suggestions for further research.

2. RELATED WORK

Convolutional neural networks (CNN) are regarded as one of the promising methods and are clearly superior to conventional methods. Convolutional layers for automatic and simultaneous feature extraction were utilised in the projected technique Tuama et al. [2016] for source camera identification, followed by pooling and fully connected layers of neural network with softmax activation. The author suggested using the unique artefact known as PRNU in Seshadri et al. [2019]. In order to extract the remaining characteristics after denoising the image, they used a CNN architecture that has weights and has been pretrained. Transfer Learning is the term used to describe this approach of leveraging pretrained CNN architectures. In Yang et al. [2019], the pre-processing layer is employed as a content-adaptive filter that can automatically learn convolutional kernels based on the input data. Three CA-CNNs are utilised, each with a different number of convolutional layers to obtain more thorough information. Three convolutional kernel sizes—3x3, 5x5, and 7x7—are utilised to preprocess the input image. Convolutional layers with ReLu activation, the batch normalisation stage, and the average pooling procedure are the fundamental building blocks of convolutional layers. The softmax activation layer is then fed the output of the last basic unit. In Cozzolino and Verdoliva [2020], the noiseprint feature as a camera identification method is proposed. The author created a method for reliable and effective device recognition in Cozzolino et al. [2020] that makes use of features, PRNU, and noise print. SVM was used to extract and train the normalised cross-correlation (NCC) of PRNU and the mean square error (MSE) for classification. Even while the method's performance when utilising simply PRNU was previously rather strong, in the worst-case scenario PRNU is unreliable, and the combination exhibits significant increases in accuracy.

3. PROPOSED METHODOLOGY

In order to increase inter-class differences, a pre-processing layer is introduced before CNN architecture, as is customary. These typically include specialised filters, like the Laplacian filter or high-pass filter, to better collect feature maps for classification. In our suggested approach The three-dimensional filtering technique, which comprises of grouping, collaborative filtering, and aggregation, is used in conjunction with block matching. The BM3D denoising filter shown in fig. 1 receives all of the images from the dataset. The method suggested[6] is used to extract PRNU (Photo Response Non-uniformity) noise, which involves subtracting the denoised image from the original input image as given in equation (1). The methods suggested by Makinen et al. [2019] is then used to extract noiseprint from the photos in addition to PRNU noise. An extended residual network with high dimensions is then fed with the retrieved feature maps from noiseprint and PRNU noise. Following a layer of the softmax activation function, the dimension-

ality expanded residual network is further connected to some layers of fully connected networks, as shown in Figure 1. The softmax function, which serves as the activation function in the output layer of neural network models, predicts a multimodal probability distribution. As a result, it is employed in multi-class categorization issues.

3.1 Block Matching and 3D Filtering (BM3D)

According to the investigation [17], the BM3D method outperformed other denoising techniques like NL-means, the discrete cosine transform, and Bayesian least-squares-Gaussian scale mixing in terms of outcomes and PSNR values. Instead of denoising based on a single pixel, [17], [18] adopt the concept of denoising method based on patches. This idea was modified from the non-local means algorithm in [19]. Hard thresholding, the initial stage of BM3D, is used to remove noise from the images. The input image is separated into a number of blocks or patches, and each patch is given its own reference patch in the form of a window. A 2D transformation filter is utilised, and the coefficients are strongly thresholded, because the noisy images reduce the algorithm's performance. Between the reference block and additional blocks, the Euclidian distance (d) is further determined.

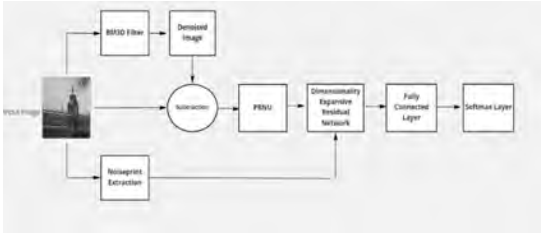


Figure 1. Block diagram of proposed methodology

3.2 Noiseprint

The forensic community is well aware of this feature's ability to deliver the best age performance. The requirement for a sizable dataset to achieve superior estimates, the weak signal of interest, and plunges in the PRNU as a result of poor filtering are the main drawbacks of PRNU. This serves as the justification for including noiseprint in our methodology. In order to ensure that all camera-related artefacts are present in the image and that semantic material is excluded, noiseprint ensures that the entire digital history of the image is preserved. The author of Cozzolino and Verdoliva [2020] offers a technique for extracting the noise print, which is a fingerprint of the camera model. The technique significantly reduces the spatial content while enhancing camera model-related errors. This method employs a Siamese network, which is trained using image patches in the form of pairs captured by the same or different cameras. Additionally, as seen in Cozzolino et al. [2020], the results point to a significant increase in model accuracies following the integration of PRNU and noiseprint.

3.3 Dimensionality Expansive Residual Network

As seen in Figure 2, the Dimensionality expanding residual network is made up of three simultaneous convolutional neural networks. The input image was initially scaled before being simultaneously converted into PRNU noise and noiseprint and sent into the noise-based residual network for model training. Dimensionality expansive residual network contains five blocks as basic units. The number of feature maps in five basic units was 8, 16, 32, 64 and 128 respectively. The naming convention of these five blocks in each convolutional network can be observed in fig 2. The output of the last three blocks conv_a128, conv_b128 and conv_c128 is first concatenated

and then fed to the softmax activation layer for classification.

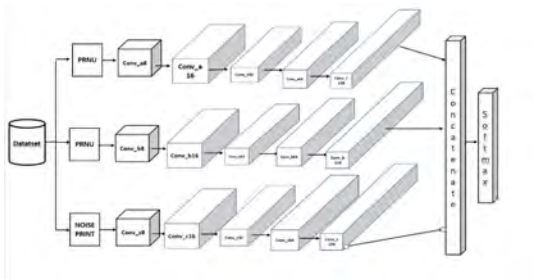


Figure 2. Architecture of dimensionality expansive residual network

4. EXPERIMENTAL SETUP

A series of experiments were run on the "VISION Dataset" to verify our suggested methodology. 35 mobile devices from a range of high to low costs make up the VISION dataset [20]. The collection consists of a total of 34,427 photos that were shared on Facebook and WhatsApp. 14 distinct camera models from the ones listed in Table 1 were selected for this validation experiment. Three of them were picked to represent devices, four were chosen to represent brands, and eight were chosen to represent camera models. Here, each image was downsized to 128 × 128 pixels and afterwards enhanced with 6 patches, each measuring 64 x 64 pixels. First, the complete dataset was split into training and testing portions with a ratio of 90:10.

Table. 1(a) Camera models and their specifications (b) Results of camera model classification.

Label	Camera Model	Resolution	Image format
C1	D19_Apple_ iPhone 6 Plus	3264 × 2448	JPG
C2	D04_LG_D290	3264 × 2448	JPG
C3	D07_Lenovo_P70A	4784 × 2704	JPG
C4	D25_OnePlus_A3000	4640 × 3480	JPG
C5	D27_Samsung_GalaxyS5	5312 × 2988	JPG
C6	D21_Wiko_Ridge4G	3264 × 2448	JPG
C7	D24_Xiaomi_RedmiNote3	4608 × 2592	JPG
C8	D03_Huawei_P9	3968 × 2976	JPG
C9	D01_Samsung_GalaxyS3Mini	2560 × 1920	JPG
C10	D08_Samsung_GalaxyTab3	2048 × 1536	JPG
C11	D31_Samsung_GalaxyS4Mini	3264 × 1836	JPG
C12	D05_Apple_Iphone5c_1	3264 × 2448	JPG
C13	D14_Apple_Iphone5c_2	3264 × 2448	JPG
C14	D18_ Apple_Iphone5c_3	3264 × 2448	JPG

	4 Camera Model	6 Camera Model	8 Camera Model
Exp 1.1	97.33	94.56	86.32
Exp 1.2	97	95.08	89.58
Exp 1.3	94.58	89.5	84.54
Exp 1.4	65.33	52.71	29.75

Later while model training the training dataset was again split in the ratio of 90:10 for training and validation dataset. The entire experiment is based on two features that are PRNU noise and Noise print. The set of experiments based on these two features were conducted as follows: Exp 1.1 Only PRNU noise was fed into three parallel convolutional networks, Exp 1.2 Among three networks, two of them were fed with PRNU noise and one was fed with Noise print, Exp 1.3 Among three networks, two of them were fed with Noise print and one was fed with PRNU noise, Exp 1.4 Only Noise print was fed into three convolutional networks. All the above stated experiments were performed for 8 camera model classification. For all the experiments

the learning rate was initialized for LR= 0.01 and then exponential learning rate decay was used with drop Rate = 0.1 and drop after every100 epochs for the learning rate schedule. The model was trained for 500 epochs i.e., max iterations.

4.1 Camera Brand Classification

A categorization style when the chosen camera equipment are distinctive is known as a camera brand classification. Eight cameras—grouped as 4, 6, and 8 cameras at once—were subjected to this brand recognition test. Eight camera devices, numbered C1 to C8, were chosen for the camera brand classification as shown in Table 1. The aforementioned tests 1.1, 1.2, 1.3, and 1.4 were run on the first 4 camera devices before being extended successively by 2 to include the 6 and 8 camera devices. Table 2's results indicate that the only outcomes that were deemed satisfactory came from experiments 1.1 and 1.2. However, experiment 1.2 was far more effective and trustworthy for classifying 8 camera devices, with a detection accuracy of 89.58 %. As seen, including Noise print as a feature is helping (Exp. 1.2) 8 camera classifications a little bit more than just PRNU noise (Exp. 1.1).

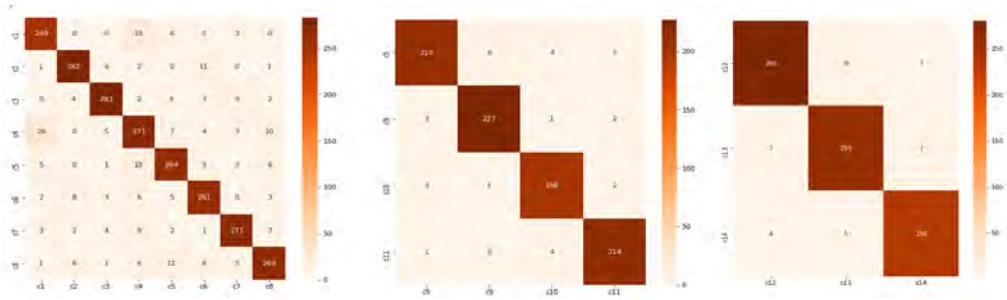


Figure. 3 (a) Confusion matrix for 8 camera brand classification (b) Confusion matrix for camera model classification (c) Confusion matrix for camera device classification

4.2 Camera Model Classification

These days, it is usual for a brand to offer several different camera model versions for sale in the market, making it challenging to distinguish between source cameras and camera models from the same brand. Four camera models from the same brand are chosen in the case of camera model identification. They are the D27 GalaxyS5, D01 GalaxyS3Mini, D08 GalaxyTab3, and D31 GalaxyS4Mini. On the basis of earlier findings, only experiment 1.2 is carried out. It can be shown that the suggested approach performs admirably for classifying camera models, with a detection accuracy of 96.6 %. The confusion matrix for categorizing camera model is shown in Fig. 3b.

4.3 Camera Device Classification

Camera device classification, or classifying photos taken with the same camera device models, is an extremely laborious operation in the source camera identification sector. The D05 Apple iPhone 5c, D14 Apple iPhone 5c, and D18 Apple iPhone 5c were chosen as the test devices to assess the performance of the proposed algorithm for camera device classification. On experiment 1.2, this classification was once more carried out. The proposed model's detection accuracy is 95.68 % despite the fact that it is a laborious operation. The classification of camera devices using our suggested method is shown to be successful. The confusion matrix for categorizing camera devices is shown in Fig. 3c.

5. RESULTS AND ANALYSIS

5.1 True Positive Rate (TPR)

The confusion matrices for several trials are displayed beside each classification method in order to assess the performance of this model. It is evident from the confusion matrix presented for a different kind of classification algorithm that the TPR obtained for various confusion matrices is high and occasionally crosses 97 %. The ratio of true positive anticipated to the actual positives, or TPR, is often referred to as recall (2). The TPR should be high for a perfect algorithm or methodology, as seen in Tables 3 (a) to (c).

$$TPRRate = TP/(TP + FN) \tag{1}$$

Table 3 (a)TPR table for 8 camera confusion matrix (b) TPR table for camera brand classification (c) TPR table for camera device classification

Camera Model	TPR
C1	90.2
C2	93.6
C3	92.1
C4	83.1
C5	88.5
C6	90.5
C7	90.6
C8	88.1

Camera Model	TPR
C9	94.1
C5	97.4
C10	97.0
C11	97.7

Camera Model	TPR
C12	95.8
C13	94.8
C14	96.3

5.2 Area Under the Curve (AUC) - Receiver Operating Characteristics (ROC) Curve

In machine learning to validate the performance of the model, AUC-ROC is used as a metric. AUC represents the degree or measure of separability. It evaluates the model's capability to distinguish between the classes. It Higher value of AUC shows the better prediction of the model at correct labels. As observed from the AUC curve of different types of classification methods, this concludes that AUC for Exp 1.2 i.e. using two PRNU and One noise print in Dimensionality expansive residual network is highest and therefore more reliable. Fig. 6a depicts AUC for camera brand classification as 0.9963, AUC for camera model classification as 0.9892 is depicted in fig. 4b and AUC for camera device classification as 0.9955 is depicted in fig. 4c.

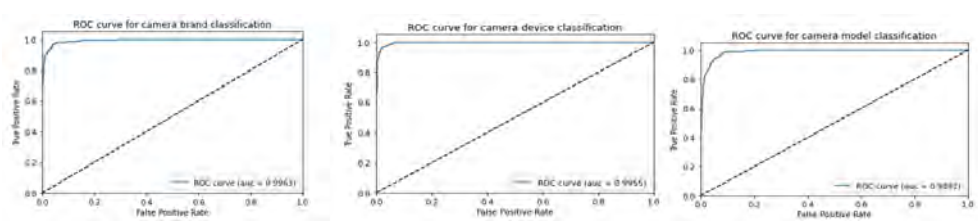


Figure. 4a ROC curve for camera brand classification, Fig.4b ROC curve for camera model classification Fig. 4c ROC curve for camera device classification

5.3 Comparison With Other Methods

Although, in the field of digital forensics and deep learning every methodologies and research has its contribution towards the forensics community. Still, the comparison of the proposed methodology with similar existing methodologies is presented even though their dataset was "Dresden dataset" and ours is "Vision dataset". As observed from fig. 5 (a), the proposed methodology achieved similar performance as compared with the model in Seshadri et al. [2019]

. Also in fig. 5(b) and fig. 5(c), our model has an edge over Yang et al. [2019] camera device classification and camera model classification performance, which is considered a difficult task in the field of image forensics.

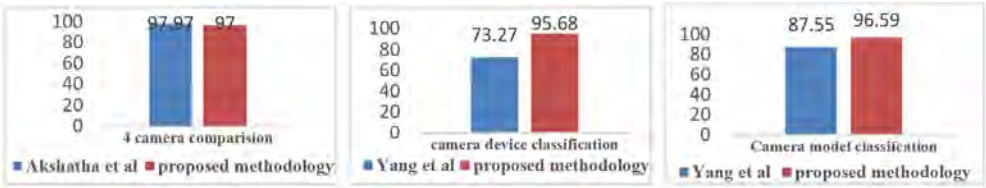


Figure. 5(a) Result comparison with Akshatha [12] (b) Result comparison with Yang [13] for camera device classification (c)Result comparison with Yang [13] for camera model classification

6. CONCLUSION

This research proposes the use of PRNU and noiseprint as features in dimensionality expanding residual networks for source camera identification. PRNU noise extraction from photos was pre-processed using Block Matching and 3D filtering. Additionally, for improved feature extraction and minimal data loss during the pre-processing stage, a filter size of 1x1 is utilised. Three convolutional neural networks with 1x1 filters are arranged in parallel and fed into fully connected layers using SoftMax activation in the proposed approach. The suggested method is capable of categorising camera brand, camera model, and camera equipment with sufficient detection accuracies, according to the results of our experiments for model validation. The findings clearly show that adding noiseprint as a feature helped with PRNU noise for a lot of camera identification. As a transfer learning model for numerous cameras in the source camera identification domain, this model can also be trained using a big dataset for future usage.

References

Akshatha, K. R., Anitha, H., Karunakar, A. K., Raghavendra, U., and Shetty, D. 2016. Source camera identification using noise residual. *2016 IEEE International Conference on Recent Trends in Electronics, Information Communication Technology (RTEICT)*.

Bayram, S., Sencar, H., Memon, N., and Avcibas, I. 2005. Source camera identification based on CFA interpolation. *IEEE International Conference on Image Processing 2005*.

Chan, L.-H., Law, N.-F., and Siu, W.-C. 2013. A confidence map and pixel-based weighted correlation for PRNU-based camera identification. *Digital Investigation 10,* 3 (10), 215–225.

Cozzolino, D., Marra, F., Gragnaniello, D., Poggi, G., and Verdoliva, L. 2020. Combining PRNU and noiseprint for robust and efficient device source identification. *EURASIP Journal on Information Security 2020,* 1 (feb 12).

Cozzolino, D. and Verdoliva, L. 2020. Noiseprint: A CNN-Based Camera Model Fingerprint. *IEEE Transactions on Information Forensics and Security 15*, 144–159.

Gisolf, F., Malgoezar, A., Baar, T., and Geradts, Z. 2013. Improving source camera identification using a simplified total variation based noise removal algorithm. *Digital Investigation 10,* 3 (10), 207–214.

Hong Cao and Kot, A. 2009. Accurate Detection of Demosaicing Regularity for Digital Image Forensics. *IEEE Transactions on Information Forensics and Security 4,* 4 (12), 899–910.

Kee, E., Johnson, M. K., and Farid, H. 2011. Digital Image Authentication From JPEG Headers. *IEEE Transactions on Information Forensics and Security 6,* 3 (9), 1066–1075.

Luka, J., Fridrich, J., and Goljan, M. 2006. Digital Camera Identification From Sensor Pattern Noise. *IEEE Transactions on Information Forensics and Security 1,* 2 (6), 205–214.

Makinen, Y., Azzari, L., and Foi, A. 2019. Exact Transform-Domain Noise Variance for Collaborative Filtering of Stationary Correlated Noise. *2019 IEEE International Conference on Image Processing (ICIP)*.

Milani, S., Bestagini, P., Tagliasacchi, M., and Tubaro, S. 2014. Demosaicing strategy identification via eigenalgorithms. *2014 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*.

Seshadri, S., Akshatha, K. R., Karunakar, A. K., and Paul, K. H. 2019. A Preliminary Approach to Using PRNU Based Transfer Learning for Camera Identification. *Advances in Intelligent Systems and Computing*, 246–255.

Tuama, A., Comby, F., and Chaumont, M. 2016. Camera model identification with the use of deep convolutional neural networks. *2016 IEEE International Workshop on Information Forensics and Security (WIFS)*.

Wang, B., Guo, Y., Kong, X., and Meng, F. 2009. Source Camera Identification Forensics Based on Wavelet Features. *2009 Fifth International Conference on Intelligent Information Hiding and Multimedia Signal Processing*.

Wolthusen, S. D. 2001. On the limitations of digital watermarks : A cautionary note.

Yang, P., Ni, R., Zhao, Y., and Zhao, W. 2019. Source camera identification based on content-adaptive fusion residual networks. *Pattern Recognition Letters 119*, 195–204.

Somesh Hemant Telang is an IT industry professional . His work focuses specifically on image forensics and image processing. He has done B.E in Electronics Engineering from Shree Ramdeobaba College of Engineering and Management, Nagpur (India).
E-mail: somesh.telang213@gmail.com

Khushalsingh Dilipsingh Bharadwaj is is an IT industry professional. His work focuses on Deep learning and Machine learning Domain. He has done B.E. in Electronics Engineering from Shree Ramdeobaba College of Engineering and Management, Nagpur (India)
E-mail: khushal.bharadwaj123@gmail.com

Shubham Anjankar is Assistant Professor in Shree Ramdeobaba College of Engineering and Management, Nagpur (India). He has done his M.E. in VLSI and Embedded System from Department of Electronics and Communication Engineering, MIT College of Engineering, Pune. He has more than 7 years of teaching Experience. He has worked on many research projects. He has over 10 published research papers in international journals/conferences.
E-mail: anjankarsc@rknec.edu

Dr. (Mrs.) Richa R. Khandelwal graduated from Madhav Institute of Technology and Science, Gwalior and completed her post graduation in Electronics Engineering from Yeshwantrao Chavan College of Engineering, Nagpur. She was awarded Ph.D. from Barkatullah University Bhopal. Her employment experience includes 21 years of teaching. She is having to her credit many International and National Conference/Journal papers. Her research and publication interest include Image Processing and Machine Learning.
E-mail: khandelwalrr@rknec.edu

Improving Health WSN with Distinguished Cloud Computing for Multi-Sensor Analytics

Mirza Moiz Baig and Dr. Srikant V.Sonekar
J D College of Engineering and Management, Nagpur, India

In the twenty-first century, automation has become more prevalent in large part due to the Internet of Things (IoT). The integration of IoT, Wireless Sensor Networks (WSNs) and health monitoring system with multi-cloud environment can optimize a lot of parameters like bandwidth, communication protocols and redundancy of the sensor network. The proposed architecture is introduced keeping in mind the current health infrastructure and monitoring system with different types of network framework. We have also discussed about machine to machine protocols for health monitoring with common entities linked with building communication protocols. The sensors data analytics carried out can sustain multi-level computation is the idea behind this research prospect to give greater depth about direct applicability in multi cloud sensor communication protocols. The offered prototype, when modelled with the unique communication system, produces a more efficient model than the standard way, with a system that is 98 percent more accurate.

Keywords: Multi-cloud, WSNs, Machine to Machine, Framework, Protocols, Standardization.

1. INTRODUCTION

Cloud computing is a full package that provides convenience to consumers, but it also has drawbacks. High-speed processing and computation of large data, which is produced and handled effectively in different applications, is one of the benefits of IoT (Sun and Hu, 2019). Smart care systems are especially important in today's fast-paced world. When fog computing and the Internet of Things (IoT) are integrated in technology than it is critical to medical sector applications, the effectiveness of operations in such healthcare systems may be improved (Oueida and Baker, 2018). The new systems are much superior than earlier or conventional systems because they combine more dependable and efficient equipment with data transmission technologies that are secure. By using fog computing and IoT, healthcare expenses are decreased (Chakraborty and Agrawal, 2016). The primary benefit of utilizing IoT in medical health care is that it reduces obstacles to monitoring vital health indicators and saves money (Chiuchisan and Geman, 2014). Wearables are mostly used in the healthcare industry since they are the most convenient and comfortable method to collect data, monitor health, and interact with general practitioners on a regular basis.The functions and processes of the gadgets and instruments that enable IoT change the face of medicine. Armbands or ECG (Eide, 2016)trackers. Cloud computing is a full package that provides convenience to consumers, but it also has drawbacks One of the advantages of IoT is high-speed processing and computation of huge data that is generated and managed efficiently in many applications (Rodrigues, 2018). Smart care systems are especially important in today's fast-paced world. The effectiveness of operations in such healthcare systems may be enhanced when fog computing and IoT are implemented in equipment important to medical sector applications (Sreenivasan M, 2021). The new systems are much superior than earlier or conventional systems because they combine more dependable and efficient equipment with data transmission technologies that are secure. By using fog computing and IoT, healthcare expenses are decreased (Ewan, 2018). The primary benefit of utilizing IoT in medical health care is that it reduces obstacles to monitoring vital health indicators and saves money (Roehrs, 2019). The functionalities and procedures of the devices and tools that make up the Internet of Things impact how medicine is practiced. Such gadgets, which rely on an IoT platform, are behind things like armbands or ECG (Sethi and Sarangi, 2017) trackers.

2. DISTRIBUTED COMPUTATIONAL FRAMEWORK

Numerous electronic machine, like smart wristwatches, Headphones and tablets are commonly used to track daily exercise performance, gathering information on activity and performance for both athletes and the general public (Ermes, 2008).(Hong, 2010).The key awareness is to involve selected sensors or wearables in application processing before sending high-level data to the devices of the medical professionals for further data analysis. Figure 1 depicts the basic layout of the suggested computing elements taken into consideration by the framework. The requirement for inclusion in this BAN, in contrast to earlier approaches (Ghamari, 2016), is that the device be worn by the user, not its computational capability. The electronic machines are often wirelessly associated to any network. The requirement for connection everywhere and improved network performance has driven the creation of WLAN standards. Table 1 lists several traits of the standard's most recent iterations up to this point (Khorov, 2015),(Baños-Gonzalez, 2016).

Figure 1:Framework's computational components

Standard Protocols (Release Date)	Occurrence Band	Capacities *	Array *	Target Submissions for the Frequency Band
802.11n (2009)	2.4; 5.4 GHz	600 Kbps	30 m	Standard Circumstances/Examples.
802.11ac (2014)	5.4 GHz	1.3 Mbps	30 m	Extremely Rapid Situations (i.e., Rooms, Stadiums, Markets, Universities, etc.)
801.11ad (2015)	60 GHz	7 Gbps	10 m	Situations with a lot of people or moving very quickly inside (i.e., Offices, Department).
802.11ah (2016)	0.9 GHz	100 Kbps	1000 m	Situations for IoT in and outside.

Table 1:Present WLAN Standards Capabilities

The current transfer rate of any device can be able to be established by just watching the network interface. The entire device's bandwidth is necessary to derive a relative frequency. It is challenging to know the full free bandwidth in a wireless network.

Framework Description : It delivers a mechanism to efficiently design and manage workload allocation for applications. General i/o for each design stages are shown in Table 2. As can be observed, utilizing the recommended framework, designing distributed applications involves three main steps: Task and information flows analysis, resource management, implementation, and empirical adaptations make up the first three steps.

The SD detection in mobile settings is the subject of the example. This approach may be used to various sophisticated healthcare monitoring applications or settings, particularly those that need a lot of data collection and processing.

Design Stages	Inputs	Outputs
(i)Task and Information Flows Analysis	• System Configuration • State-of-the-art methodologies • Application Criteria • Workplace Restrictions	•Software Modules •Sub-Modules Elements •Data-Flow Diagrams
(ii)Resource Management	•Multi-Cloud Computing Industry • Network Design	Configuring the IoT setting with BAN
(iii)Implementation, Empirical Adaptations	•Configuration Settings. •Test	Distributed Architecture in IoT environment

Table 2. Framework Approaches

(i) Task and Information Flows Analysis . The entire activity of the programme may be divided into distinct activities in a variety of ways. This task varies depending on the application area and kind. This phase has two important characteristics.To begin, a suitable software modules must be developed to spread the code for local and remote processing. It is possible to use a static or dynamic methodology. In a static methodology, the candidate application's components that will be handled by resources which are chosen during the design phase. In a dynamic methodology, application code is evaluated as it is being used to control the components that can be managed outside of the machines.The establishment of the sub-modules comes next. The size unit for the application is specified by this feature and can be determined separately. Among the most popular options are modules, processes, classes, components, and methods. Furthermore, the application needs as well as the limitations of the working environment play a significant part in the creation of appropriate data-flow diagrams.In these circumstances, it's crucial to take into account certain factors like increased communication capacity and energy consumption. Consequently, a directed graph is used to describe the target application A={T,F}. T is the set of module tasks necessary for data collection, processing, and perceiving is represented by the vertex set F The edge set T = t1,t2,...,tn .it depicts the information abstracts between the tasks. The tasks and the amount of data transferred are prioritized according to data flows. The amount of information form and to can be done in between tasks I and j is specified by function F (i,j). In order to establish the necessary data decomposition techniques for the SD application example done in this section. As a result, the list of tasks identified matches to the most frequent procedures involved in SD detection as described in current methods. Figure 3a shows a data flow diagram of an application that has been modelled using this approach. This job may be any of the previously stated sizes, or it can be variable-sized and performed in a sequential manner.

(ii) Resource Management

After establishing the computing load, the following step is to determine where each job will be handled.. In this stage of resource planning, the inputs are network architecture and IoT ecosystem. Involved devices are described as follows in accordance with the suggested framework:

—Assume B is the BAN's assortment of "things" or devices. Their duties involve both data detection and transmission to other devices. They might possibly be capable of computation.

—Pretend M is the collection of reachable devices outside the user's BAN. This category includes computers and other portable devices having processing power.

—Assume Assumption E includes Consider E to be a group of exterior sensors. It implies the collection of external device that enables the handler to perceive more data for the software. environmental elements like temperature and humidity, for instance.

That is:

$$D = B \cup M \cup E$$

Thus the data collection and processing begin in the BAN and may be finished in more advanced

devices, spanning from B to M. Despite being potential of data flow back to original devices is not anticipated.

(iii) Implementation and Empirical Adaptations Each job in the distributed system may run on a different device with its own unique set of properties. A number of variables must be considered while determining the best computer on which to perform each job, including processing resources, battery usage, network bandwidth availability and latency, and so on. The proposed IoT system for monitoring patients at home of this research. The system was made to be tiered in order to prepare for the enormous amount of Personal Healthcare Devices (AICLOUDs) required. The system is made up of Infrastructure Nodes-Common Service Entities (IN-CSEs), Middle Nodes-Common Service Entities (MN-CSEs), Application Dedicated Nodes-Application Entities (ADN-AEs), and Infrastructure Nodes-Application Entities (IN-AEs).The oneM2M-based IoT system used in this study was constructed in accordance with those specifications (??,),(??,). Then, two modules (Protocol Converter and MQL Scheduler) are added, as shown in Figure 2. Three modules make comprise a CSE: a Network Manager, a Message Handler, and a Resource Manager.

The conformation between oneM2M and HTTP messages is shown in Tables 1 and 2. For

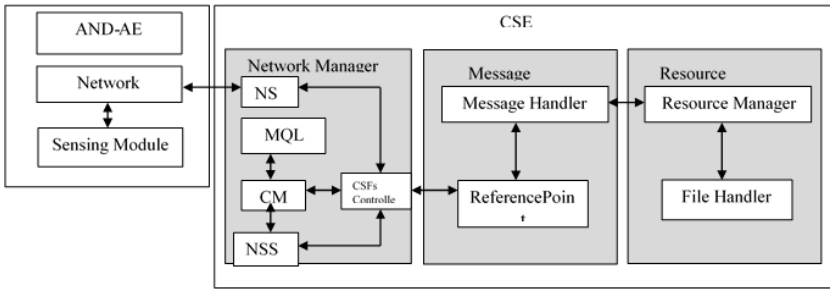


Figure 2: Internal structure of the one M2M (Machine-to-Machine) IoT system.

the purpose of data mining and visualisation, number of frameworks are available to produce knowledgeable data (Grieco, 2014),(Lam, 1988).

The algorithms mentioned in figure 3 is implemented for message communication between the nodes considering one source and 50 destination nodes and 100 destination nodes for 2 different cloud environment respectively. The whole simulation model was run for the 100 permutation and combination. For the result description we have attached the top best combination for each cloud environment. Figure 4; a, b shows the message communications for cloud 1 which has 50 nodes and Figure 5: c, d shows the message communications for cloud 2 which has 100 nodes. As per table 3 analysis more the nodes the communication network more efficient is the precision and accuracy model in the given cloud for communication protocols enhancement.

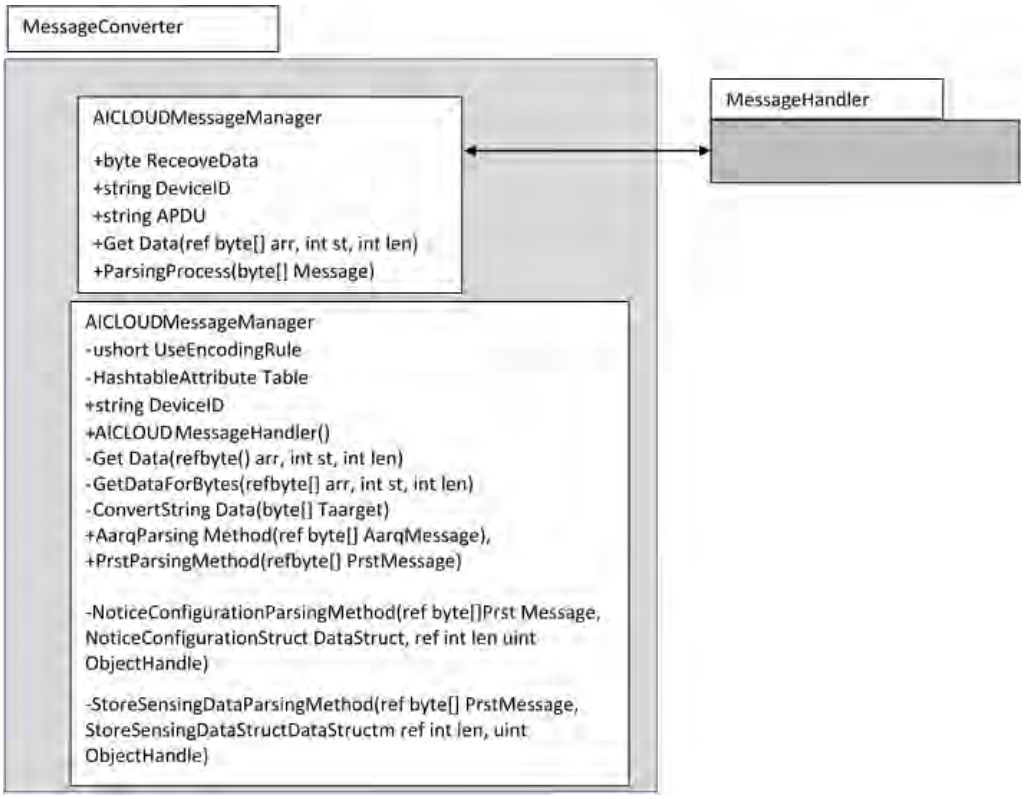


Figure 3: Modules for programmes used in protocol conversion.Results

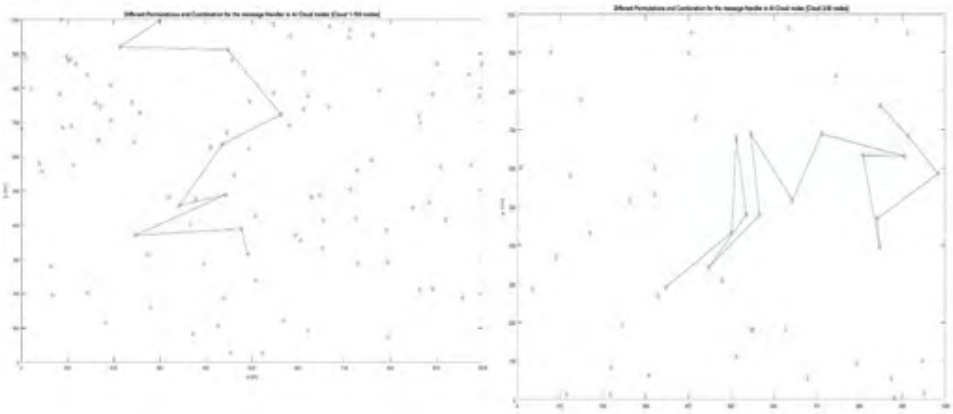


Figure 4:Different path of messages over the node for cloud 1

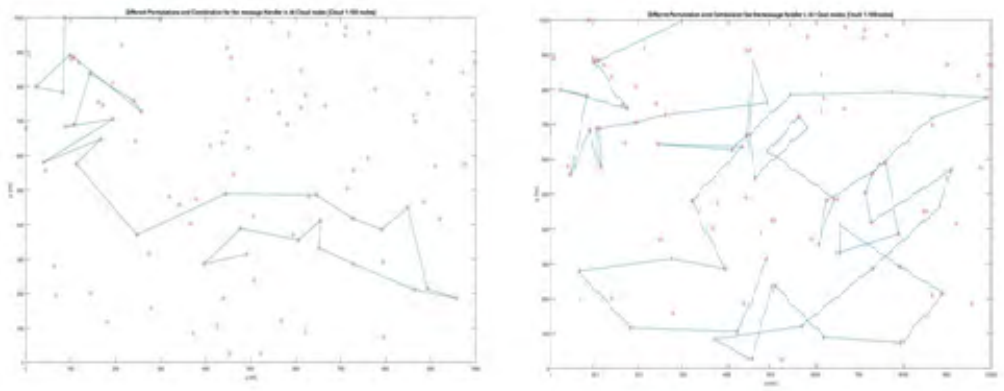


Figure 5:Different path of messages over the node for cloud 2

Description	Precision	Accuracy
Cloud 1 (50 nodes)	97.2%	98.1%
Cloud 2 (!00 nodes)	98.8%	99.4%

Result analysis for Cloud 1 and Cloud 2 framework as per new messenger algorithm proposed in Figure 5.

3. CONCLUSION

IoT has been crucial in bringing automation into the mainstream of 21st-century society. The Internet of Things (IoT), WSNs and health monitoring systems can all be integrated into a multi-cloud environment to improve bandwidth, communication protocols, and sensor network redundancy. The suggested architecture is presented with consideration for the existing health infrastructure and monitoring system, as well as the many kinds of network frameworks that are available. Specifically, the aim behind this study possibility is to provide more depth regarding direct applicability in multi-cloud sensor communication protocols by demonstrating that the sensors data analytics carried out may support multi-level computing. The HTTP protocol proposed can be made universal for data authentication with encryption algorithms for proposed message scheduler or message handler. The given prototype modeled with the unique communication system gives the higher end of efficient model compared to the conventional method with 98

References

onem2m. functional architecture.

onem2m. service layer core protocol specification.

Baños-Gonzalez, V.; Afaqui, M. L.-A. E. G.-V. 2016. A technology to face the iot challenge.

Chakraborty, S., B. S. T. P. and Agrawal, D. 2016. Fog networks in healthcare application," in mobile ad hoc and sensor systems (mass). *Journal of Healthcare Engineering*.

Chiuchisan, H., C. N. and Geman, O. 2014. Adopting the internet of things technologies in health care systems. *2014*.

Eide, R. 2016. An exploration of wireless ecg and the utilization of low energy sensors for clinical ambulatory patient monitoring.

Ermes, M.; Pärkkä, J. M. J. K. I. 2008. Sdetection of daily activities and sports with wearable sensors in controlled and uncontrolled conditions. *IEEE Trans*.

Ewan, H. 2018. A new large-scale distributed read-write file storage system for cloud computing environments.

Ghamari, M.; Janko, B. S. R. H. W. P.-R. S.-C. 2016. A survey on wireless body area networks for ehealthcare systems in residential environments. sensors. 35–57.

Grieco, L.A.; Alaya, M. M. T. D. K. 2014. Architecting information centric etsi-m2m systems.

Hong, Y.-J.; Kim, I.-J. C. A. S. K. H.-G. 2010. Mobile health monitoring system based on activity recognition using accelerometer. *18*.

Khorov, E.; Lyakhov, A. K.-A. G. A. 2015. A survey on ieee 802.11ah: An enabling networking technology for smart cities. *Comput. Commun. 58*, 55–76.

Lam, S. 1988. Protocol conversion.

Oueida, S., K. Y. A.-M. J. Y. and Baker, T. 2018. An edge computing based smart healthcare framework for resource management, sensors (basel).

Rodrigues, J. J. P. C., D. R. S. D. B. J.-H. A. S. M. H. P. R. M. A.-M. J. . D. A. V. H. C. 2018. Enabling technologies for the internet of health things.

Roehrs, da Costa CA, R. R. R. S. W. M. 2019. Toward a model for personal health records interoperability. *23*, 867–73.

Sethi, P. and Sarangi, S. R. 2017. Internet of things: Architectures, protocols, and applications. *Journal of Electrical and Computer Engineering*.

Sreenivasan M, A. M. C. 2021. Interoperability issues in ehr systems: Research directions. 13–28.

Sun, G., Y. F. X. L. X. W. Y. and Hu, H. 2019. Research on mobile intelligent medical information system based on the internet of things technology. *8th International Conference on Information Technology in Medicine and Education (ITME)*.

Mr. Mirza Moiz Baig (CSE) M.Tech. (CSE) (Fellow, ISTE) is currently working as an Assistant Professor at Department of Computer Science and Engg. at JD College of Engineering and Management, Nagpur, India. He is pursuing his Ph.D. in Computer Science and Engineering from JD College of Engineering and Management in India. He has 23 years of teaching and research experience. His research interests are in Data Warehousing and Mining, Cloud computing, Machine Learning. He is the author to book in the area of Cloud Computing and Database management System. He has received many awards and recognition from International bodies.
E-mail: mirzammb@gmail.com

Dr. Shrikant Vijayrao Sonekar has done Ph.D. Computer Science & Engineering from Rashtrasant Tukadoji Maharaj Nagpur University(RTMNU), Nagpur in 2017. Currently he's working as Officiating Principal at J D College of Engineering and Management (JD-COEM), Nagpur. He has worked almost a decade in various capacities like H.O.D, B.E. and M.Tech, Computer Science and Engineering-Information Technology. He received Rs. 3 Lacs for conducting Induction/Refresher Programmes on "Mitigation and Finding the Generic Solution for Network Security within the Wireless Domain", in March 12, 2018. He received Rs. 75,000/- as cash reward for securing "1st Place in Glimpse of IEEEDAY'19 at JDCOEM SB", Category Long Video, dt 14th Nov., 2019 at International Level- As ExeCom Member, IEEE Nagpur Subsection. He received "ISTE Best Students Chapter Award for the year 2010" at the 40th ISTE National Annual Convention at Sivakasi - As Faculty Advisor, ISTE Students Chapter. Furthermore, He also got "ISTE Best Staff Chapter Award for the year 2011" at Lalsingh Bahadur Engineering College, Fatehgarh, Punjab - As Faculty Advisor, ISTE Students Chapter. He was the Chairman, Board of Studies, Computer Engineering and Computer Science & Engg, RTMNU, Nagpur. Currently he's the member, Research Advisory Committee (RAC) for computing & Technology at PIET, Nagpur, RTMNU. He published the papers in international journals, proceedings of international conferences, patents, and book chapters and he got the total Citations is 43. He Filed/Published the Patent in interdisciplinary branches. He has been favorable to effectively engaged with proficient affiliations and is Life member of IEEE,IETE,IE, Computer Society of India (CSI) and Indian Society for Technical Education (ISTE).
E-mail: srikantsonekar@gmail.com

Optimal power allocation for NOMA-based Internet of things over OFDM sub bands

Prasheel N. Thakre and Sanjay B. Pokle
Shri Ramdeobaba College of Engineering and Management, Nagpur, Maharashtra, India

As a result of continued expansion of 5G technology, the density of IoT devices has increased dramatically. Increasing the throughput of 5G systems is now extremely important. Non-orthogonal multiple access technologies and Ultra-dense networks have lately attracted a lot of attention in the context of Internet of Things networks because to their capacity to multiplex from the space domain and power domain. In order to boost system throughput, this article integrates non-orthogonal multiple access technology with ultra-dense network technology, taking into consideration orthogonal frequency division multiplexing non-orthogonal multiple access-based ultra-dense networks with several base stations. The network model and the channel model were created first. As a result, under the condition of total power, the downlink transmission rate maximization problem is formulated. Then, the problem is divided into two subproblems to solve: device grouping and sub-band power distribution and built the best power allocation strategies by using convex optimization theory to these subproblems. Finally, numerical simulations are undertaken to validate the efficiency of proposed optimal downlink power distribution approach and the total throughput of the system has substantially enhanced as compared to orthogonal Multiple access.

Keywords: NOMA, UDN, 5G, IoT, system throughput.

1. INTRODUCTION

We are ushering in new networking era by introducing the "Internet of Things (IoT)" into people's daily lives. Ji et al. [2021] Most promising solution for IoT is NOMA technology for increasing total system capacity. Li et al. [2014] Because of NOMA's capacity to significantly enhance radio spectrum efficiency, power domain devices are multiplexed to increase total system throughput. The power domain NOMA strategy distributes power for transmitters in accordance with varied channel states by assigning less power to those with good channel condition and greater power to those with worse channel condition. To decode device input, successive interference cancellation (SIC) at the receiver is applied. As a result, several device transmissions are feasible on a single sub-channel. Akpakwu et al. [2017], Thakre and Pokle [2022] A proper power allocation strategy may reduce the error code accumulation phenomenon experienced by power domain NOMA transmission technology. As a result, power domain NOMA is becoming more common in IoT scenarios.

The effect of device pairing on NOMA system operation is studied in the literature Ding et al. [2015]. The results express that fixed power allocation NOMA scheme can outperform OMA systems in terms of throughput. The authors of the literature Zeng et al. [2019] examine the ideal power and channel distribution, and utilize the water-filling approach to address the issue of objective optimization in order to maximize the overall system rate. However, it is assumed in this literature that there is no limit to the number of subcarriers that can be assigned to a solo device. To improve network performance, blending of NOMA can be carried out with significant technologies Ding et al. [2017]. Combining NOMA with ultra-dense networks (UDNs), for example, can improve the system's total transmission rate from both the power and space domains Kim et al. [2021]. As part of UDN, a massive quantity of smaller base stations (BS) are deployed in a certain region, with significantly more small base stations deployed than devices. However, because to the dense base station deployment and confined service area of the UDN, there is a very good chance that base station overlaps, which might result in considerable base

station interference Yang et al. [2016].

In order to investigate the most effective downlink power allocation schemes, we take into account the sub-bands of orthogonal frequency division multiplexing (OFDM) and NOMA-based UDN in IoT networks. The particular work is listed below:

—When designing the problem to improve system throughput, the UDN scenario with several base stations and various IoT devices is considered.

—To address this issue, the fundamental issue is divided into two minor issues: device grouping and power distribution within OFDM sub-bands.

—Simulations are performed to verify the suggested method of allocating power for throughput maximization.

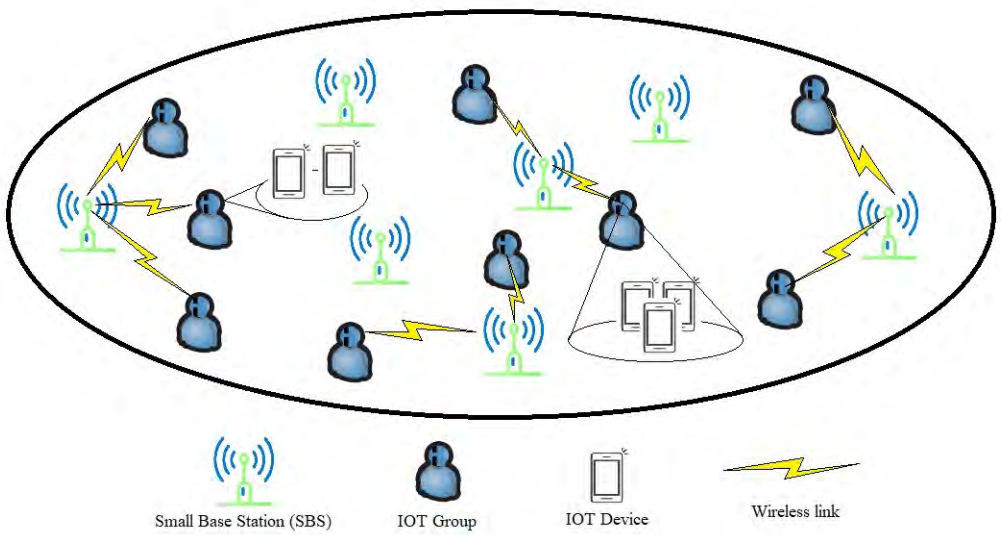


Figure 1. NOMA–based UDN system model over OFDM sub-bands

The order of the remaining portions of this article is as follows. The system throughput maximization challenge is established in the part under "The system model," which also offers the downlink system model for NOMA-based UDN across OFDM sub-bands with several tiny base stations. The maximizing issue is divided into two sub-problems in the section titled "Joint Optimization Techniques for Resource and Power Allocation," and the best downlink power allocation strategies are obtained by addressing these sub-problems. Performance test mimics the best downlink power distribution plan researched for NOMA-based UDN over OFDM sub-bands. This article is concluded in the section under "Conclusion."

2. THE SYSTEM MODEL

A downlink NOMA-based UDN system is proposed, as depicted in Figure 1, that has complete awareness of the channel-state information and is composed of several tiny base stations and IoT devices. Each IoT group is given its own OFDM sub-band and may be served by a single tiny base station. Each IoT group is assumed to have two IoT devices, which are labelled by D_1 and D_2, respectively, in order to decrease computational complexity. Let's say that $|h_1| > |h_2|$ describes the channels of two Internet of Things devices. The received signals of the kth IoT group within the range of the nth tiny base station, Fayaz et al. [2021] indicated by y_1 and y_2,

representing the near IoT device and the far IoT device, respectively, according to the channel state condition, are depicted as follows.

$$y_i = h_i x_s + \nu_i \tag{1}$$

$$y_i = h_i(\sqrt{a_1\rho_s}x_1 + \sqrt{a_2\rho_s}x_2) + \nu_i \tag{2}$$

In order to meet the total power constraint of $a_1 + a_2 = 1$, the quantity ρ_s signifies the total transmit SNR, and the values a_i, $i \in \{1, 2\}$ denote the corresponding percentage of total power. Since $|h_1| > |h_2|$, $a_1 < a_2$. ν_i, i$\in \{1, 2\}$ denotes Additive White Gaussian Noise (AWGN). By considering the D_1 message as noise, D_2 immediately decodes its message. The signal that D_2 has received is

$$y_2 = h_2(\sqrt{a_1\rho_s}x_1 + \sqrt{a_2\rho_s}x_2) + \nu_2 \tag{3}$$

With SNR of

$$\gamma_{D_2}^{x_2} = \frac{a_2\rho_s|h_2|^2}{a_1\rho_s|h_2|^2 + 1}$$

This results in the achievable rate for D_2, given by (4)

$$R_2 = log_2\left(1 + \frac{a_2\rho_s|h_2|^2}{a_1\rho_s|h_2|^2 + 1}\right) bits/s/Hz \tag{4}$$

However, D_1 employs SIC, which entails decoding both $D_2's$ message and its removal from the received signal before decoding its own, as seen in Figure 2. The received signal at D_1 is

$$y_1 = h_1(\sqrt{a_1\rho_s}x_1 + \sqrt{a_2\rho_s}x_2) + \nu_1 \tag{5}$$

SNR for decoding D_2 at D_1

$$\gamma_{D_1}^{x_2} = \frac{a_2\rho_s|h_1|^2}{a_1\rho_s|h_1|^2 + 1}$$

After decoding D_2 and cancelling interference

$$y_1 = h_1(\sqrt{a_1\rho_s}x_1) + \nu_2 \tag{6}$$

SNR for decoding D_1 at source 1 is

$$\gamma_{D_1}^{x_1} = a_1\rho_s|h_1|^2$$

Results in the achievable rate for D_1

$$R_1 = log_2\left(1 + a_1\rho_s|h_1|^2\right) bits/s/Hz \tag{7}$$

The total throughput of the system is $R_{sum} = \Sigma(R_1 + R_2)$ In conclusion, we create the NOMA-based UDN over OFDM sub-band weighted throughput maximization problem P_1, which has the following expression

$$\begin{aligned} P_1: \quad & maxU_M(p_1, p_2, \ldots . p_M) = \sum_{m=1}^{M}(w_m \times R_m) \\ & Subject\,to \sum_{m=1}^{M} p_m = p_{tot}, \\ & p_1 \geqslant p_2 \geqslant \ldots \geqslant p_M \geqslant 0 \end{aligned} \tag{8}$$

where P_{tot} is the total power available for the specified sub-band and w_m is the weight of the mth device rate. To address the aforementioned issues, we equivocally split the system's total throughput maximization challenge into two smaller issues: device grouping and allocation within sub-bands. We then created matching algorithms to address each issue independently.

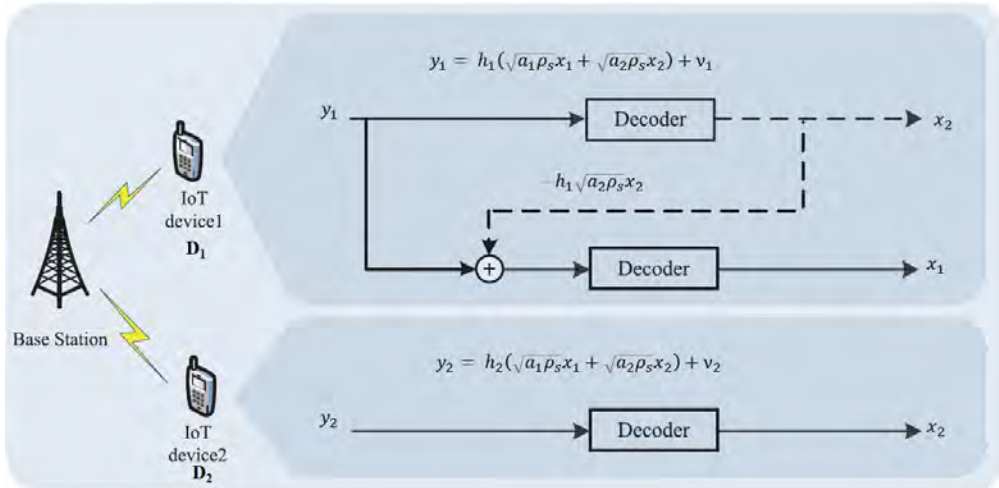


Figure 2. Example of a downlink NOMA with SIC between two IoT devices

3. JOINT OPTIMIZATION STRATEGIES FOR RESOURCE ALLOCATIONS

The aim of this section is to successfully identify a set of IoT devices that are suited for a specific sub-band and correctly distribute power across IoT devices in order to improve the weighted sum rate and assure fruitful SIC decoding. The power order constraint applies only to IoT devices whose power is non-zero. If a device is considered to be unsuitable for a specific sub-band or if $p_i = 0$, it is simply removed from the IoT device collection. For two device case equation (8) can be rewritten as

$$maxU_M(p_1) = w_1 log_2\left(1 + \frac{|h_1|^2 p_1}{\sigma^2 + |h_1|^2(p_{tot} - p_1)}\right) + w_2 log_2\left(1 + \frac{|h_2|^2(p_{tot} - p_1)}{\sigma^2}\right)$$
$$Subject\, to\, \frac{p_{tot}}{2} \leqslant p_1 \leqslant p_{tot}, \tag{9}$$

A non-convex optimization problem is the one mentioned above. We also need to determine whether these two devices can coexist well. If device 1 is chosen, p_1 must adhere to the equation's power order requirement (9). We need to discover the critical points of (9) in order to solve for optimal device selection and power allocation, thus we must differentiate the objective function's as follows.

$$\frac{\partial U_2}{\partial p_1} = \left(\frac{1}{ln_2}\right)\left(\frac{w_1}{\sigma_1 + p_{tot} - p_1} - \frac{w_2}{\sigma_2 + p_{tot} - p_1}\right) \tag{10}$$

Where $\sigma_1 = \frac{\sigma^2}{|h_1|^2}$ and $\sigma_2 = \frac{\sigma^2}{|h_2|^2}$
If $w_2 \geqslant w_1$, U_2 is a decreasing function of p_1 since $\sigma_1 \geqslant \sigma_2$. The objective function U_2 would then reach its optimum at $p_1 = 0$. In this instance, device 1 is thus terminated, and p_{tot} is given to device 2. The stationary point p_1^* at which the derivative becomes zero is determined if $w_2 < w_1$, and it is provided by

$$p_1^* = r + p_{tot} \tag{11}$$

Where $r = \frac{w_2 \times \sigma_1 - w_1 \times \sigma_2}{w_2 - w_1}$
At this time, U_2 will be at its highest since the second derivative is negative. Four scenarios are taken into consideration for combined device selection and power allocation, depending on the value of p_1^*.

case (i) : $p_1^* \leqslant 0$

This case is practically not possible and also here, for every p_1 from 0 to p_{tot}, U_2 is uniformly decreasing. Assigning 0 to P_1 removes device 1.

case (ii) : $0 < p_1^* \leqslant p_{tot}/2$
We examine the extreme points since p_1^* is an impossible point. If $U_2(0) > U_2(p_{tot}/2)$, delete device 1 by assigning 0 to p_1; otherwise, assign $p_{tot}/2$ to p_1.

case (iii) : $p_{tot}/2 \leqslant p_1^* < p_{tot}$
U_2 attains maximum at a feasible point $p_1^* = r + p_{tot}$ which is assigned to device 1.

case (iv) : $p_1^* \geqslant p_{tot}$
U_2 increases uniformly from 0 to p_1^* below the infeasible value that is bigger than p_{tot}, where it reaches its maximum. Assign p_{tot} to p_1 in this scenario, meaning that the first device will receive full power.

Thus, by combining all of the aforementioned examples and using a few basic mathematical operations, the best solution to problem (9) is provided as a closed from equation below.

$$p_1 = \begin{cases} 0, & if \ \ \frac{log_2\left(\frac{\sigma_1+p_{tot}}{\sigma_1+p_{tot}/2}\right)}{log_2\left(\frac{\sigma_2+p_{tot}}{\sigma_2+p_{tot}/2}\right)} \leqslant \frac{w_2}{w_1} < \infty, & : C_1 \\ p_{tot}/2, & if \ \ \frac{\sigma_2+p_{tot}/2}{\sigma_1+p_{tot}/2} \leqslant \frac{w_2}{w_1} < \frac{log_2\left(\frac{\sigma_1+p_{tot}}{\sigma_1+p_{tot}/2}\right)}{log_2\left(\frac{\sigma_2+p_{tot}}{\sigma_2+p_{tot}/2}\right)}, & : C_2 \\ r + p_{tot}, & if \ \ \frac{\sigma_2}{\sigma_1} < \frac{w_2}{w_1} \leqslant \frac{\sigma_2+p_{tot}/2}{\sigma_1+p_{tot}/2}, & : C_3 \\ p_{tot}, & if \ \ 0 < \frac{w_2}{w_1} \leqslant \frac{\sigma_2}{\sigma_1}, & : C_4 \end{cases} \tag{12}$$

where C_1 through C_4 represent various situations for weight ratios. The highest value of U_2 is determined as

$$p_1 = \begin{cases} w_2 log_2\left(\frac{\sigma_2+p_{tot}}{\sigma_2}\right) & , if C_1 \\ w_1 log_2\left(\frac{\sigma_1+p_{tot}}{\sigma_1+p_{tot}/2}\right) + w_2 log_2\left(\frac{\sigma_2+p_{tot}/2}{\sigma_2}\right) & , if C_2 \\ w_1 log_2\left(\frac{\sigma_1+p_{tot}}{\sigma_1-r}\right) + w_2 log_2\left(\frac{\sigma_2-r}{\sigma_2}\right) & , if C_3 \\ w_1 log_2\left(\frac{\sigma_1+p_{tot}}{\sigma_1}\right) & , if C_4 \end{cases} \tag{13}$$

4. PERFORMANCE EVALUATION

In this part, system-level simulation is used to assess how well the suggested approach performs. In this simulation, transmission of downlink data using the OFDM access system is taken into account, which offers several base stations access to a sub band of 0.1 to 1 GHz. It is assumed that the IoT devices in the cell are spread evenly and randomly, the base station's maximum coverage radius R is 50 meters, and follows the Rayleigh distribution for channel model. For the simulations, the total power at the BS is assumed to be 30 dBm with randomly chosen weight vectors.

Figure 3 depicts a schematic showing the link between the quantity of requested IoT devices and the overall system throughput at different transmitted power. Here system throughput gradually increase as no. of IoT devices increases till maxima and then further increasing device will cause degradation in system performance. Maxima point for different transmitted power is different. More is the transmitted power more are the devices NOMA can serve with maximum throughput.

Capacity of NOMA Vs OMA with respect to SNR in uplink and downlink system is shown in Figure 4. The combination of device selection and power distribution approach yields a solution that is not only SIC-stable but also optimal. The simulation results validated the recommended algorithms utility by proving that they outperform the OMA system when compared to optimal power allocation strategies.

5. CONCLUSION

In this study, the issue of optimizing overall throughput for NOMA systems on OFDM sub band with numerous base stations and various IoT devices was primarily investigated. Device grouping and sub-band power distribution were equivalently turned into two sub-problems from

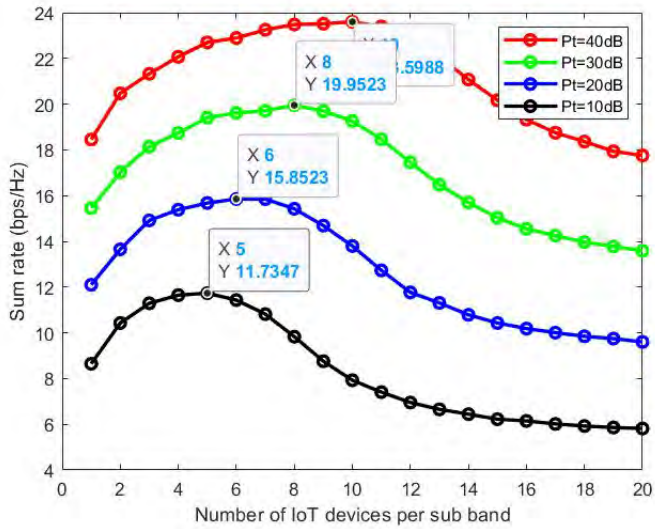


Figure 3. Performance of NOMA for serving no. of IoT devices at different transmitted power

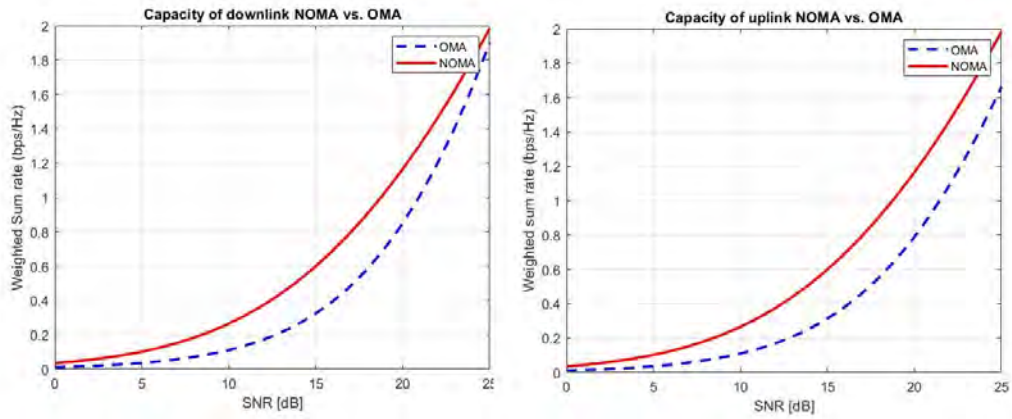


Figure 4. Capacity of NOMA Vs OMA in uplink and downlink channels

this maximizing issue. The channel state sorting and weighted sum rate maximization problem is provided as a closed form equation for all weight ratio scenarios in order to resolve these issues. A method for combined device scheduling and power allocation is derived from this outcome. Due to the integrated device selection and power distribution strategy, the offered solution is not only SIC-stable but also optimum. The simulation results demonstrated the practicality of the provided algorithms by showing that the suggested optimum power allocation approaches can outperform the OMA system.

References

Akpakwu, G. A., Silva, B. J., Hancke, G. P., and Abu-Mahfouz, A. M. 2017. A survey on 5g networks for the internet of things: Communication technologies and challenges. *IEEE access Vol.6*, pp.3619–3647.

Ding, Z., Fan, P., and Poor, H. V. 2015. Impact of user pairing on 5g nonorthogonal multiple-access downlink transmissions. *IEEE Transactions on Vehicular Technology Vol.65,* 8, pp.6010–6023.

Ding, Z., Lei, X., Karagiannidis, G. K., Schober, R., Yuan, J., and Bhargava, V. K. 2017. A survey on non-orthogonal multiple access for 5g networks: Research challenges and future trends. *IEEE Journal on Selected Areas in Communications Vol.35,* 10, pp.2181–2195.

Fayaz, M., Yi, W., Liu, Y., and Nallanathan, A. 2021. Transmit power pool design for grant-free noma-iot networks via deep reinforcement learning. *IEEE Transactions on Wireless Communications Vol.20,* 11, pp.7626–7641.

Ji, B., Wang, Y., Song, K., Li, C., Wen, H., Menon, V. G., and Mumtaz, S. 2021. A survey of computational intelligence for 6g: Key technologies, applications and trends. *IEEE Transactions on Industrial Informatics Vol.17,* No.10, pp.7145–7154.

Kim, S., Son, J., and Shim, B. 2021. Energy-efficient ultra-dense network using lstm-based deep neural networks. *IEEE Transactions on Wireless Communications Vol.20,* 7, pp.4702–4715.

Li, X., Li, J., Liu, Y., Ding, Z., and Nallanathan, A. 2014. Residual transceiver hardware impairments on cooperative noma networks. *IEEE Transactions on Wireless Communications Vol.19,* 1, pp.680–695.

Thakre, P. N. and Pokle, S. B. 2022. A survey on power allocation in pd-noma for 5g wireless communication systems. In *2022 10th International Conference on Emerging Trends in Engineering and Technology-Signal and Information Processing (ICETET-SIP-22)*. IEEE, pp.1–5.

Yang, C., Li, J., and Guizani, M. 2016. Cooperation for spectral and energy efficiency in ultra-dense small cell networks. *IEEE wireless communications Vol.23,* 1, pp.64–71.

Zeng, M., Nguyen, N.-P., Dobre, O. A., Ding, Z., and Poor, H. V. 2019. Spectral-and energy-efficient resource allocation for multi-carrier uplink noma systems. *IEEE Transactions on Vehicular Technology Vol.68,* 9, pp.9293–9296.

Prasheel N. Thakre has received Bachelor's degree in Electronics Engineering from RTM Nagpur University in 2010. He has done M.Tech. in Electronics Engineering from Shri Guru Gobind Singhji Institute of Engineering and Technology, Nanded University in 2013. Presently he is pursuing Ph. D. from Shri Ramdeobaba College of Engineering and Management, RTM Nagpur University, under the fellowship of Visvesvaraya PhD Scheme for Electronics and IT. His research area includes Non-Orthogonal Multiple Access (NOMA) for 5G Wireless Communication Systems and Wireless channel Estimation Algorithms. Presently he is working as Assistant Professor in Electronics and Communication Engineering Department, Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: thakrepn2@rknec.edu

Dr. Sanjay B. pokle has received Bachelor's degree in Electronics and Telecommunication Engineering from Govt. College of Engineering Pune, Pune University in 1993. He has done M.Tech. in Electronics Engineering and Ph. D. in Electronics from Visvesvaraya National Institute of Technology Nagpur. His research area includes designing aspects of MIMO-OFDM Wireless Communication Systems and Wireless channel Estimation Algorithms. He has published 74 research papers in the reputed national and international Journals and presented papers in the reputed national and international conferences. This includes 06 SCI indexed and 04 Scopus indexed publications. He has guided several projects in the area of signal processing, Digital image processing, Artificial intelligence etc. at post-graduation level and graduate level. He has delivered many Expert lectures in reputed Engineering institutions and also worked as judge in many national level technical competitions. He is approved supervisor for Ph. D. under R.T.M. Nagpur University, Nagpur. 07 candidates has been awarded Ph.D., and 01is pursuing Ph.D. under his guidance. He is member of technical societies like ISTE and IEEE. He has total 26 years of experience which includes 3 years industry and 23 years of teaching experience. He worked as Head of department for 10 years. Presently he is working as Professor in Electronics Communication Engineering Department, Shri Ramdeobaba College of Engineering and Management, Nagpur. Also, he is appointed as Chairman, Board of Studies Electronics Engineering by RTM Nagpur University, Nagpur.
E-mail: poklesb@rknec.edu

Improved League Championship Algorithm (ILCA) for Load Balancing in Cloud Computing

Amol D Gaikwad and Dr. Kavita Singh
YCCE, RTMNU Nagpur University, India

You can't obtain the outcomes you need without planning, thus it's at the heart of cloud computing. This article's major goal is to decrease value-added time, increase resource utilisation, and make cloud services viable for a single activity. In recent years, metaheuristic algorithms have drew attention to the correct functioning of work scheduling algorithms among the many job scheduling techniques. With sports leagues, the algorithm based on the League Championship (LCA) is fascinating because it can be used to identify the best team/task for programming.This article uses the Improved League Championship Algorithm (ILCA) to schedule tasks, reducing deployment time, cloud usage, and cost. The ILCA is implemented through the Cloudsim simulator and the Java programming language with a nonpreventive planning strategy. ILCA also enhances economies of scale and minimises the value of using the cloud. As it has proven to be versatile in terms of time to manufacture, resource usage and economics, ILCA could be a good candidate for a cloud broker as it has proven to be versatile in terms of time to manufacture, resource usage and economics usage.

Keywords: LCA, Makespan, Task scheduling, job scheduling, Cloud computing.

1. INTRODUCTION

Cloud computing has morphed into a digital concept wherein users do not need to use any resources and just pay for the resources they utilize. This rental business model has attracted cloud computing, commercial, and small clients equally for taxis, power, and plane tickets.. Servers, infinite storage, a vast number of CPUs, memory, and other components are used to offer cloud computing services. When it is stated that it has boundless resources, this does not imply that it has infinite resources. It comes with some limitations, and cloud service providers often aim to cut resource utilisation to a bare minimum, especially during peak hours. Cloud computing is growing more popular as a result of benefits such as multi-tenancy, on-demand services, and the ability to access any service at any time (Jena and R, 2018) It's difficult to manage a large number of assets and deliver great service at the same time. Due to the popularity of cloud services, a number of challenges, such as resource management, load balancing, job scheduling, energy efficiency, economics, and security, must be resolved in order to meet customer expectations. Task scheduling is one of the most fundamental and crucial functions in cloud computing. Because task scheduling is an NP-hard problem, finding the best solution is difficult (Kalra and Singh, 2015), a sub-optimal approach is investigated. In polynomial time, a sub-optimal solution to an NP-hard issue can be found. Heuristic algorithms, meta-heuristic algorithms, and hybrid algorithms are the three types of task scheduling algorithms.(Dubey, Kumar, and Sharma, 2018) Metaheuristic algorithms are divided into two categories: naturally inspired and swarm intelligence algorithms. Heuristic algorithms can be static or dynamic.. Darwin's theory-based genetic algorithms (GA) and ant colony optimization (ACO) are two examples of metaheuristic algorithms that are ideal for discovering solutions and are best suited for survival. Informally, the endpoint (at a certain moment in time) of the final job in a group that requires modification is known as Makespan. LCA has had a lot of success in cutting down on production time. Kashan (Kashan, 2009) suggested a sports league-based LCA optimization technique. The author made it useful for optimising numerical functions by providing certain ideal rules. In sports leagues with a round-robin format, this strategy can be utilised. Abdulhamid (Abdulhamid, Abd Latiff, Abdul-Salaam, and Hussain Madni, 2016) demonstrates how to apply LCA for cloud computing task scheduling,

however the flexibility of this technique can enhance LCA even more because lowering makespan alone does not address the problem. increase. This article explains how to schedule in a cost-effective manner. Applying this technique to the search space gives excellent results and motivates further research in the field of cloud computing work scheduling. This article proposes a new approach to adaptively implement LCA with higher learning rates to reduce task processing time. After collecting the results from the simulation using Cloudsim, the tasks described in this article have shown better performance than the MINMIN, MAXMIN, GA, ACO, and GBLCA algorithms. The proposed work also focused on minimizing cloud consumption by estimating the value in use of the cloud and reducing costs by using cloud resources for a short period of time.

2. RELATED WORK

Because of its relevance in cloud delivery, task planning in cloud computing has piqued the interest of researchers. Many scholars have used heuristic algorithms and metaheuristic algorithms of various types to create significant improvements in previous works. Because fitness function design is a critical topic, genetic algorithms (GA) are a popular choice among researchers. In the instance of GA, he first believed all conceivable responses as the ultimate answer to the difficulties, which they referred to as chromosomes. Only chromosomes with a certain physical strength advance to the next level of action. By executing cross-type and mutation operations on it, GA will run multiple iterations until it offers the greatest value (best fit solution) (Kalra and Singh, 2015).In order to shorten build times and boost throughput, Tamanna Jena et al. (Jena and R, 2018) used GA to identify the ideal mix of VM activities. Instead of the conventional FCFS policy, the shortest job first policy is applied. The concepts of Advanced Search (AR) and Full Effort were developed by the authors as a means of resource reservation (FE). When an AR type task arrives, BE type jobs must halt execution, implying that BE is preventive.. Type AR is meant for high-priority operations and runs in a non-blocking manner. The AR type must be given to tasks that have a deadline. Algorithms are created to maintain high levels of customer satisfaction by reducing wait times. By predicting the maximum amount of time a task may be executed on a certain CPU and then selecting the optimum alternative for that CPU, Yuja et al.(Ge and Wei, 2010) employed GA to optimise longevity and load balancing. The scientists developed a master scheduler that provides them with a complete picture of the system, including processor statistics, data, and CPU workload characteristics. The statistical foundation of the weather forecast model is biassed. The effectiveness of the implementation is significantly impacted by how long GA takes to compute. (Kaur and Verma, 2012) Shaminder Kaur along with others The proprietary underlying GA reduces latency by combining the shortest cloudlet sent to the fastest processor (SCFP) and the longest cloudlet allocated to the fastest processor (LCFP) using stochastic approaches (LCFP). Computational complexity and computational economy are terms that are sometimes used synonymously. The phrases computational economy and computational complexity are sometimes used interchangeably. The phrases computational economy and computational complexity are sometimes used interchangeably. The authors could only compare their results to standard GA, which is a drawback.. The original Ant Colony Optimization (ACO) method was enhanced for grid job scheduling by Aihong Liu et al. (Liu and Wang, 2008). They developed an adaptive algorithm for the fundamental ACO that optimises the evaporation rate, boosting efficiency and load balancing. Traditional ACO was found to produce better results, but additional research was needed to compare the modified version to other modern scheduling algorithms that lacked a vital component for widespread acceptance. in their work ,Network theory principles were used using ant colony optimization to handle load balancing in cloud computing by Zehua Zhang et al.(Zhang and Zhang, 2010), which was proven to be effective in increasing customer satisfaction and better using cloud computing capabilities. When it comes to task scheduling, Kennedy and Eberhart's Particle Swarm Optimization (PSO) approach (Kennedy and Eberhart, 2002)is a viable option. Because of its simplicity and capacity to deliver effective solutions to optimization issues, the method is extensively used..All

feasible solutions are treated as particles with a set location and velocity. Particles are utilised to find the best feasible answer from the given search space; each particle will supply the best local solution (Lb). The best position and speed among the available particles will be regarded the best global solution (Gb). Following each iteration, each country strives to provide a solution that is superior to the global best solution. If it succeeds, the newly identified best local solution will take the place of the good one. majority of the world's Fahimeh Ramezani and colleagues (Ramezani, Lu, and Hussain, 2014)In the working group technique, PSO is used in a cloud environment to maintain load balancing. In comparison to relocating overloaded VMSs, the authors have incorporated the idea of task overloading. They created a model that used the PSO algorithm to transfer overload workloads, lowering the amount of time it took to balance the load.. (Pooranian, Shojafar, Abawajy, and Abraham, 2015) Zahra Poor et al. PSO having a distinctive overall research capacity, yet it is important to help when local research is needed. The Gravitational Simulated Local Search (GELS) approach, which has the ability to realise the locally optimum option, provides this help. The proposed method has been shown to be more effective in reducing lead times and delivering some jobs that may not be completed on time. An evolutionary technique called League Championship (LCA) is utilised to solve an optimization issue. Kashan (Kashan, 2009) has created it on the basis of a sporting competition. Pre-defined (idealised) algorithms are based on any sports tournaments connected with optimization difficulties, such as the number of tournaments, the number of viable solutions, and the quantity of available solutions. The season is represented by the number of viable solutions, fitness functions such as intersection and mutation of the genetic algorithm, and changes in the team's composition such as passing and mutation of the genetic algorithm. Each group must play a round-trip game together in the basic LCA. If there are more than two teams in a tournament, L (L1) / 2 games will be played to maintain the Round Robin structure. Understanding team weakness is all about strength, while identifying new combinations is a crucial aspect of defining team strength. These are two internal team variables, but understanding the threat posed by the opponent and turning it into an opportunity is an external component. A SWOT analysis is what this is called. By scheduling jobs on the cloud, Abdul Hamid et al. (Abdulhamid et al., 2016) used LCA to reduce production time, reaction time, and use expenses. The authors have produced outstanding results when compared to well-known metaheuristic algorithms like Genetic Algorithm and Ant Colony Optimization, as well as classic methods like minmin and maxmin. By changing the SWOT technique, the authors of this research applied LCA to enhance their results. The creators of this approach didn't define a learning rate (LR) since they expected that each iteration would have the same LR. The main purpose of this essay is to determine the best LR value for reducing cloud utilisation and thereby reducing production time and expense.

3. LEAGUE CHAMPIONSHIP ALGORITHM (LCA)

The League Championship Algorithm (LCA) is an athletic way of determining the champion or, in task scheduling terminology, the best assignment. For the first time, Kashan [4] incorporates classic LCA by offering six idealised rules, such as:

(1) The team with the most players will surely win the game. The ability of a squad to outplay another team is referred to as "playing strength."

(2) India losing to Afghanistan in the World Cup is unlikely because the results of matches (games) are unpredictable.

(3) If the perspectives of both sides are considered, there is a great likelihood that team I will triumph over team j or vice versa.

(4) In this game, there will be no ties; it will either be a win or a loss.

(5) The club will focus on the upcoming games regardless of future opponents. The lineup will be determined by the previous week's results.

(6) If team I defeated team j, then team I must have possessed some advantages that contributed to their victory whereas team j's weaknesses contributed to their failure.

A stochastic approach, which is a crucial component of LCA, will be used to identify the winner or loser. It goes without saying that a stronger team has a better chance of winning.

Assume that teams I and j (job in case of scheduling) are competing in a match m, with team formations Xim and Xjm with respective playing potentials of f(Xim) and f(Xjm). Let P_i^m gives probability of team i winning with team j in match m, considering an ideal value

$$\frac{fx_i^m - f'}{fx_j^m - f'} = \frac{p_i^m}{p_j^m} \tag{1}$$

It can be deduced from LCA rules.

$$P_i^m + P_j^m = 1 \tag{2}$$

Equations (1) and (2) can be used to determine the value P_i^m

Using the idealised concepts stated above, a number between 0 and 1 is created; if this number is less than, team I will win and team j will lose; otherwise, j will win and I will lose. The Global League Championship Algorithm (Abdulhamid et al., 2016) was successfully applied, resulting in a significant reduction in game completion time.The algorithm is given below:

—Initialize parameter of LCA

—The abbreviation NL stands for "number of leagues."

—The abbreviation NS stands for "number of seasons."

—Learning Rate is represented as LR

STEPS-

(1) STEP-1
—NS for season 1
—NL for League 1
—Create a variety of virtual machines (VMs) of varying capacities.
—Randomly assign the assignment to the VMs (f)
—

$$f = Totaltasktoexecutecapacityof VM's \tag{3}$$

whereas,
—

$$Totaltasktocomplete = numberoftasksxtimespentoneachtask \tag{4}$$

—

$$CapacityofVM's = MIPSofVM's * No.ofCPU's \tag{5}$$

(2) STEP-2
Find the mean fitness (Mf) as
$M_f = \frac{\sum f_i}{NL}$
Find Threshold fitness (THf)
$THf = Mf * LR$

(3) STEP-3
if $f_i > THf$

then
A new league must be created.
else
Otherwise, the league will not be able to compete the next season.
Repeat the process for each season, then pick the league with the lowest fitness level or the largest total capacity.The creators of the global league scheduling algorithm have been reported to have paid little attention to the Cloud Utilization Value (CUV), which can result in a greater learning rate.

4. IMPROVED LEAGUE CHAMPIONSHIP ALGORITHM (ILCA)

(1) STEP-1: Iterate learning for the first time (LI)
(2) STEP-2: Create a random learning rate (LR) value for each LI iteration.
(3) STEP-3: Run the LCA with this LR value to calculate the Cloud Utilization Value (CUV), where CUV is the number of repetitions the cloud VMs require to complete the whole task set.
(4) STEP-4: When you reach the LR value with the lowest CUV value, continue this LI cycle. This LR number will deliver the best learning rate with the least amount of cloud use.

LCA	**Traditional Algorithm (EA)**
League (L)	Population
matches (m)	Iteration
team (i)	ith member in population Solution
formation (Xi m) winning	fitness value
strength f (Xi m) number of seasons (S) number	maximum iteration

Table I: LCA and a conventional evolutionary approach for parameter matching

Adaptive LCA is used to obtain the optimum learning rate by reducing cloud lifespan and hence cloud utilisation, allowing us to take advantage of economies of scale. Based on the idealisation criteria stated in the previous section, the LCA can determine which jobs are scheduled on which VMs, but first it is required to understand the relationship between the LCA parameters and the developing algorithms. traditional so that the ACL implementation's details may be readily understood Using a random approach, it was determined in the ACL that teams with greater competitive power had a larger chance of winning than other clubs. Table I offers parameter mapping for simple comprehension when using LCA to any optimization issue.

Makespan: - Makespan is the length of time required for the execution of the final task.The shortest makespan time indicates the least amount of cloud usage, i.e. the least amount of cloud usage, which eventually translates to economic usage. It can be quantitatively expressed as in the equation above. $Makespan = max(F_i)$ where Fi represents the task's completion time

5. IMPROVED LEAGUE CHAMPIONSHIP ALGORITHM (ILCA)

Experimentation This strategy focuses on cloud usage reduction (CUV), which lowers the cost of conducting operations in the cloud, in addition to lowering production time. The method was created using the CloudSim simulation platform, which is frequently used to execute cloud projects, as well as the Eclipse editor, which is written in Java. When calculating the competence of the suggested algorithm, the features of cloud usage and economics are taken into account. The parameters of certain settings for the chosen method are derived from (Gasior and Seredyński, 2013) (Chen, Du, Zhan, and Zhang, 2015) (Liu, Zhan, Du, and Chen, 2014) to get findings, the trials were repeated 60 times and the results were averaged.Workload sets are pulled from the archive The NASA Ames iPSC/860.

6. RESULT AND COMPARISON

In cloud computing, experimental data are produced for various job scheduling models.

Sr. No	No of Task	No of Computation
01	1000	260
02	2000	533
03	3000	807
04	4000	1123
05	5000	1571

Table II: Experimental Data

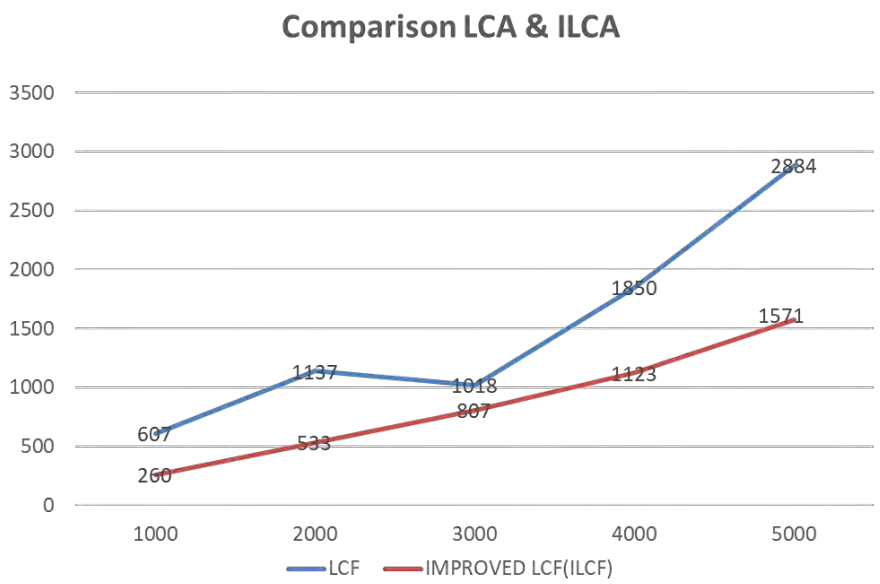


Figure1. Makespan calculations using various scheduling techniques

According to the findings, which is as per table 1 and figuure1 , The ILCA has a low cloud usage value, which shortens the term of cloud consumption. The cost of cloud services will decrease with low cloud use.

7. CONCLUSION

In this work, the tournament championship improvement approach was used to the job scheduler in the cloud architecture. The cloudsim simulator, which is extensively used to mimic cloud computing models, was employed for the investigation. The main purpose of this essay is to reduce time to market and deliver affordable cloud services. In comparison to other strategies, the data show that ILCA is the most effective. The suggested algorithm is solely intended for independent, non-preemptive jobs.Future study will focus on load prediction, which will improve the system's reactivity and intelligence. There is always a potential that the load will rise suddenly, in which case the algorithm needs to be equipped to handle the situation.

References

Abdulhamid, S. M., Abd Latiff, M. S., Abdul-Salaam, G., and Hussain Madni, S. H. 2016. Secure scientific applications scheduling technique for cloud computing environment using global league championship algorithm. *11,* 7 (jul), e0158102.

Chen, Z.-G., Du, K.-J., Zhan, Z.-H., and Zhang, J. 2015. Deadline constrained cloud computing resources scheduling for cost optimization based on dynamic objective genetic algorithm. In *2015 IEEE Congress on Evolutionary Computation*. IEEE.

Dubey, K., Kumar, M., and Sharma, S. C. 2018. Modified HEFT algorithm for task scheduling in cloud environment. *Procedia Comput. Sci. 125*, 725–732.

Gasior, J. and Seredyński, F. 2013. *Multi-objective parallel machines scheduling for fault-tolerant cloud systems Algorithms and Architectures for Parallel Processing*. Springer.

Ge, Y. and Wei, G. 2010. Ga-based task scheduler for the cloud computing systems. In *2010 International Conference on Web Information Systems and Mining*. IEEE.

Jena, T. and R, M. J. 2018. Ga-based customer conscious resource allocation and task scheduling in multi-cloud computing. *Arab. J. Sci. Eng. 43,* 8 (aug), 4115—4130.

Kalra, M. and Singh, S. 2015. A review of metaheuristic scheduling techniques in cloud computing. *Egypt. Inform. J. 16,* 3 (nov), 275–295.

Kashan, A. H. 2009. League championship algorithm: A new algorithm for numerical function optimization.

Kaur, S. and Verma, A. 2012. An efficient approach to genetic algorithm for task scheduling in cloud computing environment. *4,* 10 (sep), 74–79.

Kennedy, J. and Eberhart, R. 2002. Particle swarm optimization. In *Proceedings of International Conference on Neural Networks*. IEEE.

Liu, A. and Wang, Z. 2008. Grid task scheduling based on adaptive ant colony algorithm. In *2008 International Conference on Management of e-Commerce and e-Government*. IEEE.

Liu, X.-F., Zhan, Z.-H., Du, K.-J., and Chen, W.-N. 2014. Energy aware virtual machine placement scheduling in cloud computing based on ant colony optimization approach. In *Proceedings of the 2014 Annual Conference on Genetic and Evolutionary Computation*. ACM.

Pooranian, Z., Shojafar, M., Abawajy, J. H., and Abraham, A. 2015. An efficient meta-heuristic algorithm for grid computing. *J. Comb. Optim. 30,* 3 (oct), 413–434.

Ramezani, F., Lu, J., and Hussain, F. K. 2014. Task-based system load balancing in cloud computing using particle swarm optimization. *Int. J. Parallel Program. 42,* 5 (oct), 739–754.

Zhang, Z. and Zhang, X. 2010. A load balancing mechanism based on ant colony and complex network theory in open cloud computing federation. In *2010 The 2nd International Conference on Industrial Mechatronics and Automation*. IEEE.

Mr. Amol D Gaikwad has received his B.Tech degree in Computer Science and Engineering from RTMNU Nagpur University, Nag-pur and MTech. degree in Computer Science and Engineering Master of Technology degree from Yeshwantrao Chavan College of Engineering, Engineering (An Autonomous Institution Affili-ated to Rashtrasant Tukadoji Maharaj Nagpur University), Nag-pur, India. He is currently pursuing Ph.D. from from Yeshwan-trao Chavan College of Engineering, (An Autonomous Institu-tion Affiliated to Rashtrasant Tukadoji Maharaj Nagpur Univer-sity), Nagpur, India. His predominant research areas include High Performance Computing, Cloud Computing. He has pub-lished research papers in various reputed international confer-ences and journals. He is the life member of ISTE, India, IE, India.
E-mail: amolgaikwad.ag@gmail.com

Dr. Kavita Singh has completed her doctoral degree from SVNIT, Surat in 2014 in biometrics. Her areas of expertise are Machine Learning, soft computing, computer vision, latex and Image Pro-cessing. She has more than 50 international paper publications in reputed conferences, book chapters and journals. She worked as reviewer, session chair for many international journals and conferences. She has delivered 20 talks on different topics in-cluding her expertise area. She worked as Principal Investigator for projects funded by AICTE under RPS Scheme. She has also a strong association with industries like IBM, Nvidia etc. She is currently working as Associate Prof. at Department of Computer Technology, YCCE, Nagpur.
E-mail: singhkavita19@yahoo.co.in

Object Detection using Speech Recognition

Chetana Thaokar, Gayatri Ladsawangikar, Tanaya Wadibhasme and Sandeep Sureka
Shri Ramdeobaba College of Engineering and Management, Maharashtra, India

Nearly all practical applications, including autonomous navigation, visual systems, face recognition, and more, rely on object detection. In this paper, object detection and speech recognition are combined to help visually impaired people who want to use voice commands to find a certain object. People who are blind or visually challenged can move more independently if they are aware of their surroundings. With the use of the OpenCV libraries, a model has been implemented, and good results have been obtained. In this paper, a thorough review of object detection employing region-based conventional neural network (CNN)- based learning systems for practical applications has been conducted. This study examines the various object identification processes utilizing YOLOV4 object detection techniques and talks through detection, including a speech recognition system that was created by transcribing spoken language into text.

Keywords: Object detection, Speech Recognition, YOLOv4 algorithm, Machine Learning,Performance metric, Custom dataset.

1. INTRODUCTION

Object detection is a technology that falls under the broader domain of Computer Vision. It deals with identifying and tracking objects present in images and videos. There are different applications for object recognition, such as face detection, vehicle detection, pedestrian counting, self-driving vehicles, protection systems, etc. Object detection is inextricably linked to other similar computer vision techniques like image recognition and image segmentation, in that it helps us understand and analyze scenes in images or video. But there are important differences. Image recognition only outputs a class label for an identified object, and image segmentation creates a pixel-level understanding of a scene's elements. What separates object detection from these other tasks is its unique ability to locate objects within an image or video. This then allows us to count and then track those objects. Given these key distinctions and object detection's unique capabilities, we can see how it can be applied in a number of ways: • Crowd counting • Self-driving cars • Video surveillance • Face detection Of course, this isn't an exhaustive list, but it includes some of the primary ways in which object detection is shaping our future. In our model, we divided our work in cost two parts i.e. speech recognition part and object detection part. Firstly, in speech recognition part, we give speech i.e. voice command as an input to our model wherein using libraries such as speech recognition and pyttsx3 we convert the input speech to its text format. Herein, the user needs to speak the name of the required object he/she wants to search and then the required program would convert the name of the object to its text format. Then, the text-name is given as an input to the object detection part where we have used CNN model in which we are using YOLOV4 algorithm which makes the base for our object detection model, in which OpenCV library is used for the detection of the required object. The given text-input is matched with the dataset embedded in our model and then the camera is enabled to detect the object in the given environment or background. A bounding box is formed when the object is detected and then the model stops working. For our specific model, we also build our own custom dataset which has 52 different types of objects with more than 20,000 images for the detection.

2. LITERATURE REVIEW

In (Devaki, Shivarsha, Bala Kowsalya, and Manjupavithra, 2019) have proposed a technique Object Detection which will assist visually impaired people. Study also reviewed different deep

learning models as RCNN for different real time applications. They used OpenCV library for object detection. They have explored different object detection algorithms using Caffe model. Author (Sandeep Kumar, 2017) have used Easynet model for object detection and Recognition and compared various other models also. It was observed that Easynet model analyzes whole image by using global context which can be used for easy predictions. At the time of prediction, model generates metrics for the presence or absence of the object in a particular domain. In this object detection is regression problem that separates entities using bounding boxes and associated probabilities to it. For predictions this probability is used. In the study (Beery, Wu, Rathod, Votel, and Huang, 2020), R-CNN is used to find the temporal context from the unlabeled frames to improve the performance of the images captured by the camera. This method enables RCNN to index into long term memory bank collected from different cameras and collect contextual data. RCNN is used in two ways vehicle detection in traffic signals and species detection using camera traps. It is observed that RCNN performances better in both the settings as compared to baseline. Researchers have demonstrated that by extending contextual temporal gives better outcomes. Results shows that RCNN surpasses 3D convolution by 11.3% mAP and by 17.9% mAP as compared to single frame baseline when applied on Serengeti dataset. In study (Tan, Pang, and Le, 2020), authors have used neural network models with different optimizers for scalable object detection. They have suggested weighted bidirectional feature pyramid network (BiFPN), which uses quick and simple multi-scale feature fusion. Which scales the depth, width and resolution . So based on this EfficientDet optimization technique is proposed. It achieves state of the art 52.2% mAP on COCO test data. Object Detection and tracking methods were studied by (Senthil Murugan, Suganya Devi, Sivaranjani, and Srinivasan, 2018) for video surveillance. He explained how this technology was existing in 1950s, and has evolved since than. He also explained that how security camera monitoring can be difficult task and will take heavy toll of human time and mind. So he proposed how this task can be automated by introducing smart surveillance system which will reduce human intervention and time required to catch hold the activity. In (Flitton, Breckon, and Megherbi, 2013), study was done that analyzes and evaluates 3D interest point descriptors in Computed Tomography on airport luggage checking point using images. The focus was to detect the objects of interest using X-Ray screening. So authors compared and evaluated five methods Rotation Invariant Feature Transform, Scale Invariant Feature Transform, Density, Density histogram and Density Gradient histogram,. The methods gave good results by evaluating important metrics but this study was limited to specific area.

3. PROPOSED WORK

A detailed explanation is given related to the methods we used, the technologies implemented and the future scope regarding our model.

3.1 Methodology

Our Software implementation is basically divided into three major modules that is, Speech Recognition and Object Detection. In Speech Recognition Module, the software will take the speech input of the object name from the user and then it would verify the object name by uttering that word again for confirmation. If the user said no, then the software will ask to speak the object name again. If user said yes, then the software will convert the user-given speech to text format and pass the obtained text as an input to the Object Detection module. For speech recognition, we use python Speech Recognition library and pyttsx3. Speech recognition model is divided into different classes by describing the type of utterances that is used for recognition. Python speech recognition library uses Google speech API. We choose to use this because of its high accuracy. We test the Sphinx-4, Microsoft API, and Google API by using some audio recordings, and it showed that acoustic and language model of google is better.

In Object Detection Module, the obtained text format of object name will be taken as input for the camera and the camera will start capturing the frame to detect the object and create bounding box around the required object if detected.

System	Pocket Sphinx	Speech recognition
Recognition accuracy	79.2 %	98 %
Algorithm used	Hidden Markov Model	Hidden Markov model
Language	C/Java	C

Table I: Comparison result for accuracy of speech

3.2 Technologies Used

Given below are the technologies we used in our model and how these technologies has been implemented in our model is explained below.

3.2.1 *Machine Learning :.* Machine Learning is an integral part of our model as the whole process of speech recognition and object detection is facilitated through the help of machine learning and its algorithm. We trained our model for the object detection module and had a huge dataset for training and testing purposes.

3.2.2 *Deep Learning :.* Deep learning was also an essential part of our model as we had our own custom dataset for our model. We build our own dataset and applied supervised learning and deep leaning algorithms for gathering the data and training the data. Deep learning also helped us to achieve accuracy in our training dataset.

3.2.3 *Speech Recognition :.* Speech recognition is the crux of our model as the interpretation of voice commands to its text format is done through speech recognition and NLP(Natural Language Processing) technology. We used Speech Recognition Library and pyttsx3 for conversion of voice commands i.e. speech format to its text format. Both the libraries are explained below : Python Speech Recognition module: This is Speech to text translation and allows adjusting for Ambient Noise. pyttsx3 : It is a Text-to-speech conversion library in Python.

3.2.4 *YOLOV4 :.* It is based on a single Convolutional Neural Network (CNN). The main algorithm for this whole model is YOLOV4 which helps in the object detection module and is one of the fastest and most accurate algorithm compared to others as mentioned below. YOLOV4 divides the image into grid format and extract the necessary features for further detection and hence it makes the base of our model as it efficiently helps us to detect the object in our surrounding with maximum accuracy.

Model	Precision %	Recall %	AP50 %	F1 score %	FPS %
SSD	78.11	74.06	76.95	76.03	59.24
YOLO v3	84.24	80.66	84.53	82.41	40.02
Faster R-CNN	70.76	90.74	88.30	79.51	9.35
YOLO v4	98.11	80.00	92.95	88.13	35.61

Table II: Comparison result for different object detection model

3.2.5 *Computer vision :.* Computer vision is also used in our model as it helps in decision making for detection of objects by comparing the information previously provided in our dataset and the actual image present in the surrounding and makes the decision as to exactly which class of the image the current image belongs to. Hence, computer vision also plays a crucial role in this model. Here, we used OpenCV library in our model for object detection.

4. FUTURE SCOPE

The Object Detection via voice commands model is designed to identify things the user will ask for i.e. the required objects he/she needs for their usage. These models have become ubiquitous and are an essential tool for detecting objects through voice commands. Collaborative model of object detection and speech recognition has become a very important method as far as the issue

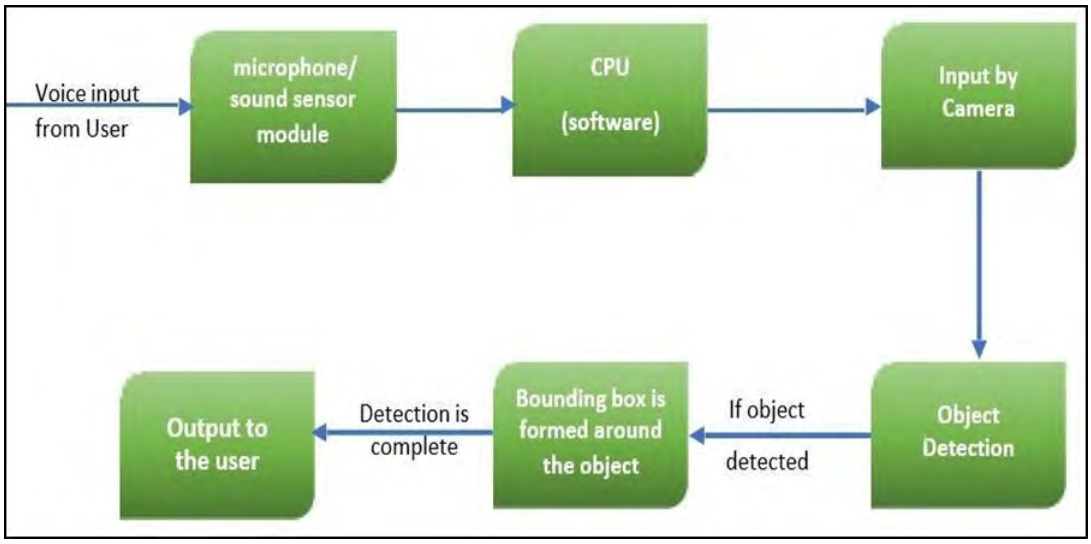


Figure 1. Control flow diagram of our model

is considered for the sector of population wherein blind people resides, as this method is using voice commands which would help these people to navigate through things. Of the countless methods that have been developed, the user approach and the closest iterative user approach are the simplest to understand and easily extendable to capture the different objects and detect the required one. Following are some areas where this model could be used :

• Blind People Navigation : This model could help these people to navigate and search through things.

• Deaf people navigation : This model added with vibrator could help these people to navigate and search through things.

4.1 Scope in different domains :

Healthcare sector : Object Detection via voice commands could help navigate electric wheelchair through voice commands and navigate through surroundings to reach its destination.

Home care: Object detection via voice commands could be of great use to the people of older generation having trouble remembering and finding things which could be easily resolved by our model with added hardware.

5. RESULTS

The results achieved so far on our model as been mentioned below. We had our own custom dataset with total of 39K images out of which 26K were for our train dataset and 13K were for our test dataset. And After training our model the results we gained are tremendous as listed below.

5.1 For object detection

For training data set	
Precision	64 %
True positive	63.78 %
False positive	36.21 %

Table III: Detection evaluation metric of our custom dataset model

Our dataset model contains 52 classes. Average precision for some of the classes are mentioned here :

Class name	**Average Precision**
Coffee cup	72.37 %
Mobile phone	77.45 %
Bed	66.84 %
Scissors	68.37 %
Mug	72.43 %
Watch	71.14 %
Bottle	76.56 %
Desk	70.12 %

Table IV: Average precision for some classes

Object detection result for unseen objects: Predicted in 54.191000 milli- seconds.
Desk: 61 % Coffee table: 61 %

Figure 2. Bounding box image

5.2 For speech detection

We tested some words with different speakers and accent using our model, which uses google speech API python Speech Recognition library :

Words	**Speaker 1**	**Speaker 2**	**Speaker 3**
hello	hello	hello	hello
louder	louder	ladder	louder
phone	fun	phone	phone
fist	fist	fist	fixed
there	there	sarah	there
fool	fool	fool	full
exactly	exactly	exactly	exactly
person	pearson	person	person
bottle	bottle	what are	bottle
start	start	start	start
Recognition %	98 %	92 %	97 %

Table V: Result of speech recognition from voice samples of 3 different speakers

6. CONCLUSION

With many embedded technologies being evolved recently, this model would help the blind sector population to easily use such technology since it has voice commands as an added feature to it and would help them to navigate search through surrounding easily via this model software. Furthermore, as discussed in future scope, our model could bring great changes in the healthcare and home-care sector with many advantages to it and different kinds of people could use this model i.e. from small children with blind or deaf illnesses or old age people who find it difficult to search for objects or a person having weak memory.

This model could be used in all walks of life and could be further improvised in different sectors. It is also easy to use and understand and also is faster and much more accurate as discussed above. This model could help us in many ways possible and could be great asset in furthering of obstacle detection and navigation areas.

References

Beery, S., Wu, G., Rathod, V., Votel, R., and Huang, J. 2020. Context r-cnn: Long term temporal context for per-camera object detection. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*. 13075–13085.

Benkerzaz, S., Elmir, Y., and Dennai, A. 2019. A study on automatic speech recognition. *Journal of Information Technology Review 10,* 3, 80–83.

Bochkovskiy, A., Wang, C.-Y., and Liao, H.-Y. M. 2020. Yolov4: Optimal speed and accuracy of object detection. *arXiv preprint arXiv:2004.10934*.

Dansena, D. K. and Rathore, Y. A survey paper on automatic speech recognition by machine.

Devaki, P., Shivarsha, S., Bala Kowsalya, G., and Manjupavithra, M. 2019. Real-time object detection using deeplearning and open cv. *Int. J. Innov. Technol. Explor. Eng 12,* 8, 411–414.

Du, S., Zhang, B., Zhang, P., Xiang, P., and Xue, H. 2021. Fa-yolo: an improved yolo model for infrared occlusion object detection under confusing background. *Wireless Communications and Mobile Computing 2021*.

Flitton, G., Breckon, T. P., and Megherbi, N. 2013. A comparison of 3d interest point descriptors with application to airport baggage object detection in complex ct imagery. *Pattern Recognition 46,* 9, 2420–2436.

Igarashi, K. and Wilson, I. 2020. Improving japanese english pronunciation with speech recognition and feed-back system. In *SHS Web of Conferences*. Vol. 77. EDP Sciences, 02003.

Këpuska, V. and Bohouta, G. 2017. Comparing speech recognition systems (microsoft api, google api and cmu sphinx). *Int. J. Eng. Res. Appl 7,* 03, 20–24.

Lyashenko, V., Laariedh, F., Sotnik, S., and Ayaz, A. M. 2021. Recognition of voice commands based on neural network.

Nijhawan, G. and Soni, M. 2014. Real time speaker recognition system for hindi words. *International Journal of Information Engineering and Electronic Business 6,* 2, 35.

Sandeep Kumar, Aman Balyan, M. C. 2017. Object detection and recognition in images. *IJEDR 5,* 4, 411–414.

Senthil Murugan, A., Suganya Devi, K., Sivaranjani, A., and Srinivasan, P. 2018. A study on various methods used for video summarization and moving object detection for video surveillance applications. *Multimedia Tools and Applications 77,* 18, 23273–23290.

Swamy, S. and Ramakrishnan, K. 2013. An efficient speech recognition system. *Computer Science & Engineering 3,* 4, 21.

Tan, M., Pang, R., and Le, Q. V. 2020. Efficientdet: Scalable and efficient object detection. In *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*. 10781–10790.

()

Chetana Thaokar is an Assistant Professor at Shri Ramdeobaba College of Engineering and Management,Nagpur.She has received master's degree from Nagpur University and currently Pursuing the Ph.D from KIIT, Bhubaneshwar. Her research interest includes Natural Language Processing, Information Retrieval, Machine Learning and Artificial Intelligence.
E-mail: thaokarcb@rknec.edu

Gayatri G Ladsawangikar is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing her B.E. Degree in stream of Information Technology.
E-mail: ladsawangikargg@rknec.edu

Tanaya C Wadibhasme is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing her B.E. Degree in stream of Information Technology.
E-mail: wadibhasmetc@rknec.edu

Sandeep S Sureka is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.
E-mail: surekas@rknec.edu

Design and Analysis of Multipliers for DNN application using approximate 4:2 Compressors

Hemant Gillurkar, Pravin Dwaramwar, Shubham Anjankar and Pankaj Joshi
Department of Electronics Engineering Shri Ramdeobaba College of Engineering and Management, Nagpur, Maharashtra, India

The demand for Deep Learning applications in resource constrained devices is booming in recent years. The use of Deep Neural Network (DNN) is the leading method in these applications which has error resilient nature. This allows the use of Approximate Computing for efficient computation to leverage efficiency accuracy trade off by replacing Approximate Multiplier in place of exact multipliers. In this paper we proposed Approximate Compressors and compared them in different cases of 8 bit integer dadda multipliers in terms of the Error metrics and accuracy in real life object classification applications. The approximate multipliers are designed using different compressors and used to perform multiplication in ResNet. We have proposed two approximate compressors designs Design 1 and Design 2.The proposed 4:2 compressors design shows the more correct outputs and less Worst Case Relative Error (WCRE) in the range of 2-16. Our proposed 4:2 compressor Design1 is utilized in the modified Reduction circuitry of dadda multiplier and shows the accuracy of 81.6 % for DNN application.

Keywords: Approximate Compressor, Approximate multipliers (AMs), Deep Neural Network (DNN).

1. INTRODUCTION

The exponential growth of digital data such as images, videos and speech from various sources like social media and the Internet of Things (IoT), is driving the demand for high-performance Machine Learning (ML) modern applications. Machine learning algorithms can learn using mathematical models based on training data without any human intervention or assistance. The Neural networks based ML algorithms are the key for these applications. As compared to other machine learning algorithms, deep neural networks (DNNs) have achieved dramatic accuracy improvements over the past decade, which are used for the vast range of applications from image classification, object detection, drone navigation, traffic prediction, etc. In the neural network (NN) the idea of a neuron is taken from the human neuron which performs a mathematical function Sze et al. [2017]. It takes one or more input signals (xi) that are multiplied by values called "weights" (wi) and added together, as shown in the fig.1(i). To perform this operation, multiply and accumulate units (MAC) units are used. In order to perform these operations, adders and multipliers are utilized. An activation function is also used to introduce the nonlinearity to the network.

The literature Vaughan [2022]Klein et al. [2021] shows the use of fixed point arithmetic is used to gain the advantage of Efficiency – Accuracy trade-off for DNN due to its error resilient nature. To reduce the energy consumption of computation, the Advantage of Efficiency – Accuracy trade-off can be utilized in the multiplier. For example, 16b FP multiplier requires 30 % energy and 21 % area compared to 32b FP multiplier which can be utilized in DNN. For AlexNet even total MAC operations are 724M but around 3000M times require DRAM accesses, hence it is costlier for battery operated devices Brodley et al. [2012].To further leverage the Efficiency – Accuracy trade-off the exact multipliers are replaced by Approximate Multipliers (AMs). The design of the approximate multipliers proposed in Manikantta Reddy et al. [2019] using a novel design of an approximate 4:2 compressor where accuracy is estimated using a modified dada multiplier. The design shows an error rate of 12.5 % compared to the other approximate multiplier and the area and the delay is reduced by 17 % and the 36 % effectiveness assessed by the image processing

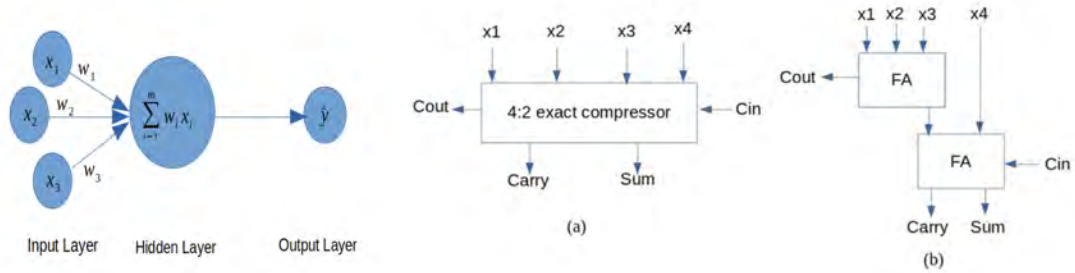


Figure. 1 (i) Neurons in Neural Networks. (ii) Exact compressor (a) Block Diagram of 4:2 Compressor (b) Implementation using Full Adders

application. The modified 4:2 approximate compressors based AM are proposed in Momeni et al. [2015] where they proposed the four different schemes. These multipliers are used in the image processing application. In the Shobana et al. [2022] 4 bit and 8-bit approximate multipliers are used with the modified architecture of the 4:2 compressors from [13] and tested on the 3 layer artificial neural network (ANN) model. Ansari et al. [2020] shows that using AMs can also improve the DNN accuracy and showing the improvement of classification accuracy by 0.63 % with reductions of energy consumption by 71.45 % and area by 61.55 %. In Mrazek et al. [2020] 8 bit approximate multipliers from EvoApprox8b library were used with Resnet DNN architecture and trained on the CIFAR-10 data set. Several different types of AM are tested on Resnet architecture and show that the acceptable accuracy can be achieved with different AMs. Therefore we can perform the integer multiplication operation with AM by introducing some amount of error, which will perform efficient operation by providing acceptable accuracy in DNN. The paper is organized as follows section 2 review of exact Compressors and in subsection two new 4:2 approximate compressors are proposed. In section 3 different cases of dadda multipliers are reviewed. Errors and accuracy of multipliers are evaluated in section 4 and section 5 concludes this paper. Past work Lecun et al. [1998], Krizhevsky et al. [2017], Aktas et al. [2022], Jongkind [2017], Shafiq and Gu [2022], Asakawa et al. [2022] discussed about popular DNN models like LeNet-5,AlexNet, VGG-16, GoogLeNet, ResNet-50, EfficientNet-B4.

2. COMPRESSORS

In this section exact compressor and Proposed approximate compressors were discussed.

2.1 Exact Compressor

In the process of multiplication, compressors are normally used to serve two major purposes, first to speed up the operation and second to reduce the number of stages in the partial product generation. To solve the partial product there are various compressor topologies that are available in different combinations 3:2, 4:2, and 5:2 Mrazek et al. [2020]. We are using 4:2 compressors which are frequently used to build exact compressors. There are a large number of 4:2 compressor designs that were proposed to design a 4:2 approximate multiplier so it's difficult to select the right combination of compressor and multiplier architectures.
The general block diagram of the 4:2 compressor is shown in Fig.1 (ii a) It consists of four inputs, i.e x1, x2, x3, x4 with a Carry in (Cin) and sum, Carry as outputs with a Carry out (Cout) for propagation.

The simple implementation of a 4:2 compressor uses two full adders (FA) in series as shown in figure 2(ii). Each FA possesses 3 inputs and 2 outputs. The Carry of the first FA will be propagated to the next FA as Cin and thus generate Sum and Carry as final outputs.

2.2 Approximate Compressor

We have proposed approximate compressors Design 1 and Design 2 in this section.

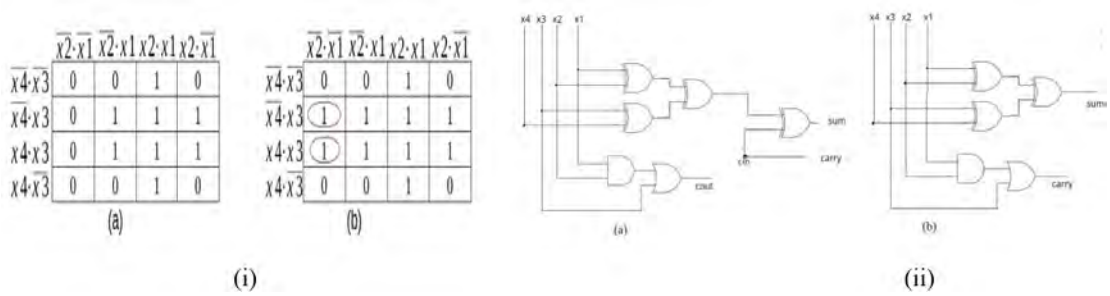


Figure. 2 (i) K-Map of the Cout (a) Exact Compressor (b) Proposed Design 1 Compressors (ii) Logic Diagram of Approximate Compressors: (a) Design 1 (b) Design 2

2.2.1 *Approximate Compressor.* To introduce error in the multiplier some of the exact compressors are replaced by approximate compressors. The Carry out (Cout) is a 1-bit binary number with higher significance because it goes to the next column. The Carry bit has lower significance as it goes to the same column but next stage. So we have introduced an error in the Carry signal. In an exact compressor, values of the Carry are identical to input values Cin in 24 out of 32 states. In our proposed Design, the Carry is rationalized to Cin by changing the value of other 8 outputs, which is expressed as Carry' shown in the equation (6), This is the same approach adopted from Momeni et al. [2015]. In the proposed design the sum equation (5) is the same as the exact compressor (1) expressed as sum'.

$$Sum' = X_1 \oplus X_2 \oplus X_3 \oplus X_4 \oplus Cin \tag{1}$$

$$Cout' = (X_1 X_2) \mid X_3 \tag{2}$$

$$Carry' = Cin \tag{3}$$

In order to reduce the design complexity, we have introduced errors at the calculation of Cout. We have introduced two 1's at the K-map as shown in fig 2 (i b) and simplified equation (5) of Cout' is calculated. This may increase the error rate in the proposed approximate compressor but reduce the design complexity which results in a reduction of the power consumption, this can be realized by comparing equations (2)-(5) and (3)-(6).

2.2.2 *Design 2.* The second design of the approximate compressor is a modified approximate compressor of [13] where the Cin and Cout signal is ignored because the same signal Cin is carried forward to Cout.

$$Sum' = X_1 \oplus X_2 \oplus X_3 \oplus X_4 \tag{4}$$

$$Cout' = (X_1 X_2) \mid X_3 \tag{5}$$

Carry and Cout signal have the same weights by hence Carry' signal is interchanged with Cout signal equation (5). In Carry of design 2 approximate compressor. sum signal (7) is kept the same as the (4). Gate level implementation is shown in fig. 2(ii b).

3. APPROXIMATE MULTIPLIER

Approximate compressors are used in 88 unsigned Dadda multiplier architecture. The most commonly used techniques for the generation of approximate arithmetic circuits are truncation [4]. where the LSB (Least significant bit) hardware is truncated to make the LSB k-bit to zero. A nk-bit of multiplier output is utilized instead of an accurate n-bit multiplier. This results in reducing partial products as well as the hardware. The multiplier uses 4 half adders, 16 full

Table 2. Truth Table of 4:2 exact compressor and Design 1 and 2 approximate compressor.

Input					Exact			Approximate design 1			Approximate design 2	
cin	x1	x2	x3	x4	cout	carry	sum	Cout ‘	Carry ‘	Sum ‘	carry’	sum’
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	1	0	0	1	0	1
0	0	0	1	0	0	0	1	0	0	1	0	1
0	0	0	1	1	1	0	0	1	0	0	1	0
0	0	1	0	0	0	0	1	1	0	1	1	1
0	0	1	0	1	1	0	0	1	0	0	1	0
0	0	1	1	0	1	0	0	1	0	0	1	0
0	0	1	1	1	1	0	1	1	0	1	1	1
0	1	0	0	0	0	0	1	0	0	1	0	1
0	1	0	0	1	0	1	0	0	0	0	0	0
0	1	0	1	0	0	1	0	0	0	0	0	0
0	1	0	1	1	1	0	1	1	0	1	1	1
0	1	1	0	0	0	1	0	1	0	0	1	0
0	1	1	0	1	1	0	1	1	0	1	1	1
0	1	1	1	0	1	0	1	1	0	1	1	1
0	1	1	1	1	1	1	0	1	0	0	1	0
1	0	0	0	0	0	0	1	0	1	1	0	0
1	0	0	0	1	0	1	0	0	1	0	0	1
1	0	0	1	0	0	1	0	0	1	0	0	1
1	0	0	1	1	1	0	1	1	1	1	1	0
1	0	1	0	0	0	1	0	1	1	0	1	1
1	0	1	0	1	1	0	1	1	1	1	1	0
1	0	1	1	0	1	0	1	1	1	1	1	0
1	0	1	1	1	1	1	0	1	1	0	1	1
1	1	0	0	0	0	1	0	0	1	0	0	1
1	1	0	0	1	0	1	1	0	1	1	0	0
1	1	0	1	0	0	1	1	0	1	1	0	0
1	1	0	1	1	1	1	0	1	1	0	1	1
1	1	1	0	0	0	1	1	1	1	1	1	0
1	1	1	0	1	1	1	0	1	1	0	1	1
1	1	1	1	0	1	1	0	1	1	0	1	1
1	1	1	1	1	1	1	1	1	1	1	1	0

adders, and 18 4:2 compressors for design 1 compressor, The multiplier fig. 3(b) uses 5 half adders, 16 full adders, and 17 4:2 compressors for design 2 compressor.

The Eighteen cases of multipliers that are implemented and analyzed are shown in table 3.

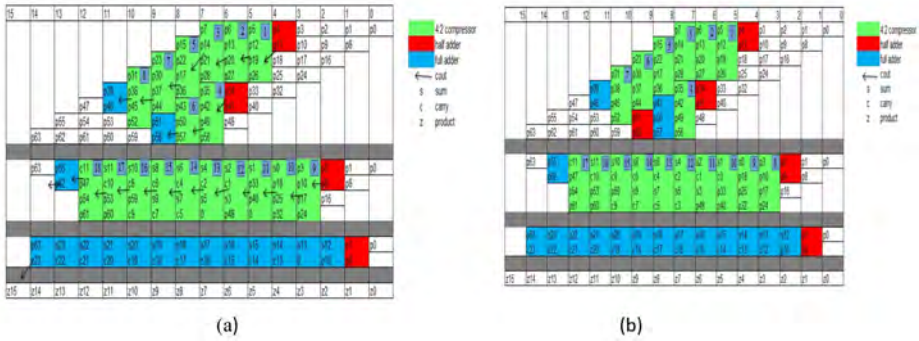


Figure. 3 8bit unsigned Dadda Multipliers for (a) Design 1 (b) Design 2

4. EXPERIMENTATION

A In this section, the error metrics and the accuracy are calculated for the proposed approximate multiplier.

4.1 Error metrics

The quality of approximate combination circuits is typically expressed using one or several error metrics such as Error Distance (ED), Mean Absolute Error (MAE), Mean Square Error (MSE), Mean Relative Error (MRE), Worst Case Error (WCE), Worst Case Relative Error (WCRE) and Normalized Error Distance (NED). Where the n-bit multiplier exact results are represented as p and the approximate results are represented as p'.

4.2 DNN Application

To evaluate the proposed multiplier in real life applications, the ResNet convolution neural network (CNN) on the CIFAR-10 data set is used. CIFAR-10 data set consists of 32 x 32 colour images in 10 classes, of an airplane, automobile, bird, cat, dog, etc with 6000 images per class. The effect of multipliers is introduced in the convolution layer; there are 7 convolution layers which perform 21 millions multiplications in the inference phase[16]. The exact multiplier is replaced with an approximate multiplier and it is used in all layers. We used the TFApprox extension to accelerate the simulation of the ResNet network. In which neural network is first frozen, quantized, and then passed through the convolutional layers, in which usual Quantized-Conv2D layers are replaced with AxConv2D which is an approximate convolution layerehw fit [2020]. The multiplier designs are analyzed and studied using error metrics and the accuracy of multipliers in the DNN application as shown in table 5. The baseline for this study is the M1 of the exact compressor having 83.3 % of accuracy and 0 errors and all correct outputs (CO) as shown in table 4. The truncated multiplier is used where LSBs are truncated one by one and the accuracy of the DNN application and it's observed that the accuracy of the multiplier is reduced after the 4th bit of truncation as shown in fig. 4 So in the M2 we use the Truncated multiplier where the 4 bit LSB's are truncated. The accuracy is reduced to 82.5 % and the COs are reduced by 81.5 %. In M3 - M10, we use the approximate compressor from [13], where the accuracy for

Table 3. Different Multipliers Design and Their Features

Design Name	Features
Multiplier 1 (M1)	Exact compressor in all columns
Multiplier 2 (M2)	Truncation of 4 bit LSB's columns
Multiplier 3 (M3)	Momeni et al[13] design 1 in all columns
Multiplier 4 (M4)	Momeni et al[13] design 2 in all columns
Multiplier 5 (M5)	Momeni et al[13] design 1 in n-1 LSB columns replacing compressor number 1,2,9-12
Multiplier 6 (M6)	Momeni et al[13] design 2 in n-1 LSB columns replacing compressor number1,2,9-12
Multiplier 7 (M7)	Momeni et al[13] design 1 in compressor number 9,10,11
Multiplier 8 (M8)	Momeni et al[13] design 2 in compressor number 9,10,11
Multiplier 9 (M9)	Truncation of 4-bit LSB columns 0-3 and Momeni et al[13] design 1 in compressor number 10,11
Multiplier 10(M10)	Truncation of 4-bit LSB columns 0-3 and Momeni et al[13] design 2 in compressor number 10,11
Multiplier 11 (M11)	Proposed Design 1 in all columns
Multiplier 12 (M12)	Proposed Design 2 in all columns
Multiplier 13 (M13)	Proposed Design 1 in n-1 LSB columns replacing compressor number 1,2,9-12
Multiplier 14 (M14)	Proposed Design 2 in n-1 LSB columns replacing compressor number 1,2,9-12
multiplier 15 (M15)	Proposed Design 1 in compressor number 9,10,11
Multiplier 16 (M16)	Proposed Design 2 in compressor number 9,10,11
multiplier 17 (M17)	Truncation of 4-bit LSB columns 0-3 and Proposed Design 1 in compressor number 10,11
multiplier 18 (M18)	Truncation of 4-bit LSB columns 0-3 and Proposed Design 2 in compressor number 10,11

M3 and M4 is 11.5 % and 10.3 % also COs are reduced by 99.84 % and 99.30 % respectively. For M5 and M6 the approximate compressors are used in n-1 list significant columns only and the MAE of 60.29, 51.44, and WCE of 208, 200 are found respectively while COs are reduced by 91.02 %, 85.78 %. The accuracy of M5 and M6 is improved as compared to the M3 and M4. To

reduce the error in M5 and M6, we utilize approximate compressors in stage 2 i.e upto n-2 list significant columns and observed that the accuracy is increased to 80.9 % and 80.5 % in M7 and M8. In M9, M10,we have truncated the 4-bit LSB of the M7 -M8 the accuracy was decreased to 79.3 %, 80.1 %, also the COs reduced to 2912 and 2816. Our proposed compressors Design 1 and Design 2 are used in the M11-18 which has CO is relatively higher but the errors are also higher than the M3-M10. In the M11-M12 accuracy 10.1 %, 11.4 % is less but the COs are reduced by 95.56 %, 87.55 %, these are more than M3, M4. M11 has the maximum NED value and lowest accuracy among all. Similarly M13, M14 uses proposed approximate compressors Design 1 and Design 2 in the n-1 list significant columns giving the accuracy of 54.8 % and 52.4 %. The accuracy is decreased with respect to the M5, M6. which is not efficient in DNN applications. The same approach which is adopted in M7, M8 is used in M15, M16 resulting in accuracy of 77.7 % and 77 %. The COs of M15 and M16 are highest among all approximate multipliers. Due to error resilient nature of application we have truncated 4 bit LSB's of M15, M16 and Designed multipliers M17, M18. The multiplier M17 gives an accuracy of 81.6 % which is the highest among all after M2 and resulting in less than 1 % loss in accuracy. Also the network accuracy calculated for M18 but it is found that 78.3. In our Design M11-M18 the WCRE is very less compared to the multipliers M3-M10. We have demonstrated that the acceptable loss in accuracy can be achieved by adding errors in MAC operations.

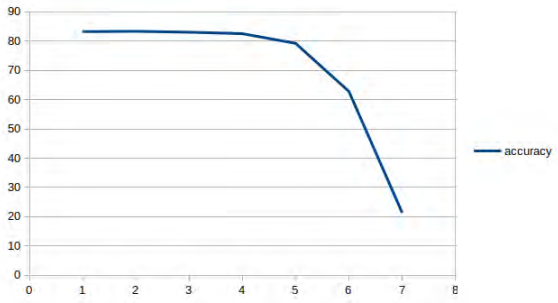


Figure. 4 ResNet Accuracy vs Truncation of Input LSBs

5. CONCLUSION

To perform efficient computation we can utilize approximate computing in DNN due to its error resilient nature. For deployment of DNN on resource constrained devices, we need to utilize Approximate Computing where exact multiplication can be replaced by approximate multiplication. Therefore In this paper, we have proposed the two approximate compressor designs and quantified the error metrics and accuracy in real life application also compared with various multiplier designs. The error is introduced in multiplier calculation and accuracy is calculated for ResNet architecture. Among all approximate multipliers, the multiplier with our proposed compressor Design 1 with truncation shows better performance of 81.6 % accuracy. It is found that due to the error resilient nature we can exploit efficiency-accuracy trade off.

References

Aktas, K., Ignjatovic, V., Ilic, D., Marjanovic, M., and Anbarjafari, G. 2022. Deep convolutional neural networks for detection of abnormalities in chest X-rays trained on the very large dataset. *Signal, Image and Video Processing*.

Ansari, M. S., Mrazek, V., Cockburn, B. F., Sekanina, L., Vasicek, Z., and Han, J. 2020. Improving the Accuracy and Hardware Efficiency of Neural Networks Using Approximate Multipliers. *IEEE Transactions on Very Large Scale Integration (VLSI) Systems 28,* 2 (2), 317–328.

Asakawa, E., Kaneko, N., Hasegawa, D., and Shirakawa, S. 2022. Evaluation of text-to-gesture generation model using convolutional neural network. *Neural Networks 151*, 365–375.

Brodley, C. E., Rebbapragada, U., Small, K., and Wallace, B. 2012. Challenges and Opportunities in Applied Machine Learning. *AI Magazine 33,* 1 (mar 15), 11–24.

ehw fit. 2020. Github - ehw-fit/tf-approximate: Approximate layers - TensorFlow extension. https://github.com/ehw-fit/tf-approximate. [Online; accessed 2022-10-19].

Jongkind, D. 2017. Book Review: Going Deeper with New Testament Greek: Andreas J. Köstenberger, Benjamin L. Merkle, Robert L. Plummer, Going Deeper with New Testament Greek. *The Expository Times 128,* 5 (2), 252–252.

Klein, S. C., Kantic, J., and Blume, H. 2021. Fixed Point Analysis Workflow for efficient Design of Convolutional Neural Networks in Hearing Aids. *Current Directions in Biomedical Engineering 7,* 2 (oct 1), 787–790.

Krizhevsky, A., Sutskever, I., and Hinton, G. E. 2017. Imagenet classification with deep convolutional neural networks. *Communications of the ACM 60,* 6 (may 24), 84–90.

Lecun, Y., Bottou, L., Bengio, Y., and Haffner, P. 1998. Gradient-based learning applied to document recognition. *Proceedings of the IEEE 86,* 11, 2278–2324.

Manikantta Reddy, K., Vasantha, M., Nithin Kumar, Y., and Dwivedi, D. 2019. Design and analysis of multiplier using approximate 4-2 compressor. *AEU - International Journal of Electronics and Communications 107*, 89–97.

Momeni, A., Han, J., Montuschi, P., and Lombardi, F. 2015. Design and Analysis of Approximate Compressors for Multiplication. *IEEE Transactions on Computers 64,* 4 (4), 984–994.

Mrazek, V., Sekanina, L., and Vasicek, Z. 2020. Using Libraries of Approximate Circuits in Design of Hardware Accelerators of Deep Neural Networks. *2020 2nd IEEE International Conference on Artificial Intelligence Circuits and Systems (AICAS)*.

Shafiq, M. and Gu, Z. 2022. Deep Residual Learning for Image Recognition: A Survey. *Applied Sciences 12,* 18 (sep 7), 8972.

Shobana, G., Chithiraimuthu, R., and Adhithyavel, A. 2022. Performance analysis and implementation of approximate multipliers on spartan 6 FPGA. *International journal of health sciences*, 10633–10652.

Sze, V., Chen, Y.-H., Yang, T.-J., and Emer, J. S. 2017. Efficient Processing of Deep Neural Networks: A Tutorial and Survey.

Vaughan, O. 2022. Accelerating deep learning with precision. *Nature Electronics 5,* 7 (7), 411–411.

Shubham Anjankar is Assistant Professor in Shree Ramdeobaba College of Engineering and Management, Nagpur (India). He has done his M.E. in VLSI and Embedded System from Department of Electronics and Communication Engineering, MIT College of Engineering, Pune. He has more than 7 years of teaching Experience. He has worked on many research projects. He has over 10 published research papers in international journals/conferences.
E-mail: anjankarsc@rknec.edu

Dr. Pankaj U. Joshi was born in Nagpur, India. He did his bachelors and Masters from the RTM Nagpur University. He completed his Ph.D. from VNIT Nagpur, India in 2018. Since 2009 he has been working with Ramdeobaba College of Engineering and Management Nagpur. His research interests include VLSI Signal Processing and Architectural Optimizations of DSP applications.
E-mail: joshipu@rknec.edu

Pravin Dwaramwar is Associate Professor in Shree Ramdeobaba College of Engineering and Management, Nagpur (India). He has done his B.E. from Department of Electronics , VNIT Nagpur. He has completed his M.Tech from Shree Ramdeobaba College of Engineering and Management, Nagpur in VLSI Desgin. He has more than 30 years of teaching Experience. He has worked on many research projects. He has over 10 published research papers in international journals/conferences.
E-mail: dwaramwarpa@rknec.edu

A Model for Rainfall Forecasting using Distinct Machine Learning Algorithm

Sachin Upadhye and Lalit Agrawal
Department of Computer Application, Shri Ramdeobaba College of Engineering and Management, Nagpur, India.

As Agriculture is the pivotal point of survival, rainfall is the important source of its cultivation. Rainfall prophecy has always been a major problem as a prophecy of downfall gives awareness to people and to know in advance about rain to take necessary precautions to cover their crops from rain. A particular dataset is taken from the Kaggle community and this design predicts whether it will rain henceforth or not by using the rainfall in the dataset. Cat Boost model is executed in this design as it's an open-sourced machine knowledge algorithm, and features great quality without parameter tuning, categorical point support, bettered delicacy, and fast prophecy. Cat Boost model is a Grade boosting toolkit and two critical algorithms classical and innovative are introduced to produce a fight in prophecy shift present in presently being prosecutions of grade boosting algorithms. Cat Boost performed truly well giving an AUC (Area under wind) score0.8 and a ROC (Receiver operating characteristic wind) score of 89. ROC is called an assessing wind whereas AUC presents a degree or measure of separability as the model is professed enough to distinguish between classes. An Exploratory data analysis is done to examine data distribution, and outliers and provides tools for imaging and understanding the data through graphical representation.

Keywords: Machine Learning; Rain Forecast; Meteorological Phenomena; Cat Boost; Outliers.

1. INTRODUCTION

Precipitation forecast is vital as serious Rainfall will bring about a few calamities. The forecast assists people with requiring preventive measures and the expectation should be right. There are two assortments measure of forecast namely, momentary and long-duration rainfall expectation. There are well known method for predicting the momentary rainfall, but most challenges is to predict the long-duration rainfall. Because it is so intimately tied to human life and the economy, accurate precipitation prediction could be a significant setback for the natural science department. Every year, people all around the world experience natural calamities like floods and droughts as a result of this unit of measurement. For nations like India, whose economy is mostly driven by agriculture, the accuracy of the rainfall statement is very important. Due to the atmosphere's complex character, applied mathematics techniques are unable to provide reliable accuracy for precipitation statements. Regression may be used in machine learning approaches for the prediction of precipitation abuse. This project aims to provide non-experts with simple access to the methodologies and techniques used in the field of precipitation prediction and to provide a comparison of the various machine learning algorithms. Precipitation may be a crucial concern right now for many important things happening all around the world. The economy of the nation is said to be heavily dependent on the farming industry, which is totally reliant on precipitation. This study uses machine learning approaches for predicting precipitation and also performs a comparison analysis of two machine learning algorithms. It is showing an affordable method for doing so. Precipitation forecasting helps with a variety of human needs, including managing water supplies, flood warnings, managing airline operations, restricting traffic, and planning construction projects. Using wired and wireless devices, high-speed computers, and meteorology satellites, precipitation information is gathered for forecasting. Since the beginning of civilization, precipitation prediction has been a desirable and appealing field, and it continues to be one of the most challenging and fascinating ones. Prediction gathers information on

local conditions such as humidity, temperature, pressure, rainfall, wind speed and direction, and evaporation. Precipitation forecasting is currently the most important concern for many water storage plans around the world. One of the most challenging problems is the unpredictability of precipitation information. The majority of precipitation prediction methods used today are unable to reveal hidden patterns or non-linear trends in precipitation data. This study would make it easier to find any hidden patterns or non-linear trends that may be required to accurately anticipate precipitation Alapaty et al. [1995]. The forecast predictions were inaccurate, resulting in significant losses, due to the presence of complex issues in existing approaches that can't effectively realise the hidden patterns and non-linear trends the majority of the time. Therefore, the goal of this analysis is to find a precipitation prediction system that can resolve all issues, recognise the gifts that high quality and hidden patterns present, and provide accurate and dependable predictions, thereby assisting the nation in developing its economy and agricultural sector.

2. LITERATURE SURVEY

All human life, along with all commercial and artificial functions, depend on water. Planning and timing these activities require accurate downfall vaticination. Numerous studies have been done on various methods for preventing deception, including but not limited to data mining, machine learning, and artificial neural networks Chen et al. [2011]. One of the key figures that pioneered the use of artificial neural networks and data wisdom in rainfall forecasting. He employed Adaline, an adaptive algorithm for categorising patterns that was trained using ocean-position atmospheric pressures and variations in wind direction over the course of a 24-hour period. The predictions performed well when compared to actual United States Weather Bureau forecasts. Hu's research laid the groundwork for the creation of precise and sophisticated methods of downfall. Cook Chen et al. [2011] provided a data-wise approach to forecast average air temperatures. The back-propagation literacy algorithm was one of many algorithms they had tested. The Linardatos Linardatos et al. [2020] experimenters accepted important exploration work in data- wisdom-founded downfall foretelling. They used a neural network model to interpret two-class downfall predictions one hour in advance. Michaelides and the platoon Michaelides et al. [2001] conducted research in which they compared the effectiveness of a neural network model with numerous direct retrogressions in thinking and bluffing, missing downfall data over Cyprus. Predictions of rainfall frequently use data mining techniques. According to astronomy, Joseph and et.al. Joseph and Ratheesh [2013] divide colourful rainfall vaticination techniques into three general groups. Synoptic rainfall vaticination: A conventional method of rainfall vaticination entails keeping an eye on the point rainfall essential elements during a certain period of compliance requirements at a harmonious frequency Joseph and Ratheesh [2013]. It entails gathering data every day and examining the vast amount of observed data to look for patterns of support. Numerical rainfall vaticination: Uses computer logic to simulate rainfall and enables the computer programme to create models after analysing the observed data rather than a human-defined parametric model. In many cases, artificial intelligence fashions are mixed with this. Statistical rainfall vaticination: The major underlying assumption is that "the future rainfall patterns will be a repetition of the past rainfall patterns," and it is usually linked with numerical rainfall vaticination styles. Using data collected between 2002 and 2005, Shah and et.al. Shah et al. [2018] uses a decision tree and wain algorithm for downfall vaticination. A clustering algorithm with K-nearest neighbours was used by Sharif and his team Sharif and Burn [2007] to identify the underlying trends in a sizable collection of rainfall data. They succeeded in achieving a high vaticination delicacy of temperature, humidity, and precipitation. The basic goal is to create a model that can identify rainfall patterns and forecast whether it will rain tomorrow or not.

3. RELATED WORK

One of the most important variables that affects how users of the system live their lives and, in turn, how the local economy and electorate are affected by it is rainfall. A prediction of future

precipitation instability behaviour should be initiated in order to prevent calamities brought on by precipitation activities. Two techniques are frequently employed to predict precipitation. The first is to take the vast volumes of data gathered over time and analyse it to get knowledge on future precipitation. The production equations, on the other hand, involve manipulating a number of factors and swapping values to produce the desired result. This method anticipates the possibility of rain by accounting for all the factors that affect precipitation. A unique, upgraded, and optimised data processing method is used to forecast precipitation. Many characteristics of the climate are assumed to indicate rain. The following types of information are gathered: evaporation, atmosphere, wind speed and direction, maximum and minimum temperatures, humidity, etc. It is stated that utilising many characteristics won't ensure the forecast will be incredibly reliable. Both supervised and unsupervised strategies for prediction can be taken into account. Predictions in Asian nations, Columbia, Australia, and India were stated in study. One of the most important factors that influenced the outcome was the previous meteorological data used to train the algorithmic software. The space in which the prediction can take place as well as the climate parameters are employed as predictors. Finding correlations between weather characteristics is one of the top recent analysis trends in this field, while others place more emphasis on programming algorithmic systems. Precipitation prediction will be influenced by numerous hidden elements, and data processing techniques will find all of the hidden patterns. This strategy should be modified and improved so that all projections are more accurate. Therefore, the goal of the future analysis is to enhance, improve, and combine this data processing technique in order to resolve all of the current difficulties in identifying hidden patterns. There is a reliable correlation between the meteorological variables.

a) **System Architecture**

Figure 1. System architecture of model

b) **Methodology** The goal of this research is to examine the opportunities provided by machine learning algorithms as alternatives to traditional vaticination techniques for rain vaticination. The posterior methods were used in this study to apply to KNN, Random Forest, Cat Boost Classifier, Logistic Regression, GuassianNB, and XGBclassifier. Random forest is a supervised algorithmic programme and associate degree ensemble learning technique of machine learning technology. A learning method known as "ensemble learning" combines various algorithmic programmes or an equivalent algorithm repeatedly to provide the best possible prediction method. It integrates a number of related algorithms, particularly the various call trees, to create what resembles a forest of trees. As a result, each classification and regression function is referred to as "Random Forest". The primary steps required to complete the random forest algorithm are to select K records at random from the information set, so use these K records to create a decision tree. Recreate the preceding stages after choosing the percentage of trees you want to employ in your algorithmic programme. Each forest tree calculates the division that the new record falls under once classification is reached. The category that obtains the most votes ultimately receive the new kind. The random forest algorithmic software is unbiased since it uses numerous trees and trains each tree on a sample of data. This algorithmic program is extremely strong. When all of the numerical and categorical attributes are available, the random forest algorithmic programme performs best. In large datasets, random forest predicts the weather quickly. The possibility of a function is examined using logistical regression

by looking at the relationship between dependent and independent variables. It takes into account more than just the relationship between the study variables as though it were a straight line. The natural exponent equation, on the other hand, is used in logistic regression to examine the relationship between variables and determine the coefficients. It is also a supervised machine learning algorithmic software since it uses real identities for training data. A little improvement over rectilinear regression is logistical regression. Although it can be used for both classification and regression, classification was its primary usage. It is known as a general-purpose categorization algorithm. The key distinction between the two is that whereas rectilinear regression makes sense when dependent variables are continuous, logistical regression is only relevant when the dependent variables are binary. Over the past ten years, the benefit of logistical regression for prediction functions has increased.

c) **Libraries and Platforms** NUMPY may be a numerical Python programme that offers efficient mathematical computation functions. It will be used for calculating processes and for searching knowledge in arrays. Various files and directories will be searched and written by PANDAS. Furthermore, the information supply file is very performant and simple to use thanks to the processing of knowledge frameworks. SEABORN is built on matplotlib, a high-level framework for showing enticing and intricate applied mathematics graphics. Matplotlib is used for knowing images in Python knowledge. A Python two-dimensional charting toolkit called matplotlib can generate excellent reports in a variety of hardcopy and graphical forms. Matplotlib is employed in Python scripts, Jupyter notebooks, IPython shells, Web frameworks, and 4 graphical computer program toolkits. Matplotlib strives to create things straightforwardly, and quickly and additionally build complex things' potential. employing a few code lines, you'll be able to generate graphs, histograms, bar charts, scatterplots, etc. Jupyter notebook is the navigator.

d) **Information Preparation** Dataset from Kaggle contains about 10 years of quotidian downfall observances from colourful different locales across Australia. vaticination of coming-day rain by training type models on the target variable Rain hereafter and colourful parameters including Date, position, Mintemp, MaxTemp, Rainfall, Evaporation, Sunshine, WindGustDir, WindGustSpeed, etc. The missing values are generally handled by arbitrary sample insinuation to observe the disunion categorical Vvlues like position, wind direction is handled by using Target guided Encoding Outliers are handled using IQR and boxplot Imbalanced Dataset was handled using SMOTE (Synthetic nonage Oversampling fashion). A number of operations, including missing information, converting categorical variables to numeric, discarding variables, information normalization, and outlier detection, were deployed to organise the data in order to extend the study.

e) **Correlation** By using Spearman Technique, we found the correlation between all continuous variables.

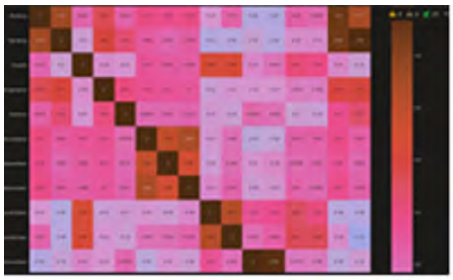


Figure 2. Correlation between all variables

f) **Key Performance Indicators**Numerous variables are frequently used in performance studies of bracket algorithms. The confusion matrix is just one of them. The colourful rainfall bracket algorithms use this in their performance comparison analyses. Two rows and two columns make up the table, which depicts two methods of correct vaticination for rainfall and two methods of incorrect vaticination for erroneous information. AUC-ROC curve, F-measure, sensitivity, specificity, root mean square error, and accuracy, precision, and recall are the main performance metrics.

4. RESULTS

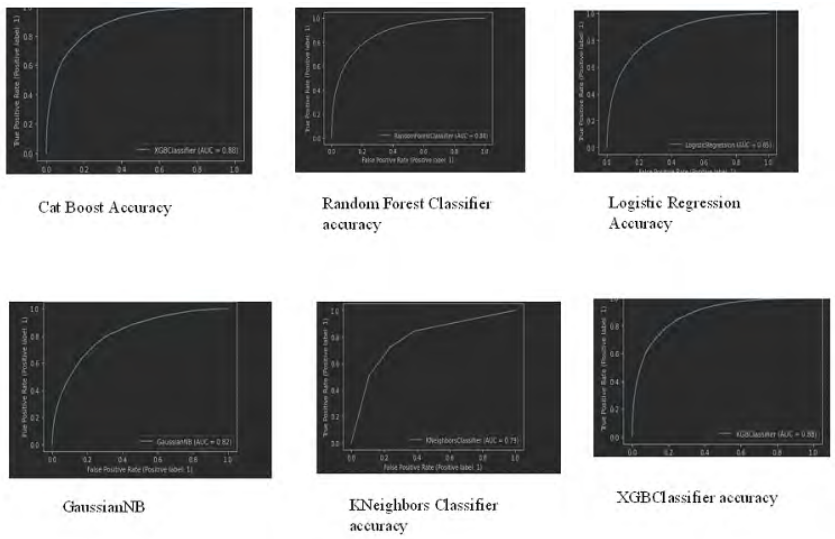


Figure 3. Python graph for different algorithm

This study's goal is to estimate the value of the variable "RainToday" using rainfall data for Australia. Below are all of the results.

a) **Catboost Model** This model follows a fashion that's also divided into four corridors.
• Data pre-processing that involves the gathering of adulterants and other necessary meteorological data alongside with correction of missing values;
• Analysis associated with the relationship between meteorological parameters or variables which of the adulterants;
• Point significance involves the network of meteorological parameters and conjoins the adulterants in the air right before the operation on the models;
• The operation of models like ARIMAANN, ARIMA- SVM, PCR, DT and CatBoost

b) **Random Forest** It is a rule of degrees that combines the fabric-based principles of decision trees in sets. There are a lot of buzzwords in it. The model uses a vote to combine the tree prognostications once the collection of decision trees has been formed. The principal benefit of this rule unit is that it lessens the possibility of over-befitting.

c) **GuassianNB** The probability theorem known as the Bayes theorem serves as the foundation for naive Bayes classifiers. For prophetic modelling, it's a crucial algorithm.

d) **K-NN rule (K- Nearest Neighbors)** In proposal, a bias-disunion trade-off is carried out to choose the number K of closest samples to admit in order to prevent overfitting and underfitting.

e) **XgBoost Model** Generally, XGBoost is presto when compared to other executions of grade boosting. This approach supports both retrogressions as well as type prophetic modelling problems.

5. CONCLUSION AND FUTURE SCOPE

In this research, the applicability of machine learning methods to the problem of precipitation forecasting in the particular situation of Australia was studied. This kind of methodology has been used in earlier papers [2-8/ bc-ij] with entirely different kinds of monthly, annual, and alternate period datasets in places other than Australia. For this project, a set of meteorological data from 49 distinct Australian cities was collected in accordance with these earlier studies. There is a variable "RainToday" in the set that indicates whether or not it rained on the day the sample was taken, and there are other variables that display other meteorological characteristics on the day the sample was taken, such as cloudiness, wind, sunlight, humidity, pressure, or temperature. In order to anticipate precipitation, numerous prediction models assisted by machine learning techniques were used. It was discovered that the cat boost classifier is the most useful model to account for this kind of development. The models' applicability to various cities was also examined in various ways. It was found that the algorithms were more effective in this scenario. Finally, it was examined whether changing the data to perform the coaching and real values may enhance the outcomes, but this improvement was not seen in comparison to earlier analyses. As a result, this new study enabled me to draw several conclusions. In a similar vein, it can be observed that algorithms based mostly on neural networks perform admirably when modelling nonlinear natural processes. Finally, it will be possible to determine where the development will take place because the algorithms are effective and very cost-effective when considering the information separately by city. A fascinating future study connected to the one shown would examine the issue of predicting, many days in advance, that models are the most engaging or what number of days beforehand is ideal for making a prediction.

References

Alapaty, K., Raman, S., Mohanty, U., and Madala, R. 1995. Sensitivity of monsoon circulations to changes in sea surface temperatures. *Atmospheric Environment 29,* 16, 2139–2156. International Conference on Sustainable Development Strategies and Global/Regional/Local Impacts on Atmospheric Composition and Climate.

Chen, C., Duan, S., Cai, T., and Liu, B. 2011. Online 24-h solar power forecasting based on weather type classification using artificial neural network. *Solar energy 85,* 11, 2856–2870.

Joseph, J. and Ratheesh, T. 2013. Rainfall prediction using data mining techniques. *International Journal of Computer Applications 83,* 8.

Linardatos, P., Papastefanopoulos, V., and Kotsiantis, S. 2020. Explainable ai: A review of machine learning interpretability methods. *Entropy 23,* 1, 18.

Michaelides, S. C., Pattichis, C. S., and Kleovoulou, G. 2001. Classification of rainfall variability by using artificial neural networks. *International Journal of Climatology: A Journal of the Royal Meteorological Society 21,* 11, 1401–1414.

Shah, U., Garg, S., Sisodiya, N., Dube, N., and Sharma, S. 2018. Rainfall prediction: Accuracy enhancement using machine learning and forecasting techniques. In *2018 Fifth International Conference on Parallel, Distributed and Grid Computing (PDGC).* IEEE, 776–782.

Sharif, M. and Burn, D. H. 2007. Improved k-nearest neighbor weather generating model. *Journal of Hydrologic Engineering 12,* 1, 42–51.

Dr. Sachin Upadhye is an Assistant Professor at Computer Application Department of Shri Ramdeobaba College of Engineering and Management, Nagpur. He holds MCA, and M. Tech. & Ph.D degrees in Computer Science & Engineering. He is an Oracle Certified Associate, IBM Rational Certified developer and has more than 25 research paper published in National & International Journals and conferences. He has 12 Years teaching experiences. He has successfully completed many certifications from NPTEL, NIT,IIT and also completed the research proposal and project.
E-mail: upadhyesd@rknec.edu

Mr. Lalit S. Agrawal received his B. E. Degree in Information technology from Shri Ramdeobaba College of Engineering and Management, Nagpur, and Postgraduate degree from Birla Institute of Technology and Science. His areas of interest include the Internet of Things and data analytics. He has published various papers in reputed journals
E-mail: agrawalls@rknec.edu

Blockchain Technology: Growing Usecases and Issues to Tackle

Firdous Sadaf Mohd. Ismail and Dattatraya S. Adane
Shri Ramdeobaba College of Engineering and Management, Nagpur, Maharashtra, India

Advantages of decentralized systems over centralized approaches are reason for increasing incorporation of blockchain technology in almost every digital task. Core benefits of blockchain include decentralization, persistency, auditability and anonymity. This paper discusses Blockchain Technology from the perspective of related attributes, applications and challenges. Specifically, we try to elaborate on the current work pertaining to application of Blockchain Technology to different domains such as Internet of Things (IoT), Artificial Intelligence (AI), Big Data and Software Defined Networking (SDN) keeping in view the challenges of optimized storage, scalability and security.

Keywords: Blockchain Technology, Smart Contract, Artificial Intelligence, Internet of Things.

1. INTRODUCTION

Blockchain is gaining recognition as the technology that powers crypto currencies like bitcoin and others because it is viewed like a latest groundwork for global transactions. This section contains the important brief introduction about this technology, section 2 of this paper reveals the shortcomings of blockchain technology during its implementations, section 3 shows the few domains on which future research work can be done followed by the conclusion section. A blockchain refers to a distributed, full, and unchangeable ongoing accounting ledger (Swan, 2015). The fundamental development has been the decentralized trusts provided by blockchain technology such as:

1) Doing away with the reliable third party that facilitates transactions.
2) Cutting trade costs.
3) Shortening the process.

1.1 Blockchain's Functional Mechanism

Blockchain operate in a decentralized peer-to-peer network. The transactions are validated before being uploaded towards the system's blockchain utilizing digital signature, hash function, and public-private keys. Inside a blockchain system, the hash function is employed to securely link each block together (Yoo, 2017). Because the users' authentication is verified via a digital signature, nobody is able to dispute the individual's self actions inside the blockchain network (Kumar, Kumar, Nerurkar, Ghalib, Shankar, Wen, and Qi, 2020). Blockchain technology has gone through three generations of technological development: Block 1.0, 2.0, and 3.0. Block1.0 is a currency, and its successful project is bitcoin. Block 2.0 not only includes cash transactions but also covers mortgages, bonds, loans, futures and smart contracts. Blockchain 3.0 is a universal application and platform used by government, science, health, culture, art, and literacy. Blockchain 4.0 is developed to gain automation, distributed ledger system and industry based application, Figure 1 shows the generations of blockchain technology.

1.2 Key characteristics of blockchain

—**Decentralization:** No need to employee the third party, individual party on the blockchain has retrieved to the ledger and can look up the transaction's provenance. Such chain's replication beyond a dispersed network has been its key benefit. Additionally, distributed ledgers naturally

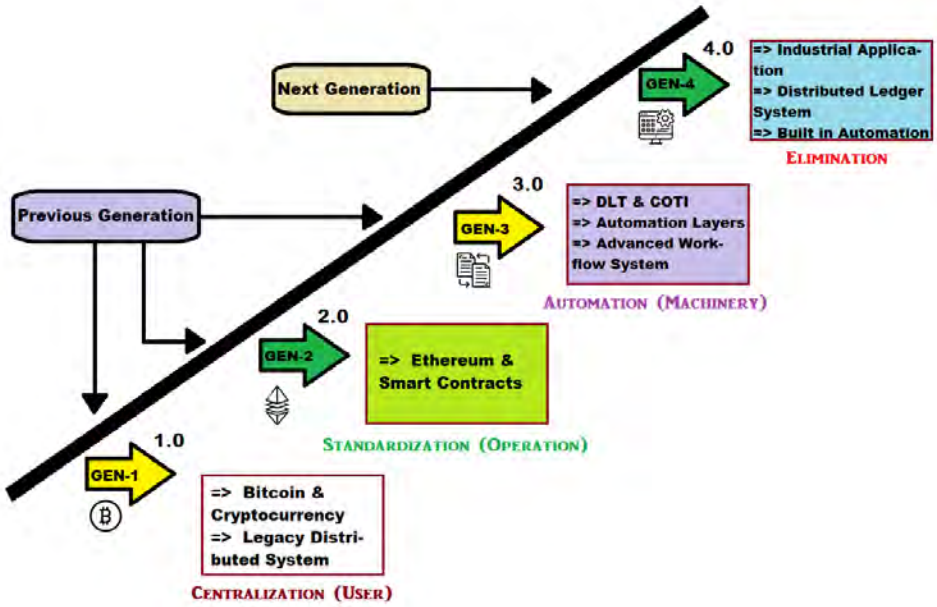


Figure 1. Generations of blockchain technology with domains

and instantly record transactions, minimizing the possibility of fraud (Tapscott and Tapscott, 2020).

—**Users' anonymity:** On a blockchain system, individual user has a distinct 'alphanumeric address' that they may choose to make public or private (Huang, Kong, Chen, Wu, Liu, and Zeng, 2019).

—**Consensus mechanism:** Since the complete network lacks a single trustworthy agent, a consensus algorithm is added. Its goal is to reach a consensus about the validity of each document (Zhang, Zhong, Wang, Chao, and Wang, 2020).

—**Execution:** Algorithms as well as regulations may be employed by users to start transactions amid nodes (Pereira, Tavalaei, and Ozalp, 2019). If definite requirements are satisfied, blockchain technology can also run applications; this is what known as a smart contract.

2. CHALLENGES AND ANALYSIS ASSOCIATED WITH BLOCKCHAIN

Although there are many obstacles to overcome, blockchain offers a lot of power but also has the ability to prevent its widespread adoption. The blockchain system's transparency and lack of centralized synchronization that has adverse effects and restricts the usage of blockchain some of them are listed in Figure 2. The subsequent technological difficulties and constraints for the potential widespread use of blockchain technology are:

—**Scalability:** The volume of the blockchain grows as more transactions are made. "Paypal can handle 193 transactions per second, compared to visa's 24,000 transactions per second, while ethereum and bitcoin can only process 20 transactions per second". It implies that the demand for executing millions of transactions quickly cannot be met (Sanka and Cheung, 2021).

—**Security:** "Blockchain-based solutions are insecure. Blockchain-based systems for bitcoin and ethernet were repeatedly robbed since 2009, costing around 600 million yuan in total" asserted by Werbach (Werbach,). Blockchain, according to Zheng et al. (Zheng, Xie, Dai, Chen, and Wang, 2018), is vulnerable to assaults by selfish, conspiratorial miners, and several other breaches have demonstrated that it isn't particularly secure. According to Price (Price, 2018),

Figure 2. Challenges in blockchain

the nature of blockchain technology makes every public blockchain susceptible to either 34 percent or 51 percent of assaults. Whenever hackers account for the majority of a blockchain's computer power, a 51 percent attack takes place. Despite its undeveloped technological state, blockchain technology has demonstrated unmatched viability and originality throughout the financial system (Valdeolmillos, Martín, González-Briones, Prieto, and Corchado, 2019). A handwritten contract is not the same as a smart contract on the blockchain. A computer language containing constraints is used in smart contracts. This will automatically start the execution longer than these requirements are satisfied. Traditional paper agreements are much dependable and secure right now. The profiles of users can be reflected in bitcoin transactions. The issue of anonymity leaking is quite serious and affects the confidentiality of user data. However several strategies have been put out to enhance blockchain privacy, the issue has not yet been fully resolved (Cong and He, 2019).

—**Latency, energy consumption throughput:** The main issue with existing blockchain technology is tamper-proof and secures blocks. Almost all of the time is dedicated to validations and verifications in order to prevent duplicate costs and fraudulent transactions. Because of the security considerations, the production of blocks and the acknowledgement of transactions take a long time. Therefore, latency is a key issue with blockchain right now. Big data applications can have greater operation and storage requirements than among prolonged storage expenditures of transaction data and electronic money transfers. According to Price (Price, 2018), the amount of computational power required to execute blockchain is experiencing exponential growth. The bitcoin network involves a significant amount of power. In fact, terawatt-hours of power are needed for just one bitcoin transaction. The amount of transactions assigned during a given time frame is a measure towards this technology's throughput. "When the bitcoin system is taken into account, the throughput can reach 7 tps (transactions per second). Blockchain technology additionally requires that it boost its throughput size in comparison to

existing networks for transaction processing, such as visa and twitter, which have 2000 and 5000 tps, respectively" (??, 2019).

—The quantity of newly produced blocks determines the length of a blockchain. Each block in bitcoin is 1 MB in size and is produced in every 10 minutes (BB1, 2019). As a result, the amount of transactions that may be included in a block is limited (Chang, Baudier, Zhang, Xu, Zhang, and Arami, 2020). The blockchain's bandwidth and size problems may be alleviated if it handled many transactions (Zhang et al., 2020). The permissionless ecosystem's mining process necessitates a huge amount of mining labor that is compute-intensive. Based on consensus mechanism and time restrictions, certain mining operations frequently fail. To achieve more effective blockchain mining, this problem of wasted resources must be fixed (Zhang et al., 2020). APIs for blockchain apps should be simple to employ. The bitcoin API when creating services has proven to be challenging to utilize (BB1, 2019). To get more traction amongst developers, blockchain has to have an API that is more user-friendly. A chain having fewer nodes and/or numerous chains involving fewer nodes has a higher attack risk. Whenever chains are divided for versioning and administrative purposes, additional problem occurs (R and K. R, 2020).

3. A COUPLE OF POTENTIAL FUTURE DIRECTIONS

Blockchain Technology has been investigated by major organizations and sectors for potential use despite being a relatively new technology (Tasatanattakool and Techapanupreeda, 2018). The potential merging of Blockchain technology to already computational domains are represented in this section (Shrimali and Patel, 2022).

3.1 Smart Contract:

Real-world scenarios typically involve collective agreement amid the two such distrusting parties that are notarized and producible in the event of a legal dispute. Both manual agreements and the legal system demand a lot of paperwork and time. Thus, smart contracts—basically a set of codes with few ifs and buts—are presented with the same goal in mind, but with less paperwork, faster reaction times, and, of course, no need for a reliable third party. Hawk (Kosba, Miller, Shi, Wen, and Papamanthou, 2016), "a decentralised smart contract framework, offers security and transparency using cryptographic protocols including zero-knowledge proofs". By introducing purposeful assaults on Ethereum, researchers have also tried to assess the susceptibility of Ethereum smart contracts (Mohanta, Jena, Panda, and Sobhanayak, 2019).

3.2 Artificial intelligence:

Latest advancements in blockchain technology are opening up new possibilities for AI-based solutions that provide more privacy, transparency, and security. Computers becoming as intelligent as people thanks to AI. AI models are employed to evaluate, categorize, and forecast information in order to ensure that machines operate as intelligently as people. Decisions were made using data from the AI disciplines of machine learning and deep learning. Well with fresh data, such models get better, learn, and train themselves. The decentralized artificial intelligence is made possible by the safe data that AI models employ. For instance, smart contract logic may be used to govern operational processes and data among applications like robotic process automation. Somdip (Dey, 2018)employed intelligent software agents to observe stakeholder behavior in blockchain networks and find abnormalities like collusion. In order to prevent the majority assault on blockchain, authors applied strategies from supervised machine learning algorithms and algorithmic game theory.

3.3 Internet of Things:

The devices and sensors are interacting in the network as a result of the IoT's exponential rise. In a network, crucial information is shared, including location, humidity, temperature, and sensitive information about people. The network may create the tempered proof data using a permissioned blockchain and IoT. Without constructing any centralized IT infrastructure, the partners automate the tempered proof procedure using permissioned blockchain. Blockchain technology has the potential to be extremely useful in many IoT applications (Kamruzzaman, 2022). Blockchain technology may be used in healthcare applications to write patient data transmitted by IoT devices, making the system secure. In the same manner, IoT-enabled packages in supply chain management might contain diverse status information, such as time, shipment time, temperature, and more, when data is sent through to authorization blockchain. The requirements that must be satisfied for packages to be sent are specified in a smart contract. Blockchain may increase the application's security in this way without adding any more weight to the existing infrastructure. In a similar vein, there are several IoT applications for blockchain (Yazdinejad, Parizi, Dehghantanha, and Choo, 2022).

3.4 Software Defined Networking:

In recent years, business and academics have embraced Software Defined Networking (SDN), a new technology that makes it easier and simpler to administer and configure networks. This is a new emerging method of creating networks which supports a much more stable atmosphere by prioritizing dependability and security to avoid, isolate, detect, limit, report and maybe ameliorate the negative impacts of the majority of network intrusions (Alharbi, 2020). The centralization of the control plane, that is scattered with the data plane functions within the routers and switches in conventional networks, has been the key idea that already has sped up the innovation processes in the SDN technology. Blockchain technology in SDN is likely to generate an unforgeable and non-tamperable data structure according to the initial investigation and research performed onto the installation of the blockchain solutions. Fog nodes can balance the load and reduce overheads thanks to SDN and blockchain technology (Khan, Hassan, Yuen, Zhao, Niyato, Zhang, and Poor, 2021).

4. CONCLUSION

This paper introduced the concept of blockchain technology along with the elements brief description which suggest the operational aspects in particular domain. This operational element of blockchain technology is suggesting how the decentralization network with other benefits (persistency, audit-ability and anonymity) can be achieved. Various issues like storage optimization, scalability, execution workload, privacy leakage, throughput, latency and security have been briefly discussed. This issues are still existed therefore these challenges can be the research keywords to get the permanent solutions so that efficient outcome can be achieved from the domains like Internet of Things (IoT), Big Data, Artificial Intelligence (AI), Software Defined Network (SDN) and Smart Contracts.

References

2019. Home page. `https://en.bitcoin.it`.

Alharbi, T. 2020. Deployment of blockchain technology in software defined networks: A survey. *IEEE Access PP*, 1–1.

Chang, V., Baudier, P., Zhang, H., Xu, Q., Zhang, J., and Arami, M. 2020. How blockchain can impact financial services – the overview, challenges and recommendations from expert interviewees. *Technological Forecasting and Social Change 158*, 120166.

Cong, L. and He, Z. 2019. Blockchain disruption and smart contracts. *32,* 5, 1754–1797.

Dey, S. 2018. A proof of work: Securing majority-attack in blockchain using machine learning and algorithmic game theory. *International Journal of Wireless and Microwave Technologies 8*, 1–9.

Huang, J., Kong, L., Chen, G., Wu, M., Liu, X., and Zeng, P. 2019. Towards secure industrial iot: Blockchain system with credit-based consensus mechanism. *IEEE Transactions on Industrial Informatics 15*, 3680–3689.

Kamruzzaman, M. M. 2022. Key technologies, applications and trends of internet of things for energy-efficient 6g wireless communication in smart cities. *Energies 15,* 15.

Khan, A. H., Hassan, N. U., Yuen, C., Zhao, J., Niyato, D., Zhang, Y., and Poor, H. V. 2021. Blockchain and 6g: The future of secure and ubiquitous communication. *IEEE Wireless Communications 29,* 1, 194–201.

Kosba, A., Miller, A., Shi, E., Wen, Z., and Papamanthou, C. 2016. Hawk: The blockchain model of cryptography and privacy-preserving smart contracts. In *2016 IEEE Symposium on Security and Privacy (SP)*. 839–858.

Kumar, A., Kumar, A., Nerurkar, P., Ghalib, M., Shankar, A., Wen, Z., and Qi, X. 2020. Empirical analysis of bitcoin network (2016-2020). In *2020 IEEE/CIC International Conference on Communications in China, ICCC Workshops 2020*. 2020 IEEE/CIC International Conference on Communications in China, ICCC Workshops 2020. Institute of Electrical and Electronics Engineers Inc., 96–101.

Mohanta, B. K., Jena, D., Panda, S. S., and Sobhanayak, S. 2019. Blockchain technology: A survey on applications and security privacy challenges. *Internet Things 8*.

Pereira, J., Tavalaei, M. M., and Ozalp, H. 2019. Blockchain-based platforms: Decentralized infrastructures and its boundary conditions. *Technological Forecasting and Social Change 146*, 94–102.

Price, D. October 3rd, 2018. 5 big blockchain issues: Security, privacy, legal, regulatory, and ethical. `https://blocksdecoded.com/Blockchain-issues-securityprivacy-legal-regulatory-ethical/`.

R, A. and K. R, S. 2020. Innovation and challenges of blockchain in banking: A scientometric view. *International Journal of Interactive Multimedia and Artificial Intelligence 6*, 7–14.

Sanka, A. I. and Cheung, R. C. 2021. A systematic review of blockchain scalability: Issues, solutions, analysis and future research. *Journal of Network and Computer Applications 195*, 103232.

Shrimali, B. and Patel, H. 2022. Blockchain state-of-the-art: architecture, use cases, consensus, challenges and opportunities. *J. King Saud Univ. Comput. Inf. Sci. 34*, 6793–6807.

Swan, M. 2015. *Blockchain: Blueprint for a new economy.* " O'Reilly Media, Inc.".

Tapscott, A. and Tapscott, D. 2020. How blockchain is changing finance. `https://hbr.org/2017/03/howBlockchain-is-changing-finance/`.

Tasatanattakool, P. and Techapanupreeda, C. 2018. Blockchain: Challenges and applications. 473–475.

Valdeolmillos, D., Martín, Y. M., González-Briones, A., Prieto, J., and Corchado, J. M. 2019. Blockchain technology: A review of the current challenges of cryptocurrency. In *BLOCKCHAIN*.

Werbach, K. Trust, but verify: Why the blockchain needs the law. *Berkeley Tech. L.J.. Berkeley Technology Law Journal 33,* IR, 487.

Yazdinejad, A., Parizi, R. M., Dehghantanha, A., and Choo, K.-K. R. 2022. P4-to-blockchain: A secure blockchain-enabled packet parser for software defined networking. *Comput. Secur. 88,* C (apr).

Yoo, S. 2017. Blockchain based financial case analysis and its implications. *Asia Pacific Journal of Innovation and Entrepreneurship 11*, 312–321.

Zhang, J., Zhong, S., Wang, T., Chao, H.-C., and Wang, J. 2020. Blockchain-based systems and applications: a survey. *Journal of Internet Technology 21,* 1, 1–14.

Zheng, Z., Xie, S., Dai, H.-N., Chen, X., and Wang, H. 2018. Blockchain challenges and opportunities: A survey. *International journal of web and grid services 14,* 4, 352–375.

Ms. Firdous Sadaf Mohd. Ismail is research scholar in Computer Science and Engineering department, Shri Ramdeobaba College of Engineering and Management, Nagpur, Maharashtra, India. She has an overall teaching experience of more than 10 years. Her expertise lies in AI and ML, Blockchain Technology and Cloud Computing. She has reviewed International Journal Coordinated by IEEE and a book chapter by IGI Global American Publication Scopus Indexed. She has published 11 International journal and conference papers in the area of computer science engineering. She is life member of ISTE. Her chapter "Comprehensive Evolution of Pharmaceutical Industries by Pioneering Blockchain Technology with 6G Wireless Networks Amalgamation" published in August 2022, International book "AI and Blockchain Technology in 6G Wireless Network Blockchain Technologies" by Springer, Singapore.
E-mail: firdoussadaf2810@gmail.com

Dr. D.S.Adane is currently working as Professor and Head, Information Technology Department, Shri Ramdeobaba College of Engineering and Management, Nagpur, India. He did his M.Tech in Computer Science and Engineering from IIT Guwahati, India and Ph.D. in Computer Science and Engineering from VNIT Nagpur, India. He has over 45 research papers to his credit in reputed International Journals and Conferences. His research interests include Distributed and Mobile Computing, Mobile Agents and Network Security. He is life member of Indian Society of Technical Education (ISTE) and Member of Institution of Engineers (MIE) of India.
E-mail: adaneds@rknec.edu

Plagiarism Detection in Programming using Performance Analyzing Features

D.S. Adane, Abhishek Angale, Ayush Singh, Rituj Aryan, Sumeet Yadav
Shri Ramdeobaba College of Engineering and Management, Katol Road, Nagpur – 440013

In recent years, plagiarism that uses the code snippets or program of others without permission has become a social problem. It is widely spread from very familiar student reports to worldwide academic papers. In this paper, we deal with plagiarism in programming assignments, and explain the plagiarism patterns often found in text. Existing plagiarism detection tools utilize string matching algorithms to calculate the plagiarism. We have brought to light the problems associated with existing tools and propose a method to rectify them efficiently with the help of algorithms proposed in the paper. To the existing detection method, we combine some heuristics which are estimation of time complexity and loop detection, to improve the accuracy of the plagiarized sections and propose it as a plagiarism detection method.

Keywords: Keywords: Plagiarism detection, String matching, estimation of time complexity

1. INTRODUCTION

Digital documents are vulnerable to copying. Plagiarism implies reproducing others work without acknowledging the source. Plagiarism can be with respect to simple words, computer programs, computer software, electronic material, graphics, drawing etc. The problem of plagiarism affects everyone be it researchers, publishers or even academic institutions. The most common cases of plagiarism include copying material from books, journals, on the Internet or the work of peers without acknowledging the original source. While licensing policies allow usage of whole or a few components of source code, but copying the complete material and putting claim on it is an unethical practice and should be treated seriously. This problem is specially significant in context of sensitive and inventive works where mentioning the source or author or inventor has to mentioned as per law [6]. In this paper, We have discussed the extensively used plagiarism detection tools in the domain of programming. These are mainly: JPlag, SIM and MOSS. Out of which, MOSS is currently the most accepted and reliable tool present. But these come with their own drawbacks, they are more focused on the string-matching algorithms but lack other major features in which are used to evaluate the efficiency, but can also be used to removes certain edge cases which tend to appear in the real-world programming assignments such as codes with similar structure but different logic or time complexities which may come as false positives in the current tools.

2. RELATED WORK

Major plagiarism detection tools which are extensively used for plagiarism detection in source codes are: JPlag [1]: This tool considers multiple sets of source code in the program and then calculates similarities between them. It considers program syntax and structure to analyze the similarities. The tool supports text in natural language and programming languages such as Java, C, C++. JPlag generally operates in two phases. In first phase programs are parsed and converted into string of tokens. In second phase, token strings are compared pairwise to get similarity of each pair.

SIM is a plagiarism tool developed by Dick Grune in 1989. It supports languages like Pascal, C and Java. Like JPlag, it works on tokenization of programs fed to it. It uses flex lexical analyzer to produce tokens [1]. After tokenization, SIM uses forward table that is used for

detecting best matches. The tokens representing symbols, keywords, comments, and identifiers are assigned dynamically and saved in a shared symbol table after deleting the whitespaces. SIM detects similarities between two different source codes by using their correctness, fashion, and uniqueness. Specifically, SIM is used for DNA string matching.

MOSS [2], stands for Measure of Software Similarity. This plagiarism detection tool was first proposed by Alex Aiken and UC Berkeley in 1994. It provides plagiarism support for programming languages like C, C++, JAVA, and Pascal. It is said to be a sophisticated tool for plagiarism check [2]. The input file is divided into k-grams which are contiguous substrings of length k. The tool then uses winnowing technique for locating similar sequences between two input files. This tool provides support to UNIX as well as Windows platforms and available as freeware

Field	**Description**	**Description**	**Description**	**Description**	**Description**
1.	Brenda S. Baker 1995	Work on source code is exactly matched or near matched.	Text matching, parameter matches.		Much duplication has been found.
2.	T. Kamiya 2002	Code clone detection technique.	Token based code clone detection method.	CCFinde	Detecting the similar term into source code.
3.	Mark Gabel 2004	Identifying similar code fragments in programs.	Clone Detection Method.	CloneDR	Detecting fragments into single program.
4.	C. Collberg 2007	Identify duplication in java code.	Java code obfuscetor.		To checting the code duplication.
5.	Enrique Flores 2011	To detect cross-language reuse between source codes.	Character N-Grams comparison model.		To detect cross-language reuse between source codes.
6.	Ameera J adalla , Ashraf Elnagar 2007	To create a one engine that detect the source code plagiarism in Jva.	Clustering, N-Gram, Tokenization.	JPlag	Performance of the system, pair wise similarity measurement.
7.	A. Bugarin, M. Carreira	This paper shows how software tools detect the plagiarism		JPlag and Turnitin	There are mainly two tools used, one is JPlag and other is Turnitin.
8.	Dong-Kyu Chae	Main aim of this research is to create a software plagiarism detection system.	API- labelled control flow graph.		Accuracy and credibility in a reasonable computation time.

Table I: Table 2.1. Literature Survey of existing papers on Plagiarism Detection in programming

All the above-mentioned plagiarism detection tools are mainly based on string matching techniques but they lack the cases of logically similar codes with different variable names, statements or functions with similar utility. Time Complexity of code also plays a role in calculating plagiarism. It provides an insight about the flow logic and helps us to eliminate false positives generated by similar syntax but logically different codes. These existing tools lack an important factor i.e

There is no correlation between complexity of codes and plagiarism. We try to incorporate this correlation in our software in order to try and remove above mentioned drawbacks.

3. PROPOSED METHODOLOGY

Our approach targets time complexity as a criteria for checking plagiarism. Here we used 4 modules as described in Fig 3.1 below. These modules are Preprocessing of code, String Similarity Check, Loop Detection and Time Complexity Analyzer.

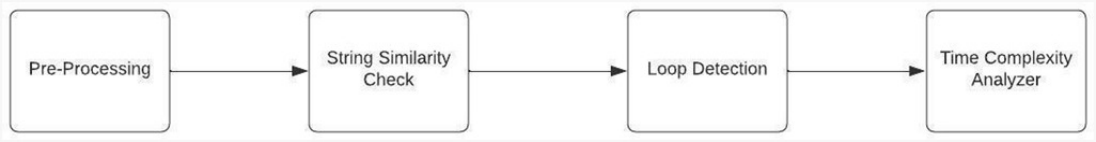


Figure 3.1 Flow of proposed modules.

3.1 Preprocessing

The job of Preprocessing module is to make the input data more suitable for use by the successive modules [5]. This module involves processing of the input to either manipulate or drop data to ensure enhanced performance. IT is also called Normalization step i.e. rewriting the entire of all program files so as to ensure simplification of comparison task at later stage. This process can be applied on source files and token stream, both. It performs the following operations:

3.1.1 *Deleting Comments:.* This operation deletes all the comments which exists in the source file. This done to counter extra comments in plagiarized text, so that it is easier to compare w.r.t the actual content. Also, it diminishes the possibility of excess tokens at the latter stage

3.1.2 *Renaming the Identifiers:.* This operation renames fields and methods of the classes used in the input program. Depending on implementation and choice, it is possible to rename entire class or few fields or even methods of class in the input code. This process ensures that just renaming the fields and methods by the user should not give the perception or false notion of originality of code [6]. This problem of renaming is rampant in student community.

3.1.3 *Sorting by size, the class members:.* This operation sorts the class members according to ascending order of selected file. The order is fields, followed by constructors and finally methods in the code. Methods are sorted w.r.t statements within them. The lesser statement methods come first. Thus, the methods with two statements would be considered first followed by the method with three statements. Similarly, classes are sorted on the basis of number of methods in the classes. This step ensures that just rearranging the fields, methods and classes should not constitute an original code and be difficult to detect plagiarism [5].

3.2 String Similarity Check

We need to compare two source codes in order to detect plagiarism. String comparison algorithms exists which can be used to compare text or source codes. However, just comparing text or source codes may not be sufficient. Existence of whitespaces and modifications in the names of variables, identifiers and methods can give a wrong perception of uniqueness of the input text or source code. We have incorporated the following concepts to find similarities between the strings in the input text / strings:

3.2.1 *Dynamic Programming.* Dynamic programming is a well-known paradigm for solving computational problems. We have implemented a recursive function to find the distance between the strings by implementing a logic for Least Common Subsequence (LCS) problem. An important characteristic of Dynamic Programming is to write a function to solve the problem by

considering first the optimal subproblems and then use the same process to get optimal solution to the main problem (String comparison). Dynamic Programming is known to reduce exponential time complexity to polynomial time complexity. Many real-life problems are solved in polynomial time by Dynamic Programming. In order to apply Dynamic Programming, the original problem must exhibit optimal substructure property. We have incorporated the following concepts in our model:

3.2.2 *Levenshtein Distance.* The measure of distance between the two strings is given by Levenshtein Distance [3], named after the author. It is the minimum number of single character edits to convert one string into another string. Mathematically, the Levenshtein distance between the two strings, x and y is given as lev(x,y) where,

$$lev(i,j) = \begin{cases} \max(i,j), \min(i,j) = 0 \\ \min \begin{cases} lev(i-1,j)+1 \\ lev(i,j-1)+1 \\ lev(i-1,j-1)+eq(i,j) \end{cases}, \min(i,j) \neq 0 \end{cases}$$

Where eq (i, j) returns 1 if a[i] = b[j] and 0 otherwise.
For example, the Levenshtein distance between the string "kitten" and "sitting" is 3. The steps to change "kitten" into "sitting" are: (1) replace "k" with "s", (2) replace "e" with "i", and (3) insert "g" at the end.

3.2.3 *Levenshtein Distance.* The Levenshtein logic enables us to compute distance by simply writing logic as stated above. The main problem with this computation is that the algorithm recalculates the distance of same substrings many times and hence becomes inefficient from implementation perspective. We have implemented Wagner Fischer Algorithm, which uses two Dimensional matrix to resolve the above issue. The new algorithm implements Levenshtein logic to solve the problem. The pseudo code for the algorithm is as follows [3]:

```
int levenshteindistance( char a[1..m], char b[1..n] )
// dp[i][j] contains levenshtein distance between a[0..i] and b[0..j]
dp: array of int [0..m][0..n]
// the levenshtein distance of a string and an empty string is equal with the length of the string
for i in [0..m] dp[i][0] = i
for j in [0..n] dp[o][j] = j
for j in [1..n]
for i in [1..m]
if a[i] == b[j]
// no operation is required
dp[i][j] = dp[i-1][j-1]
else
// select minimum levenshtein distance between deletion,insertion, and substitution
dp[i][j] = min( dp[1-1][j ] + 1, dp[i ][j-1] + 1, dp[i-1][j-1] + 1 )
// the levenshtein distance of the whole two string is stored in the bottom-right cell of the dp table
return dp[m][n]
```

Levenshtein distance algorithm to calculate minimum number of single character edits to convert one string into another string

The above code assumes the cost of 1, for every action. Since two-dimensional matrix is used for traversal, the time requirements are restricted to O (mn), assuming the sizes of input strings as m and n respectively. The space requirement also O (mn). The space requirement can be

further optimized to O (m) by observing that only previous and current rows are required at any point of time.

3.3 Loop Detection

Loops are inseparable and important part of software. We propose a technique of limit less loop detection based on simple logic. After pre-processing, all annotations are cleaned and absolute endless loops discovered. Using GCC compiler, an intermediate code is generated and the structural functions and the managed waft graph are abstracted. Using Depth First approach we get a set of directions and circles. The graph so obtained is then used to locate the exit of the loop and determine where the loop condition is satisfied. Implementations have shown that the approach improves the performance and accuracy of loop detection.

3.4 Time Complexity Analyzer

Time complexity computations have special significance in time calculations of algorithms. In fact optimal time algorithms are more preferred over optimal space algorithms. Usually the aim and objective is to design an algorithm and determine and propose, in terms of time, the estimated upper bound on the amount of work performed by the algorithm. Time complexity is also an important metric for comparing the algorithms. Only the differences between the algorithms are emphasized on during the comparison [4], ignoring the constant time operations. A simplified analysis based on Time Complexity can be done by considering parameters like number of operations performed, number of comparisons made, number of times operations within the loops are performed, Size of input (ex. Array) etc. Intuitively, the time requirements are dependent on size of the input hence for smaller input size for example small size array or matrix will take less time as compared to larger dimension inputs. Note that an algorithm might take different amounts of time on inputs of the same size. We have defined the worst-case time complexity, which means that we count the maximum number of steps that any input of a particular size could take. For example, if the time complexity of an algorithm is 3n, it means that on inputs of size n, the algorithm requires up to 3n2 steps. An algorithm was devised which analyzes the loop statements based on the initiation value, termination constraint and the increment/decrement of the counter variable and accordingly devises the Time Complexity. This algorithm is heuristic in nature since the possibilities of variations is infinitely many [4]. Our logic for Time Complexity Analyzer is as follows:

Algorithm for Time Complexity Analyzer:

1) Regular Expression Matching for detecting loop statements: Regular Expressions of Loop statements used: For loop: for *\(.*;.*;.*) While loop: while *\(.*\)

2) Arrangement of Extracted Data: All loop statements are arranged as per the source code format like Nested Loops, skipping of tokens other than loops, etc.

3) Semantic analysis of complexity: Every loop has – Initialization variables, Termination constraints, Increment, Decrement operations. After identifying these three elements of a loop, the number of repetitions were calculated and a higher order approximation was done on the same.

4) Summing up the complexity: A final measure of Higher order time complexity was computed on the evaluation of all the loop statements analyzed in the previous step.

4. IMPLEMENTATION DETAILS

For the modules: String Similarity Check and Time Complexity Analysis, an estimated threshold contribution of each module towards the final plagiarism result was calculated and verified through extensive unit testing. A ratio of 4 : 1 threshold for String Similarity to Time Complexity is an estimated accurate measure. After integration of the mentioned modules, we can take source codes as input and calculate plagiarism based on the equation:

$$P(f) = T(f)*P(s) + T(t)*P(t) \text{ where,}$$
$$P(f) = \text{Final Plagiarism Score}$$

$$P(s) = \text{Plagiarism Score using String Similarity Check}$$
$$P(t) = \text{Plagiarism Score using Time Complexity Analysis}$$
$$T(s) = \text{Threshold for String Similarity Check}$$
$$T(t) = \text{Threshold for Time Complexity Analysis}$$

	1	2	3
1	Input Code	Source Codes	Percentage Similarity
2	test.cp	code1.c	100.00
3	test.cp	code2.c	84.64
4	test.cp	code3.c	88.98
5	test.cp	code4.c	71.08
6	test.cp	code5.c	0.00
7	test.cp	code6.c	0.00
8	test.cp	code7.c	0.00
9	test.cp	code8.c	0.00

Figure 4.1 Plagiarism Score for multiple test cases

5. CONCLUSION AND FUTURE WORK

In this paper we proposed how to detect plagiarism of programming assignments. First, we defined characteristics of code which we consider as plagiarized. And then we explained the plagiarism patterns often found in assignments. The basic method for plagiarism detection is to generate one-dimensional string from code snippets compared respectively, and repeat shifting and mutual comparison. This is a simple and steady method however, it has disadvantages that the amount of calculation is large, and lack of robustness against small modification like variable name change and use of unwanted lines of codes to escape from plagiarism detection. So we developed some heuristics to overcome these disadvantages. These consist of early judgment of detection possibility, pre-processing, time complexity analyzer, string similarity checking and token analyzer. In this work, we combined these heuristics with the above basic detection method and proposed it as a plagiarism detection method. In addition, the proposed method simultaneously calculates the composition rate of the plagiarized section which is named plagiarism rate. Therefore, it's possible to automatically eliminate plagiarized assignments by previously determining a threshold to be rejected. Finally, we showed that the developed heuristics can improve the accuracy of plagiarism detection and significantly reduce the calculation time. We have also explained how our approach is useful in practise. The proposed method is designed to work well against assumed plagiarism patterns, but there is also a possibility that various patterns of plagiarism will emerge in the future. It's necessary to keep catching up with these unknown new patterns.

References

Bowyer, K. W. and Hall, L. O. 1999. Experience using" moss" to detect cheating on programming assignments. In *FIE'99 Frontiers in Education. 29th Annual Frontiers in Edu-*

cation Conference. Designing the Future of Science and Engineering Education. Conference Proceedings (IEEE Cat. No. 99CH37011. Vol. 3. IEEE, 13B3–18.

Deokate, B. and Hanchate, D. B. 2016. Software source code plagiarism detection: a survey. *Journal of Multidisciplinary Engineering Science Technology 3,* 1, 3747–3750.

Heres, D. and Hage, J. 2017. A quantitative comparison of program plagiarism detection tools. In *Proceedings of the 6th computer science education research conference.* 73–82.

Karnalim, O. and Chivers, W. 2020. Preprocessing for source code similarity detection in introductory programming. In *Koli Calling'20: Proceedings of the 20th Koli Calling International Conference on Computing Education Research.* 1–10.

Kilinç, D., Bozyiğit, F., Kut, A., and Kaya, M. 2015. Overview of source code plagiarism in programming courses. *International Journal of Soft Computing and Engineering (IJSCE) 5,* 2, 79–85.

Dr. D.S.Adane is a Professor at Shri Ramdeobaba College Of Engineering and Management, Nagpur, besides being a Professor at the Dept. of Information Technology, he has a wide range of knowledge and experience in IoT, Data Analytics, Network Security domains with total teaching experience of 30 years.
E-mail: adaneds@rknec.edu

Abhishek Angale is student at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: angalean@rknec.edu

Ayush Singh is student at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: singhaj_2@rknec.edu

Rituj Aryan is student at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: niralara@rknec.edu

Sumeet Yadav is student at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: yadavss$_1$@*rknec.edu*

IoT Based on Potholes and Speed Breakers Detection and Alert System

Rakesh K Kadu, Ayushi Mishra, Devang Baheti, Himangi Pilkawar.
Shri Ramdeobaba College of Engineering and Management, Katol Road, Nagpur - 440013

In a world where 90 percent of people travel by road, the safety of the same becomes of utmost importance. And two of the most major issues a road traveler faces are Potholes and speed breakers. The total number of road accident deaths due to potholes in 2018, 2019, and 2020 stood at 2015, 2140 and 1471, respectively. Although speed breakers are intended to prevent traffic accidents, 49.6 per cent of crashes still happen in areas where there are speed breakers.
This paper aims to present a method for locating, identifying, and documenting speed breakers and potholes. The suggested method will employ driving information collected by various sensors, such as vibrations, jerks, bumps, changes in distance from the base of the vehicle, etc., to detect and then store the location of the object in an online database. Additionally, a stream of images of the object spotted will be simultaneously taken and uploaded to a server, to analyze using an Image Detection model. This model will facilitate the live detection of potholes and speed breakers more accurately than previous solutions.
Once this data is added to a database, it will be effectively used by government agencies to repair the roads as well as by daily commuters to avoid the route with more obstacles, when the database is supplied to mapping services like Google Maps.

Keywords: IoT, Potholes, Speed Breakers, Sensors, Image Detection, Image Processing, GPS, Accelerometer, Ultrasonic sensor, Road Safety, Road Development.

1. INTRODUCTION

It is claimed that terrorism is less lethal than a pothole. One can find a pothole in India every kilometer, making them a highly common occurrence. Road surfaces that have cracked, deteriorated, and eventually developed a hole are called potholes. They initially appear as little fissures. If they are not immediately rectified, the entire road and occasionally the surrounding region may be damaged. There are more than 10,000 cases still open involving the potholes. According to government figures, almost 5,000 people died in road accidents in India between 2018 and 2020 as a result of potholes. According to data from the Ministry of Road Transport and Highways (MoRTH), there were a total of 5626 fatalities from road accidents caused by potholes in 2018, 2019, and 2020, totaling 2015, 2140, and 1471, respectively. As many as 4775 and 3564 accidents were caused by potholes in 2019 and 2020, respectively. A speed breaker is a rounded hump surface that spans the road and has a width greater than the majority of the vehicles that use it. According to a Ministry of Road Transport and Highways research, nine people die in traffic accidents every day, and there are roughly 30 incidents per day caused by speed breakers. 3,409 deaths attributed to speed bumps were documented in 2015. This indicates that the number of deaths from speed bumps in India is more than the sum of all road-related deaths reported in the UK and Australia put together!
Every life lost as a result of these irregularities on the roads has been a serious issue, which necessitates the search for a solution to this issue. To bring potholes and speed humps on roads to the attention of government officials for repair and to prevent accidents and life losses, our paper outlines a more effective method for detecting them that was developed. It involves detecting potholes and speed breakers using IoT components and image detection. After detection, the data will be saved on a database whose access will be given to road construction authorities. The result section demonstrates the filtering of acquired images using an image detection model and the triggers from IoT components to remove false positives and improve data accuracy.

Further in section 2 we have discussed the literature review which analyses various existing models that we have studied during our research. section 3 deals with the working model of proposed system. Results of our implementation, which were carried out using the tiny-YoloV4 algorithm, are illustrated in section 4. The conclusion of this paper is further discussed in section 5 followed by the references.

2. LITERATURE REVIEW

Several attempts have been made to create a technique that can identify potholes and speed bumps. The numerous potholes detecting systems currently in use include vibration-based, 3D laser scanner, 2D image-based, ultrasonic-based, and accelerometer-based techniques.

The Euler angle Computation normalizes the accelerometer data before using it to find potholes. This study considers the drawbacks of prior systems, which required the mobile device to be put at a specified angle for exact scans, consideration of only one threshold for detection, and the inaccuracy in GPS location. All of the recommended detection methods begin with Accelerometer Data Normalization and employ the Z-THRESH and G-ZERO approaches to lower the number of false-positive pothole detection results.(Wang, Chen, Cheng, Lin, and Lo, 2015)

When a sensor, such as an accelerometer, ultrasonic sensor, Arduino, etc., is used to detect a change in the motion of the vehicle, such as when the vehicle goes through a pothole. They are using a GPS module, an Accelerometer sensor, an Arduino Uno, a Node MCU, and an Ultrasonic sensor. They are using two main pieces of software, the Arduino IDE and the Blynk Application, to control all the hardware components.

This system's primary objective is to identify speed bumps on the roadways that pose a major threat to motorists who are unable to see them because of things like snow, leaves, darkness, etc. They have suggested a method for identifying speed-breakers using data from a 3-axis accelerometer. A speed-location breaker is shared with the SWAS server by the SWAS application operating on a specific smartphone when it discovers a previously unidentified speed-breaker. The authors state that it uses a lot of battery when using a continuous GPS lookup approach.(Reddy and S., 2016)

The suggested system consists primarily of two modules: a mobile application module and a microcontroller module. The purpose of the microcontroller module is to gather data on the bumps and potholes experienced, as well as their geographic locations, which is subsequently communicated collectively to a mobile phone to alert the driver.

The paper introduces a method for identifying speed bumps and potholes, along with an alert system to warn drivers. This device uses a camera to take pictures of potholes and speed bumps and then stores those pictures on a computer as part of an image processing module. The distance between the automobile body and the ground is measured using an ultrasonic sensor, model number HC-SR04. The threshold distance is the separation between the body of a car and the ground, measured concerning a smooth road.

The system consists of three modules: the server module, the mobile application module, and the microcontroller module. Ultrasonic sensors, GPS, a GSM modem, and a PIC 16F877A microcontroller make up the microcontroller module. The ultrasonic sensor's function is to measure the distance between the car's body and the road, which is then sent to the microcontroller for analysis. This embedded SIM serves as a server for an android handset. The third module, known as the mobile application module, is a robot application that uses audio beeps to distinguish itself from flash messages and gives timely alerts as pop-up messages.

The paper introduces a method of dynamic speed breaker identification, autonomous data gathering of speed breakers, and warning generating for on-road drivers. The device includes the ability to monitor drivers in real-time and spot rules infractions. It also sheds light on several already-built pothole detection models. A smartphone-based application for notifying drivers is also among the techniques listed.(Afrin, Mahmud, and Razzaque, 2015)

The paper examines various approaches that can be utilized to find speed bumps and potholes

and can occasionally send out an alarm that can help prevent numerous traffic accidents and damage to automobiles. The authors have proposed a method of pothole detection and identification to prevent these frequent traffic accidents.
Comparatively, they discovered that the existing methods can employ a variety of approaches, including vibration-based, 2D reconstruction-based, and vision-based methods, but they discovered that these methods are cost-effective and they encounter challenges when trying to accurately detect a pothole due to distorted signals when gathering image and video data. As a result, they concluded that the current pothole detection approach may be improved by creating a pothole detection method using multiple attributes in 2D photos and that additional system enhancement is required by speeding up the pothole detecting system's picture processing.(Ryu, Kim, and Kim, 2015)
The method suggested is a low-cost and effective solution for pothole identification by utilizing a vision-based strategy that tries to find potholes and forecast their severity. Additionally, the authors recommended using GPS to locate potholes on a local server. Two piezoelectric sensors connected to the front wheels' shock absorbers are used by the algorithm described in this research to detect potholes and speed bumps. The piezoelectric sensor was consequently mounted on the front wheels. They put this strategy to the test by utilizing a toy car with shock-absorbing springs on it. Finally, the local server's location of the pothole is discovered using GPS.(Suhail and IGDTUW, 2020)
Using Android's built-in GPS technology, the location where the pothole or speed breaker will be identified will be noted. They concluded that they could utilize z-axis input to identify between a smooth road, a speed breaker, and a pothole after analyzing a variety of graphs they had gathered after conducting multiple experiments. They also provided an accelerometer graph for a smooth road, a road with a speed limiter, and a road with potholes. When a pothole is found, the GPS of the Android device will be used to retrieve the current location coordinates.(Rishiwal and Khan, 2016)

3. PROPOSED WORKING

Figure 1 shows the working model of our proposed system. In this system, we are using different sensors and all these sensors are connected to the main microcontroller module of ESP 32 CAM. The connectivity of all components and data flow are shown in figure 1.

The following section will discuss a detailed working of the proposed system.

3.1 Detection and Trigger Mechanism

The potholes and Speed Breakers are detected using the ultrasonic sensor and the accelerometer sensor. The accelerometer detects sudden jerks in the road and the ultrasonic sensor detects depressions that occur in the road. Once these are detected both of these devices send a trigger signal to the ESP32 Cam module.

3.2 Recording Coordinates of The Pothole

Once the trigger signal is sent to the ESP 32 Cam module it sends a signal to the GPS module and fetches the GPS coordinates of the pothole or speed breaker that is detected. These GPS coordinates are attached to the data that is sent to the remote server and will be linked with the images of the bottle or the speed breaker and uploaded to the server. This way the data can be used to create an overlay over Google Maps or give the location data of the portals to the government authorities which will repair the roads.

3.3 Sending Signal to The Camera Module

After a few milliseconds of gap ESP 32 Cam module sends a signal to the camera module to take a set of images and store it in the local storage available on ESP 32. This interval of time is

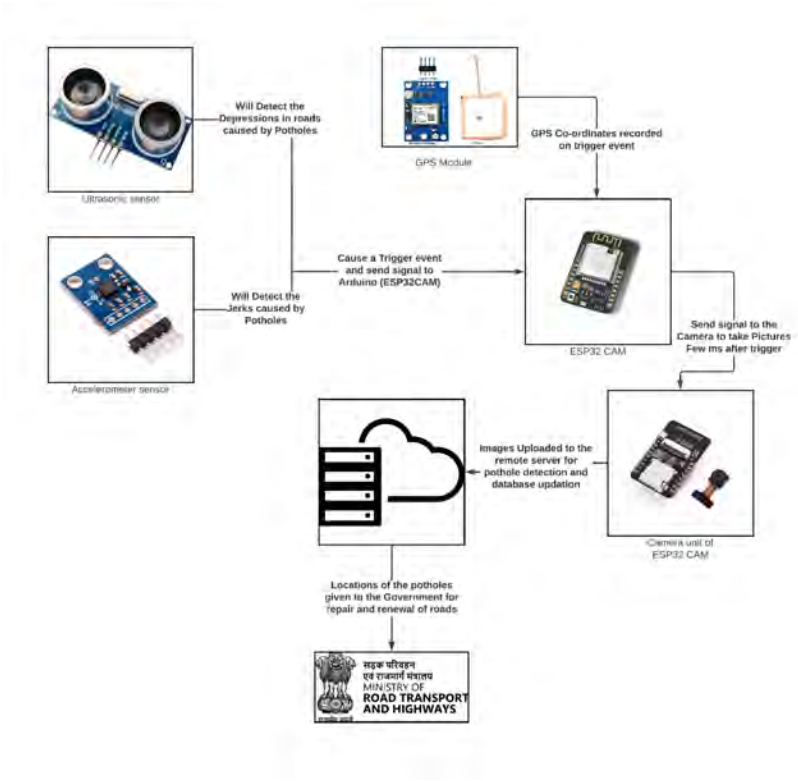


Figure 1: Working Model of Proposed System

because the camera is attached to the back of the vehicle and the images of the portal will be taken after a short interval, once the car passes over it. This set of images is likely to have more accuracy than a continuous stream of photos that are uploaded to the server in other existing methods.

3.4 Uploading Captured Images to Server

Once the images are captured and stored in the local storage, they are uploaded to the remote server which can be Google Drive or other online database utilities and from there the data can be sent to the authorities or overlaid over the Google Maps API.

3.5 Image Detection

We've studied various image detection methods and conducted a comparative analysis of the models that are currently being used to detect potholes. Here is the study's breakdown. The various models that we have covered in our study include Deep convolutional neural networks (DCNNs), Region-based convolutional neural network family (R-CNN), YOLO family, and SSD family, which are available in deep learning for training.
On the image collection, the Tiny-YOLOv4, YOLOv4, and YOLOv5 exhibit the highest mean average precision of 80.04 per cent, 85.48 per cent, and 95 per cent, demonstrating the effectiveness of the suggested approach for pothole identification and implemented on OAK-D for real-time detection. The following is the conclusion that was drawn: In comparison to other models, YOLOv5 demonstrated the greatest accuracy of 95 per cent, but it also displayed miss-classification and no identification of potholes at great distances. Tiny-YOLOv4 was found to be the best-fit pothole detection model for real-time pothole detection.

The image detection model used, that is YoloV4 presented a major drawback of giving false positives in the previously implemented solution. Our approach provides a solution to make this

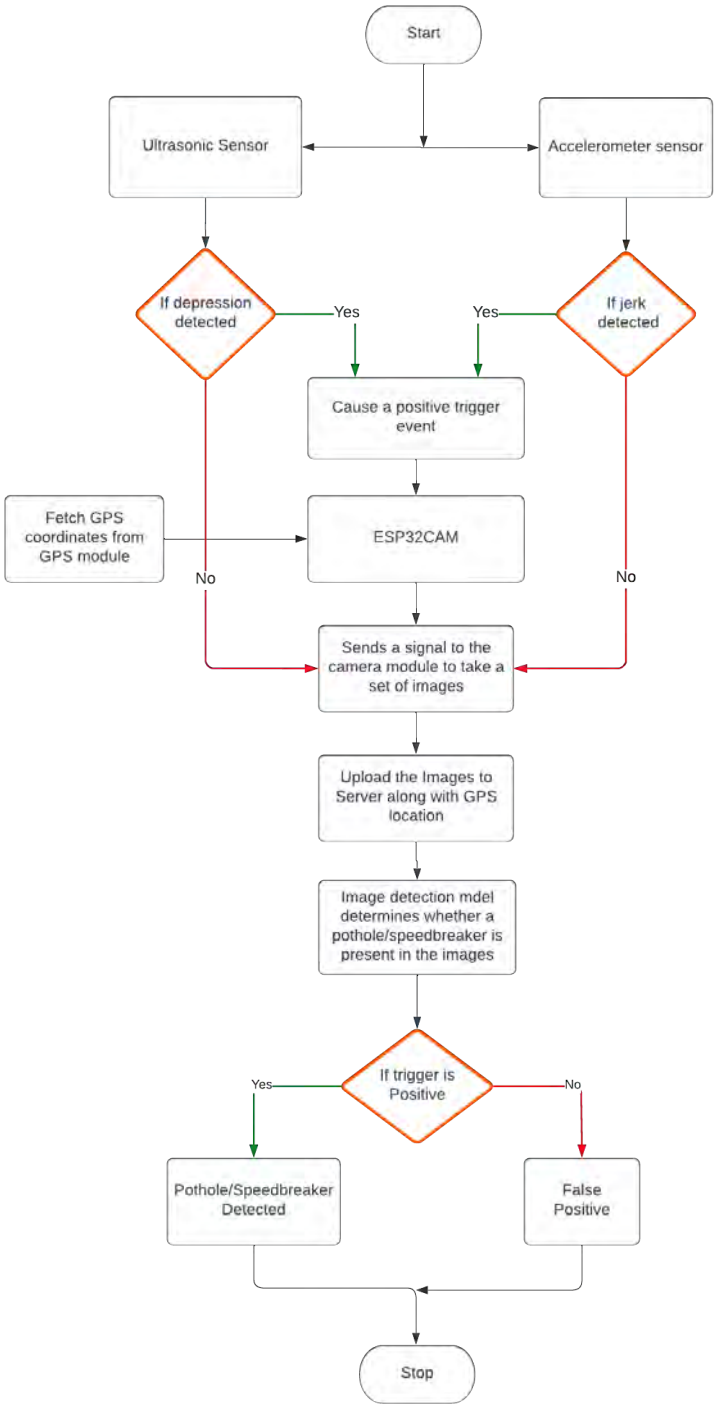


Figure 2: Flowchart of Proposed System

more accurate and reduce the false positives significantly. Once the trigger is created by the Ultrasonic sensor or Accelerometer sensor, it sends the positive trigger to the server. When the image detection model detects a pothole in any of the images, it cross-checks whether the trigger was also positive for those captured images. If yes, then it marks the potholes or Speed breakers as positive. Otherwise, it does not mark it positive.

4. IMPLEMENTATION AND RESULTS

In this section, we've shown the results of our implementation, which involves capturing the images and using the tiny-YoloV4 model to train them. We have used Python language for implementing the model.

Figure 3: Original Captured Image

Figure 4: Pothole Detected using YOLO4 and Trigger Value (Positive) of Accelerometer Sensor

Figure 5: False Pothole Detected using YOLO4 and Trigger Value (Negative) of Accelerometer Sensor

Figure 3 shows the originally captured image using the Cam module. Figure 4 the detection of potholes marked with the red square box in the image and along with that, we are taking the accelerometer trigger value to confirm the potholes. From image detection and the positive value of the trigger system conclude that there is a pothole and then the image will send to the server for further processing, but if the repaired pothole was detected by the image detection model

shown in figure 5, the trigger negative value will confirm that there is no pothole and the image will be discarded.

5. CONCLUSION

In this paper, we have presented an implementation of the pothole detection system. For the detection of potholes, we have used the Tiny-YOLOv4 image detection algorithm which is the best algorithm compared with other existing algorithms. In addition to image detection, we have used an accelerometer sensor and ultrasonic sensor to detect the pothole. The image detection algorithm and sensors' positive trigger value confirm there is a pothole and the negative value will confirm there is no pothole. Here we conclude that our proposed system can detect the potholes accurately and only the detected pothole image along with the location coordinates will be sent to the server for further processing. The proposed system improves the accuracy of the existing system and also saves storage space on the server discarding false images.

References

Afrin, M., Mahmud, M. R., and Razzaque, M. A. 2015. Real time detection of speed breakers and warning system for on-road drivers. In *2015 IEEE International WIE Conference on Electrical and Computer Engineering (WIECON-ECE)*. IEEE.

Asad, M. H., Khaliq, S., Yousaf, M. H., Ullah, M. O., and Ahmad, A. 2022. Pothole detection using deep learning: A real-time and AI-on-the-edge perspective. *Adv. Civ. Eng. 2022*, 1–13.

Deshmukh Prof Manoj A, Sanjekar, M. P. V., Patil, M. S. S., and Maradkar, M. D. S. 2020. Automatic potholes and humps detection and alerting through SMS. *International Journal of Innovative Technology and Exploring Engineering 9,* 7 (May), 533–535.

Jiang, Z., Zhao, L., Li, S., and Jia, Y. 2020. Real-time object detection method based on improved YOLOv4-tiny.

Prasetyo, E., Suciati, N., and Fatichah, C. 2021. Yolov4-tiny and spatial pyramid pooling for detecting head and tail of fish. In *2021 International Conference on Artificial Intelligence and Computer Science Technology (ICAICST)*. IEEE.

Reddy, V. and S., N. 2016. Smart phone based speed breaker early warning system.

Rishiwal, V. and Khan, H. 2016. Automatic pothole and speed breaker detection using android system. In *2016 39th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO)*. IEEE.

Ryu, S.-K., Kim, T., and Kim, Y.-R. 2015. Image-based pothole detection system for ITS service and road management system. *Math. Probl. Eng. 2015*, 1–10.

Suhail, R. and IGDTUW. 2020. Automated sensor based pothole detection system for preventing unfortunate causality. *Int. J. Eng. Res. Technol. (Ahmedabad) V9,* 07 (Aug.).

Wang, H.-W., Chen, C.-H., Cheng, D.-Y., Lin, C.-H., and Lo, C.-C. 2015. A real-time pothole detection approach for intelligent transportation system. *Math. Probl. Eng. 2015*, 1–7.

Yao, Y., Han, L., Du, C., Xu, X., and Jiang, X. 2022. Traffic sign detection algorithm based on improved YOLOv4-Tiny. *Signal Process. Image Commun. 107,* 116783 (Sept.), 116783.

Rakesh K Kadu is an Assistant Professor of Shri Ramdeobaba College of Engineering and Management, Nagpur in the Department of Information Technology. He has pursued his Bachelor of Engineering from Government College of Engineering, Amaravati and has completed his PhD from Yashwantrao Chavan College of Engineering, Nagpur. He has an experience of 20 years of teaching. His research specializations include IoT, Networks, Cryptography and Security, Cloud Computing and Linux. He has a patent publication in the Indian Patents and Trademarks Office and has published over 16 Research papers in various National/International journals and conferences. He is an active member of ISTE and CSI.
E-mail: kadurk@rknec.edu

Ayushi Mishra is currently pursuing her Bachelors of Engineering from Shri Ramdeobaba College of Engineering and Management, Nagpur in the stream of Information Technology. She is currently working on an IoT and ML based project titled as "A Pothole and Speed Breaker Detection and alert System". The domain of her interest includes IoT, Cloud Computing, Machine Learning and Blockchain. She has done a training in Google Cloud Platform.
E-mail: mishraad_3@rknec.edu

Devang Baheti is currently pursuing his Bachelors of Engineering from Shri Ramdeobaba College of Engineering and Management, Nagpur in the stream of Information Technology. He is currently working on an IoT and ML based project titled as "A Pothole and Speed Breaker Detection and alert System". His domain of interest includes IoT, Cloud Computing, Machine Learning, Linux and Data Analytics. He has done a training with Google Cloud platform.
E-mail: bahetidu@rknec.edu

Himangi Pilkawar is currently pursuing her Bachelors of Engineering from Shri Ramdeobaba College of Engineering and Management, Nagpur in the stream of Information Technology. She is currently working on an IoT and ML based project "A Pothole and Speed Breaker Detection and alert System". The domain of her interest includes IoT, Cloud Computing, Machine Learning and Blockchain. She has done a training Google Cloud Platform. She was a finalist in WCE Hackathon.
E-mail: pilkawarhn@rknec.edu

Identification and Evaluation of Factors Influencing Software Quality using Pythagorean Fuzzy DEMATEL Approach

Mangesh Joshi, Shri Ramdeobaba College of Engineering and Management, Nagpur.
Rahul Mankar, Symbiosis Law School, Nagpur (SIU, Pune).
Himanshu Shukla, Shri Ramdeobaba College of Engineering and Management, Nagpur.

One of the recognized techniques for making decisions in ambiguous environment is the fuzzy Decision Making Trial and Evaluation Laboratory [DEMATEL] method. The fuzzy set [FS] and intuitionistic fuzzy set [IFS] concepts are generalized in the Pythagorean fuzzy set [PFS]. This study focuses on the software quality evaluation problem in software management using the DEMATEL approach with PFS. It is suitable for addressing ambiguous human judgments and unclear and inadequate information when choosing the criteria for a software quality review. The method discovers cause-and-effect system components while taking into account the independence of the criteria and provides mutual links among the criteria. Based on information gathered from a group of professionals, the implemented method is illustrated. Originality: Software quality evaluation is handled first time with Pythagorean fuzzy set-based DEMATEL approach.

Keywords: Software engineering, Software quality, DEMATEL, fuzzy sets, MCDM

1. INTRODUCTION

Designers are really aware of the major issues that arise when developing software systems: the systems' performance is unsatisfactory after delivery and the expected costs for development and operation exceed those estimates. Due to its high cost and crucial functionalities, software as such is still a crucial component in the majority of large-scale systems. Due to this, the research community has placed a lot of emphasis on the issue of software quality (Galin, 2018), (Cavano and McCall, 1978). One of the most frequently discussed aspects of huge software systems is their dependability and quality. In reality, the number of software products is growing quickly, and they are employed in practically all aspects of daily life. As a result, quality evaluation of software has become essential for many businesses. Many models have been put forth to assist various user types with quality difficulties. The construction of models to judge the quality has been affected by the advancement of software development methodologies. Since 2000, software construction has begun to rely on produced or manufactured components, creating new difficulties for evaluating quality. New ideas like configurability, re-usability, availability, improved quality, and reduced cost are introduced by these components. Softwares are developed by developers, but software quality assessment is associated with the user which uses software products. There may be difference of opinions in developer's view point of software quality and the user who uses it. Hence evaluating overall software quality is important. This paper hence deals with the factor identification and its evaluation which affects software quality. The pythagorean fuzzy DEMATEL approach has been used for this purpose. This approach follows number of steps and divides the identified factors into cause and effect groups. To improve overall system performance, cause factors are targeted first which have impact on the effect group factors. It can be visually demonstrated with the help of causal diagram/cause and effect diagram.

The article is divided into the following sections. The literature on the DEMATEL technique is reviewed briefly in Section 2. Some fundamentals of Pythagorean fuzzy sets, and Pythagorean fuzzy DEMATEL approach are presented in Section 3. The numerical outcomes of a Software quality evaluation problem that was resolved using the suggested strategy are discussed in Section

4. Finally, Section 5's concluding observations bring the paper to a close.

2. LITERATURE REVIEW

Literature review is done to dig out the factors (Kitchenham and Pfleeger, 1996), (P. Miguel, Mauricio, and Rodríguez, 2014),(Kassie and Singh, 2020),(Khaddaj and Horgan, 2004), and (Sharma, 2012).

2.1 Product Operation

2.1.1 *Correctness: Software correctness implies the degree to which software complies with its requirements and accomplishes the user's mission objectives..*

2.1.2 *Integrity: Software integrity implies the degree to which unauthorized users' access to software or data can be restricted..*

2.1.3 *Usability: Software usability implies the level of efforts needed to operate a program, prepare input, and interpret results..*

2.2 Production Revision

2.2.1 *Maintainability: Software maintainability implies the time and effort needed to find and fix a bug in a working application. This criterion mainly answers the question "Can one fix it?".*

2.2.2 *Flexibility: Software flexibility implies the operational program modification effort. This criterion mainly answers the question "Can one change it with ease?". Keeping in mind that this quality is more abstract than augmentability..*

2.2.3 *Testability: Software test-ability implies the time and effort put into testing a program to make sure it serves its intended purpose. This criterion mainly answers the question "Can I test it for its fitness to use?".*

2.3 Product Transition

2.3.1 *Portability: Software portability implies the level of efforts involved in transferring a program between different hardware configurations and/or software system environments. This criterion mainly answers the question "Will one be able to use it on another machine?".*

2.3.2 *Reusability: Software re-usability implies the degree to which a program can be used in other applications, as determined by its packaging and the range of its capabilities..*

2.3.3 *Interoperability: Software interoperability implies the work involved in connecting two systems..*

3. MATERIALS AND METHODS

In this section, authors provide some introductions to PFS and briefly explain the PF-DEMATEL method. The method had been applied in so many varied areas like supplier selection problem, solid waste management, nuclear energy investment, circular supply chain, safety analysis,quality function deployment, machine tool selection, selecting investment projects etc. It has not been applied in software engineering domain. Hence this paper has originality value as the first attempt to software quality evaluation.

3.1 Pythagorean fuzzy DEMATEL method

Utilizing the foundation of graph theory, the DEMATEL approach is paved (Gabus and Fontela, 1972). According to its criteria, the DEMATEL technique examines and depicts the direct and indirect interactions between the various parts of the research system. All of the factors are bifurcated into cause and effect group by examining level of connections or association between the aspects that make up the entire system. The DEMATEL approach is explained in the steps below.

Step 1: Forming Pythagorean fuzzy direct relation (PFDR) In order to address the ambiguities of human assessment, the Pythagorean-fuzzy linguistic measure is considered that is allocated the appropriate TrPFN value. For this criteria, the Pythagorean-fuzzy direct-relation-matrix (PFDRM) 'D' with criteria namely C1, C2,.., Cn as

$$D = [d_{ij}]_{nxn} \tag{1}$$

where d_{ij} are trapezoidal intuitionistic fuzzy number (TrPFNs). The predicted value of TrPFNs was given in the study by (Govindan, Rajendran, Sarkis, and Murugesan, 2015), and (Govindan, Khodaverdi, and Vafadarnikjoo, 2015). Using reference (Grzegrorzewski, 2003), the expectable value of each d_{ij} is computed and the expected PFDRM 'D' was developed.

Step 2: Normalizing the obtained direct relation matrix (DRM). In this process, different criteria are converted into non-dimensional criteria. Consequently, the following is how the normalized PFDRM is obtained:

$$X = KD \tag{2}$$

where,

$$K = \frac{1}{Max_{1 \leq i \leq n} \sum_{j=1}^{n} d_{i,j}} \tag{3}$$

Step 3: Constructing total relation matrix[PFTRM] The TRM considering PFS is considered as

$$T = X[I - X]^{-1} \tag{4}$$

Where, T = TRM and I = Identity matrix (IM).

Step 4: Generating causal diagram 'D' represents the summation of rows and the 'R' indicates summation of columns of the PFTRM. Calculate D and R as:

$$R = [\sum_{j=1}^{n} t_{i,j}]_{1xn} \tag{5}$$

$$D = [\sum_{i=1}^{n} t_{i,j}]_{nx1} \tag{6}$$

By summing the value of D and R, we get influence strength. By subtracting the value of R from D, we get the important factor index. By making scatter plot, of [D-R], and [D+R], the causal diagram may be formed which bifurcates the factors into cause and effect groups.

4. RESULT AND DISCUSSION

In order to numerically illustrate the method, we tackle the problem of software quality evaluation in this part. The key variables in the evaluation of software quality are frequently intricate. To make the cause-and-effect criteria for the provider simpler, we employ the PF DEMATEL approach. The subsequent stages outline the used method. Step 1: In this instance, linguistic analysis is a reasonable method for determining how two criteria relate to one another. We employ a seven-point scale for linguistic evaluation that is explained by linguistic phrase and associated TrPFN. The equivalent predicted value of each TrPFN as determined and taken from by (Grzegrorzewski, 2003). The initial DRM (as shown in Table I), is obtained after choosing the maximum linguistic assessment value for the relevant criterion.

Step 2: The expected PFDRM can be created by replacing the TrPFN value with the relevant expected value. The maximum summation value is determined after obtaining row-wise summation. Each cell is divided by the maximum row summation value of the anticipated PFDRM 'D', to produce normalized PFDRM.

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
C1	-	AH	AH	AH	H	FH	H	FH	FH	AH	FH
C2	H	-	FH	FH	FL	FL	L	L	AH	FH	AH
C3	FL	FH	-	FH	AH	ML	FL	FL	L	ML	ML
C4	FH	ML	ML	-	L	ML	FH	FL	FH	ML	ML
C5	H	ML	H	L	-	ML	FH	L	L	H	FL
C6	FH	H	FH	FH	H	-	ML	L	L	FL	FL
C7	FH	L	ML	FH	H	FL	-	FH	FH	FH	FH
C8	FH	H	H	FH	FH	FH	FH	-	L	L	L
C9	L	L	L	H	FL	H	H	L	-	L	L
C10	H	ML	ML	ML	FH	L	H	L	L	-	L
C11	FH	ML	FL	H	H	ML	H	L	L	L	-

Table I: Initial direct relation matrix

Step 3: We utilized the Microsoft Excel 2016 to perform the calculations and obtaining the result as shown in Steps 2 and 3. Table II represents PFTRM.

Step 4: The values of [D + R] and [D - R] are then calculated. If [D-R] is more than zero, a criterion is handled as a cause category, and if [D-R] is less than zero, as an effect category. Due to the significance of the criteria, the horizontal axis of the vector [D + R] is presented and is referred to as prominence. The values of [D + R] and [D-R] for each criterion are shown in Table III. Fig. 1 displays the causal diagram of the set [D+R, D-R].

4.1 Discussion

From Figure 1 and Table III, If the value of [D-R] for a criterion is more than zero, then the criteria belong to cause group and if it is less than zero, then in effect group. Here, the cause group includes the criteria C1, C2, C6, C8 and the effect group includes the criteria C3, C4, C5, C7, C9, C10, C11. The cause criteria group may have a significant impact on the overall system. Those are correctness [C1], reliability [C2], maintainability [C6], and test-ability [C8]. In the cause group, correctness [C1] has the highest value of [D-R] i.e. 0.698 which indicates that C1 has more influence on the whole system. Additionally, Table III demonstrates that the value of [D+R] of C1 is 3.700, demonstrating the significance of C1 as a criterion for assessing software quality.

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
C1	O.139	O.245	O.255	O.266	O.235	O.153	O.221	O.121	O.158	O.243	O.163
C2	O.176	O.08	O.144	O.165	O.124	O.094	O.115	O.057	O.19	O.136	O.193
C3	O.1	O.122	O.07	O.129	O.2	O.089	O.093	O.055	O.064	O.105	O.093
C4	O.125	O.101	O.104	O.073	O.089	O.089	O.127	O.057	O.108	O.098	O.091
C5	O.167	O.114	O.167	O.099	O.089	O.093	0.136	O.053	O.069	0.161	O.082
C6	O.138	O.158	O.137	O.139	O.17	O.051	O.113	O.051	O.073	O.096	O.086
C7	O.142	O.089	O.121	O.145	O.176	O.083	O.084	O.098	O.113	O.131	O.115
C8	O.143	O.166	O.172	O.146	O.151	O.117	O.136	O.038	O.078	O.091	O.082
C9	O.074	O.067	O.07	O.15	O.087	O.13	O.146	O.044	O.041	O.064	O.058
C10	O.16	O.105	O.113	O.116	O.137	O.064	O.158	O.052	O.067	O.067	O.07
C11	O.138	O.108	O.1	O.167	O.17	O.093	O.164	O.053	O.071	O.087	O.056

Table II: Pythagorean fuzzy total relation matrix (T)

The criteria 'Usability' [C5] has the highest [D + R] value of 2.861 which indicates that C5 is the most important criterion in software quality evaluation in the effect group. Usability level of software should be an important factor in software quality evaluation as it can directly affect the customers' satisfaction. The [D - R] value of portability [C9] is close to zero and its [D+R] value is also not significant hence it can be considered as a non-influential to the system. The impact group criteria for "interoperability" [C11] and "Reusability" [C10] have high [D + R] values of

Sub-criteria	D	R	D+R	D-R
Correctness [C1]	2.199	1.501	3.7	0.698
Reliability [C2]	1.475	1.356	2.831	0.119
Efficiency [C3]	1.12	1.453	2.573	-0.333
Integrity [C4]	1.062	1.595	2.657	-0.533
Usability [C5]	1.231	1.63	2.861	-0.399
Maintainability [C6]	1.213	1.056	2.269	0.156
Flexibility [C7]	1.298	1.495	2.793	-0.198
Testability [C8]	1.32	0.677	1.997	0.643
Portability [C9]	0.931	1.032	1.963	-0.101
Reusability [C10]	1.108	1.28	2.388	-0.172
Interoperability [C11]	1.088	1.207	2.295	-0.119

Table III: Classification into cause and Effect group

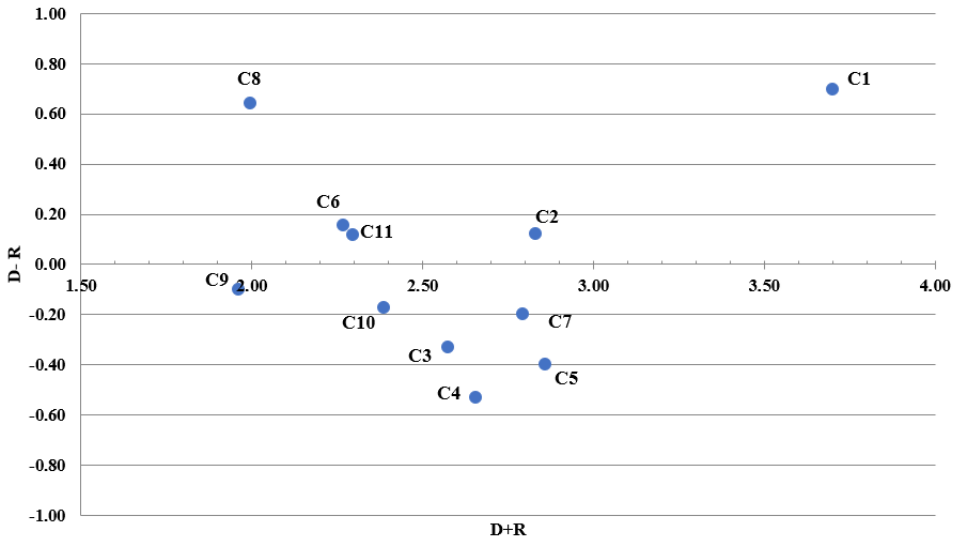


Figure 1. Cause and effect diagram

2.295 and 2.388, respectively, and relatively low [D-R] values, as can also be shown in Fig. 1. It implies that C9 and C10 have little effect on the system as a whole but are vulnerable to other influences.

5. CONCLUSION AND FUTURE WORK

The DEMATEL approach was used in this work to address the Software Selection Problem in the field of Software Quality Management in a Pythagorean fuzzy environment. The study's findings had significant ramifications for software developers and project managers. Managers can evaluate the effects of a set of criteria on the quality of the software and use them to pick a best software. The developers must focus on the cause group criteria, as they have influence on the effect group criteria. Therefore, this research can help software developers and project managers to better grasp the relationship between a software and its selection criteria.

References

Cavano, J. and McCall, J. A. 1978. A framework for the measurement of software quality. *SIGSOFT Softw. Eng. Notes 3,* 5, 133–139.

Gabus, A. and Fontela, E. 1972. World problems, an invitation to further thought within the framework of dematel. Switzerland, Geneva: Battelle Geneva Research Centre.

Galin, D. 2018. Software quality factors (attributes). In *Software Quality: Concepts and Practice*. John Wiley & Sons, Inc., Hoboken, NJ, USA, 23–44.

Govindan, K., Khodaverdi, R., and Vafadarnikjoo, A. 2015. Intuitionistic fuzzy based dematel method for developing green practices and performances in a green supply chain. *Expert Systems with Applications 42,* 20, 7207–7220.

Govindan, K., Rajendran, S., Sarkis, J., and Murugesan, P. 2015. Multi criteria decision making approaches for green supplier evaluation and selection: a literature review. *Journal of Cleaner Production 98*, 66–83.

Grzegrorzewski, P. 2003. The hamming distance between intuitionistic fuzzy sets. *In Proceedings of the 10th ifsa world congress, Istanbul, Turkey*, 35–38.

Kassie, N. and Singh, J. 2020. A study on software quality factors and metrics to enhance software quality assurance. *Int. J. Productivity and Quality Management 29,* 1, 24–44.

Khaddaj, S. and Horgan, G. 2004. The evaluation of software quality factors in very large information systems. *Electronic Journal of Information Systems Evaluation 7,* 1, 43–48.

Kitchenham, B. and Pfleeger, S. L. 1996. Software quality: the elusive target [special issues section]. *IEEE Softw. 13,* 1, 12–21.

P. Miguel, J., Mauricio, D., and Rodríguez, G. 2014. A review of software quality models for the evaluation of software products. *Int. j. softw. eng. appl. 5,* 6 (Nov.), 31–53.

Sharma, A. K. 2012. An analysis of optimum software quality factors. *IOSR Journal of Engineering 2,* 4, 663–669.

Prof. Mangesh Joshi is working as Assistant Professor in Shri Ramdeobaba College of Engineering and Management, Nagpur. He has completed B.E. in Industrial Engineering. He pursued his master of technology from Visvesvaraya National Institute of Technology, Nagpur. He is currently pursuing his Ph.D. from Rashtrasant Tukdoji Maharaj, Nagpur University. He has total 11 years of teaching experience along with 3 years of research experience. He has more than 10 research papers in SCI/SCIE/ESCI/SCOPUS indexed journals. He served as reviewers in many SCI/SCOPUS indexed journals of repute.He has completed consultancy work of more than 30 Lakhs till date. He is a life member of Indian Institution of Industrial Engineering, India and Institute of Engineers, India.
E-mail: joshimp@rknec.edu

Mr. Rahul Dashrath Mankar is currently working as Information officer at Symbiosis Law School, Nagpur. He has completed Bachelors of Engineering (B.E.) and Master of Technology (M.Tech) in Industrial Engineering. from Ramdeobaba college of Engineering and Management, Nagpur. He has 12 years of experience in Mechanical Engineering Dept as Asst. Prof. and 3 years of experience as an Information officer.He has also published various research paper in the field of vibration, manufacturing and management in reputed journals.He is a life member of Indian Institute of Industrial Engineering (IIIE), India.
E-mail: informationofficer@slsnagpur.edu.in

Prof. Himanshu Shukla is working as Assistant Professor in Shri Ramdeobaba College of Engineering and Management, Nagpur. He has completed B.E. in Mechanical Engineering. He pursued his master of technology in Industrial Engineering. He is currently pursuing his Ph.D. from Rashtrasant Tukdoji Maharaj, Nagpur University. He has total 9 years of teaching experience along with 3 years of research experience. He has many research papers in international journals of repute. He served as reviewers in many SCI/SCOPUS indexed journals of repute.He has completed consultancy work of more than 30 Lakhs till date. He is a life member of Indian Institution of Industrial Engineering, India and Institute of Engineers, India.
E-mail: shuklah1@rknec.edu

Energy Aware Job Scheduling and Simulation in a Cloud Datacenter

Purushottam J Assudani, Mehvash Khan, Mukesh Kumar and Tejas Bhutada
Shri Ramdeobaba College of Engineering and Management Nagpur, Maharashtra, India

Virtualization technology is used by cloud systems for the users to utilize cloud resources through Virtual Machines. These VM's process the task requests made by users. Ever since inefficient hardware utilization is the concern for the future and the environment, efficient work load balancing and allocation of VMs helps to bring down the hardware usage and results to efficient working. That being said, this paper proposes task scheduling framework where the task will be assigned to a VMs running on the active hosts(servers) through preemption as required and classification of the cloudlets. The algorithm that we have taken into consideration will categorize the cloudlets into three distinct types and allocate them a VM based on first come, first served resource time in regards to that particular host. This in turn will reduce the energy consumption by having lesser machines running in the active state meanwhile preserving efficient utilization of the active servers. Such kind of simulations are fairly achieved using the CloudSim framework

Keywords: Energy saving, CloudSim, Scheduling, Job types, energy-aware algorithms.

1. INTRODUCTION

Among other leading technologies, Cloud Computing has anchored to deliver scalable computing services in a sustainable, fault-tolerant manner. Cloud computing services have been divided into Iaas, Paas, and Saas over the years, leading to a change in the way large-scale cloud computing used to work. In addition, many large organizations and technology moguls around the world are working and investing in creating a public cloud that offers cheap and reliable services. While many have contributed to the creation of private and hybrid cloud infrastructure. The underlying problem of infrastructure investment on a massive scale for operations makes it difficult to evaluate performance. In addition, simulation studies help fill the gap using tools such as Cloudsim. These tools have resulted in model environments to optimize various performance, security, management and reliability methodologies. So, we use Cloudsim to generate our performance data center model and simulate the processes to check the performance.

Cloudsim is an extensible simulation framework, generalized to enable impeccable implementation and experimentation of various existing and emerging cloud computing setups and services. It has helped technology researchers, on-field engineers and developers take care of system design challenges without worrying about cloud infrastructure costs. Over the years, the energy and resource consumption of cloud data centers has grown rapidly, and energy awareness has become an issue, as one Google data center consumes the energy equivalent of a small city. Thus, minimizing power consumption can be achieved by increasing resource utilization, as this has become a challenge in cloud data centers.

Concentrating on energy awareness in a cloud environment will benefit two folds such that the power consumption will also stoop down resulting in lower carbon emissions and the companies can then invest in better cloud models and infrastructures to deliver cutting-edge services to users in abundance.

2. RELATED WORK

For a long time, the focus of researchers around cloud computing has been on distinguished verticals. Whereas, in the overview of the current studies, virtual computing has emphasized planning techniques that involve cost and resource utilization significantly. The authors in [6]

applied constrained forward control to maximize data center profit through the minimization of energy consumption in VM consolidation-based work. The number of VCPU's and Vm's to be allocated is decided by Controller. However, they did not consider how the first rejection would affect energy consumption when demand takes precedence. The authors in [7] consolidate servers using a modified Best Fit Reduction (MBFD) algorithm in scheduling. Ranks hosts based on host usage and migrates VMs using a double threshold method. The authors of [8] argue that VM migration helps successfully meet various resource management needs such as load balancing, power management, fault tolerance, and system maintenance. However, the migration itself comes with real challenges such as transmission delays and performance degradation, and incurs a lot of overhead and cost. The authors of [9] considered dynamic voltage and frequency scaling (DVFS) and deadline constraints for scheduling tasks. The optimal power-to-performance ratio for each host is calculated and scheduled tasks are assigned to those host VMs. Finally, consolidation is used to reduce the energy that migration uses. This method is not well suited for data centers with heterogeneous systems. As part of the scheduling algorithm, Selvarani [10] proposed an improved cost-based scheduling algorithm that efficiently allocates tasks to available resources by grouping them based on cloud capacity. did. Jiayin Li [11] proposed a feed-forward task scheduling algorithm that generates a schedule with the shortest average task execution time. 9 In [12], Yang introduced his V-heuristic like V-MCT in task assignments. It assigns each task to a virtualized resource in arbitrary order with minimum completion time. In this case, the completion time of the executed tasks is taken into account, but not the assigned tasks in the queue. Antony Thomas[13] introduced credit job scheduling in cloud computing using user priority and job length. Algorithms proposed in [14] discussed preemptive reservation and non-preemptive scheduling of tasks in a grid environment as part of job request types. FRWS [15] was proposed by Kaushik et al. However, it does not address the problem of low resource utilization by only considering advance reservation requests. Our proposed method consolidates VMs based on request type, host availability, and avoids VM migration

Sr No.	Author's Name(s)	Paper Title	Algorithms And Methodology.	Tools
1.	1. D.Meisner 2. B.T. Gold 3. T.F. Wenisch	Powernap: Eliminating Server Idle Power	Host server can be in any one of the states such as Active State, Idle state and Standby State. The energy consumption at each state is different.	RAILS, an innovative power distribution system that boosts power conversion effectiveness
2.	1. R.N.Calheiros 2. R.Ranjan, A 3. Beloglazov 4. C.A De Rose 5. R. Buyya	Cloudsim: A Toolkit for Modeling and Simulation of Cloud Computing Environments and Evaluation of Resource Provisioning Algorithms	Cloudsim toolkit for modeling simulation setup..	CloudSim toolkit
3.	B. Sotomayor Basilio	Provisioning Computational Resources Using Virtual Machines And Lease, Report	Resource provisioning system and lease abstraction Disk Image Transfer for Advance reservation. Creating a resource utilization setup for Advanced Reservation and Best Effort Jobs	Amazon EC2, Haizea Tool for simulating lease workload.
4.	1. S. Long 2. Y. Zhao 3. W. Chen	A Three Phase Energy-Saving Strategy for Cloud Storage Systems	Energy Saving model of hadoop Distributed File system, and three phase energy saving strategies.	Cloudsim toolkit for modeling simulation setup and energy aware resource management.
5.	1. M.A. Salehi, 2. P.R Krishna, 3. K.S. Deepak 4. R. Buyya,	Preemption-Aware Energy Management in Virtualized Data Centers	PEMP, GESP, SESP	Haizea, a scheduling platform for virtual data centers.

Table 1. Tabulation Representation of Comparative Parameters

3. METHODOLOGY

In this chapter, the explained system model briefly addresses VM consolidation based on request types, host availability, and VM migration avoidance to maximize resource utilization even for jobs that do not fall into the pre-booking category. Hosts have been revised to be in three different states to regulate and minimize power consumption. A system model architecture is a detailed representation of how a concept is implemented with various components to build the resulting Task Scheduler.

3.1 System Model

A physical server can be in any of the three described states such as the active state, the standby state, and the Idle state. Likewise, the power consumption varies from each state for the server. Amongst the three states, the active state consumes the maximum amount of energy since the hosts or servers process the requests in that state. The standby state consumes up to 10% of the electricity of the operating mode. The Idle state is defined as the state between the active state and the standby state and those servers consume about 70% of the electricity in operating mode. Conceptually, in a data center 50% of the servers are in Idle state for system startup and the rest of 50% is in the Standby state.
The cloudlets(jobs) are conceptualized into three types Advanced Reservation, Best Effort, and Immediate.
Here the highest priority is given to the AR, then BE and so IM jobs can be preempted for the two anytime. Initially. the best-effort jobs are stored in a queue and they are processed whenever the resources are available and are not in use by the AR and IM jobs. The transition of the host's state(Active, standby, idle) is controlled by the administrator as it monitors which hosts or servers are under utilization and which ones are free. The idle time threshold value computes how long the system can be in the Idle state. The MinNum values of each Ith state are set by the data center itself. And with time these values can change based on the availability of resources and the requests made by the users in the form of cloudlet with the help of resource monitoring according to the current workload of the data center. Priority $\rightarrow$ Immediate jobs $>$ Advanced Reservation Jobs $>$ Best Effort Jobs.
So, if there is any Immediate job it can preempt AR jobs and BE jobs. Similarly, AR jobs can preempt BE jobs.

3.2 System Model Architecture

In the cloud, the request received from a user for any kind of service is known as a job, which in cloudsim framework is considered as 'Cloudlet'. All the cloudlets are assigned to a VM. A host is a homogeneous physical machine (or server) with computing power on which virtual machines run. In the proposed cloud model shown in Figure 3.2, a data center consists of m hosts well connected to a CMS (Control Management System). Based on the number of cores in the VM request, VMs come in different sizes such as small, medium, and large. Each host consists of n VMs of various sizes attached to the host. Job requests are assigned to these VMs and can run in parallel on different host cores with different completion times. Each VM within a host maintains a request queue RQ(k) in which tasks assigned to that virtual machine by the CMS are queued. The proposed CMS is a centralized server that manages all hosts residing in a data center deployed in a web-based job submission portal. A customer submits an order to her CMS. CMS maintains an inbound JQ job queue where all submitted jobs are queued for scheduling. In addition, CMS schedules and classifies queued jobs based on policies such as advance reservation, best effort, and immediate responsibility. The incoming workload of virtual machines from different hosts by detecting resource (VM) availability and schedule based on proposed preemption policies. The proposed scheduling process algorithmically selects hosts based on VM availability. We differentiate the jobs on the basis of information entered by the user while filling the job request where the main idea to differentiate the jobs is the Execution Start Time(ExeST) and

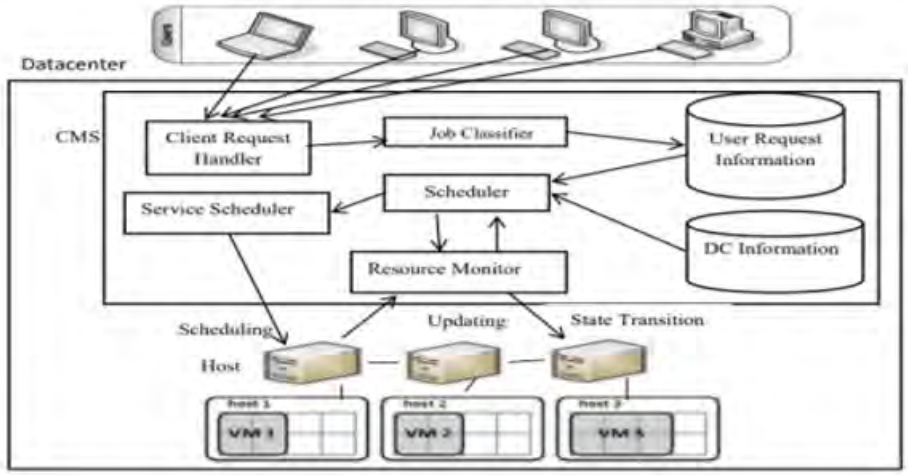


Figure 3.2 System Model Architecture

Execution_End_Time(ExeET). If the ExeST and ExeET are provided in the request then the request is of AR job type. If only ExeST is given then the request is of IM job type. And finally, if both the ExeST and ExeET are not given then the request is of BE job type.
Also in every Job request some additional information is required like the Number of Cores, amount of RAM, and Bandwidth required for the execution of the process.
Depending on the type of information entered by the user during the request, the task is identified as follows:
Advanced-Reservation - Job Request = <Num_core, aRam, a_D, BW, Exe_time, St_time, End_time
Best Effort – Job request = < Num_Core, a_Ram, a_D, BW, Exe_time, Nil, Nil>
Immediate - Job Request = <Num_Core, a_Ram, a_D, BW, Exe_time, St_time, Nil>
For each task, some details are required, i.e. number of cores required, amount of RAM required, bandwidth, and total time required to execute the process.
And the processes are distinguished based on:
If a start time and an end time are given, then the job type is AR job_type. If only the start time is specified, then the job type is Immediate job_type.
And if no start and end time are given, then the task has a task_type of Best Effort.

4. IMPLEMENTATION

To implement the above system model, we have used the following algorithms to achieve the desired outcomes from the simulation environment:

Algorithm 1: Creation of Available Virtual Machines List.
In: Resources list, Requested vm_size, ar_list.
Out: List of matching vm's with av_time.

```
Create a List <vm>available_vmlist == new arrayList<vm>()
do for host_i : host_i ε datacenter(D) ∀ 1 < i < m
do for vm_j : vm_j ε host_i ∀ 1 < j < t:
// Three things to be done;
Check if VMsize == Req VMsize in Res list
Find Available Time(av_time) for the vm
Using eq. { vm(vm_j) = ct(host_i) }
eq. { at(vm_j) = [ max ( ft( jobvm_j:host_i ))] }
```

Where, at ⇒ av_time
ct ⇒ Current Time ft(job) ⇒ finish time of the job
If vm_i has not assigned any future advanced reservations
add vm_i to available_Vvmlist.
available_vmlist.add(VM_i)
Return available_list

The goal of Algorithm 1 is to generate a list of available Virtual Machines that can then be utilized to allocate them to the worthy assignment (Best Effort, Immediate). In order for the VMs assigned to jobs of advance reservation to not be considered for available VMs for jobs like Best Effort and Immediate type, it accepts the input of all the VM sizes as desired based on jobs and the available resources.

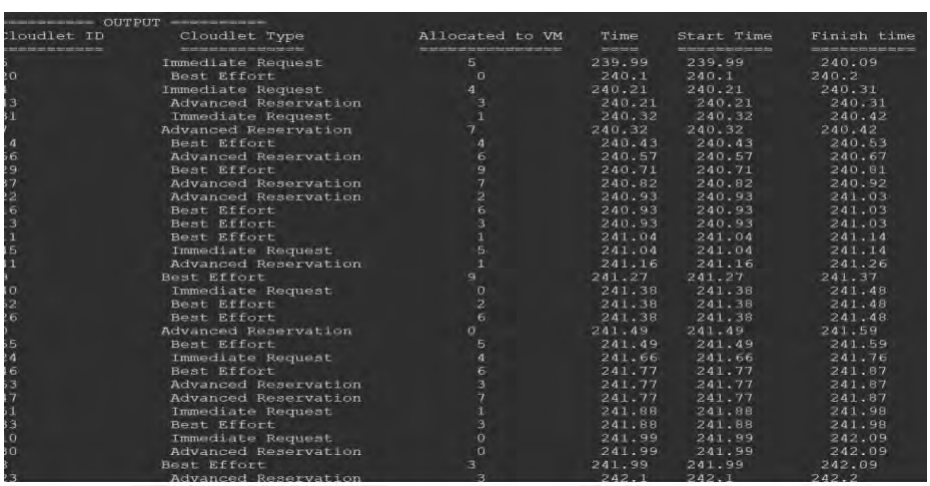
Algorithm 2: EAVMAT scheduling algorithm.
In: JQ list of resources, available_vmlist, and incoming job j.
Out: Job allocation to hosts.
For every J_n ε JQ $\forall$ n= 1 to J
If Job_type == BE request (Best Effort)
Allocate the request if the necessary resources are available and on a host that is active (Host j).
Else if the host is found in an active or idle state with a minimum EAT (Earliest Available Time) and no AR requests have been issued to it.
Assign the request.
Else: Add to the backfill queue.
If Job_type == IM request (Immediate Job)
Allocate the request if the required resources are available, free, and on Host j.
In the event that no AR requests have been issued to the host, discover it in an active or idle state with a minimum EAT (Earliest Available Time)
If VM_i's earliest available time on Host j is the same as Job_n's start time, i.e EAT(VM i)==ST(Job n)
Assign the request
If not, call preemption() on Job n;
If AR request and Job type match (Advanced Reservation)
Select the top host on the list.
If the available resource has the following properties:
ST(ji) ! $\leq$ ST(jARassigned)t ! $\leq$ FT(ji) and (ST(ji) ! $\leq$ FT(jARassigned)k ! $\leq$ T(ji)) Then
Assign the request
If not, call preemption() on Job n;
If not, deny the job request.
Revise the RQ job list (Ready Queue)
End while Preemption()
Obtain all BE jobs on the host for time T and look at the flag status.
For(s=1) to the host's BE task count.
If Job_type==IM request
If the start time of Job_n equals the Earliest Available Time (EAT) of VM_i on Host_j i.e. (EAT(VM_i)==ST(Job_n))
Schedule the request on Host_j and preempt the existing Best Effort request.
Else type==AR request
(ST(Job_n)t==ST(ji) $\forall$ Job_assigned ε Ready Queue Schedule the incoming request on Host_j and preempt the existing Best Effort Job.

For Loop End.

Algorithm 2's goal is to reduce the number of servers in order to conserve energy. We suggest the EAVMAT) scheduling strategy to achieve this. When an AR or IM request is received, CMS will first determine whether the requested resource is available on one of the active hosts on the list it maintains before allocating it to the hosts. If no open slots are available, the earliest host that becomes available is assigned. If none of the possibilities are true, the request is preempted and the existing host is used instead of turning on a new one. If there is an increase in workload and the current active hosts are not sufficient, the off-state hosts are brought online. The sole situation where an AR/IM task is denied because other AR jobs have reserved resources at the needed time and there aren't enough resources left for the present work in any active host or idle hosts is because resources are reserved by other AR jobs at the required time. Table 2 lists the values that were assigned during the simulation. When comparing the outcomes of various runs, these parameters are held constant at these values.

4.1 Code

```
public class Available_VM_List {
  public static void main(String[] args) {      // Display of the VMs assigned to each job type.
  Private static String X1(String cloudlet_type){
  for (int i=0;i<60;i++) {
  Random r1 =new Random();
  int x1 = r1.nextInt(3);
  if(x1==0) {
  cloudlet_type = ("Best Effort ");
  }
  else if(x1==1) {
  cloudlet_type = ("Immediate Request ");
  }
  else {
  cloudlet_type = ("Advanced Reservation");      } }
  //TODO Auto-generated method stub
  return cloudlet_type      }
```



Cloudlet ID	Cloudlet Type	Allocated to VM	Time	Start Time	Finish time
5	Immediate Request	5	239.99	239.99	240.09
20	Best Effort	0	240.1	240.1	240.2
1	Immediate Request	4	240.21	240.21	240.31
13	Advanced Reservation	3	240.21	240.21	240.31
31	Immediate Request	1	240.32	240.32	240.42
7	Advanced Reservation	7	240.32	240.32	240.42
14	Best Effort	4	240.43	240.43	240.53
36	Advanced Reservation	6	240.57	240.57	240.67
29	Best Effort	9	240.71	240.71	240.81
37	Advanced Reservation	7	240.82	240.82	240.92
22	Advanced Reservation	2	240.93	240.93	241.03
16	Best Effort	6	240.93	240.93	241.03
33	Best Effort	3	240.93	240.93	241.03
11	Best Effort	1	241.04	241.04	241.14
15	Immediate Request	5	241.04	241.04	241.14
11	Advanced Reservation	1	241.16	241.16	241.26
9	Best Effort	9	241.27	241.27	241.37
10	Immediate Request	0	241.38	241.38	241.48
32	Best Effort	2	241.38	241.38	241.48
26	Best Effort	6	241.38	241.38	241.48
0	Advanced Reservation	0	241.49	241.49	241.59
35	Best Effort	5	241.49	241.49	241.59
24	Immediate Request	4	241.66	241.66	241.76
16	Best Effort	6	241.77	241.77	241.87
33	Advanced Reservation	3	241.77	241.77	241.87
17	Advanced Reservation	7	241.77	241.77	241.87
31	Immediate Request	1	241.88	241.88	241.98
33	Best Effort	3	241.88	241.88	241.98
10	Immediate Request	0	241.99	241.99	242.09
30	Advanced Reservation	0	241.99	241.99	242.09
3	Best Effort	3	241.99	241.99	242.09
23	Advanced Reservation	3	242.1	242.1	242.2

Figure 4.1.1. Allocating cloudlets a random integer.

50	Immediate Request	0	242.21	242.21	242.31
54	Advanced Reservation	4	242.21	242.21	242.31
39	Immediate Request	9	242.21	242.21	242.31
17	Immediate Request	7	242.32	242.32	242.42
58	Best Effort	8	242.43	242.43	242.53
27	Best Effort	7	242.43	242.43	242.53
34	Immediate Request	4	242.54	242.54	242.64
44	Immediate Request	4	242.54	242.54	242.64
48	Advanced Reservation	8	242.54	242.54	242.64
1	Immediate Request	1	242.54	242.54	242.64
25	Immediate Request	5	242.54	242.54	242.64
12	Best Effort	2	242.54	242.54	242.64
6	Advanced Reservation	6	242.54	242.54	242.64
21	Advanced Reservation	1	242.65	242.65	242.75
57	Advanced Reservation	7	242.65	242.65	242.75
36	Best Effort	6	242.76	242.76	242.86
15	Best Effort	5	242.87	242.87	242.97
42	Immediate Request	2	242.87	242.87	242.97
28	Immediate Request	8	242.98	242.98	243.08
35	Best Effort	5	242.98	242.98	243.08
32	Advanced Reservation	2	242.98	242.98	243.08
18	Advanced Reservation	8	243.09	243.09	243.19
59	Immediate Request	9	243.2	243.2	243.3
8	Immediate Request	8	243.31	243.31	243.41
2	Immediate Request	2	243.31	243.31	243.41
19	Immediate Request	9	243.42	243.42	243.52
49	Best Effort	9	243.53	243.53	243.63
38	Immediate Request	8	243.64	243.64	243.74

Figure 4.1.2. Allocating cloudlets a random integer.

During our implementation, we have created a data center, broker, and 60 cloudlets. Ultimately we created 10 VM's for simulation purposes. Lastly, in the above-written code, we tried to assign random integer values to each classified Job type (AR,BE,IM) in the range of 0-2. This will help the system to identify each job separately and simulate accordingly thereafter.

5. CONCLUSION

In this research, we introduced EAVMAT, a cloud-based job scheduling method that considers energy consumption. In the data centers of cloud service providers, the issue of the task to VM mapping was examined in this article. The suggested scheduling algorithm's innovative feature is that it maximizes resource use while minimizing energy consumption. In data centers, where certain requests are given preemptive precedence over others, we took use of job preemption to lower energy usage. Depending on the system loads, a significant amount of energy can be saved. The increase is 46% under low load, which is noteworthy. Although the savings are reduced with higher weights, they are still important enough. We might infer from the findings that our algorithm also performs better in terms of other measures, like success rate, makes pan and throughput. Additional research may focus on the applicability of this method in a different cloud situation, such as a federated cloud environment that accepts deadline-sensitive request types.

References

Ahmad, R. W., Gani, A., Hamid, S. H. A., Shiraz, M., Yousafzai, A., and Xia, F. 2015. A survey on virtual machine migration and server consolidation frameworks for cloud data centers. *Journal of network and computer applications 52*, 11–25.

Basilio, B. S. 2010. *Provisioning computational resources using virtual machines and leases.* The University of Chicago.

Beloglazov, A., Abawajy, J., and Buyya, R. 2012. Energy-aware resource allocation heuristics for efficient management of data centers for cloud computing. *Future generation computer systems 28,* 5, 755–768.

Calheiros, R. N., Ranjan, R., Beloglazov, A., De Rose, C. A., and Buyya, R. 2011. Cloudsim: a toolkit for modeling and simulation of cloud computing environments and evaluation of resource provisioning algorithms. *Software: Practice and experience 41,* 1, 23–50.

Ding, Y., Qin, X., Liu, L., and Wang, T. 2015. Energy efficient scheduling of virtual machines in cloud with deadline constraint. *Future Generation Computer Systems 50*, 62–74.

Kaushik, N. R., Figueira, S. M., and Chiappari, S. A. 2006. Flexible time-windows for advance reservation scheduling. In *14th IEEE International Symposium on Modeling, Analysis, and Simulation*. IEEE, 218–225.

Kusic, D., Kandasamy, N., and Jiang, G. 2011. Combined power and performance management of virtualized computing environments serving session-based workloads. *IEEE Transactions on network and service management 8,* 3, 245–258.

Leverich, J. and Kozyrakis, C. 2010. On the energy (in) efficiency of hadoop clusters. *ACM SIGOPS Operating Systems Review 44,* 1, 61–65.

Li, J., Qiu, M., Niu, J., Gao, W., Zong, Z., and Qin, X. 2010. Feedback dynamic algorithms for preemptable job scheduling in cloud systems. In *2010 IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology*. Vol. 1. IEEE, 561–564.

Loganathan, S. and Mukherjee, S. 2013. Differentiated policy based job scheduling with queue model and advanced reservation technique in a private cloud environment. In *International Conference on Grid and Pervasive Computing*. Springer, 32–39.

Long, S., Zhao, Y., and Chen, W. 2014. A three-phase energy-saving strategy for cloud storage systems. *Journal of Systems and Software 87*, 38–47.

Mashayekhy, L., Nejad, M. M., Grosu, D., Lu, D., and Shi, W. 2014. Energy-aware scheduling of mapreduce jobs. In *2014 IEEE International Congress on Big Data*. IEEE, 32–39.

Meisner, D., Gold, B. T., and Wenisch, T. F. 2009. Powernap: eliminating server idle power. *ACM SIGARCH Computer Architecture News 37,* 1, 205–216.

Miao, K. X. and He, J. 2012. Cloud computing and open data centers. *Intel® Technology Journal 16,* 4, 8–19.

Selvarani, S. and Sadhasivam, G. S. 2010. Improved cost-based algorithm for task scheduling in cloud computing. In *2010 IEEE International Conference on Computational Intelligence and Computing Research*. IEEE, 1–5.

Smith, W., Foster, I., and Taylor, V. 2000. Scheduling with advanced reservations. In *Proceedings 14th International Parallel and Distributed Processing Symposium. IPDPS 2000*. IEEE, 127–132.

Thomas, A., Krishnalal, G., and Raj, V. J. 2015. Credit based scheduling algorithm in cloud computing environment. *Procedia Computer Science 46*, 913–920.

Yang, Y., Zhou, Y., Sun, Z., and Cruickshank, H. 2013. Heuristic scheduling algorithms for allocation of virtualized network and computing resources. *Journal of Software Engineering and Applications 6,* 1, 1–13.

Zhang, Q., Cheng, L., and Boutaba, R. 2010. Cloud computing: state-of-the-art and research challenges. *Journal of internet services and applications 1,* 1, 7–18.

Dr. Purushotam J Assudani is working as an Assistant Professor in Department of Information Technology, Shri Ramdeobaba College of Engineering and Management, Nagpur, India. He has done Ph.D. in Computer Science and Engineering from Vellore Institute of Technology (VIT), Vellore, India. He has also completed his Bachelors and Masters in Computer Science and Engineering. He has published one Indian patent and published several papers in International Journals and conferences. He has a total teaching experience of more than 13 years and specializes in Cloud Computing, Distributed Systems and Operating Systems. He is a Certified Cloud Architect and Certified Trainer on Microsoft Azure and Amazon Web Services cloud platforms. He has delivered multiple corporate trainings on multi cloud platforms. He has also conducted online training sessions of Ms Azure at Caltech, USA. He has received a Best Paper Award in an International Conference. He has the membership of Indian Society for Technical Education (ISTE).
E-mail: assudanipj@rknec.edu

Ms Mehvash Khan is a student at Shri Ramdeobaba College of Engineering and Management and pursuing her B.E Degree in Information Technology
E-mail: khanmj2@rknec.edu

Mr Tejas Bhutada is a student at Shri Ramdeobaba College of Engineering and Management and pursuing his B.E Degree in Information Technology.
E-mail: bhutadats2@rknec.edu

Mr Mukesh Kumar is a student at Shri Ramdeobaba College of Engineering and Management and pursuing his B.E Degree in Information Technology
E-mail: kumarm_1@rknec.edu.

Mathematical Word Problem Solver System Using Deep Learning

Rohini Joshi and Kalpak Punwatkar, Chinmay Wankhede, Parth Dhorajiya
Shri Ramdeobaba College of Engineering and Management,Nagpur

Since the introduction of the idea of Math Word Problem(MWP) solver, platforms like Intelligent tutoring system and computer based training have gained much popularity and hence the development of MWP proves to be an essential part. As many types of word problems exist we primarily tend to have our focus on arithmetic single operation word problems of elementary grade level. We add our contribution to this open research by working on an already existing model which uses word cues and patterns to understand the semantics of the word problem. Hence we also add our ideas to introduce the model of inference so as to make the system in-sync with basic world knowledge.

Keywords: Math Word Problem, NLP, Classification,Word Cues.

1. INTRODUCTION

Even though elementary mathematics does not require much complex thinking for a human being, it has been a difficult task to make a computer solve it on its own. It's proven that machines such as computers hold supremacy over high speed and accurate calculations but fails in cases to solve worded problems due to its inability to extract information from natural language and understand accordingly.

As Intelligent tutoring Systems and computer-based training is gaining much popularity, the development of such models would prove to be essential for such platforms. Thus, the MWP solver is considered as an open research domain in the field of AI. Designing algorithms to solve mathematical word problems ,this idea came up long ago in the year of 1960 and since then lots of research has been carried out still the progress is slow and at a preliminary level .

Previous works have defined the structure of a MWP in different ways. But the broad classification remains almost similar in every case. Such differentiation is based on the nature of mathematics used in the problem, for example, arithmetic word problem, algebraic word problems, and geometric word problems.

Through this paper we tend to bring our focus on solving arithmetic word problems. first we discuss the approach that already exists . we explore the categories of symbolic semantics and structure prediction that has been developed through the decades of research. later we present our approach as an extension a study based on pattern prediction.

2. LITERATURE REVIEW

Researchers have proposed multiple ways in the last two decades.

One can categorise these methodologies into three categories(Charnaik, 1968) – symbolic semantics parsing ,using structure prediction and using deep learning.

Semantic parsing refers to capturing the meaning of input by converting a natural language text into a logical form is proposed in paper (M. J. Hosseini and Kushman, 2016)(R. Koncel-Kedziorski and Hajishirzi, 2016)

Structure prediction in paper (Roy and Roth, 2015)(Swagata Acharya, 2022) refers to producing a data model which then aligns simple representation with representation of word problem which is done by training a neural network.

In paper (N. Kushman and Artzi, 2016) the researcher tries to find the final expression /equation by the means of templates, they used both supervised and semi-supervised learning methods to

solve the algebraic word problem. One of the major drawbacks of this approach is if a problem does not fit into the template, then the model would not be able to solve it and a new template would not be generated.
In paper (Roy and Roth, 2015)(Bobrow, 1964) the researcher suggested tree based models which would form multiple binary trees for a given expression and then using a weighted ranking system to select the most optimal tree to calculate the final answer. The main advantage of this is that there is no need for extra equation templates, logic form or tags.
In recent years deep learning has gained significant popularity due its accuracy when trained with enough data. The researcher in paper (Charnaik, 1968) proposed deep neural solver which does not require any human intelligence for feature extraction.it directly converts a word problem into equation templates using RNN using feature engineering. RNN models are generally used to perform seq2seq modelling.
In paper (Mandal, Ahmed, and Naskar, 2020) the researcher has proposed an intelligent Deep Learning based Arithmetic Word Problem Solver, DLAWPS. The proposed systems consists of two main techniques i) Bi-directional Long Short-Term Memory (BiLSTM) and ii) Irrelevant Information Removal Unit (IIRU)BiLSTM is a Recurrent Neural Network (RNN) based method whose main task is to identify from the input arithmetic word problem the operation that would create the equation for finding the solution. The intelligent Irrelevant Information Removal Unit IIRU (P. Wang and Hao., 2016)extracts the relevant information from the input word problem that will be used to generate the solution and discards that which is irrelevant for generating the equation.

3. SYSTEM DESCRIPTION

The word problem consisting of single operation, single equation and single step arithmetic word problem P is considered as sequence of n wordw0,w1. . . .wn which contains a set of contains set of quantities ($numericvalues$) $Q = (q1, q2 \ldots qx)$ where $n > x$. Set Q is sorted in order of their appearance in the word problem.
The first step involves the prediction of the operation. For this a multilevel classification model is used as shown in the fig 1. The task is done manually by studying the characteristics of each problem and then are classified into four categories → change, combine, compare and division – multiplication.

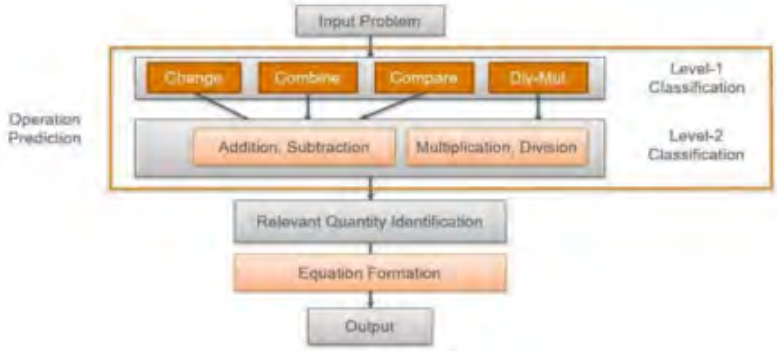


Fig 1. Overview for rule-based word problem solver.

After the prediction of operation the next step is to identify the relevant quantities as a word problem may contain many irrelevant quantities. By analysing the dataset, it is observed that all four types of problems contain irrelevant quantities and hence the process to deal with them

Class	Word cues	Description
Change	Gives, takes, loses, add, join, now, rest, away, empty, etc.	This category is defined as a set of actions that causes an increase or decrease in quantity.
Combine	All, total, together, altogether	This represents the set of questions where either the combined numerical value, all the quantities or a particular quantity is asked.
Compare	More, less, longer, heavier, fewer, another, than etc	Here one quantity is compared with other quantity
Division multiplication	Each, every, per, speed, minutes, split , times, share etc	This section contains all the basic problems related to division and multiplication.

also changes. But the basic idea remains the same as to divide the problem into the query part and story part and according to the appearance of quantities in both parts we try to remove the irrelevant data.
Next steps involve the formation of equations. In this step the order of quantities matters in the case of subtraction and division. Since the dataset consist of 2nd and 3rd grade mathematics no complex logic is required to determine the order. Basically dividing the larger valve by smaller value or subtracting the smaller value from the larger value.

4. PROPOSED WORK

We tend to add our contribution by working on the below mentioned area

(1) We formulate a strategy to automate the process of detecting the operation or the function in the word problem by training a classifier using machine learning. We tend to achieve this by studying the manual algorithm used by the author and apply its logic into our model.
(2) We would like to introduce our approach to integrate an inference module for systems world knowledge. For starters we have a fixed pattern where only one quantity as an aggregate is asked in the question for example 4 pupil + 4 parent =? People. So here the quantity in query part in and story part have only one aggregated form that is people.
(3) And at last we explore ways to describe the solution step by step. We do this at a basic level by showing how an equation is processed and later on try to have it depict it using statements.

5. IMPLEMENTATION

The following steps and algorithms are used to implement this research work:

(1) Automatic prediction of word problem function using machine learning
—For this purpose we use the already existing SingleOp dataset(D. Huang and W.-Y, 2016) as depicted below. Since this dataset contains word problems based on basic four mathematical operation. We can use the word cues to classify this problems into the first level

classes i.e. compare, change, combine and division-multiplication.
$Algorithm:$
$Intput: stringinlowercase$
$Verbs = String_searching_for_verbs(string)$
$Similarity(verbs, classes)//usingclusteringtechniques$
$Classes[class].append(question_id)$
This classification is helped in the later stages for operation prediction
Dataset:-To implement the above algorithm we have used the following dataset and classified the problem statement as shown below:

```
In [2]: df = pd.read_csv("dataset.csv")

In [3]: df.head(10)
```

Out[3]:

	Id	Question	Operator
0	1	A restaurant served 8 hamburgers during lunch ...	1
1	2	Dan picked 9 oranges and Joan picked 5 oranges...	1
2	3	There are 4 dogwood trees currently in the par...	1
3	4	Sandy has 4 yellow marbles Dan has 7 yellow ma...	1
4	5	Fred went to 8 soccer games this year. He went...	1
5	6	Benny found 7 seashells and Joan found 9 seash...	1

Fig 2. Dataset Example.

```
In [85]: classifier(df)

In [86]: print(len(ch))
         print(len(comp))
         print(len(comb))
         print(len(dm))
         print(len(misc))

         14
         10
         11
         41
         24

In [87]: print(comp)

         [(3, 'there are 4 dogwood trees currently in the park. park workers will plant 8 more dogwood trees today.how many dogwood tree
         s will the park have when the workers are finished ?'), ('there are 2 erasers in the drawer. tim placed 8 more erasers in the d
         rawer. how many erasers are now there in total ?', 7), (9, 'keith had 2 dimes in his bank. his dad gave him 6 more dimes. how m
         any dimes does keith have now ?'), ('keith had 2 dimes in his bank. his dad gave him 6 more dimes.how many dimes does keith hav
         e now ?', 10), ('there are 6 walnut trees currently in the park. park workers will plant 4 more walnut trees today. how many wa
         lnut trees will the park have when the workers are finished ? ', 12), ('dan had 2 dimes in his bank. his dad gave him 5 more di
         mes.how many dimes does dan have now ?', 13), ('there are 6 maple trees and 4 oak trees currently in the park. park workers wil
         l plant 8 more maple trees today. how many maple trees will the park have when the workers are finished ?', 21), ('shelly went
         to buy 568 cookies. she got only 233 cookies in the bakery. how many more cookies she has to buy?', 43), ('mike has to learn 35
         3 words meaning. he finished learning 120 words. how many more words he has to learn?', 44), (64, 'shyam works for 10 hours in
         a day and ram works for 9 hours in a day. ram works for 6 days in a week and sham works for 5 days in a week. who works for mor
         e hours in a week and by how much?')]
```

Fig 3. First Level Classification.

(2) Basic Inference model

—Our idea for this is to consider the question for the time being in which the collective form of the entity in question is the same. For example "ram has 10 apples and 3 watermelons. How many fruits does he have " - in this question the collective form of the entity is fruits whereas watermelon and apples are the types of fruits. $Algorithm$
$Input{-}stringinlowercase$
$Entities = find_entities(string)$
$Collective = find_collective_form(entities)$

Basically the above function looks through the already created mapping of entities and collective verbs and returns the required verb. This mapping can be done manually or using string searching algorithms.
Replace all the existing entities with collective form and return the string
This process will be done before classifying the problem into their respective type based on word cues.

The next step is to depict the step-by-step approach that is appealing the best for single operation word problems. The only case where we have to involve logic is in the case of subtraction and division where we just divide the larger by smaller or subtract the smaller from larger quantity.

(3) Prediction of operators:
—We present our approach for comparing type arithmetic math word problems. The prediction consist of three main condition –
(a) Presence of keyword "some" in compare type problems always indicates "subtraction" and presence of keyword "another" always indicates "Addition"
(b) Presence of comparative adjective in the "query part" of the problem indicates the operation "subtraction"
(c) For combines cues we look for the order of entities and then decide the operator.

On the basis of above steps of algorithm the following output is generated and which shows the operators as addition and subtraction has been predicted and calculated according to the defined word problem.
In the following word problem the prediction is done correctly according to the problem definition and in the next example the answer is addition and the prediction is done accordingly.

```
st="ram has 223 whistles.he has 95 more than charles.how many whistles does charles have?"
```

```
ram has 223 whistles
he has 95 more than charles
he has 95
 charles
-
how many whistles does charles have?
```

```
st= "ram has 31 presents,sham has 22 more than ram.how many presents does sham have?"
```

```
ram has 31 presents
sham has 22 more than ram
sham has 22
 ram
+
how many presents does sham have?
```

6. CONCLUSION AND FUTURE WORK

In this research, our approach has formulated the strategy to solve arithmetic word problems using NLP. Our main focus is to build a system to identify the operation of the problem for which two level classification is used. In this paper research we have shown the implementation of the addition and subtraction type arithmetic word problems.

The inference model which is used in this research methodology is the best and straightforward algorithm for solving mathematical word problems. The application of this proposed architecture can help school teachers in understanding, translating, solving and checking the answers of students within less time with less effort.

In future, other calculations such as multiplication and division of mathematical word problems can be implemented and also the method to solve multi-operation math word problem can be implemented.

References

Bobrow, D. 1964. Natural language input for computer problem solving.

Charnaik, E. 1968. . computer solution for calculus word problem.

D. Huang, S. Shi, C.-Y. L. J. Y. and W.-Y. 2016. How well do computers solve math word problems? large-scale dataset construction and evaluation. *North American Chapter of the ACL (NAACL HLT),*.

M. J. Hosseini, H. Hajishirzi, O. E. and Kushman, N. 2016. Learning to solve arithmetic word problems with verb categorization. In *Conference on Empirical Methods in Natural Language Processing*. pg.523–533.

Mandal, S., Ahmed, A., and Naskar, S. K. 2020. Solving arithmetic word problems: a deep learning based approach. *Intelligent and Fuzzy Systems*.

N. Kushman, L. Zettlemoyer, R. B. and Artzi, Y. 2016. Learning to automatically solve algebra word problems. pg.271–281.

P. Wang, B. Xu, J. X. G. T. C.-L. L. and Hao., H. 2016. Semantic expansion using word embedding clustering and convolutional neural network for improving short text classification. *Neurocomputing*, pp.806–814.

R. Koncel-Kedziorski, S. Roy, A. A. N. K. and Hajishirzi, H. 2016. Mawps: A math word problem repository. In *NAACL HLT 2016, The 2016 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies*. pg.1152–1157.

Roy, S. and Roth, D. 2015. solving general arithmetic word problems in proc. 2015.

Swagata Acharya, Sourav mandal, r. b. 2022. Solving arithmetic word problem using nlp and rule based classification.

Prof. Rohini Harshad Joshi is an Assistant Professor in department of Information Technology in Shri Ramdeobaba College of Engineering and Management , Nagpur (India). She has done her M.Tech in Computer Science Engineering . . She has more than 6 years of teaching Experience. . Her research interests are in Image Processing, Machine Learning, Web Development and Natural Language Processing.
E-mail: joshirh@rknec.edu

Kalpak Punwatkar is an final year student in Shri Ramdeobaba College of Engineering and Management , Nagpur (India), pursuing Bachelor's degree in Information Technology. His interests are in Database management systems, game development, internet of things and Cloud Computing.
E-mail: punwatkarkv@rknec.edu

Chinmay Wankhede is final year student at Shri Ramdeobaba College of Engineering and Management, Nagpur majoring in Information Technology.He has worked on two projects in the past two semester, both of which have been accepted for publication. He is a Known active and friendly student in the department having good interpersonal and communication skills.
E-mail: wankhedecs@rknec.edu

Parth Dhorajiya is a final year Student at Shri Ramdeobaba College of Engineering and Management , Nagpur (India).He is Pursuing Bachelor's degree in Information Technology. He has keen interest in Data Structures and algorithms and loves to do Competitive Programming. He has done good extra co-curricular experience wherein he has been the Sports Secretary of his department ,Problem Setter of Codechef RCOEM Chapter,Captain of College Cricket Team.
E-mail: dhorajiyapg@rknec.edu

Role of Blockchain Technology and Machine Learning in Design of Smart and Secure Warehouse Management System: A Survey

Kapil N Hande and Dr Manoj B Chandak
Shri Ramdeobaba College of Engineering and Management, Nagpur, India

Blockchain network is defined as interconnection of many computers, and each and every computer holds the copy of the ledger. It can be observed as continuously budding chain of blocks, and blocks are interconnected with the support of hash function. Validating of new blocks is followed by a set of protocols and consensus mechanism from every node in the network. The records are kept and arranged in linear fashion chain. The main feature of the Blockchain technology is that it allows secure communication between untrusted parties without the involvement of any third party authority. Artificial intelligence, which emulates the human intelligence, is impacting heavily on the business and social media applications nowadays. Machine learning which is the subset AI, automatically learns and improve based on input data. Whereas deep learning which is subset of machine learning uses networks to identify complex patterns in data. The basic approach of machine learning is to collect and analyze the data at central location like server. But in today's scenario the data is decentralized and emerges from multiple sources. Hence the need of distributed machine learning algorithms in many applications is required. ML can be used to make chain smarter than before. By making use of decentralized data architecture of Blockchain we can build good models of machine learning. This paper investigates the possibility of integrating Blockchain Technology and Machine learning for optimization and improvement of Warehouse operations at data and transactions levels by providing security processes needed for smart and secure system.

Keywords: Blockchain Technology (BCT), Machine Learning (ML), WMS, IoT, Supply chain management.

1. INTRODUCTION

Supply chain management provides the structure and flow to the goods and services of finished and semi-finished materials between provider and consumer of the product end to end. It is based on network of suppliers that handles the product and raw materials. Warehouses are inevitable element of the Supply chain. Storage and handling of the products and items of varied category are the part of operations of Warehouse Management System (WMS) (Enna Hirata, 2021). Channelizing the products in and out of warehouse and creating the space for new items is complex activity in WMS. Traditional WMS operates by using DBMS to store the records and access it. Improving the efficiency and effectiveness of the WMS operations is the need of the era. Warehouse Management System is the backbone of Supply chain and impacts the success of the supply chain. (K. SALAH M. H. REHMAN and Al-Fuqaha, 2018) The goods, products or the items in warehouse must not be overstocked or understocked, as both may reduce the efficiency based on particular order pattern of the material. Operations like Route optimization for the product delivery, physical space management are some of the issues which can be automated using the new technologies like Blockchain and Machine Learning (Mostafa and Elawady, 2018)(Alessandro Tufano, 2022). Because of unpredictability of the product movement and demand in and out of warehouse, stock needs and forecasting of inventory, the use of machine learning based algorithms will be effective in addressing these needs. Machine Learning can understand the pattern of supply chain and WMS working processes in many directions thereby generating the scope for better decentralized ML based algorithms for operations. Logistics industry is also using the ML based algorithms for prediction of the operations required and improving the overall performance of the system.(Sarkis, 2020) Forecasting and pattern understanding feature of ML based

techniques helps to automate the multiple processes and activities of WMS. With the invention of the Blockchain technology, secure communication between untrusted parties without the involvement of any third party authority become possible (et. al., 2019)(N. Chandrasekaran and Demkah, 2019)(Xuhui Chen and Li, 2018). Blockchain technology has many applications because of its incorruptible structure of digital ledger format. The decentralized nature of Blockchain and availability of smart contracts make it possible to use this technology in various business and industrial applications. The remainder of the paper is organized as follows. Section II throws some light on current scenario as far as technology of BCT and ML is concerned. Section III deals with possibilities and approaches for integration of Blockchain Technology and Machine learning methods for improvement of warehouse management system operations. Section IV discusses some future directions and concludes the paper.

2. BACKGROUND

2.1 Blockchain as a Technology

Blockchain is the core technology designed to use initially for the implementation of the crypto currency Bitcoin. The decentralized and distributed data and operations environment of the Blockchain makes it most promising technology in areas like finance, healthcare, supply chain, logistics, and cold chain and so on.(Xuhui Chen and Li, 2018) It is basically a continually growing chain of blocks of data, transactions, events or information. Block holds the transaction history updated persistently. Blockchain provides the environment for multiple systems (nodes) at multiple locations to cooperate and interact for common task without the need of centralized authority or third party. Security of data and transactions is guaranteed because of immutability feature of the block at chain level. Each new block is mined by the miner using proof-of-work concept, and if succeed the block is added in the chain as well as distributed to all the nodes for updating the chain.

The data can be added, updated and used in real time in the form of new blocks thereby supporting consistency of operations and transactions in the applications where in Blockchain technology is being used. Cryptographic technique of hashing is used to create and link the blocks. It's hard and difficult to generate the hash and crack the old block, which makes the chain secure (Xuhui Chen and Li, 2018)(Shahbazi and Byun, 2021). Transaction is secure as all the hashes mapped to original starting block known as genesis block. Blocks in the Blockchain are validated through consensus mechanism called as proof-of-work (PoW) in which miners compete to solve the complex mathematical problem to generate the cryptographic hash, which requires computing power and time.

Feature of Smart contracts in Blockchain helps to store transactions in secured way. Smart contracts are self-executable and immutable computer programs stored in Blockchain server. Smart contracts holds some business logic and are executed if some criterions are met. Smart contracts are enforceable agreements in the form of computer code which are executed when some conditions are fulfilled. Availability of Smart contracts in Blockchain makes it more useful for many applications.

2.2 Machine Learning approach for Huge Data Analysis

Artificial intelligence, which emulates the human intelligence, is impacting heavily on the business and social media applications nowadays. Machine learning which is the subset of AI, automatically learns and improve based on input data or historical data. Whereas deep learning which is subset of machine learning uses networks to identify complex patterns in data (N. Chandrasekaran and Demkah, 2019)(et. al, 2020). The basic approach of machine learning is to collect and analyze the data at central location like server. But in today's scenario the data is decentralized and emerges from multiple sources. Hence the need of distributed machine learning algorithms in many applications is required.

In Blockchain Technology, ML can be used to make chain smarter than before. By making use

of decentralized data architecture of Blockchain we can build good models of machine learning. Blockchain uses massive data in the background which is supporting parameter for machine learning environment. Blockchain can be linked with Machine learning for huge data analysis.

Machine Learning techniques can predict the patterns of movement in supply chain or patterns of items and inventory flow in the warehouse. Effective applications of ML algorithms makes it easy to detect the problems or delays in the supply chain and can predict the future issues too (Kushal Singla, 2018)(Xuhui Chen and Li, 2018)(Enna Hirata, 2021). Strong inventory and efficient warehouse management system are the building blocks of any supply chain. The ML based approaches can help to identify and forecast the demand of items or products thereby improving the performance of warehouse and supply chain.

The techniques of Supervised learning, Unsupervised learning and reinforcement learning can be applied in supply chain and warehouse management system. In some cases ML can be combined with Computer Vision for detection, analysis and improvement of item management in warehouse. Warehouse management system produces large amount of data related to product pick-up path, delivery schedules, In-out movement, route management and sensory data through RFID or barcode. This huge amount of data can be analyzed by ML algorithms to take better decisions and to have a strategic planning of warehouse operations.

3. PROPOSED METHODOLOGY

3.1 Issues in Warehouse Management System Operations

Handling and transportation of goods, items, and products is the vital part of warehouse. Operations and management of activities of warehouse is becoming more complex. The use of modern techniques like ML and Blockchain can optimize the warehouse operations and will improve the performance and productivity. Unpredictability of the items required and shipped is the major issue in WMS. Machine Learning can help here by analyzing the patterns in the item movement, physical space management, pick-up route optimization and management.

Projection of stock needs and inventory of warehouse can be improved through ML approach. Physical space management and warehouse layout usage optimality can also be addressed with ML based solutions (Mostafa and Elawady, 2018)(Alessandro Tufano, 2022). Efficiently picking the product in the warehouse, scheduling of workers and staff, path optimization of warehouse vehicles or carts are some of the other issues which may be improvised with the help of ML methods.

Blockchain Technology can improve the security processes in the warehouse operations. Transactions occurring in the warehouse operations would be implemented through smart contracts. Warehouse operations can be digitized along with physical assets being used, and decentralized immutable transaction records of it can be created. Blockchain technology helps in machine-to-machine communication in IoT enabled environment (mmar Muthanna Ibrahim A. Elgendy and El-Latif, 2021)(Lin, 2014). Applications implementing Blockchain technology have benefits like high speed of data sharing and transactions, secured shared data, minimization of intermediate procedures with the help of smart contracts. Transparency and traceability of transactions is improved through use of smart contracts.

The decentralized nature of blockchain provides the fundamental protocols to enable decentralized ML algorithms taking security and privacy into consideration. By applying blockchain, ML could learn, train, and derive decision-making on local devices in decentralized and distributed networks

3.2 Blockchain Technology and Machine Learning Integration approaches for WMS

As discussed earlier Blockchain is a decentralized database of transactions, events or other application specific data, which helps in sharing of information for domains that do not trust each other or belong to different areas. Using this decentralized data architecture of Blockchain we can build good models of ML. As source of data is decentralized and emerges from multiple loca-

tions it must be first collected through some channel like sensors or RFID using appropriate IoT enabled system (Shahbazi and Byun, 2021). This approach hence needs decentralized machine learning algorithms.

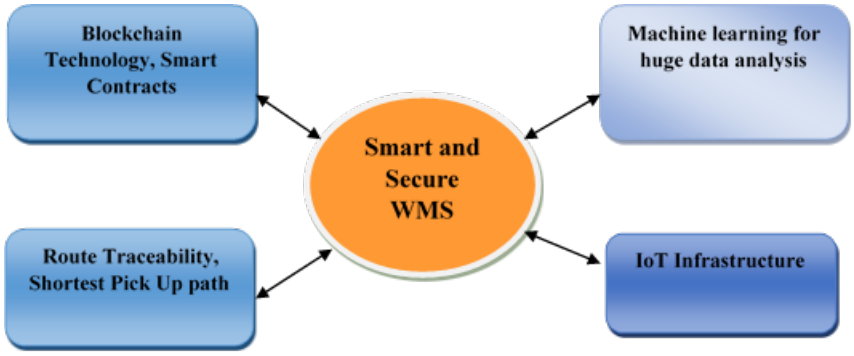


Figure 1. Proposed Conceptual Block Diagram

The major approach of integration is to link Blockchain with ML for huge data analysis. Programmable Blockchain platforms like Etherium may cut cost and can implement the computable services at warehouse level. Information like quality parameters, batch, safety, traceability data, and date etc. for item or product can be maintained through Blockchain structure.

Machine- To-Machine (M2M) transactions, technology which enables networked devices to remotely exchange information and perform actions without human involvement, can be used for warehouse management and monitoring(Kushal Singla, 2018). Supply chains, Logistics companies and warehouses produces huge and large quantity of data in many formats. This is the basis for using ML to learn, analyze and test this data for strategic planning.

The main objective of this research work is to implement security aspect through Blockchain and smarter data analysis through machine learning for effective and productive warehouse management system. Complex flow of data and financial transactions in warehouse need to be optimized. Secure exchange of data between various stakeholders and integrity of the documents holding this operational data can be materialized using Blockchain.

Tracking and tracing the item in warehouse is a crucial operation. To digitize this we need to provide the digital sameness for physical products and items which will be secure and smart. This digital equivalent of the products can be merged with IoT enabled systems to structure, compile and record the data of operations in warehouse.(Saurabh Singh, 2020)(mmar Muthanna Ibrahim A. Elgendy and El-Latif, 2021)(Lin, 2014)

Data collected through RFID tags or sensors for the products in the warehouse or supply chain need to be secured and trusted. Blockchain makes this possible and provides the trustless environment to all the parties involved in transactions and data handling and usage. Role of Blockchain is to provide the solutions based on collected data for secure usage, planning, distribution and renewal of information.

By implementation of digitization at all levels in a warehouse operations, the overall control and management of the warehouse can be improved. Need is to connect the digitization process with data analytics and trustworthy transactions through Blockchain smart contracts. Verification and maintenance of critical data can be handled and automated through the use of smart contracts.

4. CONCLUSION AND FUTURE DIRECTIONS

Warehouse operations are becoming complex day by day because of volume of items and data it handles for the Supply chain industry. Since its inception, Blockchain is proving to be a disruptive technology in many applications and domains of social and national use. Since the

data or information is distributed and has many sources, the need of suitable distributed machine learning algorithms for huge data analysis at warehouse level is forecasted. Using appropriate technology for data capturing and storing in a warehouse is required. Blockchain can handle the security processes at transaction and data level, distributed machine learning algorithms can analyse this data, and this smart and secured integration of Blockchain and ML can be built on top of IoT environment. In future work we will build a mathematical model for the state of art system for WMS. Initially simulation based approaches for data analytics and security in WMS would be examined. Real time data of warehosue then will be used to justify the research observations. This paper has investigated the possible aspects of inclusion of Blockchain and ML along with IoT model for smart and secure WMS.

References

Alessandro Tufano, Riccardo Accorsi, R. M. 2022. A machine learning approach for predictive warehouse design. The International Journal of Advanced Manufacturing Technology.

Enna Hirata, Maria Lambrou, D. W. 2021. Blockchain technology in supply chain management: insights from machine learning algorithms. Maritime Business Review.

et. al, N. K. 2020. An autonomous food wastage control warehouse: Distributed ledger and machine learning based approach. 11th ICCCNT 2020 IIT KHARAGPUR.

et. al., S. T. 2019. Machine learning adoption in blockchain-based smart applications: The challenges, and a way forward. *IEEE Access Vol.8*.

K. SALAH M. H. REHMAN, N. N. and Al-Fuqaha, A. 2018. Blockchain for ai: Review and open research challenges. IEEE Access.

Kushal Singla, Joy Bose, S. K. 2018. Machine learning for secure device personalization using blockchain. 2018 International Conference on Advances in Computing, Communications and Informatics (ICACCI).

Lin, X. 2014. Regression testing in research and practice. Computer Science and Engineering Department, University of Nebraska, Lincoln, 1-402-472-4058.

mmar Muthanna Ibrahim A. Elgendy, K. A. L. A. T. A. R. and El-Latif, A. A. A. 2021. Convergence of blockchain and iot for secure transportation systems in smart cities. Hindawi Security and Communication Networks.

Mostafa, W. H. N. and Elawady, H. 2018. Towards a smart warehouse management system. International Conference on Industrial Engineering and Operations Management Washington DC, USA.

N. Chandrasekaran, Radhakhrishna Somanah, D. R. R. K. D. T. S. C. and Demkah, M. 2019. Digital transformation from leveraging blockchain technology, artificial intelligence, machine learning and deep learning. *Advances in Intelligent Systems and Computing Information Systems Design and Intelligent Applications, 2019 Springer*, pp.271–283.

Sarkis, L. K. A. D. J. 2020. Blockchain in transport and logistics – paradigms and transitions. *International Journal of Production Research Vol 58,* No.7, 2054–2062.

Saurabh Singh, Pradip KumarSharma, e. a. 2020. Convergence of blockchain and artificial intelligence in iot network for the sustainable smart city. Journal of Sustainable Cities and Society, Science Direct.

Shahbazi, Z. and Byun, Y.-C. 2021. Integration of blockchain, iot and machine learning for multistage quality control and enhancing security in smart manufacturing. Sensors 2021.

Xuhui Chen, Jinlong Ji, C. L. W. L. and Li, P. 2018. When machine learning meets blockchain: A decentralized, privacy-preserving and secure design. IEEE International Conference on Big Data (Big Data).

Prof. Manoj B Chandak is Dean of Academics and Professor in the Department of Computer Science and Engineering at Shri Ramdeobaba College of Engineering and Management, Nagpur. India. He has total 27 years of academic experience. His area of interest are Natural Language Processing, Machine Learning, Big Data Analytics, Cloud storage, and data management. He is also a recognized Ph.D. supervisor. His current research work includes the Development of coal quality exploration technique based on convolutional neural networks and hyperspectral images. The project is sponsored by the Ministry of Coal, Government of India with the grant of INR 1.03cr. He is the reviewer of IEEE Access, Journal of Supercomputing
E-mail: chandakmb@gmail.com

Mr kapil N Hande is research scholar at Dept of CSE, Shri Ramdeobaba College of Engineering and Management, Nagpur. He has total 23 years of teaching experience. His research areas includes Cryptography, Artificial Intelligence, Machine learning and Blockchain technology. He has completed MODROB and DST funded projects and also guided several PG projects. He has published a book on Operating System. He has also published papers in many conferences and journals.
E-mail: kapilhande@gmail.com

Smart College Campus Recruitment System

Purshottam J. Assudani, Rakesh K. Kadu, Rizwan Sheikh and Tushar Khanna
Shri Ramdeobaba College Of Engineering and Management Nagpur, Maharashtra, India

Abstract— The demand for an online college job board network and its copy in relating college pupils and career vacancies Traditionally, career sites are used by talent managers for candid exploration and recruitment. This task is based on an employment portal organized for one of the well-known engineering campuses and is a variation of a job council designed precisely for campus students. Providing job introduction riding to the talents of students and services such as candidate filtering for companies to survey candidates will help learners and companies to find suitable aspirants for the job. We aim to be beneficial. Keywords— Natural Language Processing, Recruitment, Artificial Intelligence, Knowledge Base.

Keywords: Software maintenance, automated regression analysis, application baselining.

1. INTRODUCTION

The accomplishment of employment search engines integrating the gap between job petitioners and employers occurred to thousands of job committees. Rising unemployment has released the demand for jobs. In some countries where there were even vacancies, candidates were unknown became there were no sufficient means of exchanging information about vacuity. The lack of a common platform for employers and seekers made communication difficult between them and prevented timely dissemination of information about vacancies, Advances in web technology and the availability of the Internet have generated popularity and prestige to business applications and enterprise systems. It was recognized that companies and groups needed a system that would help them grow, connect with skill, and find the best. Rising unemployment and the difficulty of finding a job have also contributed to the development of job sites. This is how career boards and employment investigation engines were born, many of which post job listings in particular regions such as B Education, Health Care, Hospital Administration, Academics, and Non-Government Sectors. The purpose of these job panels was to help job seekers locate better jobs and employers find promising candidates for those jobs. Today's job websites propose services varying from simple search engines to career advice and job interviews. Many portals such as Jobs Nepal 1. more jobs, MeloCamier, etc. have been set up in Nepal to provide various services. Hoer, institutes in developed countries use such systems, there are no prevailing job beads or portals precisely designed for students in universities in developing countries. The part such a system could play in helping studies interact with current market needs was the motivation for this project. A census was administered to determine student aspects considering the use of the recruitment system.

2. RELATED WORK

In the conventional system, to recruit students, companies contacted numerous departments or class representatives (CRS) on campus to distribute information about student opportunities. The department communicated this information about CR through its Facebook page. And when my students unlocked this page, they found out about the chasms. Facebook was heavily used and knowledge about work was not transmitted well. There were many portals on the market, why did you feel it important to build this system, and what are the benefits this system offers? We reply to these issues in this section about retail job portals and how students benefit from them. A trend seen over the past few years is that companies prefer students from some universities over others when hiring college students. They also publicize the same jobs on various

retail job outlets, which costs a lot and time-consuming access. Now you can effortlessly vacancies in our electronic recruiting system. Not only this is free, but it curtails the time it takes to hire the perfect candidate. And because it's a modest system with limited user access, campuses can run this system for free. This is to ultimately profit students and me as much as possible Monitor student employment status. Reasonable investing is needed to learn about job seekers' and employers' preferences and congruences with available programs. This will help determine the success of your online recruitment system. There is still a long wayame employer spend a lot of money on online recruitment, with mixed success. Job matching systems, therefore, need to become smarter to help employers find the best candidates. After the system is built, it is significant to evaluate the effectiveness of the system in terms of performance, reliability, security, and cost-effectiveness by panel respondents. Charging employees a lot of money to post a job does nothing for job seekers or employers. An effective electronic recruitment system takes the recruitment process to a global level. Recruiting through an online process may not be effective for all positions. Depending on the circumstance, it may cost more than that. But if you consider all the factors that are present and build an effective system, you can save a lot of money spent on promotion and its costs. It can be used for career growth and employee training.

3. PROBLEM STATEMENT AND OBJECTIVE

Problem Statement In recent years, there have been many transformations regarding the recruitment strategy. Both companies and candidates have changed they're influential and reliable said for those looking for hotel jobs can be found in The electronic application system very convenient for students when using the Internet.

Objectives

- Students will gain a thorough knowledge of the placement process.
- Students are given sufficient preparation time..
- Everyone knows their strengths and weaknesses and what areas they need to work on.
- The way to reach your goals will be much easier as we will help you every step of the way.
- Even if students fall behind academically, our proposed system will help them follow themselves and choose different paths.
- We also suggest companies that match your abilities

4. PROPOSED WORK

Python is one of the most widely used data analytics languages in the industry. With refined data mining and machining capabilities, it's the perfect practical language for product development. This makes Prison prominent for data processing. When it comes to computing, there is often a trade-off between scale and Sophie, and Python period as a made-off Python Notebook and Namky a bend a note posts flight work, but Python is a powerful tool for medicines de data processing Python so hyd, a chan community that offers a wide variety of y folks and fees. So Kimia very epic rood for Python inches almost all major machine learning agents. A training dining 2014 pass-out stack placement data is loaded into Python code macros with variables for ease of pressing and a decision tree classifier model is fitted using the scikit library. Once the modeling is complete, the data is uploaded to Python, and macros are used to examine the variables and provide them to the predictors in Scikit Leam. This generates the macro results that conform to the placement such as on the training data. Finally, the macro results are mapped to the placement state variables used in the model.

5. MODULES

This analysis is a campus-based online recruitment strategy. Given the conventional method of recruiting students through companies. the need to build this system was recognized. Traditional methods are slow, tedious, and discriminatory for most students, as job offers come from a wide variety of people on campus. Without a separate platform for work-related topics, job listings

would not reach all students on campus in time. I've run into the problem a few times. By the time I learned of the vacancy, several others had already been hired Therefore we set out to develop a system that would treat each student fairly in terms of timely information and the appeal of their skills to en2yers. The system also defines the role of departmental departments (administrators) during the recruitment process. He has his three actors involved in this system. They are students, companies, and departments. The faculty department's mile in the recruitment strategy is minimal but valuable.

Admin Module
a) View all student
b) View all alumni
c) Delete alumni
d) Delete Student

Alumni Module
a) Login
b) Registration
c) Post a job
d) View student application
e) Update job post

Student Module
a) Login
b) Registration
c) View Job
d) Apply for Job
e) View Job-status
f) Prediction of future job role

6. IMPLEMENTATION

The electronic petition system that we strived to build to solve the existing problems on campus was successfully implemented. The primary motivation for building this system was to overcome the shortcomings of traditional recruitment methods and give each student a fair chance to demonstrate their skills and seize the employment opportunities illustrated to them. It also helped participants in a common platform and set up an immediate communication channel between them. The overall motive of this system is to replace the conventional method of recruiting students on campus and bring students and businesses together on a solitary platform. The system has been validated with real-time data obtained from businesses and students.

7. OUTPUT

8. FIG 1.LOGIN MODULE FIG 2.ADMIN MODULE FIG 3 .ALUMNI MODULE

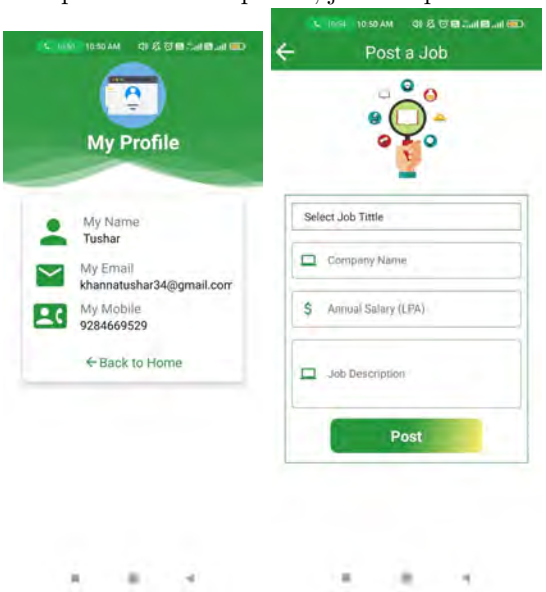
Login Module This is login page from where students and alumni can login to our app. In case someone wants to register, they can register by clicking the "create an account" button and then filling their respective details.

Admin Module This is the dashboard page when you login form the admin credentials . Here the admin has all the powers to view delete and change the details of students or alumni those who have registered with the app.

Alumni Module This is the dashboard page when you login from the alumni credentials. Here the alumni has the options to: Edit their profiles. Post new job and vacancies. Check all the applications received.

Student Module

This is the dashboard page when you login from the student credentials. Here the student has the options to: Edit profile, job role prediction (uses ML), Recommended jobs all Available jobs.



9. CONCLUSION

AI-powered HR applications, including recruitment, have powerful potential to improve employee productivity and help HR professionals become knowledgeable advisors to improve employee accomplishment. HR applications integrated with Al can analyze. predict, diagnose and become stronger Artificial intelligence is rapidly becoming a popular tool for human capital tasks such as recruitment and promo. There are promising reasons to be optimistic about the adoption of Al in recruitment. Al will only broaden the role of recruiters by authorizing them to move higher in the hiring value chain. Recruiters need to be cognizant of the upcoming changes and hone their skills in areas where artificial intelligence cannot easily take over. H. Jobs that require a high level of imagination, creative analysis, and strategic thinking. In the future, as Ad becomes an integral part of employment, recruiters will no longer compete with machines for jobs, but rather use their imagination, creativity, strategy, and relationship-building talents at their disposal to suit candidates will be able to connect and influence Artificial intelligence has great potential in recruitment. Not used to scale, but to simplify, automate, and transform critical parts of the recruiting workflow. especially repetitive, high-volume, transactional chores that greatly enhance recruiter productivity is needed. I have. Technology pervades every aspect of the hiring strategy

10. FUTURE WORK

With constant technological innovation, it's important to continue advancing research to incorporate AI into recruitment. HR professionals are reluctant to use AI in their processes, but the use of AI in business activities is growing exponentially. It is therefore important to explore, understand and familiarize yourself with this new technology that is finding its way into the core of organizational management. Since artificial intelligence has wide scope and promise in all areas including recruitment, researchers should mainly focus on the role and use of AI in recruitment.

References

Breaugh, J. A. 2013. Employee recruitment. *Annual review of psychology 64*, 389–416.

Childers, N. F., Bish, E., and Merhaut, D. 1994. A horticultural student recruitment system that works. *HortScience 29,* 3, 139–140.

Gangwar, M. Utilization of multi agent system for man-power recruitment system. In *Artificial Intelligence and Soft Computing*. Vol. 4. 15.

Hu, X., Wu, L., Li, C., and Huang, M. 2011. Sms-based mobile recommendation system for campus recruitment in china. In *2011 10th International Conference on Mobile Business*. IEEE, 152–157.

Shenoy, V., Aithal, P., and Ramesh Pai, A. 2018. Online e-campus recruitment process of muthoot finance ltd. *Quality in higher education challenges & opportunities, ISBN* 978-93, 5311–082.

Syamala, G. and Devi, R. T. 2015. A study of gender discrimination at campus recruitment in the professional colleges. *Journal of Commerce and Management Thought 6,* 2, 323–339.

Torres, E.-D. and Joanna, A. 2021. Implementation of decision support personnel recruitment system for laguna state polytechnic university-san pablo city campus. *International Journal of Managing Information Technology (IJMIT) Vol 13*.

Yadav, V., Gewali, U., Khatri, S., Rauniyar, S. R., and Shakya, A. Need of e-recruitment system for universities: Case of pulchowk campus, nepal.

Yadav, V., Gewali, U., Khatri, S., Rauniyar, S. R., and Shakya, A. 2019. Smart job recruitment automation: Bridging industry and university. In *2019 Artificial Intelligence for Transforming Business and Society (AITB)*. Vol. 1. IEEE, 1–6.

Yang, X. 2016. Research on the risks of campus recruitment. In *6th International Conference on Electronic, Mechanical, Information and Management Society*. Atlantis Press, 490–494.

Dr. Purshottam J. Assudani is working as an Assistant Professor in Department of Information Technology, Shri Ramdeobaba College of Engineering and Management, Nagpur, India. He has done Ph.D. in Computer Science and Engineering from Vellore Institute of Technology (VIT), Vellore, India. He has also completed his Bachelors and Masters in Computer Science and Engineering. He has published one Indian patent and published several papers in International Journals and conferences. He has a total teaching experience of more than 13 years and specializes in Cloud Computing, Distributed Systems and Operating Systems. He is a Certified Cloud Architect and Certified Trainer on Microsoft Azure and Amazon Web Services cloud platforms. He has delivered multiple corporate trainings on multi cloud platforms. He has also conducted online training sessions of Ms Azure at Caltech, USA. He has received a Best Paper Award in an International Conference. He has the membership of Indian Society for Technical Education (ISTE).
E-mail:assudanipj@rknec.edu

Dr. Rakesh K Kadu is an Assistant Professor at the Department of Information Technology, Shri Ramdeobaba College of Engineering and Management, Nagpur, India. He has 1 patent is published in the Indian Patents and Trademarks Office and over 16 published re- search papers in National/International journals/conferences. Dr. Rakesh pursued his engineering education at the Govt College of Engineering, Amravati, India in Computer Science and Engineering. He completed his Ph.D. at Yashwantrao Chavan College of Engineering, India. His research interests are in Cryptography and Security, Cloud computing, Computer networks, network management, and IoT. He is a life member of the ISTE and CSI
E-mail: kadurk@rknec.edu

Rizwan Sheikh is student at Shri Ramdeobaba College of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.
E-mail: sheikhrr$_1$@*rknec.edu*

Tushar khanna is student at Shri Ramdeobaba College of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Information Technology.
E-mail: khannatm@rknec.edu

Options Trading using Artificial Neural Network and Algorithmic Trading

Sayandeep Ghosh, Sudhanshu Kumar, Atharva Deshmukh, Akshay Kurve and Dr. Rashmi Welekar
Shri Ramdeobaba College of Engineering and Management,Nagpur

Predicting stock market movements is a well-known problem of interest. Financial markets employ a staggering amount of sophisticated and complex technologies for getting efficient results while trading. Algorithmic trading (AT) is one of the major steps in this direction as it is gaining wide acceptance in the global market. There are various Computational intelligence models that have produced a significant number of results over a period of time. Some of them are neuro fuzzy models, systems based on genetic algorithm and support vector machines (SVM). Every day a huge volume of data is produced from Dotex International Limited which is also known as NSE Data Analytics Ltd. This data contains all the factors which more or less directly affect the movement of the market. A stock market is a complicated system which attract a lot of people everyday but there have been many instances where people have lost their entire life savings within a day specially while trading in options. Hence, it requires a lot of knowledge and one should be able to control his emotions while trading. Usually, newbies consider stock market as a money vending machine and jump into it directly without even knowing the basics of it. Every one knows that one who can predict the momentum of market is the real king of this game and thus we have made an attempt for predicting the trend of the stock market. Two models are built, one for daily forecast and one for monthly forecast.

Keywords: Artificial neural network, Stock market, multi layer perceptron, algorithmic trading, technical analysis

1. INTRODUCTION

Accurate prediction of stocks is one of the most important factors the investor must consider before investing their hard-earned money in the stock market. There are Multiple factors that affect the price of any stock like market conditions, demand and supply, interest rates. As a result of which there is a larger amount of data in which we have to find the patterns. Various market experts and researchers are always involved in finding various techniques to maximize the profits. Thus, algorithmic trading has evolved over the years which uses automated trading strategiesThe remainder of this paper is organized as follows. Section 2 describes an overview of Model Features,followed by an overview of Evaluation which includes data collection and pre-processing in Section 3. Section 4 discusses Model training and section 5 about the modelling and prediction.

2. MODEL FEATURES

a) **Relative Strength Index (RSI)**
The Relative Strength Index (RSI) is a momentum predictor technical indicator. On the y-axis of the RSI indicator, values range from 0 to 100.Usually, this range of values helps the trader to predict whether the stock is in the overbought or oversell stateWhen the value of RSI has value above 70, it indicates that the stock is now in overbought state and those people who are buying it are paying more than what it actually deserves. When the value of RSI has value below 30, it indicates that the stock is now in oversold state. It also indicates a state of panic where people are selling the stock blindly based on some news. All this are the rough estimates and can't be said as a sure shot strategy to predict the buying or selling(Araujo and Ferreira, 2013) (Kim., 2003).

b) **Moving Average Convergence and Divergence (MACD):** The MACD indicator which is moving average convergence and divergence is one of the technical indicator used to detect

the trend along with the momentum.While trading when we use MACD, when the value is above 0 then we consider it as a bullish momentum whereas when the value is below 0 then we consider it as a bearish momentum. Usually, MACD is considered to be a better option when we trade on time frame of a week or month as compared to intraday trading.

c) **Bollinger Bands:** The Bollinger bands plotted over the candles consists of 3 bands viz. upper, middle and the lower band.

- ✓ Middle band is plotted based on the moving average. Moving average is calculated by adding all the previous data points and then dividing it by n
- ✓ The upper and lower band is calculated by adding and subtracting the standard deviations to the Moving Average respectively.(Jireh Yi-Le Chan, 2022)(S Z Mahfooz, 2022)

The Bollinger bands are plotted based on the market volatility so it is generally considered that if the two bands are squeezing then the market seems low volatile. Bollinger bands are generally used as a combination with any other indicator like RSI or MACD as per the trader's choice and preference.(J. Wang and Guo, 2011)(F. Zarandi and Neshat, 2009)

3. EVALUATION

3.1 Data Collection

The live data for trial testing was obtained from the NSE website and money control API.For obtaining the data in real time, Trigger time of a minute was set and every minute a particular code was triggered that used to fetch data from the money control site.

```
function getNFTdata()
{

  var queryString = Utilities.formatDate(new Date(), "GMT", "yyyyMMddHHmmss");
  // Nifty Data
  var cellFunctionDataNft = '=IMPORTHTML("https://www.moneycontrol.com/india/indexfutures/nifty/9/2022-03-17/OPTIDX/CE/15150.00/true' + queryString +
'","table",6)';


  SpreadsheetApp.getActiveSpreadsheet().getSheetByName("Live_data").getRange('A3').setValue(cellFunctionDataNft);


}
```

Figure 1. Fetching Live Data

We have to call the Ticker module to access ticker data. Fig.2. shows how the sixty days of NSEI data of interval 15 minutes can be retrieved and saved as .csv file, while fig.3. shows the sample of fetched data. There are more params we can set for the history () method as seen in fig.

```
from datetime import date
from pandas_datareader import data as pdr
yf.pdr_override()
data = yf.download(  # or pdr.get_data_yahoo(...
        # tickers list or string as well
        tickers = '^NSEI',

        # use "period" instead of start/end
        # valid periods: 1d,5d,1mo,3mo,6mo,1y,2y,5y,10y,ytd,max
        # (optional, default is '1mo')
        period = "60d",

        # fetch data by interval (including intraday if period < 60 days)
        # valid intervals: 1m,2m,5m,15m,30m,60m,90m,1h,1d,5d,1wk,1mo,3mo
        # (optional, default is '1d')
        interval = "15m",

        # group by ticker (to access via data['SPY'])
        # (optional, default is 'column')

        # adjust all OHLC automatically
        # (optional, default is False)
        auto_adjust = True,

        # download pre/post regular market hours data
        # (optional, default is False)
        prepost = True
    )
data
def SaveData(df, filename):
  df.to_csv(filename + '.csv')
today = date.today()
dataname='^NSEI'+'_'+str(today)
SaveData(data, dataname)
data= pd.read_csv(dataname+'.csv')
data
```

Figure 2. Accessing ticker data (15 minutes Interval)

The data used for training the model was fetched from yahoo finance site which consists of 4 attributes viz. open, high, low, close. The data was the data was trained from 01-01-2015 till the date with one day interval. For prediction based on live data, the interval was of 1 day having 1 minute time frame.

```
[*********************100%***********************]  1 of 1 completed
```

Out[3]:

	Datetime	Open	High	Low	Close	Volume
0	2021-12-30 09:15:00+05:30	17201.449219	17216.300781	17148.800781	17208.750000	0
1	2021-12-30 09:30:00+05:30	17208.699219	17221.250000	17201.000000	17218.250000	0
2	2021-12-30 09:45:00+05:30	17220.300781	17237.349609	17213.650391	17230.300781	0
3	2021-12-30 10:00:00+05:30	17230.150391	17248.250000	17225.849609	17247.900391	0
4	2021-12-30 10:15:00+05:30	17247.599609	17264.000000	17243.199219	17257.699219	0
...	...	...	...	...	...	...
1491	2022-03-28 13:15:00+05:30	17216.650391	17225.400391	17179.300781	17200.400391	0
1492	2022-03-28 13:30:00+05:30	17200.099609	17200.099609	17136.150391	17151.000000	0
1493	2022-03-28 13:45:00+05:30	17150.699219	17182.550781	17150.099609	17175.849609	0
1494	2022-03-28 14:00:00+05:30	17175.849609	17193.550781	17165.599609	17166.400391	0
1495	2022-03-28 14:10:21+05:30	17165.300781	17165.300781	17165.300781	17165.300781	0

1496 rows × 6 columns

Figure 3. - Sample of fetched data

3.1.1 *Data Pre-Processing.* For modeling purposes, we fetched data from Nifty site using Pandas library. Column mismatch was faced where the forecasting and predicting data columns were not matching. To resolve this, we separated the forecasting and prediction data. We chose

the minimum number of columns (Open, high, close, low and volume for forecasting) as possible for training our model. To manipulate data, we used Pandas library.

4. MODEL TRAINING

The data has been fetched using Yfinance library Contains 6 attributes – Open, Close, Adj Close, High, Low, Volume. Unwanted "Adj Close" column was dropped. Preprocessing was done using sklearn (MinMax scaler). Seq. LSTM model. Batch size – 64, epochs - 1000 First, based on 'Close' attribute. Second, based on all 5 attributes, i.e., features (Finalized model). The finalized model was tested on the 20 percent dataset entries (80:20) that gives accuracy of 70.77 percent.

Using this model, forecasting was done for the next 5 days market closing price, by analyzing previous 28 days data. By comparing with the original data, the accuracy lied between 40-70 percent, as it also considers the rapid fall or rise of the market during weekly opening day (Monday). This trained model was saved in .h5 and .json format, and loaded at the time of forecasting.

Finally, the data has been fetched using Yfinance library. This data contains 6 attributes – Open, Close, Adj Close, High, Low, Volume. The time period is 1 day and interval 1 min. The graph was plotted using plotly and matplotlib libraries. Applied indicator for algorithm trading – Bollinger bands (70 percent accuracy) and MACD. PUT/CALL signals are generated based on the indicators individually. The plots will be plotted individually. Based on the method, PUT/CALL signals will be generated.

The graph was plotted using plotly and matplotlib libraries. Applied indicator for algorithm trading – Bollinger bands (70 percent accuracy) and MACD. PUT/CALL signals are generated based on the indicators individually. The plots will be plotted individually. Based on the method, PUT/CALL signals will be generated. It is recommended for the user to gain some insight about intraday option trading, so that they can analyze the plot and go for the CALL/PUT option All the phases of methodology applied in the backend part. Model was trained based upon the five parameters. (Close, Open, High, Low, Volume).

5. MODELLING AND PREDCTION

For prediction based on the live data, we have implemented the Bollinger band algorithm and MACD. In the prediction part of our OTP model, we have predicted the trend using Bollinger bands facts that the Bollinger Bands should be narrow on the price chart and the bandwidth of it should be somewhat close to the six months range. After that we wait for a clear breakout and the most important fact is that it should sustain the price. So, if the breakout is on the upper side, then we consider it as a bullish breakout and a breakout on the lower side is consider a bearish one.

5.1 Model Trials

We tested some already made primitive models on GitHub and trained them on nifty data, on 'Closing' attribute, which gave the varying accuracies, as you can see below. The first testing was done on bidirectional gru model and the accuracy found was 80.4574. (ipynb link for bidirectional gru model

https://github.com/Kumarsn680/Research-paper/blob/main/5_bidirectional_gru.ipynb

Similarly, testing was done on the LSTM2 path model and the accuracy found was 91.7144(ipynb link for lstm2 path model-

https://github.com/Kumarsn680/Researchpaper/blob/main/3_lstm_2path.ipynb)

5.2 OTP model Evaluation(Forecasting)

We came up with final OTP model whose forecasting part uses sequential LSTM and the accuracy of which is 40-70 percent, when compared with the live data, and 70.77 percent on test data. For forecasting we found two approaches

(1) Single entity based on "Close" attribute which showed high accuracy while training and testing on test data. As you can see,loss and valloss of the trained model is extremely, which means high accuracy.

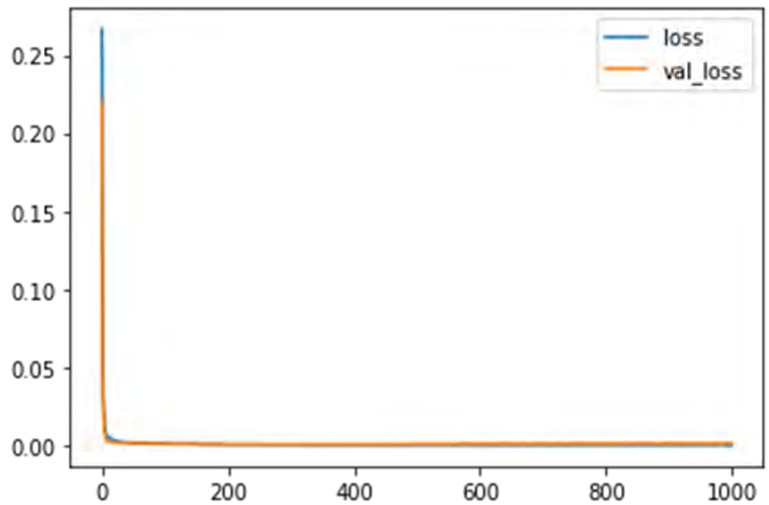


Figure 4. Loss and value loss in LSTM forecasting single parameter

The output of the trained model on the "Close" parameter gives high accuracy on the test dataset (refer Figure 4.), but in real life it fails, as a single entity cannot determine the "Close" parameter.

(2) The output of the trained model on the all 5 parameters gives high accuracy on the test dataset, also in real life, there is need of all 5 parameters for the prediction, and hence it shows good results in real life scenario too. Epoch cycle was 1000, and the applied model is sequential-LSTM. So, what we tried is to forecast the upcoming trends based on all 5 parameters (Open, High, Low, Close, Volume)(Liao and Wang, 2010)Park and Shin [2013].Our OTP model shows the accuracy of 40-70 percentage, on real time evaluation. While on the test dataset it shows70.75 percent (Figure 5). This variation in accuracy is due to following reasons.

✓ Sudden disruption in the market due to the current Ukraine war crisis.

✓ The data that we fetch from the NSE site is not continuous. It is obtained for every five days due to which it is difficult for the model to differentiate the data of one week from the other one.

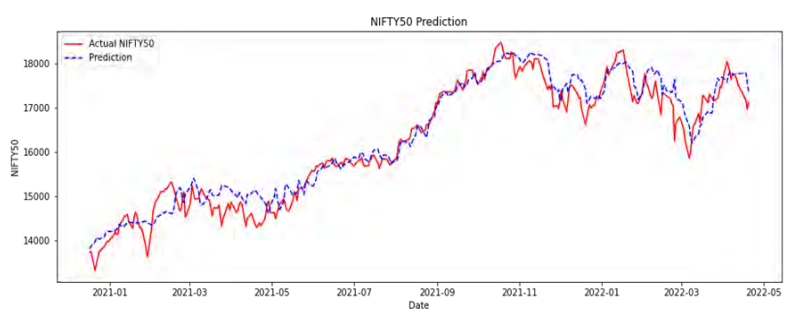


Figure 5. Prediction of test dataset in LSTM forecasting (5 parameters)

5.3 OTP model Evaluation(Prediction)

We deal entirely with live data and we plot the graph by making the use of Bollinger bands The equation to plot was set up by our group members themselves. We used plotly for plotting Bollinger bands graph, while used matplotlib for plotting put/call signals, and used Yahoo Finance website for fetching live data.

Figure 6. Bollinger bands on live data, using plotly)

In Figure 6-., as the plot interprets, if 2-3 candlesticks touch Upper band or Lower band, go for PUT or CALL. We can show indicators on MACD and Bollinger Bands (Figure 7 and Figure 8), but it is preferred to go through this live plot, as the indicators may result you net profit zero as only a few predictions were correct (use of pandas trading library), while your own observation from the live graph will give you accurate results.

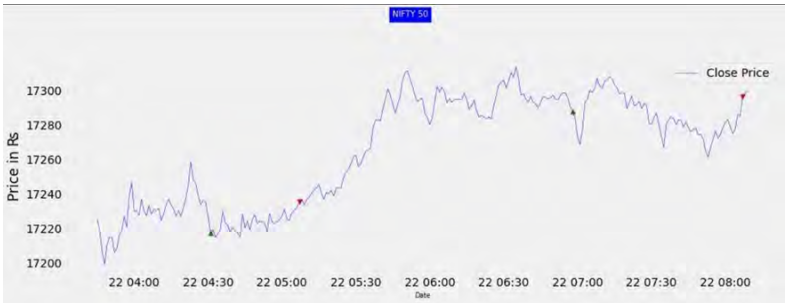


Figure 7. Signal using BB algorithm on live data, using matplotlib)

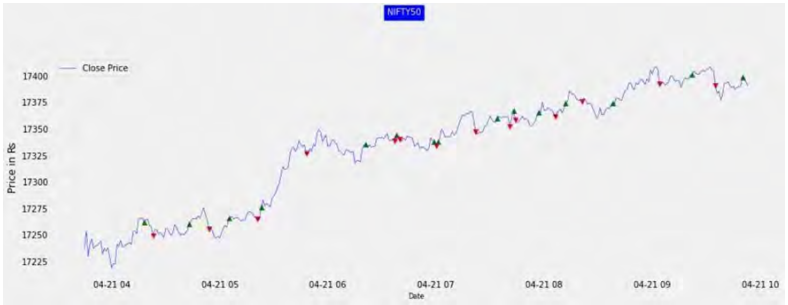


Figure 8. Signal using MACD algorithm on live data, using matplotlib)

6. CONCLUSION

Option trading or any other market trading is mainly focused on three vital points.

(1) Presence of historical data, to analyze the market behaviour.
(2) Availability of accurate live data, which on which you will do the trade, with the help of trading algorithms and indicators.
(3) Market sentiments, to see how the market is reacting. These all points are analysed and different approaches are applied which resulted in an open-source tool (named as Open Trading Prediction model), provides us an accuracy range of overall 40-70 percentage for option trading. This open-source tool can be further developed as a product platform with availability of custom dataset creation which can merge all the vital points in a single model.

References

Araujo, R. and Ferreira, T. 2013. A morphological-rank-linear evolutionary method for stock market predictions. *Information Sciences*, 3–17.

F. Zarandi, B. Rezaee, I. T. and Neshat, E. 2009. Forecasting model of global stock index by stochastic time effective neural network. *Expert Systems with Applications 36*, pp.139–154.

J. Wang, J. Wang, Z. Z. and Guo, S. 2011. Forecasting stock indices with back propagation neural network. *Expert Systems with Apps. 38(11)*, pp.14346–14355.

Jireh Yi-Le Chan, Seuk Wai Phoong, W. K. C. Y.-L. C. 2022. Support resistance levels towards profitability in intelligent algorithmic trading models.

Kim., K. 2003. Financial time series forecasting using support vector machines. *Neurocomputing 55(1–2)*, pp.307–319.

Liao, Z. and Wang, J. 2010. Forecasting model of global stock index by stochastic time effective neural network. *Expert Systems with Applications, 37(1))*, pp.834–841.

Park, K. and Shin, H. 2013. Stock price prediction based on a complex interrelation network of economic factor. *Engineering Applications of Artificial Intelligence 26*, pp.1550–1561.

S Z Mahfooz, Iftikhar Ali, M. N. K. 2022. Improving stock trend prediction using lstm neural network trained on a complex trading strategy. *Expert Systems with Applications*.

Sayandeep Ghosh is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Computer Science and Engineering.
E-mail:ghoshs@rknec.edu

Sudhanshu Kumar is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Computer Science and Engineering.
E-mail: kumarsn_1@rknec.edu

Atharva Deshmukh is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Computer Science and Engineering.
E-mail: deshmukhav@rknec.edu

Akshay Kurve is student at Shri Ramdeobaba College Of Engineering and Management, Nagpur and pursuing his B.E. Degree in stream of Computer Science and Engineering.
E-mail: kurveaa_1@rknec.edu

Dr.Rashmi Welekar is working as an Assistant Professor in the Computer Science and Engineering Department at Shri Ramdeobaba College of Engineering and Management. She has done PhD in Computer Science Technology.She has 18 years of teaching experience and more than 30 research publications in refereed journals. Her areas of interest are Computer Networks, Evolutionary Computing and Cyber Security..
E-mail: welekarr@rknec.edu

Analysing the Factors Influencing the House Prices and Studying House Price Prediction Methods

Purshottam J. Assudani and Chinmay Wankhede
Shri Ramdeobaba College Of Engineering And Management, Nagpur, 440013

Home buyers looking for a new house tend to be very cautious with their budgets and market strategies. They always try to optimise the budget in such a way that it matches their requirements and needs. Therefore prediction of price becomes a very important thing when it comes to planning a budget and there is a need for a prediction tool. This can be achieved by doing data analysis notably Exploratory Data Analysis (EDA) and by developing Machine Learning models. An ideal home that a customer dreams of is something that matches as well as fulfils the customer's requirements but at the same time with an appropriate budget. So instead of going to the real estate agent and paying an additional expense in the form of commission, the same work of suggesting and predicting the price after analysing large data, is done by various machine learning models in a more efficient manner.
Thus the research on house price prediction is of much significance as it caters to two stakeholders in this real estate market, home buyers will have a better understanding of property value and will be helped in the decision making process and hence stand a better stand at negotiating. The other stakeholder i.e. the home seller will get a better estimate to put selling cost on property.

Keywords: House Price, Machine learning Model, Data Analysis.

1. INTRODUCTION

House price prediction mainly comprises two categories, first one by exploring the house characteristics and features, and second by focusing on the Machine Learning prediction model to be used.

The general method of analysing and forecasting the real estate market is by studying the real estate data by using the multiple linear regression model and then drawing a conclusion. Various machine learning models are used by previous researchers. Therefore selection of models to be employed for predicting becomes important since the available choices are many.

2. ML MODELS DISCUSSED

In this paper we discussed the various techniques used by researchers for house price prediction such as various machine learning regression algorithms like Multiple linear regression, Random Forest, Least Absolute Selection Operator (Lasso), Ridge, Gradient boosting, Support Vector Regression(SVR) and Artificial Neural Network (ANN). On the basis of their score we can then compare the performance of these techniques and find which models are claimed to be working best (QuangTruong, MinhNguyen, HyDang, and BoMei, 2020)(Rawool, V, Rogye, Rane, and Bharadi, 2021).

2.1 Multiple Linear Regression

Multiple Linear Regression (MLR) is a supervised type of Machine Learning technique that is used to estimate the relationship among more than one independent variable and a single dependent variable. MLR is the most common type of linear regression.
The equation for MLR can be simply given as
$E(Y|X) = \alpha + \beta 1X1 + ... + \beta nXn$

where α is the intercept and βi are the coefficients (Madhuri, Anuradha, and Pujitha, 2019).

MLR is a model used to determine the relationship between variables for identifying the correlation of the variables, its cause-effect, regression equation to make predictions by using these relations
For the prediction using this model the house price is considered as the target or the dependent variable and the factors such as property location, property size, number of bedrooms and many more as independent variables.

2.2 Ridge Regression

Ridge Regression is preferred where there exists a near–linear relationship between the variables that are independent or exhibit multicollinearity.
The Ridge Regression overcomes the problem faced by MLR as it manages collinearity without removing variables from the regression model isted adds a degree of bias to the regression model. Its a L2-norm(least squares) regularised regression technique that makes the prediction less sensitive and helps to reduce variance by shrinking parameters.

2.3 Lasso Regression

Least Absolute Shrinkage and Selection Operator performs regularisation and feature selection. It uses the L1- norm (least absolute deviations) regularised regression technique instead of the L2- norm.
Unlike Ridge regression where squaring of slope is done, lasso adds penalty term which is the absolute value of slope.(Abdulal and Aghi, 2020)
Therefore, Lasso enhances the accuracy of prediction by assigning zero weights to the most redundant features of the regression model. Therefore, Lasso is powerful in terms of feature selection and reducing the overfitting as only those variables that have non-zero coefficients during the feature selection process are included for model building.

2.4 Support Vector Regression (SVR)

The SVR model is derived from a powerful form of supervised learning which is a neural network called SVM. Support vector regression is capable of processing non-linear results and is able to overcome learning issues with small samples such as in the real estate prediction and it gives one possible optimal solution only. The benefit of this model is that it avoids overfitting problems by minimising structural and empirical risks and gives a single optimal solution

2.5 Random Forest

Random Forest model can be used for classification and regression both. For this a method called the Bootstrap Aggregation or Bagging that uses multiple decision trees is leveraged.
Here the tree is the model formed of nodes and branches. The interior nodes act as the input attribute and leaf is where the prediction of the output variable occurs.

The prediction we get is an aggregate prediction that is calculated by summing each of the individual trees as shown in figure 1. This is the reason for Random Forest to be an effective model because a wide variety of trees when aggregated provide better prediction than individual decision trees.

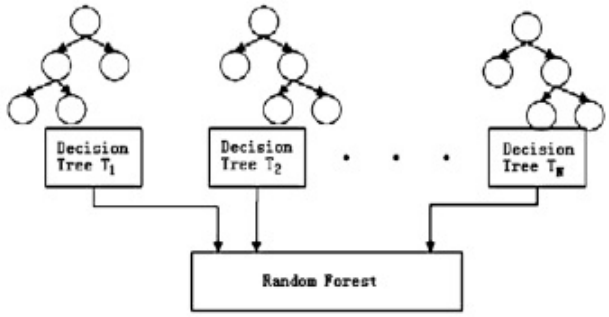


Fig 1. Architecture of Random Forest

2.6 Gradient Boosting algorithm

[GBR] Gradient boosting can solve both regression as well as classification problems. It gives the result of a prediction model as decision trees that represent a group of weak prediction models. This is shown by using equation
Loss or MSE =(yi - yip)2
Where yi is the ith target and yip is the ith prediction,$yip = yip + (a1 * \sum(yi - yip)^2)/yip$
Of which $yip = yip–a1 * 2 * \sum(yi - yip)$, where, a1 is called the learning rate and $\sum(yi - yip)$ is the summation of residuals. (Madhuri et al., 2019)
GBR algorithm is commonly used for its performance, consistency and interpretability in multiple topics , such as click prediction, multistage classification and ranking.

2.7 Artificial Neural Network (ANN)

ANN as its name suggests is just like the simulation of the work of our brain and therefore based on the structure and role of a neural network in our brain. It is generally used for non linear attributes, thus ANN can be a good choice as price of housing is also non-linear.

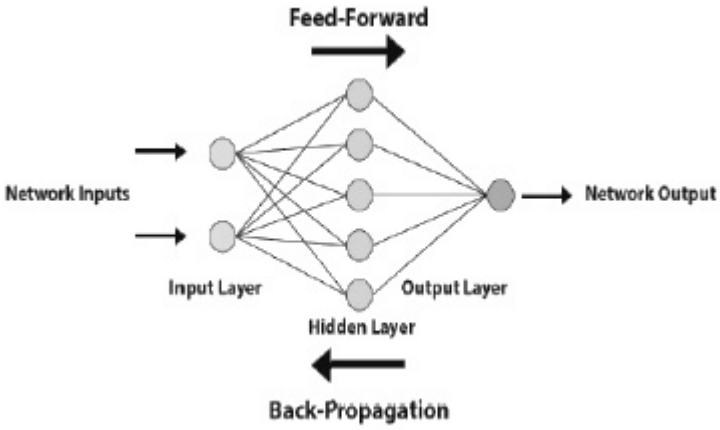


Fig 2. ANN Architecture

ANN model has generally the choice whenever a non-linear attribute is present . Since the

house price is a non linear variable as well, ANN can be used for prediction.
As shown here , input data passes from layer to layer to reach the outer layer.
During this transfer the data that is stored inside each neuron is called activation. The value of activation lies between 0 to 1. To decide whether the activation will trigger for a layer or not an average is done by taking all activations from the first layer and compute their weighted sum as follows
w1a1+w2a2+w3a3+...wnan
Where w represents the weight and a is activation. Additionally to limit the output of above equation between 0 and 1 ,Sigmoid function is used.Also to reduce the error percentage calculated using cost function, back-propagation is applied by running the procedures backwards.

3. COMPARISON

Firstly for calculating the efficiency parameters such as scores of the algorithm, Mean Square Error[MSE] and Root Mean Square Error[RMSE].(Abdulal and Aghi, 2020)(Madhuri et al., 2019)(Rahman and Hasbiah, 2020)
(Madhuri et al., 2019) Tried comparing the performances of various techniques for House price prediction to find out the best among them. Their study has shown that the gradient boosting algorithm has a higher accuracy value among the algorithms.
(Rahman and Hasbiah, 2020) analysed the various data mining techniques used to predict house prices and their survey has shown that ANN, SVR and gradient boost algorithm are more efficient models when compared to other models.

Algorithm	Score	MSE	RMSE
Multiple Linear Regression	0.732072	39187574448.88446	19795851699
Ridge Regression	0.732164	39174049629.73141	19792435330
LASSO Regression	0.732072	39187553734.32263	19795846466
Elastic Net Regression	0.665228	48964293085.00798	22127876781
Ada Boost ing Regr ession	0.7801099	32161481079.94242	17933622355
Gradient Boosting Regression	0.9177022	12037006088.27804	10971390390

	Multiple Linear	Lasso	Ridge	Random Forest	ANN
R2	0.6971	0.6953	0.6966	0.8555	0.6593
RMSE	44717.9238	44853.7815	44754.3819	30880.0679	28194.8593

Tables showing the comparison of the algorithms

(Abdulal and Aghi, 2020) Their study performed a comparison between Artificial Neural Network (ANN) and various machine learning regression algorithms such as Random Forest, Multiple linear regression, Ridge regression, Least Absolute Selection Operator (Lasso). Their outcome was that Lasso has the best score among other algorithms using R2 and RSME values. R2 indicates how well the data is fitted in the model. A score near to 1 indicates better fitting.

4. SOME FOCUSED RESEARCHES ON THIS TOPIC

The researchers in (Chen, 2022) used correlation analysis along with multiple linear regression models for the Chinese city of Zhaoqing, the model is based on the relationship between data on various influencing factors and prices of houses in the region.
The researchers used correlation analysis, this is done so as to select variables that are very likely to be correlated with house price data among the various variables, this is decided by correlation coefficients namely the Pearson correlation coefficient.

Those variables with high value of the pearson correlation coefficient are chosen and then analysed based on the linear regression model to so as to get the value of goodness of fit of R^2
'Income of urban population','population desnsity','Investment in real estate development', 'Employed persons of residents' etc. are some the factors for which the value of pearson correlation coefficient was found to be more than 8.0 during the correlational analysis. These factors were then selected to build the prediction model based on linear regression.

The researchers in (Li, Liu, and Lv, 2021) considered that factor for house price prediction which is ignored in most of the other works on the same topic and that factor is seasonal variation of housing price. Seasonal factors are also an important factor and hence to take that into consideration a novel grey seasonal model was proposed by these researchers.
This was done by a way of introducing seasonal factor decomposition into the "New Information Priority Accumulated Grey Seasonal Model" (NIPAGSM).

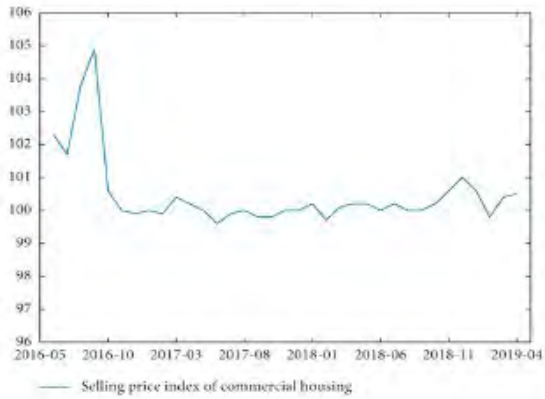


Fig.3 Seasonal variation of selling price index for around seventy chinese cities

The challenge was that though the Grey prediction model is good with its ability to predict accurately by processing poor information but it is not good with large data therefore the principle of new information priority was used for analysing the seasonal factors.
Fig3 for example gives an idea of how much the prices can vary according to season

Generally studies on the topic consider the factors like locational factors, structural factors etc. But very few studies have built the model on factors such as economic factors, policy factors, amount of investment in real estate development, housing supply factors, monthly income level of residents, the per capita housing expenditure of residents, the per capita disposable income of

residents etc.

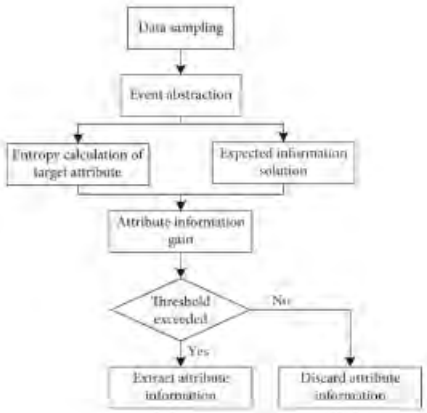


Fig4 Flow chart for extraction of main factors based on the information gain method (Liu, 2022)

One such example is the research done by (Liu, 2022) on real estate data of four Chinese cities.

In this case also the prediction requires reference data from a large complex and diverse factors in the form principal components or the main factors that influence the property prices. This is done by using the Information Extraction method.

Their test results have shown the prediction error of the model to reach a maximum of just 7.6 percent.

5. IMPLEMENTATION OF SEMESTER PROJECT

The project was on Analysing the Factors Influencing the House Prices In Some of The Metropolitan Cities In India. We worked on the first category of work on the topic i.e focusing on the characteristics of the property characteristics.
The dataset for the same was taken from website Kaggle and for the cities Mumbai, Bangalore. It mainly consists of the various attributes of the property such as Area Location No. of Bedrooms etc against the price.
With about 35+ variables one can predict the final price of houses in these regions.
Below is an example of the data for the city of Banglore.

	Price	Area	Location	No. of Bedrooms	Resale	MaintenanceStaff	Gymnasium	SwimmingPool	LandscapedGardens
0	30000000	3340	JP Nagar Phase 1	4	0	1	1	1	1
1	7888000	1045	Dasarahalli on Tumkur Road	2	0	0	1	1	1
2	4866000	1179	Kannur on Thanisandra Main Road	2	0	0	1	1	1
3	8358000	1675	Doddanekundi	3	0	0	0	0	0

The Data is binary i.e. 1 and 0 indicates the presence and absence of that factor and 9 to indicate the absence of information.
The normal process involves collecting, cleaning, analysis and model building
We start by importing the various libraries for analysing and processing the data.

```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import seaborn as sns #for data visualization
import matplotlib.pyplot as plt
```

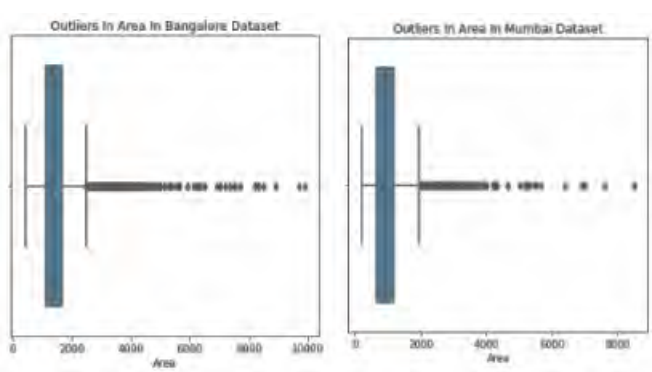
Then the data is imported and read from kaggle (BHATIA, 2020). Next comes the cleaning. Many of the values in the dataset are unknown, indicated by 9.

They had to be replaced by nan and then dropped from the tables.
Also removing the duplicate rows from the dataset

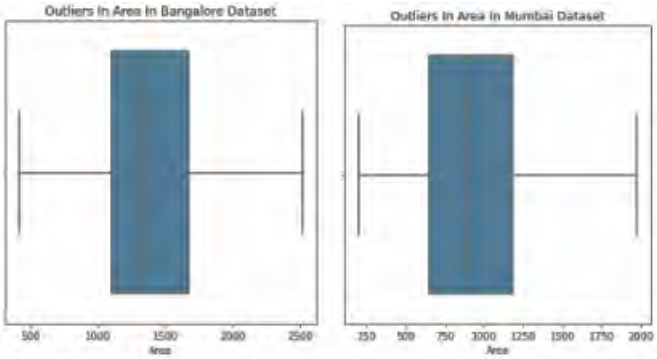
```
mumbai.replace(9,np.nan,inplace=True)
```

```
mumbai = mumbai.dropna()
```

The dataset contained outliers as well which had to be removed. The first pair of figures below shows the data is heavily right-skewed indicating the existence of outliers in 'Area' attribute for both the cities

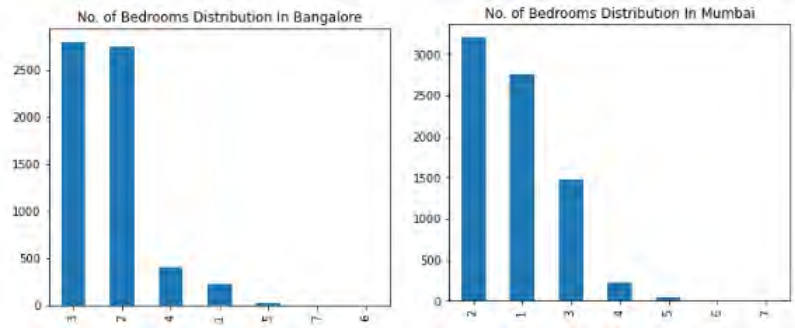


The next figures show data without outliers.

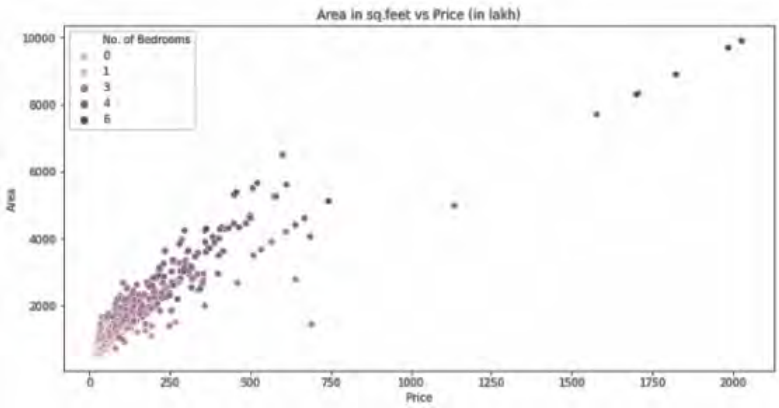


This was followed by the creation of visualisations to have a better insight into the data Using the plt from matplotlib we can plot histograms, distance plot, barchart etc.

Similarly we can visualise how the bedrooms vary in these cities. From the plot it is clearly shown that in Mumbai city 2-bedroom houses are highest whereas Bangalore city has 3-bedroom houses highest in number immediately followed by 2-bedroom ones.

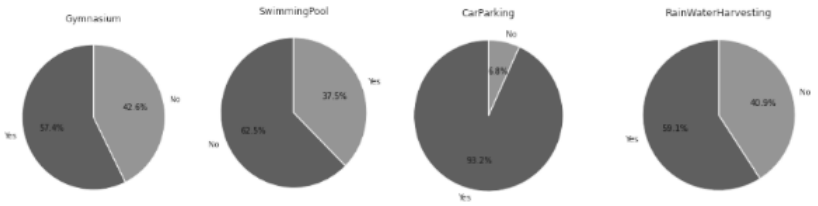


This supports the previous plots which indicates higher frequency of houses when area is smaller because that indirectly means the most housesare with lesser number of bedrooms.



Data visualisation library seaborn is also used to draw scatter plots. For example, plotting Area v/s Price for the city of Banglore gives the following chart. Here the price was first converted in lakhs for better fitting. It's a clear inference from the above scatter plot that houses with larger

area are more costly.(Sonavni, 2021)(UDUPA, 2022)(kaaviya Modi,)



Additionally Pie charts are good to visualise especially with the binary attributes that can be described as yes or no for present or absent respectively.

Creating these visual representations certainly gives a better understanding of the attributes so as to do feature engineering, dividing the dataset into test and train sets, choose and deploy the model for prediction and then finally analyse the performance.

6. CONCLUSION AND FUTURE WORK

This semester project was focused mainly on collecting, cleaning, preprocessing and analysing the dataset. The creation and deployment of house price prediction models that have been discussed and analysed in this paper on this processed and cleaned dataset is considered for future work.

References

Abdulal, A. and Aghi, N. 2020. House price prediction. Kristianstad University. Independent project.

BHATIA, R. 2020. Housing prices in metropolitan areas of india. www.kaggle.com.

Chen, N. 2022. House price prediction model of zhaoqing city based on correlation analysis and multiple linear regression analysis. *Wireless Communications and Mobile Computing vol. 2022*, 18 pages.

kaaviya Modi. Real estate price prediction — a machine learning and data science project. https://kaaviyamodi.medium.com/real-estate-price-prediction-2c0c845f3884.

Li, D., Liu, L., and Lv, H. 2021. Prediction of china's housing price based on a novel grey seasonal model. *Mathematical Problems in Engineering vol. 2021*, 11 pages.

Liu, G. 2022. Research on prediction and analysis of real estate market based on the multiple linear regression model. *Scientific Programming vol. 2022,* No.4.

Madhuri, C. R., Anuradha, G., and Pujitha, M. V. 2019. House price prediction using regression techniques: A comparative study. In *2019 International Conference on Smart Structures and Systems (ICSSS).*

QuangTruong, MinhNguyen, HyDang, and BoMei. 2020. Housing price prediction via improved machine learning techniques. In *International Conference on Identification, Information and Knowledge in the Internet of Things (IIKI2019.* Vol. vol. 174.

Rahman, S. A. and Hasbiah, U. N. 2020. House price prediction using a machine learning model: A survey of literature. In *December 2020 International Journal of Modern Education and Computer Science.*

Rawool, A. G., V, D., Rogye, Rane, S. G., and Bharadi, D. V. A. 2021. House price prediction using machine learning. *IRE Journals Vol. 4,* issue 11 (May).

Sonavni, V. 2021. Real estate house price prediction using data science. www.kaggle.com.

UDUPA, A. 2022. housing-prices-in-bangalore. www.kaggle.com.

Dr. Purshottam Jiwatram Assudani is working as an Assistant Professor in Department of Information Technology, Shri Ramdeobaba College of Engineering and Management, Nagpur, India. He has done Ph.D. in Computer Science and Engineering from Vellore Institute of Technology (VIT), Vellore, India. He has also completed his Bachelors and Masters in Computer Science and Engineering. He has published one Indian patent and published several papers in International Journals and conferences. He has a total teaching experience of more than 13 years and specializes in Cloud Computing, Distributed Systems and Operating Systems. He is a Certified Cloud Architect and Certified Trainer on Microsoft Azure and Amazon Web Services cloud platforms. He has delivered multiple corporate trainings on multi cloud platforms. He has also conducted online training sessions of Ms Azure at Caltech, USA. He has received a Best Paper Award in an International Conference. He has the membership of Indian Society for Technical Education (ISTE).
E-mail: assudanipj@rknec.edu

Chinmay Wankhede is final year student at Shri Ramdeobaba College of Engineering and Management, Nagpur majoring in Information Technology.He has worked on two projects in the past two semester, both of which have been accepted for publication. He is a Known active and friendly student in the department having good interpersonal and communication skills. Apart from this he is a fan of rock music and plays electric guitar.
E-mail: wankhedecs@rknec.edu

Plant leaves disease detection using Image Processing and Machine learning techniques

Prof P.Kokardekar, Aman Shah, Arjun Thakur, Prachi Shahu, Rohan Raggad, Sudhanshu Keshaowar, Vineet Pashine.
Shri Ramdeobaba College of Engineering and Management, Katol Road, Nagpur - 440013

Agriculture plays a very important role in strengthening the economy of a country. Disease in plants is the major cause of production and economy loss which also reduced the quality and quantity of agriculture products. Farmers face a lot of difficulty in detecting the diseases with naked eye which is the traditional and most used way. It is an important and tedious task to detect disease on crops. It requires a lot of skilled labour and huge amount of time. This paper compares the benefits and limitations of existing techniques for disease detections. Finally, it will talk about a method for disease detection in plants using convolutional neural network (CNN).

Keywords: Disease detection, Convolutional neural network.

1. INTRODUCTION

India is a heavily agrarian nation where agriculture supports the majority of the population. Agriculture research aims to boost output and food quality while spending less money and making more money. The size and productivity of an agricultural land mass affect a nation's economic development. Depending on the fertility of the land and the availability of resources, farmers plant a variety of crops. Crops may become infected by fungi, bacteria, and viruses as a result of changes in environmental factors like rainfall, temperature, and soil fertility. To stop diseases from spreading, boost plant productivity, and improve product quality, they employ the right pesticides and herbicides for the plants. Plant diseases are recognized and researched using visual patterns on the plants. It will be advantageous to find plant diseases early on because they can be managed. This paper describes the technique for detection of plant diseases with help of their leaves picture and we have compared the benefits and limitations of other techniques currently used. Image processing is the process of transforming an image into digital form and performing certain operations to get some useful information from it. The image processing system usually treats all images as 2D signals when applying predetermined signal processing methods. Machine learning is the field of study that gives computers the capability to learn without being explicitly programmed. Understanding the training data and incorporating it into models that should be helpful to people is the basic goal of machine learning. Consequently, it can help in making wise selections and forecasting the right output using the vast training data. In the past, professionals used chemical techniques or visual inspection of the leaves to identify plant diseases. This requires a sizable team of experts and ongoing plant monitoring, both of which are expensive when done with large farms. The suggested technique works well in these circumstances for keeping an eye on vast fields of crops. This paper first discusses various existing methods for detection of disease stating their advantages and limitations, then a method is briefly explained which uses image processing and CNN algorithm for disease detection, followed by the results of the proposed technique is presented with its accuracy.

2. LITERATURE REVIEW

Title	**Proposed technique**	**Benefits**	**Limitation**
Smart Farming: Pomegranate Disease Detection Using Image Processing (Bhange and Hingoliwala, 2015)	CCV + K-means clustering + SVM for training and claassification + Intent search Accuracy: 82 %	Two options for disease detection i.e with or without intent search. Used mobile camera also for capturing images for training and testing because thats what the farmers will use.	Disease detection less accurate in early stages of disease because of small spots
Deep Neural Networks Based Recognition of Plant Diseases by Leaf Image Classification (Sladojevic, Arsenovic, Anderla, Culibrk, and Stefanovic, 2016)	Neural Network Ensemble + CNN with ReLU Accuracy: 96.3 %	High accuracy range. Method used in this paper provides better result than a commercial solution Leafsnap as does not identify type of leaf and other methods of detecting diseases from leaves images.	Disease recognition limited to leaves and can be further more expanded to aerial photos of orchards and vineyards and CNN for object detection.
Hybrid Feature-Based Disease Detection in Plant Leaf Using Bayesian Optimized SVM, and Random Forest Classifier (Singh, Sreenivasu, Mahalaxmi, Sharma, Patil, and Asenso, 2022)	BO-SVM+Random forest+CNN Accuracy: 96.1 %	Binary particle swarm optimization plays a crucial role in hybrid feature selection the purpose to obtain the suitable output with the least features is achieved	The related works in the literature for the same database are considered a multilabel classification, which makes comparative performance analysis difficult with the results proposed
Using Deep Learning for Image-Based Plant Disease Detection (Mohanty, Hughes, and Salathé, 2016)	CNN Accuracy: 85.53 %-99.34 %	without any feature engineering, the model correctly classifies crop and disease from 38 possible classes in 993 out of 1000 images	When tested on a set of images taken under conditions different from the images used for training, the model's accuracy is reduced substantially
Plant Disease Detection Using Image Processing and Machine Learning (Kulkarni, Karwande, Kolhe, Kamble, Joshi, and Wyawahare, 2021)	Digital image processing and random forest classifier Accuracy: 93%	High accuracy, does not require specialized hardware and is computationally efficient, the accuracy scores are nearly equal to f1 scores.	It requires much time for training as it combines a lot of decision trees to determine the class for larger datasets
Tomato Leaf Disease Detection using Back Propagation Neural Network (Roopali and Verma, 2020)	Back Propagation Neural Network for classification Accuracy: 91%	Can reduce the computing time if weights chosen initially are small. And minimizes the error	Sensitive to noisy data and irregularity and relies very heavily on training data

Table I: Some of the existing systems/methodologies are summarized above.

3. PROPOSED METHODOLOGY

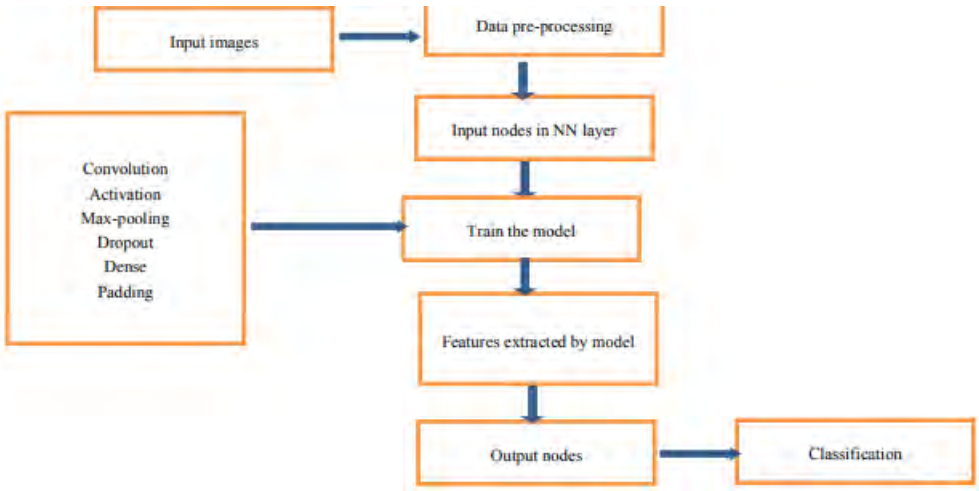


Figure 1: Steps of Methodology

3.1 Input

This layer's ultimate goal is to obtain a feature map. At low levels, fewer filters are utilized to detect features. We utilize more filters (often smaller ones) to detect high level features as we go deeper into the CNN.

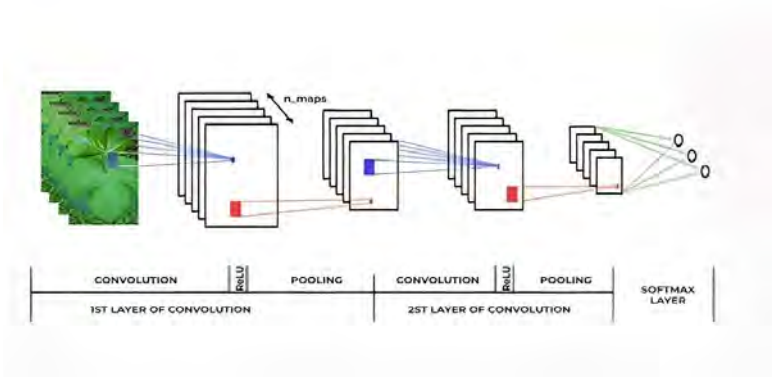


Figure 2: Convolutional Neural Network

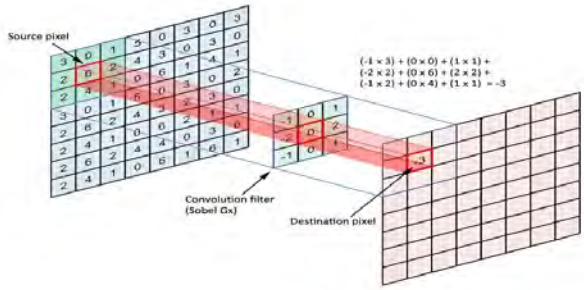


Figure 3: Input of CNN

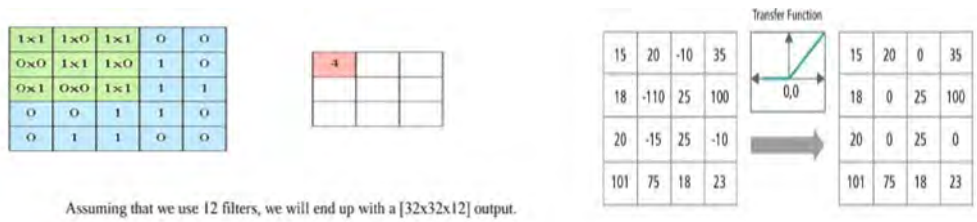


Figure 4: Input of CNN

3.2 Preprocessing

Transforming the input image data into usable floating-point tensors for the convolutional neural networks by pre-processing. Tensors can be thought of as multidimensional arrays simply because they are meant to hold knowledge rather than actual data. The dimensions of a tensor encoding a 3 channel, 64 X 64 picture (64, 64, 3). Let's look at the methods necessary to achieve it as the data is currently kept on a drive as JPEG files. Examine the image files (stored in data folder). Translate the JPEG content into RGB pixel grids with channels.

• These need to be processed into floating-point tensors for neural network input.

• Scale the values of the pixels (between 0 and 255) to the [0, 1] range (as training neural networks with this range gets efficient)

3.3 Padding

Convolution is followed by the padding process. It enables us to use a CONV layer without necessarily reducing the volumes' height and width. As we get into deeper layers without padding, height and width are diminishing. It enables us to maintain more details at an image's edge. 2-Stride operation is used to streamline computation and minimize overlap.

3.4 Pooling

Pooling Layers are used to minimize the number of parameters when photos are too huge. It uses nonlinear down sampling to cut down on the amount of parameters. After convolution, the Max Pooling operation is applied to every 2x2 matrix to extract the most value possible from the feature map. Thus, data corruption is prevented. Finally, flattening is the process of converting a matrix into a vector and connecting it to a fully linked layer, much like a neural network. The parameters are taken from the training set in order to categorize the leaves and parameters from a test image with the best degree of accuracy.

Activation : ReLU activation function is applied, and it outputs the same value for every positive and 0 for every negative value in the input image.

The number of pixels by which the local receptive field is pushed to the right in CNN is determined by the stride length (or down). Convolutional layer with rectified linear unit (ReLU), max pooling, and fully linked layer with ReLU make up the proposed CNN. From the photos that were taken, two (positive and negative) images are selected for each input. These two pictures are provided as input for the planned CNN architecture together with the original.

4. RESULT AND DISCUSSION

Figure 5: Homepage

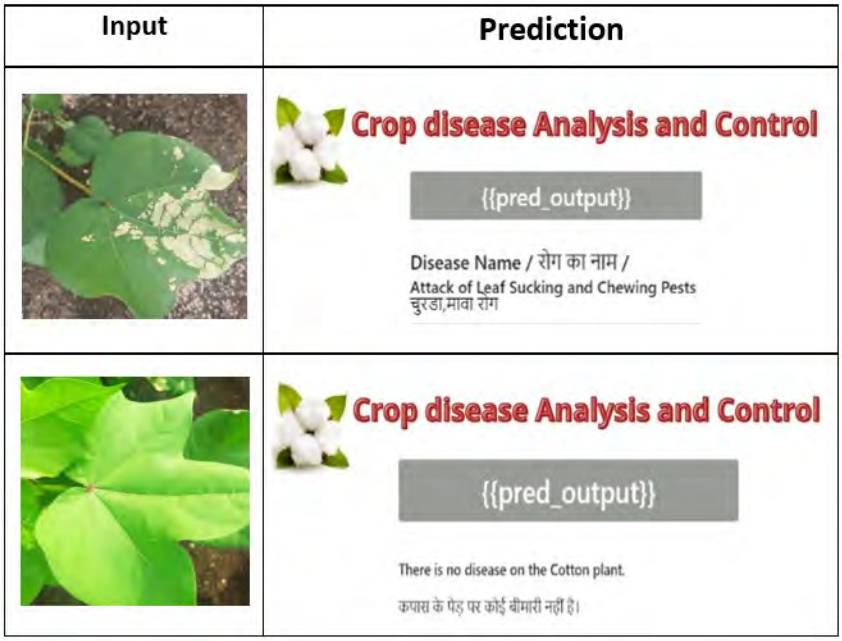


Figure 6: Inputs and outputs of the system

The proposed method uses convolutional neural network algorithm. The dataset is classified into 2 classes, healthy and diseased leaf with an accuracy of 95.2%. We have developed a flask-based web application for detecting the plant disease. For real-time plant disease identification, we can, however, deploy an intelligent robot vehicle with a powerful CPU attached to it.

5. CONCLUSION

This paper described a technique for leaves disease detection which uses image processing and Convolutional Neural Network (CNN) algorithm. The system is verified on the record of about 520 test images and 2400 training dataset and successfully classifies the leaves as healthy or diseased with the accuracy of 95.2%. A user-friendly flask-based web application has also been developed so that the farmers can upload the images of leaf and get instant result. This system would help farmers to quickly detect a diseased plant which would stop it from spreading, this system would reduce the expense which is caused in field examination by experts for detection of diseased plant.

References

Bhange, M. and Hingoliwala, H. 2015. Smart farming: Pomegranate disease detection using image processing. *Procedia computer science 58*, 280–288.

Kulkarni, P., Karwande, A., Kolhe, T., Kamble, S., Joshi, A., and Wyawahare, M. 2021. Plant disease detection using image processing and machine learning. *arXiv preprint arXiv:2106.10698*.

Mohanty, S. P., Hughes, D. P., and Salathé, M. 2016. Using deep learning for image-based plant disease detection. *Frontiers in plant science 7*, 1419.

Roopali, G. and Verma, T. 2020. Tomato leaf disease detection using back propagation neural network. *International Journal of Innovative Technology and Exploring Engineering 9,* 8, 529–538.

Shinde, P. and Manjrekar, A. 2013. Efficient classification of images using histogram based average distance computation algorithm extended with duplicate image detection elsevier, proc. of int. conf. *On advances in Computer Sciences, AETACS*, 102–110.

Singh, A. K., Sreenivasu, S., Mahalaxmi, U., Sharma, H., Patil, D. D., and Asenso, E. 2022. Hybrid feature-based disease detection in plant leaf using convolutional neural network, bayesian optimized svm, and random forest classifier. *Journal of Food Quality 2022*.

Sladojevic, S., Arsenovic, M., Anderla, A., Culibrk, D., and Stefanovic, D. 2016. Deep neural networks based recognition of plant diseases by leaf image classification. *Computational intelligence and neuroscience 2016*.

Prof. Pratibha Kokardekar is the Assistant Professor at the Shri Ramdeobaba College Of Engineering and Management, Nagpur, besides being a Professor at the Dept. of Information Technology. She has a wide range of knowledge and experience in Data mining, Microprocessor, Digital Circuits and Software Project Management domains with total teaching experience of 17 years.
E-mail: kokardekarpv@rknec.edu

Aman Shah is student at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: shahav@rknec.edu

Arjun Thakur is student at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: thakurap_1@rknec.edu

Prachi Shahu is student at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: shahupp1@rknec.edu

Rohan Raggad is student at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: raggadrr@rknec.edu

Sudhanshu Keshaowar is student at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: keshaowarss_1@rknec.edu

Vineet Pashine is student at Shri Ramdeobaba College of Engineering and Management, Nagpur.
E-mail: pashinevy@rknec.edu

Voice Based Authentication System for Web Applications using Machine Learning

Rakesh K Kadu, Purshottam J. Assudani, Sahil Bhojane, Tanish Agrawal, Vidhi Siddhawar and Yash Kale
Shri Ramdeobaba College of Engineering and Management, Nagpur, India

Due to security concerns, the biometric trend is being used in many systems. Biometric authentication is a cheap, easy, and reliable technology for multi-factor authentication. Cryptosystems are one such example of using biometric data. However, this could be risky as biometric information is saved for authentication purposes. Therefore, voice biometric systems provide more efficient security and unique identity than commonly used biometric systems. Although, speech recognition-based authentication systems suffer from replay attacks. In this paper, we implement and analyze a text-independent voice-based biometric authentication system based on the randomly generated input text. Since the prompted text phrase is not known to the speaker in advance, it is difficult to launch replay attacks. The system uses Mel-Frequency Cepstrum Coefficients (MFCC) to extract speech features and Gaussian Mixture Models (GMM) for speaker modeling.

Keywords: Voice, Authentication, Machine Learning, Voice Activity Detection, Gaussian Mixture Model.

1. INTRODUCTION

Today, many residential areas and businesses use all sorts of security systems to keep their property safe, including the Use of Passwords and User IDs/PINs for Protection. Unfortunately, all of these security systems are insecure as PIN codes can be hacked and ID cards stolen or cloned. For this reason, it is necessary to release entirely new technology for security systems in order to restore civilian confidentiality regarding security systems. Biometric technology uses a user function parameter as a password. Each function parameter is unique, even if the users are twins. These features are based basically on three factors i.e., what you know? what you have? and what you are. Biometric falls into the third category. Biometric authentication is based on a person's unique biological characteristics, as a person's biometric are unique and belong to that person until the user dies. The most natural way for humans to communicate is through language, which makes voiceprint technology for user authentication more appropriate and accurate. It's convenient because you don't have to carry or remember anything, and no need to worry about ID cards being stolen or passwords being hacked. Therefore, the speech recognition system is safe for admin users. This work examines the topic of speech recognition and develops a speech recognition system for specific spoken words.

2. LITERATURE SURVEY

Biometric technology uses biometric to uniquely define an individual. Biometric are believed to pose a much lower risk of information theft or counterfeiting compared to traditional security methods. Common biometric systems used are facial recognition, iris recognition, fingerprint recognition, and speaker recognition. In recent years, biometric authentication technology is used in multiple devices such as smartphones and laptop computers has progressed, and the biometric authentication market is expanding as organizations that emphasize security, such as companies, government agencies, and financial institutions, are increasing their use. It is also used in mobile applications, and telecom companies also use speech recognition technology to allow users to access their accounts. A typical device that acquires voice is a microphone, and it has the advantage of being less expensive than other devices that acquire biometric information

such as fingerprint recognition, face recognition, and iris recognition.

3. VOICE-BASED BIOMETRIC AUTHENTICATION SYSTEM

The human language contains several types of information. i.e, Language, Content, and Speaker Identity. Human voice features are extracted from his/her voice samples. Human language is modulated by the speaker's vocal tract, which is unique to each human being. (Matyáš and Říha, 2010) (Khan, 2022) Voice-based biometric authentication systems use the uniqueness of voice signals to verify a person's identity. Voice-based biometric authentication systems have advantages over other forms of biometric authentication systems in terms of low implementation and maintenance costs (Nassif, Shahin, Attili, Azzeh, and Shaalan, 2019) (Reddy, 1976). It also easily integrates into multi-factor authentication environments. Based on the input type, the speech recognition system can be divided into types, which are text-dependent and text-independent. In a text-dependent speech recognition system, the user has to say a text/phrase that the system knows in advance. Prior knowledge of text/speech gives a better recognition rate but suffers from replay attack. The impostor can record the genuine user's text and replay it later to breach system security. The text-independent speech recognition system does not expect a fixed text/phrase from the user. Users can speak randomly selected text/phrases. Text-independent recognition systems are flexible in use but less accurate than text-dependent systems. Similar to text-dependent speech recognition systems, text-independent speech recognition systems also suffer from the weakness of replay attacks. The third type of system is text-prompted which eliminates the inconvenience of replay attack to a large extent. In this case, the speaker has to speak a text/phrase randomly requested by the system. As the attacker doesn't know the text/sentence in advance, a replay attack is very difficult to launch. Depending on the type of application, A speech recognition system consists of mainly two modules which are feature extraction and feature matching. Feature extraction is the process of extracting a small amount of data from the audio signal which later can be used to represent each user. Feature matching, on the other hand, involves identifying unknown users by matching features extracted from the administrator's voice input with features extracted from the administrator's voice input. Compare against a set of known users.

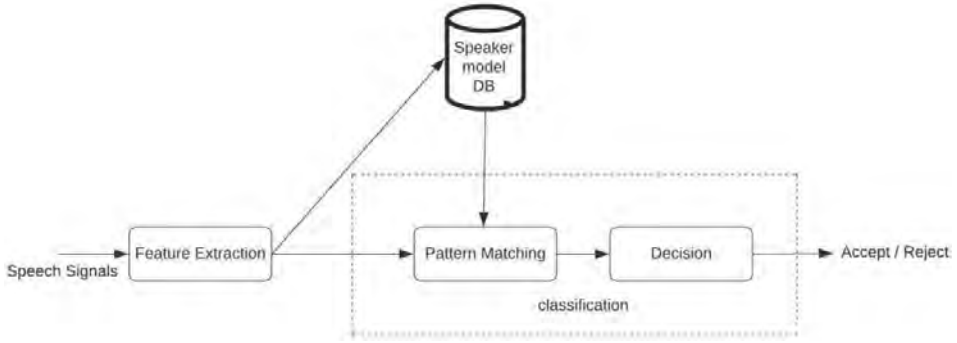


Figure 1: Block Diagram of Simple Speaker Recognition System.

4. LITERATURE SURVEY

(A. Maesa and Cusani, 2012) (Reynolds and Rose, 1995) presented and evaluated the use of Gaussian speaker mixture models for robust text-independent speaker identification. This paper mainly focused on the task domain of real applications. B. Voicemail labeling and searching. Gaussian-speaker mixture models were evaluated specifically for identification tasks using short utterances of unconstrained conversational speech, presumably transmitted over a noisy channel. Gaussian mixture models are motivated to model speaker identity based on two interpretations.

It was first shown that the Gaussian component exhibits a characteristic spectral shape (vocal tract configuration) from speech that makes up the human voice. By modeling the underlying acoustic class, the speaker model can better model the short-term fluctuations of the human voice, enabling high discrimination performance for short utterances. Gaussian mixture speaker models have additionally been interpreted as non-parametric multivariate PDF models that can model arbitrary feature distributions. Various aspects of using Gaussian mixture speaker models for text-independent speaker identification were explored after experimental evaluations. Some observations and conclusions are:

—The discriminative performance of the Gaussian mixture speaker model is independent of how the model is initialized.

—It is important to limit the training variance to avoid model singularities.

—There seems to be a minimum model order (16 for this 16-speaker database) required to model the speakers well and achieve good discrimination performance.

—The Gaussian mixture speaker model maintains high discrimination performance as the population size increases (the system achieves 96.8%, 15 We achieved an 80.8% recognition rate for phone utterances per second). Cepstrum means normalization effectively compensates for the deterioration of the spectral fluctuations of the phone. Using nodal distributed parameterization, the Gaussian mixture speaker model outperforms TGMM, GC, VQ, and RBF speaker modeling methods on the same telephone speech task.(Reynolds and Rose, 1995)

These results demonstrate that the Gaussian mixture model provides robust speaker representations for the tough assignment of speaker identification using corrupted and unconstrained speech. The models are computationally inexpensive and easy to implement on real-time platforms. Moreover, their probabilistic framework allows direct integration with speech recognition systems and the incorporation of newly developed voices.(Sahidullah and Saha, 2012)

5. METHODOLOGY

The objective of the proposed system is to implement a text-prompted voice-based biometric authentication system. The system will prompt a random text that will be used for authentication by voice recognition. As part of the process of building a voice biometric solution, you must take the following steps: Enrolment Phase and Verification Phase
The following steps have to be carried out in the Enrolment Phase:

Step1: To Generate Words Randomly
As the proposed system relies on text-prompted speech recognition, the initial step of building it is to generate random words. As a result, both phases are protected against replay attacks.

Step2: To Match the Text
To ensure that the user is uttering the correct word, We are using the text-to-speech API provided by the IBM cloud to convert the voice sample captured from the user and compare the similarity between the original word and the voice sample. Along with that, to avoid just comparing two strings, we are trying to compare by checking how similar the two strings are. For this purpose, fuzzy logic is used. Fuzzy matching is a method of processing word-based match queries to improve the ability to find matching phrases or sentences from a database. If you cannot find an exact match for a sentence or phrase, you can apply fuzzy matching. Fuzzy match attempts to find matches that exceed an application-specified match threshold, rather than 100% matches.

Step3: Voice Activity Detection (VAD) and Long Time Spectral Deviation (LTSD)
After accepting the audio input, to extract features, it is important to remove as much noise as possible from the raw audio input. Two steps are involved in this process: As part of the Voice Activity Detection (VAD) method (Tong, Chen, Qian, and Yu, 2014), background noise

is recorded and used to create a baseline for analyzing the voice activity of the user. VAD is the detection of the presence or absence of human speech. It can also be used to facilitate voice processing and disable some processes during the non-voice portion of the voice session. Disabling means removing the same type of noise in the desired file at the first sample taken from the user. To get more unique features of audio files. Once you have selected only frames that contain speech activity, you can use Long Time Spectral Deviations to filter them. By using this most of the noise is filtered out from the user's voice input.

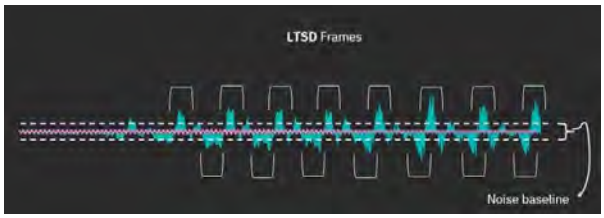


Figure 2: LTSD and VAD algorithms are used to pre-process the speech sample.

Step 4: Use MFCC to Extract Feature

The feature extraction process in this solution is one of the most crucial processes. The MFCC algorithm (Han, Chan, Choy, and Pun, 2006) is used to accomplish this. The procedure starts by dividing the user's voice input into discrete processing windows. Additionally, windowing involves dividing the audio signal into segments, each of which has an Xms width and Yms signal. The number of states produced by a person speaking at the average rate of 3 words per second on 4 phones, with 3 states in each phone, is 36, or (X+c/X- c)ms (c: 0 to 3), which is close to our Xms window. Each segment is being processed for 39 characteristics. Furthermore, when a signal is interrupted, clipping occurs right at the signal's edges, which causes a sudden reduction in amplitude at the edges and high-frequency noise. So, in place of a rectangular window, we are utilizing a Hamming/Hamming window to chop signals that don't generate noise at high frequencies.

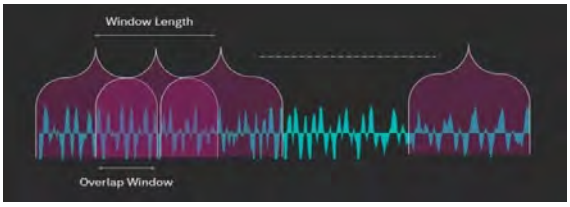


Figure 3: Feature Extraction using MFCC.

Then, to create a short temporal Fourier transform, we take a window and apply the discrete Fourier transform to it. The Discrete Fourier Transform will be used to transform the signal from the time domain to the frequency domain. (For audio signals, frequency domain analysis is simpler than time domain analysis.) This is run through the mel scale to obtain the filter bank coefficients. Due to the fact that machines do not detect sound the same way that human ears do. Low frequencies are more easily resolved by our hearing than high frequencies. So when we heard sounds at 200 Hz and 300 Hz, they were 100 Hz apart from sounds at 1500 Hz and 1600 Hz, but they are easily distinguishable. Machines, on the other hand, have a resolution that is constant across all frequencies. Notably, the model performs better when the peculiarities of human hearing are modeled throughout the feature extraction process. In order to translate actual frequencies into frequencies that people can sense, we employ the mel scale. And it becomes the attribute that best describes our voiceprint. Nevertheless, because there are a lot of covariant

characteristics, we utilize a discrete cosine transform to cut down on the number of features and obtain a final set of features that can be applied to model training.

Step 5: Gaussian Mixture Model (GMM)

The model must be trained using Gaussian Mixture Models as the last step. Each voiceprint is a cluster because this algorithm brings together different voice characteristics to generate a user's voiceprint. Th0e voiceprint is then kept in a database of voiceprints. The same process continues in the validation stage. The user's voiceprint is then compared with those present in the voiceprint database. For each existing model, log probabilities are computed, and the best model is chosen by the user. The program accepts the user if the user ID matches the person attempting to authenticate. If not, the user will be denied.

6. RESULTS AND DISCUSSIONS

The outcomes of the proposed system's implementation are shown in the section that follows. In order to extract features from speech samples and do other voice sample processing that provides us accurate results and effectively verifies the user, we have constructed the system utilizing some machine learning techniques. We have employed the Python-based SciPy environment for science, engineering, and mathematics, the IBM Watson Speech to Text speech API, and Fuzzy Wuzzy for string matching. MFCC and LTSD, the Skitlearn Gaussian Mixture Model package, the Random Words Python module for generating random words, and the Speech Recognition library for performing speech recognition.The system's functionality is depicted below :

A. Enrollment Phase:

The user must first enlist with a voice sample in order to be verified. The user's voice sample and login information are recorded during this initial stage. Once the user has successfully registered, a sample of his or her voice is saved in the object form for future user verification.

Figure 4: Home Page.

Figure 5: User Sign-Up Page.

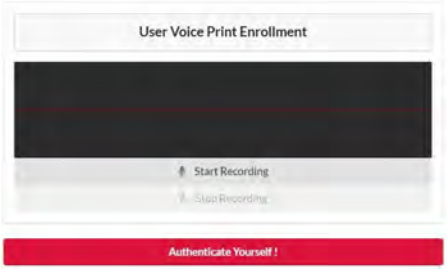


Figure 6: Voice Print Enrolment Page.

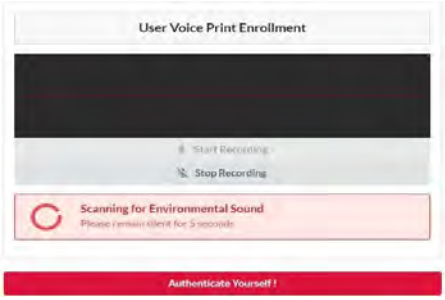


Figure 7: Creating a baseline for voice enrolment.

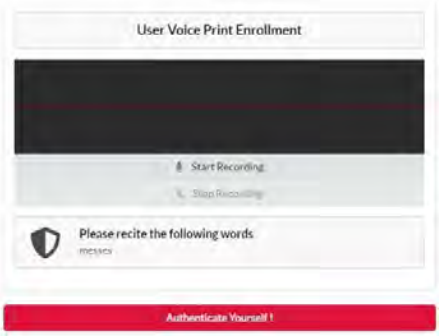


Figure 8: Recording voice sample.

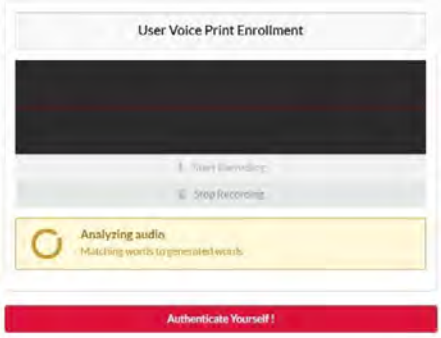


Figure 9: Analyzing Voice sample.

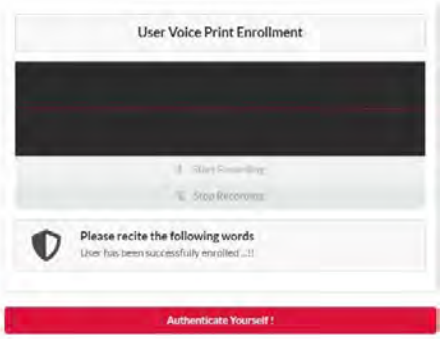


Figure 10: Successful Enrolment of User.

Figure 11: User Sign In for verification.

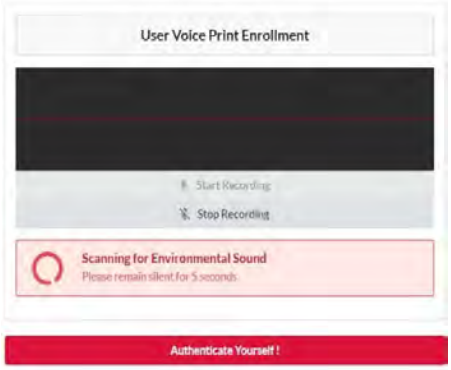


Figure 12: Creating a baseline for voice verification.

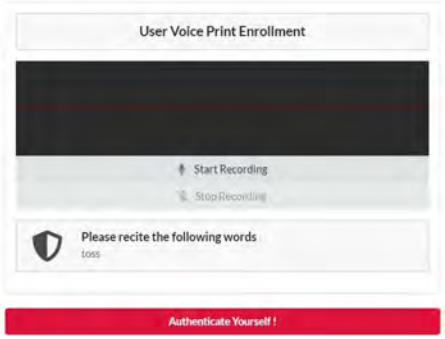


Figure 13: Recording voice sample for verification.

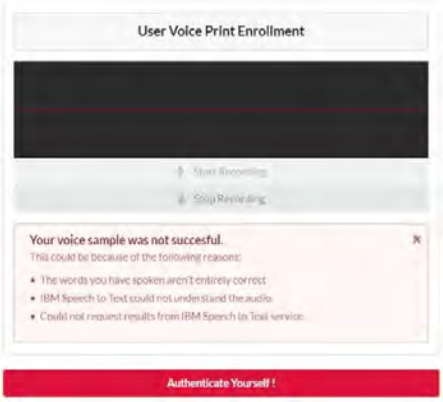


Figure 14: Authentication Failed.

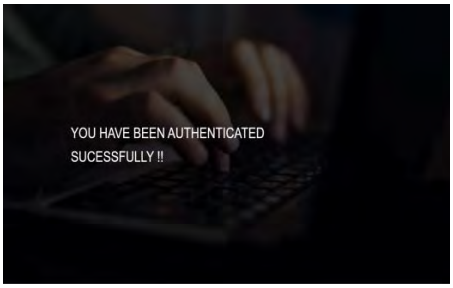


Figure 15: Successful Authentication of User.

7. CONCLUSION

The biometric system is a foundation and backbone of many securities systems for the authentication and identification of individuals. The voice biometric system has many advantages over other biometric methods, due to easy use, acceptance, and authentication. For voice biometric, we took the user's voice sample and converted it to text using IBM speech-to-text. Further, we compared the converted text and the actual text using fuzzy, and then to remove noise from the accepted voice input we used Voice Activity Detection (VAD). To recognize a given voice we must understand the features of the voice sample, this is done using Mel-frequency Cepstral Coefficients (MFCC) algorithm. Last but not least, the voice print of the voice sample is produced using the Gaussian Mixture Model and then used for the verification procedure. In the current scenario, biometric solutions offer user-friendly authentication, accuracy, and cost-saving methods. So while the use of voice biometric systems is currently slow, it has a bright future.

References

A. Maesa, F. Garzia, M. S. and Cusani, R. 2012. Text independent automatic speaker recognition system using mel-frequency cepstrum coefficient and gaussian mixture models. *Journal of Information Security Vol.3*, pp.335–340.

Han, W., Chan, C.-F., Choy, C.-S., and Pun, K.-P. 2006. An efficient mfcc extraction method in speech recognition. In *2006 IEEE International Symposium on Circuits and Systems (ISCAS)*. IEEE, 4–pp.

Khan, S. P. A. H. 2022. Google scholar citation: Ijaeml. *International Journal of Applied Engineering and Management Letters (IJAEML) A Refereed International Journal of Srinivas University Vol.6*, pp.2581–7000.

Matyáš, V. and Říha, Z. 2010. Security of biometric authentication systems. *2010 International Conference on Computer Information Systems and Industrial Management Applications, CISIM 2010*, pp.19–28.

Nassif, A. B., Shahin, I., Attili, I., Azzeh, M., and Shaalan, K. 2019. Speech recognition using deep neural networks: A systematic review. *IEEE Access 7*, 19143–19165.

Reddy, D. R. 1976. Speech recognition by machine: A review. *Proceedings of the IEEE 64*, 4, 501–531.

Reynolds, D. A. and Rose, R. C. 1995. Robust text-independent speaker identification using gaussian mixture speaker models. *IEEE Transactions on Speech and Audio Processing Vol.3*, pp.72–83.

Sahidullah, M. and Saha, G. 2012. Design, analysis and experimental evaluation of block based transformation in mfcc computation for speaker recognition. *IEEE Access Vol.54*, pp.543–565.

Tong, S., Chen, N., Qian, Y., and Yu, K. 2014. Evaluating vad for automatic speech recognition. In *2014 12th International Conference on Signal Processing (ICSP)*. IEEE, 2308–2314.

Dr. Rakesh K Kadu is an Assistant Professor at the Department of Information Technology, Shri Ramdeobaba College of Engineering and Management, Nagpur, India. He has 1 patent is published in the Indian Patents and Trademarks Office and over 16 published re- search papers in National/International journals/conferences. Dr. Rakesh pursued his engineering education at the Govt College of Engineering, Amravati, India in Computer Science and Engineering. He completed his Ph.D. at Yashwantrao Chavan College of Engineering, India. His research interests are in Cryptography and Security, Cloud computing, Computer networks, network management, and IoT. He is a life member of the ISTE and CSI.
E-mail: kadurk@rknec.edu

Dr. Purshottam J. Assudani is working as an Assistant Professor in Department of Information Technology, Shri Ramdeobaba College of Engineering and Management, Nagpur, India. He has done Ph.D. in Computer Science and Engineering from Vellore Institute of Technology (VIT), Vellore, India. He has also completed his Bachelors and Masters in Computer Science and Engineering. He has published one Indian patent and published several papers in International Journals and conferences. He has a total teaching experience of more than 13 years and specializes in Cloud Computing, Distributed Systems and Operating Systems. He is a Certified Cloud Architect and Certified Trainer on Microsoft Azure and Amazon Web Services cloud platforms. He has delivered multiple corporate trainings on multi cloud platforms. He has the membership of Indian Society for Technical Education (ISTE).
E-mail: assudanipj@rknec.edu

Mr. Sahil Bhojane is a Student in Information Technology, at Shri Ramdeobaba College of Engineering and Management, Nagpur, (India). He is pursuing his Bachelor's Degree (BE) in Information Technology. He is currently working on the project "Voice based Authentication for Web Applications using Machine Learning". His research interests are in Machine learning, Salesforce and Cloud Computing. He has completed his schooling at Modern School Nagpur.
E-mail: bhojaness@rknec.edu

Mr Tanish Agrawal is a Student in Information Technology, at Shri Ramdeobaba College of Engineering and Management, Nagpur, (India). He is pursuing his Bachelor's Degree (BE) in Information Technology. He is currently working on the project "Voice based Authentication for Web Applications using Machine Learning". His research interests are in Machine learning, Computer Vision and Cloud Computing.
E-mail: agrawaltm_1@rknec.edu

Ms Vidhi Siddhawaris a Student in Information Technology, at Shri Ramdeobaba College of Engineering and Management, Nagpur, (India). She is pursuing his Bachler's Degree (BE) in Information Technology. She is born and brought up in Nagpur. She is currently working on the project "Voice based Authentication for Web Applications using Machine Learning". Her research interests are in Cryptography, Cloud Computing, Application Development and Machine learning.
E-mail: siddhawarvv@rknec.edu

Mr Yash Kale is a Student in Information Technology, at Shri Ramdeobaba College of Engineering and Management, Nagpur, (India). He is pursuing his Bachelor's Degree(BE) in Information Technology. He is currently working- on the project "Voice based Authentication for Web Applications using Machine Learning". His research interests are in Competitive Programming , Salesforce and Machine learning.
E-mail: kaleyv@rknec.edu

Authors are encouraged to submit high-quality, original work that has neither appeared in, nor is under consideration by, other journals.

Types of Papers

The Journal accepts the following categories of papers:

(a)	Original research
(b)	Position papers/review papers
(c)	Short-papers(with well-defined ideas,but lacking research results or having preliminary results)
(d)	Technology Discussion/Overview Papers

Length of Papers

For original research articles and review papers, the length of the final camera-ready paper in ACM format should not exceed 25 pages. For short/technology discussion papers, the final camera-ready paper should be confined to a maximum of 10 pages.

Peer Review Process

All submitted papers are subjected to a comprehensive blind review process by at least 2 subject area experts, who judge the paper on its relevance, originality, clarity of presentation and significance. The review process is expected to take 8-12 weeks at the end of which the final review decision is communicated to the author. In case of rejection authors will get helpful comments to improve the paper for resubmission to other journals. The journal may accept revised papers as new papers which will go through a new review cycle

Formatting Instructions

IJNGC conforms to the Transactions of the ACM formatting style. Draft papers for review can be submitted in any format. Upon acceptance authors shall be required to submit a camera-ready paper as per the formatting guidelines available online. Both LaTeX and Microsoft Word template files are available for formatting.

Paper Submissions

IJNGC offers authors, editors and reviewers of Next-Generation Computing a web-enabled online manuscript submission and review system. Our online system offers authors the ability to track their manuscript through the review process.

Manuscripts should be submitted online athttp://ijngc.perpetualinnovation.net

This online system offers easy and straightforward log-in and submission procedures, andsupportsawiderangeofsubmissionfleformats.

NOTE: The Journal does not levy any page charges for authors.

IJNGC International Journal of Next-Generation Computing

The International Journal of Next-Generation Computing (IJNGC) is a high-quality peer-reviewed journal aimed at providing a platform for researchers to showcase and disseminate high-quality research in the domain of next-generation computing. IJNGC promises to be a highly competitive dissemination forum for new ideas, technology focus, research results and discussions in these areas.

To this end IJNGC publishes research articles, review and position papers, technology discussion and overview papers pertaining to all aspects of computing, with attention to the following domains:

- Cloud Computing
- Peer-toPeer Computing/Networks
- Grid Computing
- Evolutionary Computing
- Autonomic Computing
- Bio-Inspired Systems
- Storage Networks/Systems
- Sensor Networks/Computing
- Pervasive Computing
- Mobile Computing
- Agent-Based Systems
- Algorithms for Parallel Computing
- Enterprise Computing
- Security and Intrusion Resilience
- Continuous Event Processing
- Virtualization
- Smart Environments
- Dynamic Distributed Systems

Article submissions are welcome. Authors are invited to submit their previously unpublished work to the journal. Notes for authors regarding the submission and review process are available online at http://ijngc.perpetualinnovation.net

International Journal for Next-Generation Computing (IJNGC) is an independent journal published by Perpetual Innovation Media Pvt. Ltd., Delhi, in collaboration with Model Institute of Engineering & Technology (Autonomous), Kot Bhalwal, Jammu, India

Published by: Perpetual Innovation Media Pvt. Ltd.
5006, Hauz Qazi (Near Canara Bank), Delhi - 110006
E-mail: ijngc@perpetualinnovation.net
http://perpetualinnovation.net Ph: +919560404488

Printed at: ABC Press, Delhi
http://www.abcpress.in

Perpetual Innovation
together let's innovate