Secure deep learning model for disease prediction and diagnosis system in cloud based IoT

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Secure Deep Learning Model for Disease Prediction and Diagnosis System in Cloud Based IoT

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Abstract. In the past few decades, IoT (Internet of Things) based m-healthcare applications are arising to provide real time services in the fast world. These applications save people's lives by getting regular updates about health conditions of them for their easy lifestyle. Cloud based health care framework are provide better outcomes when compared to conventional methodologies. Nowadays Incorporating IoT devices in clinical environments plays major role in handling huge volume of medical data. Researchers thus sought to automate the process of detecting and diagnosis diseases using could computing technology. Accordingly, number of explores has been proposed an infection forecast and analysis framework in cloud based IoT utilizing distinctive secure ML (Machine Learning) calculations. This paper reviews the existing heart disease classification research frameworks with its pros and cons. Here, totally twenty-five papers are analyzed. In addition, this study gives an elaborate idea about disease prediction and diagnosis system.

Keywords: Heart disease, Internet of Things (IoT), machine learning, could computing, m-health

INTRODUCTION

Nowadays, well-being monitoring essentially increased with the trending advancements of IoT [1]. For emergency situations, patient investigations and to keep the patient analysis reports, numerous emergency clinics may utilize mobile applications amazingly [2]. To screen few health care measures such Blood sugar, pressure, ECG and other parameters, wearable gadgets are utilized like Smart ECG machine, Blood Glucose measuring device etc...[3].Developing intelligent gadgets in Well-being area has numerous benefits in terms of cost management. These smart gadgets considered as powerful tool to lessening the health care staff responsibilities and highly gives better understanding of patient's medical conditions. But the main issues with these gadgets for the above mentioned purpose is inter connectivity among them.

Enormous exploration works are developed to associate wise things via short range same as long range WC ("Wireless Communication") because standard wired transmission can't be pertinent for mobile applications [4]. For the learning and prediction of diseases in individuals, various ML ("Machine Learning") strategies are developed to improve the clinical outcomes [5]. Everyday these systems are really helpful in observing and learning the patient data constantly. Moreover, ML based wellbeing frameworks has best feature like little dimensions and light weight and which significantly monitors the patients with gadgets either in home or clinic. They can move unreservedly without meddling daily schedule, and the gathered data has communicated to clinical specialists to analyze the situation of patient [6]. So to overcome every one of these issues, healthcare Industry proposed a model utilizing the IoT where specialist and patient can communicate directly with each other utilizing their advanced mobile phone even when a specialist isn't available in Hospital [7]. What's more, the patient does not have to go to the hospital for their routine check-up. The prerequisite in the advancement of the human wellbeing and to give early notification to the old individuals is a definitive objective of mankind. IoT in medical services assists with changing emergency clinic driven situation to mostly home adjusted condition [8]. Individuals staying away from metropolitan urban areas need a respectable clinical benefit to take preventive measures against diabetics as well as hypertension conditions [9]. This IoT in health care are used to identify and determination in blood pressure screen,

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internal heat level was checking and oxygen immersion observing. Because of the shortfall of ability and standard method of clinical office prompts expanded disarrays in the way of life. Nonappearance of information in the wellbeing related parts hoist the intricacy [10].

LITERATURE SURVEY

Lot of researcher has been developed cloud based IOT to predict a disease and diagnosis process using soft computing approaches. Nowadays, cardiac issues, brain diseases, breast cancer, leukemia, thyroid disease and heart problems and some more diseases are using computer approaches for prediction and diagnosis. The sequence of process like healthcare, environment production, emergency responding, and traffic managing and also quality monitoring are done by neuro fuzzy system. To achieve medical requirements of the individuals in a medical field they need best medical resources, health care service, and delivering medical resources. Table 1 gives the existing frameworks with its advantages and disadvantages.

Kumar et al. [11] have presented a cloud IOT based tool to predict a disease and diagnose system for healthcare using "Fuzzy neural classifier". This work used the UCI repository database of diabetes disease and related health issues and also utilized sensors for predicting the people who having diabetes. With the help of records from varies hospitals and UCI repository dataset experiment was done.

An efficient "privacy-preserving disease prediction" method, called PPDP have developed by Zhang et al. [12]. This work stored the medical history of the patients, which can be used in future to train the prediction of the disease with the help of "Single-Layer Perceptron Learning algorithm". They predict the risk of the new coming disease with the help of prediction models data. This work builds on data encryption, learning the disease and disease prediction algorithm, this framework utilized a random matrices. The security analysis shows this work provides a required level of privacy. It also a low cost method while comparing with existing prediction schemes.

Vermaet al. [13] have presented a disease diagnosis healthcare framework using cloud-centric IoT. Key terms were defined to create user-oriented measuring by using the concept of computerized science. It also creates architectural prototype for smart student healthcare were designed for application scenario. The results were stored after processing the measurements in a specific context. This framework uses "UCI dataset" and sensors to different disease prediction to generate a student perspective health data. Different Diagnosis schemes were applied with help of classification algorithms and the outcomes were calculated based on parameters such as F-measure, accuracy and sensitivity.

Manogaranet al. [15] have investigated a heart disease diagnosis by introducing a framework called ANFIS (Adaptive Neuro-Fuzzy Inference System) which incorporates MKL (Multiple Kernel Learning). MKL the initial method compare parameters between heart disease patient and normal individuals. The result from the MKL method was taken as input to the ANFIS classifier to classify the heart disease with normal persons. Specificity and Mean Square Error (MSE), Sensitivity were achieved in the evaluation of MKL with ANFIS type.

Tuliet al. [16] have developed a framework called Health Fog which integrates the learning in Edge computing devices. It deals with the real time application of automatic Heart problem analysis. It delivers fog service using IoT and also effectively handles the heart patient'sdata. Fog-enabled cloud framework, the proposed framework consumes power, network bandwidth to deploy and test the performance. It also having good accuracy but little bit latency and execution time. HealthFog was configured with some other operation modes to create best quality of service.

Chen et al. [17] have implemented a disease prediction method by ML (Machine Learning). We conducted an experiment of modified prediction method by using the data collected from china central hospitals. They focused on the chronic disease which spread regionally. They proposed a new "conventional neural network" (CNN) - based multimodal risk prediction method using different types of data from hospitals called structural and non-structural data. This is only method of above focused on both types of data analytics.

Kaur et al. [18] have presented a big data and defines its role in healthcare. Big data architecture and texture are continuously helps in manage the expeditious data growth. It observed the importance of big data in healthcare. But

it fails in privacy and security of data. It overcome with a novel design of smart and secure healthcare information system using ML (Machine Learning) and latest security mechanism.

Lakshmanaprabuet al. [19] have presented a hybrid reasoning-based methodology on predicting diseases. The enlaced prediction results were formed with help of previous theories like fuzzy sety & k-nearest neighbor. Even having promising performance in healthcare& security DPSS faced crucial challenges. Further it extended as “Privacy-Aware Disease Prediction Support framework” with the help of paillier Homomorphic encryption. Keep the PDPSS, has improved the prediction accuracy and best security.

Asghari et al. [20] have introduced a monitoring framework for cloud-based IoT platform. In it patients medical conditions are derived through predicting disease are collected by psychological data through IoT devices. This model used to offer a composite prescription. After the conformation from the medical team, it sent to the patient. Then patients need to provide their location, cost and time to get composite medical service.

Noise et al. [21] have executed an alternate IoT-based ML components that are utilized in the referenced fields among others.ML strategies are expected to give unavoidable associations with remote hubs. The ML based IoT is a well-known network that supports communication among different gadgets without human co-operations. Likewise, the exercises learned are accounted for and the evaluations are investigated seeing the fundamental point ML procedures are relied upon to play in IoT frameworks.

Hussein et al. [23] main idea is to detect and predict MBD ("Mosquito Borne Diseases") and for this new framework is presented namely "fog-cloud based cyber-physical system". this diseases considered to be a dangerous irresistible illnesses those send rapidly through contaminated mosquitoes to human or starting with one tainted individual then onto the next, bringing about significant expansion in overall bleakness and death rate. The side effects are practically like each other which make it very hard to analyze the particular illness. Be that as it may, it is needed to analyze the patient for appropriate treatment and nonstop checking of tainted patients to control the contamination of MBDs. J48 DT classifier is utilized for the classification infection for every client. The alarms are quickly created and sent on clients versatile from fog layer if there should be an occurrence of any anomaly. "Radio Frequency Identification" is utilized to detect the nearness between clients. "Transient Network Analysis" is applied to screen and address the present status of the MBDs episode utilizing closeness information.

Hussein et al. [23] presented cloud based remote monitoring framework to observe the heart rate of the patient. This work utilized 2 data sets namely MIT Physionet and MIT-St. Petersburg. While the subsequent data set was gathered in the wake of checking 30 individuals who were approached to utilize these wearable sensors. The evaluation is done using the following parameters namely specificity (99.17%), accuracy (99.02%), sensitivity (98.78%). this proves this framework is highly robust, reliable. additionally, this framework ensures the security. Also, this created observing framework produced cautioning messages, coordinated towards the patients and the specialists, during some basic circumstance.

Gupta et al. [24] have presented intelligent framework to predict the heart disease via ensembling. Recently ML approaches mainly concentrating on prediction of heart diseases based on cloud computing. Henceforth, an endeavor has been settled on to propose a clever choice help model that can help clinical specialists in anticipating coronary illness dependent on the recorded information of patients. Different AI calculations have been executed on the coronary illness dataset to foresee precision for coronary illness.

Liu et al. [25] have introduced a structure called CloudDTH ("Cloud based Digital Twin Healthcare"). This is an extensible framework which uses wearable medical devices for the disease diagnosis, especially for elder ones. CloudDTH plans to accomplish communication and union between clinical physical and virtual spaces. Appropriately, a novel idea of advanced twin medical services was proposed and talked about, and a DTH model is executed. Then, a reference structure of CloudDTH dependent on DTH is built, and its key empowering advancements are investigated. At last, the practicality of some application situations and a contextual analysis for ongoing oversight are illustrated.

Arabasadi et al. [26] presented hybrid NN genetic algorithm for coronary illness identification. Cardiovascular sickness is perhaps the most widespread reasons for death all throughout the planet and was considered as a significant ailment in Middle and Old ages. Specifically, it is an inescapable cardiovascular disease involving high

death rates. Angiography is, viewed as the best strategy for the conclusion of coronary supply route infection; then again, it is related with significant expenses and significant results. Much exploration has, thusly, been led utilizing AI and information mining to look for elective modalities. This work propose high accuracy for coronary artery disease diagnosis.

Amin et al. [27] concentrated on cardiovascular disease diagnosis and prediction. This framework introduces prediction model by incorporating 7 classifiers namely SVM, NN, k-NN, DT, NB, LR and Vote. From the evaluation, this heart disease prediction model achieves high performance in terms of accuracy (87.4%).

Ali et al. [28] introduced "Type-2 fuzzy ontology–aided recommendation framework" to screen the diabetic patient's body while taking drugs and specific foods. This work separates the estimations of patient danger factors, significantly decides the patient's ailment with the help of wearable sensors, and afterward suggests diabetes-explicit solutions for a savvy medication box and nourishment for a brilliant cooler. This framework outcome shows, it gives better precision rate for food and drug suggestions hence provide high prediction accuracy.

Samuel et al. [29] introduced a methodology known to be Fuzzy_AHP ("Fuzzy analytic hierarchy process") which is a decision support system for the cardiac clinician. Here, based on their individual contribution, the global weights computed for the attributes. This framework utilizes ANN classifier for the prediction mechanism. Online clinical dataset of 297 HF patients were adopted for the evaluation and which is contrasted with traditional ANN technique.

Parthasarathy et al. [30] implemented a framework to monitor arthritis disease patients with help of time wrapping algorithm. This framework uses the patient's foot movement data for the arthritis diagnosis. Sensitivity and specificity parameters are calculated for the proposed algorithm and it shows better characterization for the arthritis disease.

Ali et al. [31] have diagnosed and predicted heart disease with the proposed framework called, "Optimally Configured &Improved Deep Belief Network" ("OCI-DBN"). The evaluation utilizes 6 parameters namely MCC ("Matthew's Correlation Coefficient"), precision, accuracy, specificity, F1 score as well as sensitivity. The outcomes are compared with the existing methodologies and assures that this framework provides better prediction results for heart disease prediction regards of accuracy of 94.61 %.

TABLE 1. Overall analysis of survey

Authors name	Proposed System	Algorithm	Types of Dataset	Disease Advantages	Limitations
Kumar *et al.* [11]	Disease Prediction & Diagnosis framework	FN – (Fuzzy Neural) Classifier	UCI Repository dataset	Diabetes disease	For the Effective decision making, the classification is done on time constrains
Zhang *et al*. [12]	An efficient disease prediction framework	SLP ("Single-Layer Perceptron")learning algorithm	Synthetic dataset	Breast Cancer & Heart Disease	This framework provides new idea for the disease prediction in individuals.
Verma *et al*. [13]	IoT based cloud centric Disease diagnosis framework	k-NN classificatio n algorithm	UCI data	Heredity disease	This provides better services for healthcare.
Manogaran *et al*. [14]	Smart Healthcare Monitoring system based on Big Data Ecosystem	Stochastic Gradient Descent for Logistic Regression	Cleveland Dataset	Heart disease	Calculation is done for CPU utilization and inter arrival time for the efficiency.

Authors name	Proposed System	Algorithm	Types of Dataset	Disease Advantages	Limitations
Manogaran *et al*. [15]	Heart disease diagnosis framework	MKL with ANFIS	KEGG Metabolic Reaction Network	Heart disease	Heart disease Classification done with less number of parameters.
Tuli *et al*. [16]	HealthFog model framework	Set Partitioning In Hierarchical Trees (SPIHT) algorithm	Cleveland Dataset	Heart disease	The advantage of reducing response time proposed system.
Chen *et al*. [17]	Early disease detection scheme	convolution al neural network (CNN)	Hospital datasets	Chronic disease	A convergence speed is faster for the disease prediction
Kaur *et al*. [18]	healthcare framework	Fuzzy logic controller (FLC)	Hospital datasets	Heart disease	This framework provides high precision rate.
Lakshmanaprab u *et al*. [19]	Disease Prediction framework	FLC	UCI data	Asthma & Diabetes, Alzheimer's disease	This frameTo diminish the intricacy and encryption standard for accomplishing better security on the CDS.
Asghari *et al*. [20]	The wellbeing clinical benefit organization model in cloud-based IoT stage	Fuzzy rule–based neural classifier	UCI data	Renal disease (Rd), hypertension (HTN), and heart disease (Hd)	The potential for creating sicknesses forecast framework in medical services headings.
Din *et al*. [21]	Prediction framework for Health care	Machine learning algorithms	RDF datasets	Airborne	ML for gadget security with nine applications, and AI in savvy lattices.
Sood *et al*. [22]	Fog cloud based digital actual framework for recognizing and distinguishing	Rapid Automatic Keyword Extraction (RAKE) algorithm	Cleveland Dataset	Mosquito borne diseases	To utilize the TNA for addressing every mosquito borne illness contaminated individual on the TNA chart
Hussein *et al*. [23]	A computerized distant cloud-based pulse changeability observing framework	Pan-Tompkins QRS detection algorithm	HRV data	Heart disease	To give a greater end-client nearness and greater geological appropriation also.
Gupta *et al.* [24]	Heart disease prediction framework	Naive Bayes (NB) algorithm	Cleveland Dataset	Heart disease	To lessen the quantity of passings from coronary illness.

Authors name	Proposed System	Algorithm	Types of Dataset	Disease Advantages	Limitations
Liu *et al.* [25]	Digital healthcare system	NN (Neural network)	Hospital datasets	Chronic diseases	The computerized twin gives a powerful method to tackle the bottleneck of data actual connection and combination.
Arabasadi *et al.* [26]	Heart disease detection framework	Neural network-Genetic algorithm	Clinical dataset	Heart disease	In particular, utilizing this technique, CAD can be identified without angiography which can help kill significant expenses and significant results.
Amin *et al*. [27]	Improve the exactness of anticipating cardiovascular illness is proposed framework	k-NN classification algorithm	Clinical dataset	Heart disease	To get a more extensive viewpoint on the huge highlights to improve the precision in expectation.
Ali *et al*. [28]	The proposed framework extricates the estimations of patient danger factors, decides the patients' ailment	Fuzzy logic controller	Clinical dataset	Chronic diseases	To utilize the SVM that is more successful to sift through unessential information.

Summary of the Survey

In this survey, totally 31 papers are analyzed. Each paper has been used different algorithm and different dataset. In this survey, we have analyzed, which algorithm they used, how much disease they classified, what are the limitation they attains and evaluation metrics are analyzed. Existing research works analysis are presented in table 1, some methods are given low computation complexity, accuracy, &some methods are not performs well for disease segmentation. Lot of classifiers are used for disease detection. Even though, some improvement is needed to classify human disease.

Figure 1 shows disease based survey. Here, various types of diseases are utilized namely, Arthritis, Airborne, Chronic, heart, etc. this paper considers totally 31 literatures, sixteen literatures are under heart disease, three literatures reports chronic disease, two literatures reports diabetes, one literature report airborne, one literatures report Arthritis disease and one literatures report mosquito borne disease. In figure 2 shows datasets based survey. The evaluated data sets are namely UCI, Cleveland, clinical etc. In figure 3, algorithms are analyzed. Here, fuzzy, and NN are mostly utilized algorithms. Figure 4 shows statistical analysis based survey for the prediction of disease as well as diagnosis. The “sensitivity, accuracy and specificity” of diseases prediction are analyzed for different methods (“Fuzzy, method”, “NN method”, “KNN, method” and other).

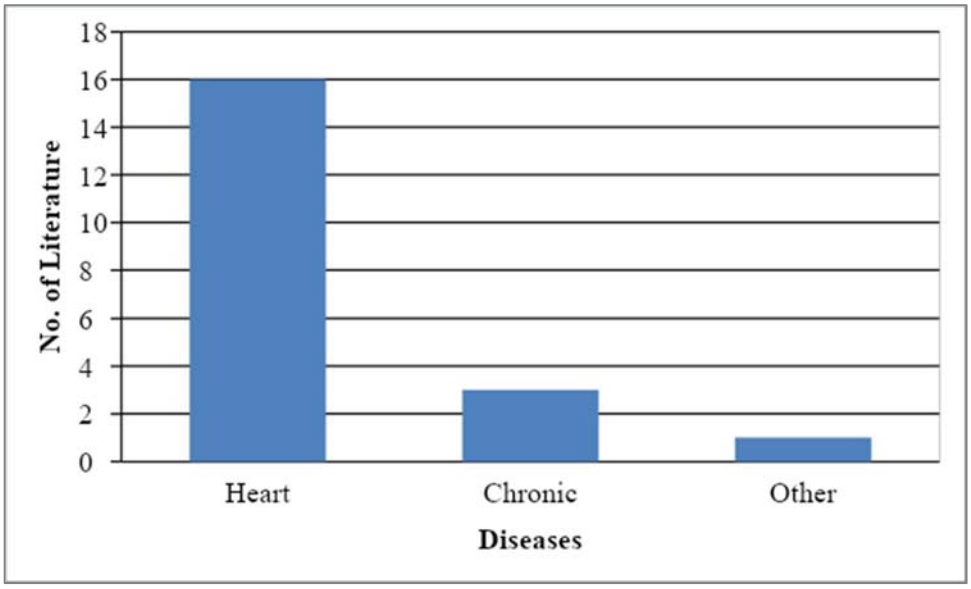

FIGURE 1. Diseases based survey

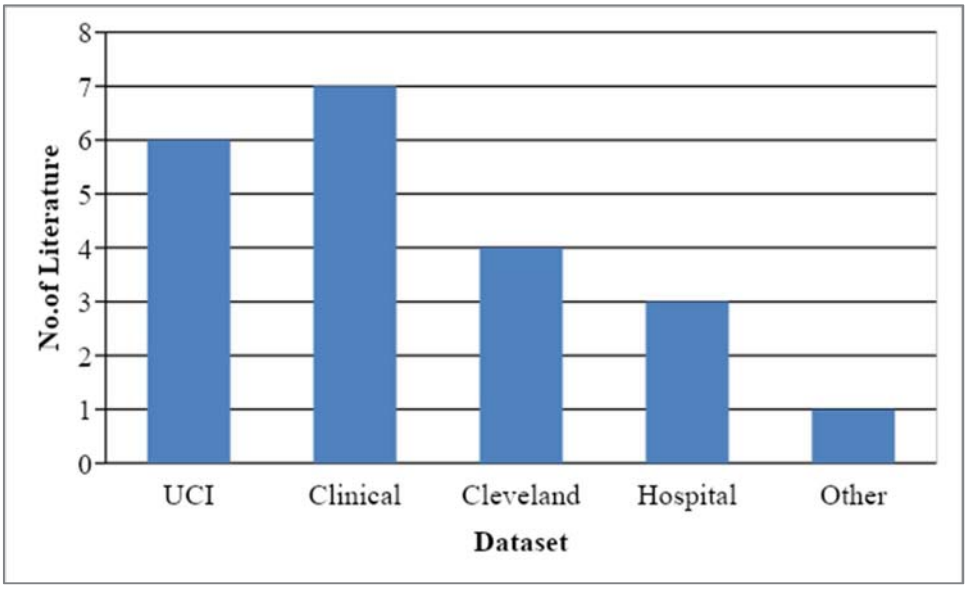

FIGURE 2. Dataset based survey

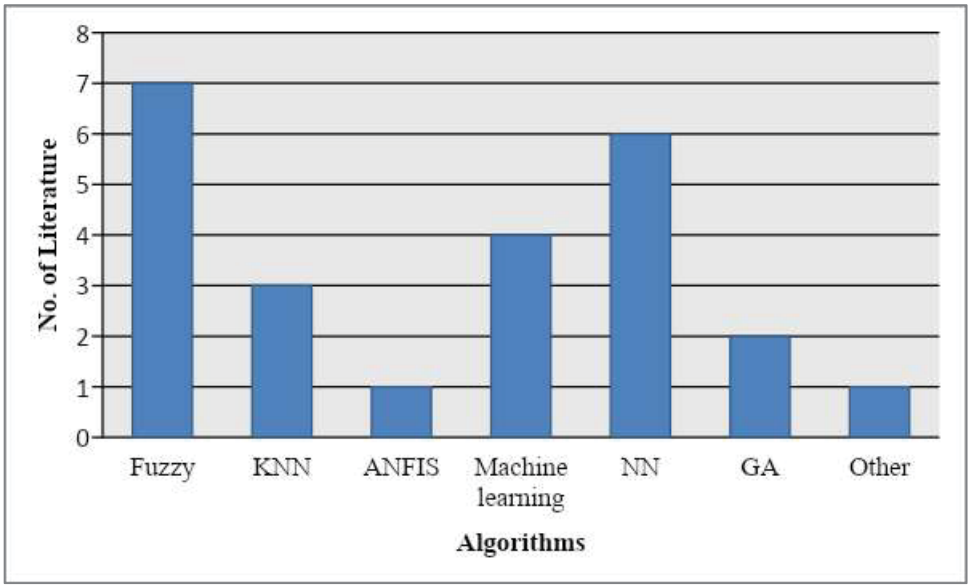

FIGURE 3. Algorithms based survey

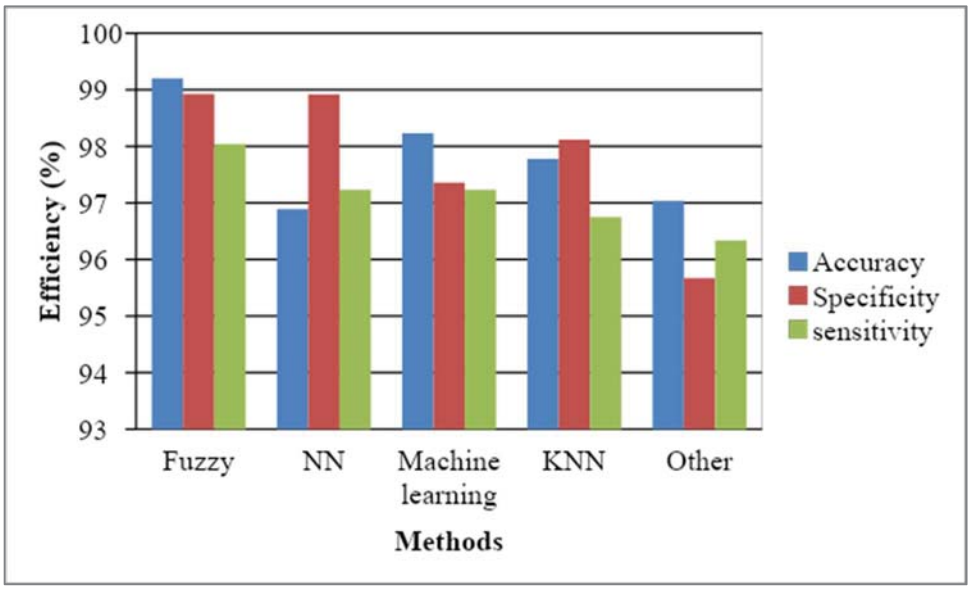

FIGURE 4. Statistical analysis based survey

CONCLUSION

The m-medical services framework plays very vital role to save individual wellbeing information. The cloud based medical care framework makes the individual wellbeing record more productive. For the big data storage, medical record uses healthcare clouds for the mobile patients and health care professionals. This review covers various approaches to predict the disease in early stage. In each work, proposed prediction methods, utilized data types, pros and cons are discussed in detail. The analysis done different datasets collected from real time environment. This survey helps to understand handling medical data in cloud.

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