Proceedings of the Sixth International Conference on Inventive Computation Technologies [ICICT 2021]
IEEE Xplore Part Number: CFP21F70-ART; ISBN: 978-1-7281-8501-9

Requirements Identification on Automated Medical Care with Appropriate Machine Learning Techniques

Balajee R M [1], Hitesh Mohapatra [2] and Deepak V [3]
Department of Computer Science and Engineering
Koneru Lakshmaiah Education Foundation,
Vaddeswaram, Guntur, Andhra Pradesh, India
[1] balajee.rm@gmail.com, [2] hiteshmahapatra@gmail.com and
[3] v.d@live.in

Vijendra Babu D [4]
Department of Electronics and Communication Engineering
Aarupadai Veedu Institute of Technology, Vinayaka Mission's
Research Foundation,
Chennai, Tamil Nadu, India
[4] drdvijendrababu@gmail.com

Abstract. Generally, medical diseases can be identified based on their symptoms already derived. Most of the medical diseases are not new and the symptoms are already plotted with results. The diseases like COVID19 are new and it is still in the observation stage. Whenever the symptoms are conceivable such as, the demand for automation in prediction exists. Such demand leads to the development of automated medical care machine which can deliver the suggestions or prescriptions in absence of doctors due time or place constraints (now it is higher due to COVID19 pandemic). In a few situations, doctors can also help patients with live video streaming assist mechanism. The automated machine can also produce the required medicine as per the basic needs. Many research papers are coming up on this aspect now a day. It is important to focus on this medical need on the way of researches done and the room to improve further shortly. When dealing with such automated prediction, the previous predictions and results happened should be taken into considerations. In such case, the big data with machine learning algorithms play a vital role in this process. In this article, the best-fit machine learning algorithm was identified for medical-related data sets.

Keywords: Automated Medical Care Machine, Video Streaming Assist Mechanism, Medical Diseases, Prescriptions and Medicine, COVID19 pandemic.

I. INTRODUCTION

The symptoms play a major role in identifying the diseases [1, 17], and few symptoms are listed below for child between 2 months and 5 years. Most of the symptoms are from a common problem like a cough or difficult breathing, diarrhea, fever, and ear problem.

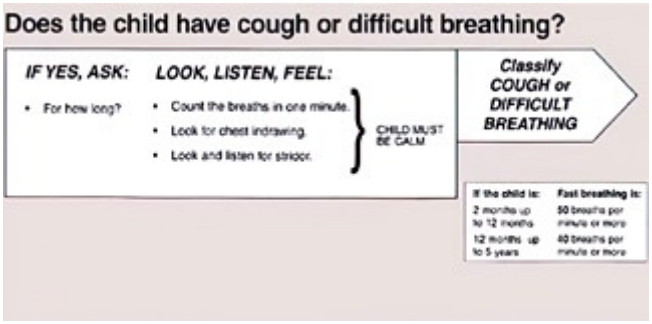

Fig. 1 (a): Main Symptom 1 – Child between 2 Months and 5 Years

SIGNS	CLASSIFY AS	TREATMENT (Urgent pre-referral treatments are in bold print.)
• Any general danger sign or • Chest indrawing or • Stridor in calm child.	SEVERE PNEUMONIA OR VERY SEVERE DISEASE	▸ ***Give first dose of an appropriate antibiotic.*** ▸ ***Refer URGENTLY to hospital.****
• Fast breathing.	PNEUMONIA	▸ ***Give an appropriate antibiotic for 5 days.*** ▸ Soothe the throat and relieve the cough with a safe remedy. ▸ Advise mother when to return immediately. ▸ Follow-up in 2 days.
No signs of pneumonia or very severe disease.	NO PNEUMONIA: COUGH OR COLD	▸ If coughing more than 30 days, refer for assessment. ▸ Soothe the throat and relieve the cough with a safe remedy. ▸ Advise mother when to return immediately. ▸ Follow-up in 5 days if not improving.

Fig. 1(b): Main Symptom 1 – Child between 2 Months and 5 Years

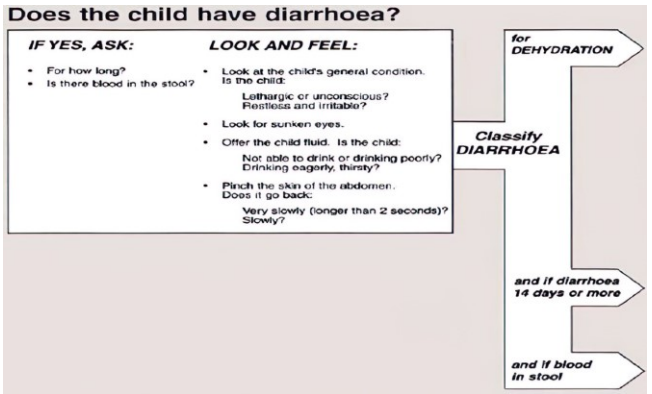

Fig. 2(a): Main Symptom 2 – Child between 2 Months and 5 Years

2021 6th International Conference on Inventive Computation Technologies (ICICT) | 978-1-7281-8501-9/21/$31.00 ©2021 IEEE | DOI: 10.1109/ICICT50816.2021.9358683

Two of the following signs: • Lethargic or unconscious • Sunken eyes • Not able to drink or drinking poorly • Skin pinch goes back very slowly	SEVERE DEHYDRATION	▸ If child has no other severe classification: - Give fluid for severe dehydration (Plan C). OR ***If child also has another severe classification:*** ***- Refer URGENTLY to hospital with mother giving frequent sips of ORS on the way.*** ***Advise the mother to continue breastfeeding.*** ▸ ***If child is 2 years or older and there is cholera in your area, give antibiotic for cholera.***
Two of the following signs: • Restless, irritable • Sunken eyes • Drinks eagerly, thirsty • Skin pinch goes back slowly	SOME DEHYDRATION	▸ Give fluid and food for some dehydration (Plan B). ▸ ***If child also has a severe classification:*** ***- Refer URGENTLY to hospital with mother giving frequent sips of ORS on the way.*** ***Advise mother to continue breastfeeding.*** ▸ Advise mother when to return immediately. ▸ Follow-up in 5 days if not improving.
Not enough signs to classify as some or severe dehydration.	NO DEHYDRATION	▸ Give fluid and food to treat diarrhoea at home (Plan A). ▸ Advise mother when to return immediately. ▸ Follow-up in 5 days if not improving.
• Dehydration present.	SEVERE PERSISTENT DIARRHOEA	▸ Treat dehydration before referral unless the child has another severe classification. ▸ Refer to hospital.
• No dehydration.	PERSISTENT DIARRHOEA	▸ Advise the mother on feeding a child who has PERSISTENT DIARRHOEA. ▸ Follow-up in 5 days.
• Blood in the stool.	DYSENTERY	▸ ***Treat for 5 days with an oral antibiotic recommended for Shigella in your area.*** ▸ Follow-up in 2 days.

Fig. 2(b): Main Symptom 2 – Child between 2 Months and 5 Years

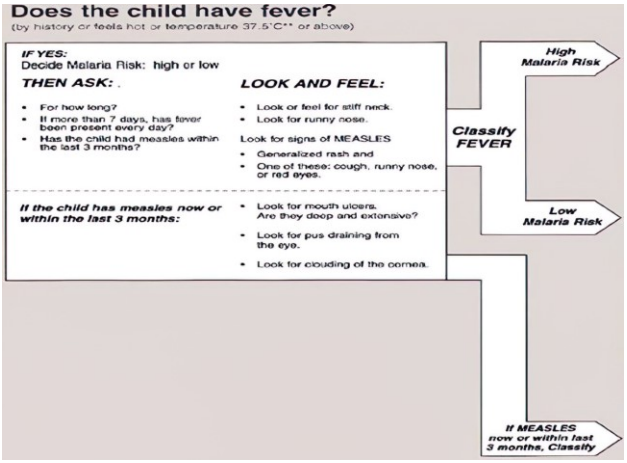

Fig. 3(a): Main Symptom 3 – Child between 2 Months and 5 Years

HIGH MALARIA RISK		
• Any general danger sign or • Stiff neck.	VERY SEVERE FEBRILE DISEASE	▸ ***Give quinine for severe malaria (first dose).*** ▸ ***Give first dose of an appropriate antibiotic.*** ▸ ***Treat the child to prevent low blood sugar.*** ▸ ***Give one dose of paracetamol in clinic for high fever (38.5˚C or above).*** ▸ ***Refer URGENTLY to hospital.***
• Fever (by history or feels hot or temperature 37.5˚C** or above).	MALARIA	▸ ***If NO cough with fast breathing, treat with oral antimalarial.*** ***OR*** ***If cough with fast breathing, treat with cotrimoxazole for 5 days.*** ▸ ***Give one dose of paracetamol in clinic for high fever (38.5˚C or above).*** ▸ Advise mother when to return immediately. ▸ Follow-up in 2 days if fever persists. ▸ If fever is present every day for more than 7 days, refer for assessment.
LOW MALARIA RISK		
• Any general danger sign or • Stiff neck.	VERY SEVERE FEBRILE DISEASE	▸ ***Give quinine for severe malaria (first dose) unless no malaria risk.*** ▸ ***Give first dose of an appropriate antibiotic.*** ▸ ***Treat the child to prevent low blood sugar.*** ▸ ***Give one dose of paracetamol in clinic for high fever (38.5˚C or above).*** ▸ ***Refer URGENTLY to hospital.***
• NO runny nose and NO measles and NO other cause of fever.	MALARIA	▸ ***If NO cough with fast breathing, treat with oral antimalarial.*** ***OR*** ***If cough with fast breathing, treat with cotrimoxazole for 5 days.*** ▸ ***Give one dose of paracetamol in clinic for high fever (38.5˚C or above).*** ▸ Advise mother when to return immediately. ▸ Follow-up in 2 days if fever persists. ▸ If fever is present every day for more than 7 days. refer for assessment.
• Runny nose PRESENT or • Measles PRESENT or • Other cause of fever PRESENT.	FEVER - MALARIA UNLIKELY	▸ ***Give one dose of paracetamol in clinic for high fever (38.5˚C or above).*** ▸ Advise mother when to return immediately. ▸ Follow-up in 2 days if fever persists. ▸ If fever is present every day for more than 7 days. refer for assessment
• Any general danger sign or • Clouding of cornea or • Deep or extensive mouth ulcers.	SEVERE COMPLICATED MEASLES***	▸ ***Give Vitamin A.*** ▸ ***Give first dose of an appropriate antibiotic.*** ▸ ***If clouding of the cornea or pus draining from the eye, apply tetracycline eye ointment.*** ▸ ***Refer URGENTLY to hospital.***
• Pus draining from the eye or • Mouth ulcers.	MEASLES WITH EYE OR MOUTH COMPLICATIONS***	▸ ***Give Vitamin A.*** ▸ ***If pus draining from the eye, treat eye infection with tetracycline eye ointment.*** ▸ If mouth ulcers, treat with gentian violet. ▸ Follow-up in 2 days.
• Measles now or within the last 3 months.	MEASLES	▸ ***Give Vitamin A.***

Fig. 3(b): Main Symptom 3 – Child between 2 Months and 5 Years

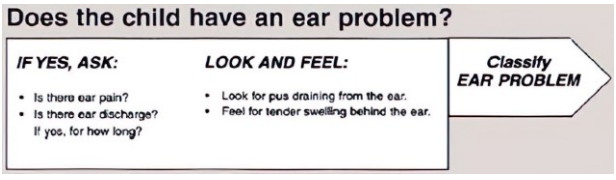

Fig. 4(a): Main Symptom 4 – Child between 2 Months and 5 Years

• Tender swelling behind the ear.	MASTOIDITIS	▸ ***Give first dose of an appropriate antibiotic.*** ▸ ***Give first dose of paracetamol for pain.*** ▸ ***Refer URGENTLY to hospital.***
• Pus is seen draining from the ear and discharge is reported for less than 14 days, or • Ear pain.	ACUTE EAR INFECTION	▸ ***Give an antibiotic for 5 days.*** ▸ Give paracetamol for pain. ▸ Dry the ear by wicking. ▸ Follow-up in 5 days.
• Pus is seen draining from the ear and discharge is reported for 14 days or more.	CHRONIC EAR INFECTION	▸ Dry the ear by wicking. ▸ Follow-up in 5 days.
• No ear pain and No pus seen draining from the ear.	NO EAR INFECTION	No additional treatment.

Fig. 4(b): Main Symptom 4 – Child between 2 Months and 5 Years

At present, sensors are utilized for gathering patient data such as pressure, pulse rate, etc. These sensors are connected with the system to produce the report (summary) [13, 16, 25]. Then the consolidated report and the patient's medical history are sent to the doctor for review and [2, 19] the doctor will suggest the prescription to patients based on received data. The schematic diagram for the IoT based embedded treatment model is shown below,

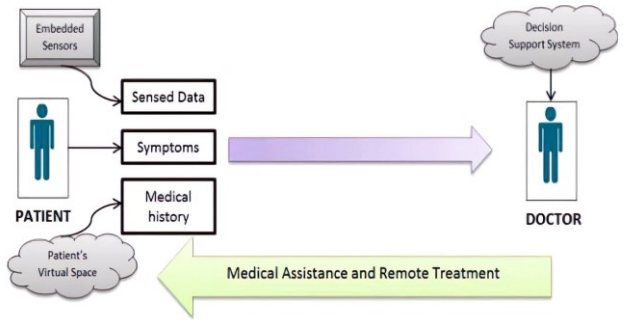

Fig. 5: IoT Based Embedded Treatment Model

When analyzing the medical related data, the following datasets were considered in the scenario [27].

Data Set 1: The data set for symptom disease relationship should be formed with the name of Data Set – Symptom Disease Relationship (DS-SDR).

Data Set 2: The data from different patients are stored in a separate data set called Data Set – Patient (DS-P). Here, doctors may be in different location as well.

Data Set 3: Every individual doctor's prescription will be collected in such a way, that the Doctor's name as Key and Prescription as Values (documents). The data set named Data Set – Doctor Prescription (DS-DP).

Data Set 4: Randomly collected handwritten prescriptions in the data set called Data Set – Hand Written Prescription (DS-HWP).

II. LITERATURE SURVEY

The machine learning techniques play a vital role in medical data sets [20, 21, 26], here are some machine learning techniques which can be used for better efficiency on the above data sets. The DS-SDR dataset is having various diseases as a branch of different symptom combinations. [15] As proof of a similar scenario in the survey, this type of dataset can be effectively handled by supervised learning algorithms and especially decision trees because of Θ (log n) complexity to search in most of the cases. In the worst case, it may reach O

(n) but it is a rare scenario. Here 'n' is the number of symptom nodes [22, 23].

The dataset's DS-P and DS-DP are having individual's record/prescription sheets, so the rule set can be clearly written after analyzing the overall data and requirement. When the rule set is clear and there cannot form a hierarchical structure, in such a situation SVM classification will be effective. These prescriptions required text extraction techniques [14, 18] to do the internal process for storing the data in the required format.

The data set DS-HWP will have randomly collected prescriptions where the understanding of the data set to form a clear ruleset will be difficult and further using the data set efficiently by giving equal priority over each data is almost very difficult. Giving equal priority is important because to know about each prescription since those are randomly collected ones. In such a situation, a random forecast technique will be much effective than other machine learning techniques [24].

The medical care machine can be as small as finding the pressure and symbolizing the diseases. It can also be as big as a machine that can produce the tablets as per doctor's prescription. The doctors are writing the prescription based on the collected input data and there is always a question, if the input data collected is not correct or inaccurate then the prescribed medicine will lose its efficiency against the actual disease. Eventually, the betterment of medical prescription is based on the accuracy of the device used to gather data. The legal standard needs to be set for testing or validating such devices regularly to produce the accuracy measured [3]. All ways engineering offered technology over health care plays a major role in terms of communication and data collection [4]. The mathematical models also playing a vital role in proving the accuracy and results of such induced technology over the area of health care.

ATM kind of machine is developed for providing medicine for patients as per the doctor's prescription and on the physical absence of doctors, the machine can provide video conference for patients to doctors [5, 8]. It is connected online to a doctor. The doctor "consults" and "prescribes" the medicines, which are "acquired" and "dropped" to the user like money is dropped from Automated Teller Machine (ATM). Further, it reduces the cost of visiting a doctor at the hospital/clinic at distant places and it also provides immediate access to doctors for patients and also a quick delivery of medicines.

Against Chronic obstructive pulmonary disease, a home health care system is introduced for improving personalized health care [6]. This system will alert the user when it finds the problem in measurement – over or below the threshold value. The problem associated here is the cost and usage of the device by the user. Since it is a personalized health care system, it cost bigger due to many individual's contributions. It required continuous monitoring to alert the user against any deviation from the standard value.

The patient's status is more critical in ICU (Intensive Care Unit) than patients in the normal room admitted condition. So it becomes important to detect the emergency in ICU for every patient. There is already an alarm system that will start alarm when the patient's state goes critical than the expected value. This method is based on SVM classification, but still, this results in false alarm most of the time. To overcome this, two new techniques are introduced in the machine learning algorithm such as LASVM, and I-SVM. I-SVM proved to be better than other stars of the art protocols used in the same scenario [7].

Traditionally doctors used to identify the pain level of patients on seeing the reactions on their faces. Based on the pain level, the disease prediction was done by doctors in the olden days. One of the research articles focused on identifying patterns on the patient's face and finding the probability of diseases before reacting on them [9]. The problem here is the major one, identifying or finding the probability of disease utilizing analyzing the patterns over patients face is very difficult.

Cardiac is one of the major diseases to deal with and researchers are also researching it. They had developed a machine learning-based portable device which can work by sensing the heart sound for a long duration. The data analysis takes place in this process to detect the abnormal situation and alert the patients over that [10]. This ECG signal is transmitted via Bluetooth/Wi-Fi/Zigbee module to the smart device with support software simulation where feature extraction and detection algorithm is set up for cardiovascular disease [11, 12]. The mechanism of human heart disease detection is shown in figure 6.

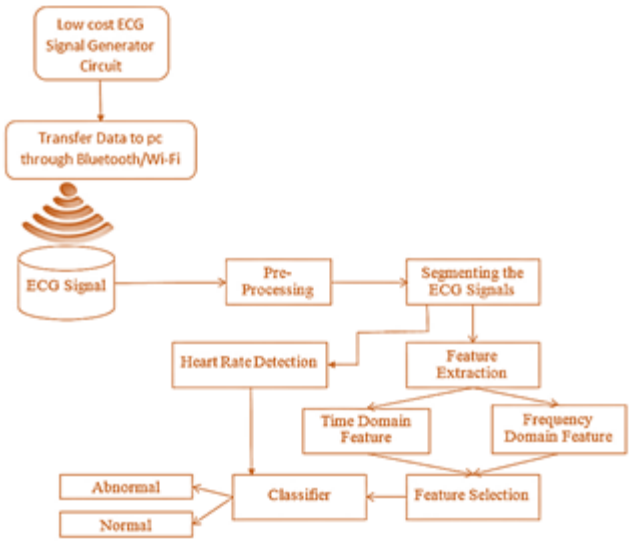

Fig. 6: Mechanism of Human Heart Disease Detection

The new diseases are difficult to predict by their symptoms, anyhow it can be matched out with the existing symptoms to figure out the relationship that it is having over health. In

this aspect, the symptoms are very important in disease identification. Table I shows the symptoms and disease relationship.

Table 1: Symptoms and Disease Relationship

SYMPTOMS	COLD	FLU	STOMACH FLU
Fever/Chills	Rare	Common	Low grade fever & chills common
Headache	Not Common	Common	Common
Body Aches	Slight	Severe	Common: stomach-ache & cramps
Runny, Stuffy Nose	Common	Runny Nose is Common	None
Sneezing	Common	Common	None
Sore Throat	Common	Common	None
Cough	Cough with Mucus	Often. Dry & Hacking Cough	None
Diarrhea/ Vomiting	None	Not Common. Occurs more often in children than adults	Moderate to severe, as well as moderate to severe nausea
Chest Discomfort	Mild to Moderate	Moderate to Severe	None
Fatigue	Mild	Moderate to Severe	Common

III. REQUIREMENTS OF AUTOMATED MEDICAL CARE MACHINE

The need for the automated medical care machine has been derived for today's world. Few needs are already achieved and most of the specified needs are not matched until now.

1. Providing medicine and prescriptions to patients through live video streaming via IoT.
2. Checking medicine expired data for providing medicine.
3. Finding the root cause of the disease.
4. Providing disease spread control alert.
5. Reducing disease spread frequency.
6. Providing suggestions for doctors regarding local medicines with previous results.
7. Providing the recursive feedback for the doctors
8. Classification of records with the filtering mechanism

The first two requirements are met by other authors [5], which can serve static behavior and assist treatment with live video streaming between doctors and patients.

IV. CONCLUSION

In the proposed work, the significance is to select the specific algorithm for the data set according to the nature of the data. In this survey, for the medical dataset, the best-fit algorithms for the current state-of-the-art in the domain can be a decision tree for disease prediction from the input symptoms, an iterative decision tree for recursive feedback or opinion analysis, SVM classification of individual patient's and doctor's record, map-reduce for overall mapping and filter process, random forecast technique for random prescription storage in datasets and finally polynomial smooth support vector machine for text extraction. The research papers are focusing a lot on medical care, and there is some improvement to be further improvised. The medical care machine still now is more static and not enough to treat patients. The technologies which are available now will provide support for dynamic behavior to a great extent but still, machine learning algorithms are not used up to the expected level of the medical care machines developed. The last six points of the requirements specified for the automated medical care machine provide the discussions made on machine learning algorithms and the aspect the improvisation can be done.

REFERENCES

[1]. Integrated Management of Childhood Illness (WHO, 35 Pages), assess and classify the sick child age 2 months up to 5 years. http://helid.digicollection.org/en/d/ Jwho53e/ 1.html

[2]. Sankar V, Krishna R, Reddy VK, Mahendiran NM, Hussain S, Parthasarathy R. Role of Pictograms in Educating Diabetic Patients about Medication use and Life Style Modifications. Indian Journal of Pharmacy Practice. 2015 Jul;8(3):103.

[3]. Badnjević A, Gurbeta L, Bošković D, Džemić Z. Medical devices in legal metrology. In2015 4th Mediterranean Conference on Embedded Computing (MECO) 2015 Jun 14 (pp. 365-367). IEEE.

[4]. Pavel M, Jimison HB, Wactlar HD, Hayes TL, Barkis W, Skapik J, Kaye J. The role of technology and engineering models in transforming healthcare. IEEE reviews in biomedical engineering. 2013;6:156-77.

[5]. Babitha, D., Jayasankar, T., Sriram, V.P., Sudhakar, S., Prakash, K.B. Analysis, Prediction Speech emotion recognition using state-of-art learning algorithms. International Journal of Advanced Trends in Computer Science and Engineering. 2020.

[6]. Yang G, Kong C, Xu Q. A Home Rehabilitation Comprehensive Care System for Patients with COPD Based on Comprehensive Care Pathway. In2018 IEEE Fourth International Conference on Big Data Computing Service and Applications (BigDataService) 2018 Mar 26 (pp. 161-168). IEEE.

[7]. Rejab FB, Nouira K, Trabelsi A. Incremental support vector machines for monitoring systems in intensive care unit. InScience and Information Conference (SAI), 2013 2013 Oct 7 (pp. 496-501). IEEE.

[8]. Sangavi RS, Reddy TS, Prabhu TM, Kumar AJ. AMM-an Automated Medical Machine enabling enhanced features for telemedicine using cloud computing. InInformation Communication and Embedded Systems (ICICES), 2013 International Conference on 2013 Feb 21 (pp. 125-129). IEEE.

[9]. Thevenot J, López MB, Hadid A. A survey on computer vision for assistive medical diagnosis from faces. IEEE journal of biomedical and health informatics. 2018 Sep;22(5):1497-511.

[10]. Bhattacharya A, Mishra M, Singh A, Dutta MK. Machine learning based portable device for detection of cardiac abnormality. InEmerging Trends in Computing and Communication Technologies (ICETCCT), International Conference on 2017 Nov 17 (pp. 1-4). IEEE.

[11]. Deb S, Islam SM, Robaiat Mou J, Islam MT. Design and implementation of low cost ECG monitoring system for the patient using smart device. InElectrical, Computer and Communication Engineering (ECCE), International Conference on 2017 Feb 16 (pp. 774-778). IEEE.

[12]. Alam ST, Hossain MM, Islam MK, Rahman MD. Towards Development of a Low Cost and Portable ECG Monitoring System for Ru-

ral/Remote Areas of Bangladesh. International Journal of Image, Graphics & Signal Processing. 2018 May 1;10(5).

[13]. H. Mohapatra et al., "An Efficient Energy Saving Scheme Through Sorting Technique for Wireless Sensor Network," International Journal of Emerging Trends in Engineering Research, vol. 8, no. 8, 2020.

[14]. Prasanna PL, Rao DR. A text mining research based on topic modeling using latent dritchlent allocation. International Journal of Recent Technologies in Engineering. 2019;7(5):308-17.

[15]. Li N, Zhao L, Chen AX, Meng QW, Zhang GF. A new heuristic of the decision tree induction. InMachine Learning and Cybernetics, 2009 International Conference on 2009 Jul 12 (Vol. 3, pp. 1659-1664). IEEE.

[16]. Kumar, Ranjan, Edalatpanah, SA, and Mohapatra, Hitesh. 'Note on "Optimal Path Selection Approach for Fuzzy Reliable Shortest Path Problem"'. 1 Jan. 2020: 1 – 4, DOI: 10.3233/JIFS-200923.

[17]. Vandana K, Reddy VC, Sudhir KM, Kumar K, Raju SH, Babu JN. Effectiveness of stevia as a mouthrinse among 12–15-year-old schoolchildren in Nellore district, Andhra Pradesh-A randomized controlled trial. Journal of Indian Society of Periodontology. 2017 Jan;21(1):37.

[18]. Bharadwaj YS, Rajaram P, Sriram VP, Sudhakar S, Prakash KB. Effective handwritten digit recognition using deep convolution neural network. International Journal of Advanced Trends in Computer Science and Engineering. 2020 Mar;9(2):1335-9.

[19]. Pawan YN, Prakash KB, Vadla PK. Patient health monitoring using soft computing techniques. InIOP Conference Series: Materials Science and Engineering 2020 Jun 1 (Vol. 872, No. 1, p. 012025). IOP Publishing.

[20]. Prakash KB, Imambi SS, Ismail M, Kumar TP, Pawan YN. Analysis, Prediction and Evaluation of COVID-19 Datasets using Machine Learning Algorithms. International Journal of Emerging Trends in Engineering Research. 2020 May;8(5).

[21]. Changala R, Rao DR. Development of Predictive Model for Medical Domains to Predict Chronic Diseases (Diabetes) using Machine Learning Algorithms and Classification Techniques. ARPN Journal of Engineering and Applied Sciences. March 2019.

[22]. Al-Rawi A, Lansari A, Bouslama F. A new non-recursive algorithm for binary search tree traversal. InElectronics, Circuits and Systems, 2003. ICECS 2003. Proceedings of the 2003 10th IEEE International Conference on 2003 Dec 14 (Vol. 2, pp. 770-773). IEEE.

[23]. Al-Furajh I, Aluru S, Goil S, Ranka S. Parallel construction of multidimensional binary search trees. IEEE Transactions on Parallel and Distributed Systems. 2000 Feb;11(2):136-48.

[24]. Desarkar A, Das A. Big-Data Analytics, Machine Learning Algorithms and Scalable/Parallel/Distributed Algorithms. InInternet of Things and Big Data Technologies for Next Generation Healthcare 2017 (pp. 159-197). Springer, Cham.

[25]. Chandy A. A review on iot based medical imaging technology for healthcare applications. Journal of Innovative Image Processing (JIIP). 2019;1(01):51-60.

[26]. Smys S, Chen JI. Special Section on Innovative Engineering Solutions for Future Health Care Informatics. Journal of Medical Imaging and Health Informatics. 2016 Nov 1;6(7):1570-1.

[27]. Balajee RM, Venkatesh K. A Survey on Machine Learning Algorithms and finding the best out there for the considered seven Medical Data Sets Scenario. Research Journal of Pharmacy and Technology. 2019;12(6):3059-62.