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Health Care Patient Monitoring using IoT and Machine Learning

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Abstract: *Security and privacy is the most essential thing in Big Data environment, there are many algorithms have been proposed in existing approaches for data privacy as well as security. In many applications like Healthcare are banking applications having available data where third party attacker can easily access the privacy of victims. In Internet of Things (IoT) environment there is the major issue of data security. In this paper we proposed high dimensional Healthcare big data security as well as disease prediction using machine learning approach. Basically the system has categorized into two sections first we implement IoT based environment which generates the data of patient body. This section be used some wearable devices like ECG sensor, BP sensor temperature sensor heart rate sensor etc. Once data has generated from various sensors it will upload on cloud database. In the second phase we monitor the data which is generated by various sensors. Here we have generated Android base graphical user interface with monitors the data 24 by 7. Where machine learning algorithms are has used to predict the disease of patients. The authentication mechanism will achieve role based access control for specific users and proposed machine learning algorithms provides the patient disease probability according to given parameters. The experiment analysis has done based on the partial implementation of system which provide proposed system is more effective than some existing IoT systems*.**
Keywords: *Wearable sensors, healthcare, bigdata, cloud computing, authentication, security.*

I. Introduction

During recent years, rapid evolvement of healthcare services for providing wireless communication media between doctor and patient through wearable technologies which refers in "telemedicine". The artifact is to provide real-time monitoring of chronic illness such as heart failure, asthma, hypotension, hypertension etc. located far away from the medical facilities like rural area or a person out of health services for a change. In all such circumstances, heart disease becomes leading cause of death due to change in life style applicable for all age groups. Literature narrates approximately 2.8 billion people die because of heart problem due to overweight or obese which ultimately affects cholesterol level, ups and down of blood pressure and more importantly influence of stress hormones on ultimate heart conditions. In much of wearable technologies common parameters of heart functioning like BP, blood glucose level, blood oxygen saturation, ECG etc. were analyzed. In accordance with all these, need of hormonal imbalance due to stress factor i.e. mood of the person (mental health status) and impact of good / bad cholesterol is also deliberated in detail.

Basically, the wearable devices accessible within the market embrace smart watches and bracelets, wearable sleep aid devices, etc. because of tremendous advancement in recent years in wearable techniques, these devices square measure loosely accepted within the market by the customers. the info generated from the wearable devices has high rate and thence, it must be hold on and handled carefully at the cloud central information server The wearable sensors live varied physiological information together with electromyography, cardiogram, vital sign, heart rate, vital sign, blood vessel saturation, etc. The advances in wireless communication technology have conquered most of the temporal, geographical likewise as structure barriers to ease a completely roaming means of transferring medical information and documentations to the involved authorities. In this work, a state of affairs within the Cloud of Things central for a sensible medical tending system is taken into account, wherever a collection of wearable device nodes area unit embedded.

II. Literature Survey

According to de Carvalho Junior et.al. [1] authors had presented the feasibility study and the progress of heart disease classification embedded system. It provides a time diminution on electrocardiogram – ECG signal which can be practiced by decreasing the amount of data samples, without any significant loss. The objective of the urbanized system is the study of heart signals. The ECG signals are subjected onto the system that executes a preliminary filtering, and then utilizes a Gustafson–Kessel fuzzy clustering algorithm in order to exert for signal organization and correlation. The classification denotes usual heart diseases such as angina, myocardial infarction and coronary artery diseases. The system could also be used sudden "on duty" physicians, of any area of expertise, and could afford the first, or initial diagnose of any cardiopathy. If any system detects a

heart problem, this system endows with better disease diagnose PPV evaluated to other testimonies, and therefore it tenders elevated assurance than other methods. Another foremost contemplation is the reality that this system was analogous to many other systems by accessing full data set, and this system exercised fuzzy clustering algorithm in order to diminish the data set, thus mitigating its use.

According to de Mirmozaffari Junior et.al Data mining [2], as a resolution to haul out hidden pattern from the scientific dataset is projected to a database in this research. The database consists of 209 occurrences and 8 attributes. The system was employed in WEKA and MATLAB software and prophecy accuracy within Apriori algorithm in just 3 steps, are compared. MATLAB is pioneer as better performance software. Wide ranges of Apriori algorithms‟ sturdy system in data mining were evaluated to predict heart disease. A sole model consisting of one filter and appraisal methods are evolved. Three strong rules, as well as different estimation methods, are applied to find the superior software. Apriori rules are measured concerning their actual number of support, better accuracy, and considering strong rules. The high-performance software was introduced. The experiment can serve as a realistic tool for physicians to in effect predict uncertain cases and recommends consequently.

According to [3] presented a proficient advance for the forecast of heart attack from the heart disease database. Initially, the heart disease database is huddled using the K-means clustering algorithm, which will extort the data appropriate to heart attack from the database. This approach permits expertise the number of fragments through its k parameter. Consequently the frequent patterns are excavated from the extracted data, relevant to heart disease, using the MAFIA (Maximal Frequent Item set Algorithm) algorithm. The machine learning algorithm is modeled with the selected major patterns for the effectual prediction of heart attack. They have engaged the ID3 algorithm as the training algorithm to prove level of heart attack with the decision tree. The results showed that the designed prediction system is competent of forecasting the heart attack effectively.

According to [4] authors described about a prototype using data mining techniques mainly Naïve Bayes and WAC (Weighted Associated Classifier). The dataset is composed of important factors such as age, sex, diabetic, height, weight, blood pressure, cholesterol, fasting blood sugar, hypertension, disease. The system indicates whether patient had a risk of heart disease or not.

According to [5], authors proposed confidential scheme for predicting heart disease using two different models, Naive Bayes and Logistic Regression. As identified through survey, it is a need to have combinational approach to increase the accuracy of prediction for heart disease.

According to [6] authors proposed that, heart disease is one of the major causes of demise in the region of the world and it is essential to forecast the disease at a precipitate phase. The computer aided systems assists the doctor as a gizmo for forecasting and establishing heart disease. The intention of this paper is to extend about Heart related cardiovascular disease and to brief about accessible decision support systems for the computation and study of heart disease continued by data mining and hybrid intelligent techniques. Many DSS remains to predict the heart disease with several methodologies. The World life expectation statistics involve that heart disease has extended more in number. So it is essential to construct an efficient intelligent trusted automated system which predicts the heart disease precisely based on the symptoms according to gender/age and province knowledge of experts in the field at the lowest cost.

According to [7] explicate that figures reveal that a heart disease is one of the foremost factors behind deaths throughout the world. Data mining techniques are pretty effectual in manipulative scientific support systems and having the capability to determine hidden patterns and relationships in medical data. Till now, Data mining classification techniques is applied to examine the various kinds of heart based problems. This paper is intended at mounting a heart disease prediction system using data mining clustering methods. This paper crews the various clustering techniques, k-mean, EM and the farthest first algorithm for the prophecy of heart disease. End result proves that farthest first clustering algorithm is the finest algorithm as evaluate to other algorithms. Since the ratio of correctly classified occurrences to the cluster is highest and the time taken to construct the model is minimum. This system can be further extended. More number of input attributes can be used and it can be further expanded by escalating the no. of the clusters. The same experiment can also be performed on other data mining tool such as R. And also the ensemble of classifiers can also be done to estimate their performance with the unique classifiers. Above algorithms can be subjected to other datasets in order to scrutinize whether the identical algorithm gives the highest precision or not.

Authors in this paper [8] proposed the incorporation of accessing a clustering approach and regression methodology. The clustering approach used is DBSCAN and for regression, multiclass logistic regression is subjected. By executing DBSCAN clustering algorithm, the entire dataset is fragmented into disjoint clusters. Resulted clusters were found to enclose fewer occurrences are then taken for consideration .These clusters are focused to multiclass logistic regression. This result is due to the clustering approach acquired by an unsupervised process. Once regression is achieved, we have accomplished at a termination, about actual variety of cardiac arrhythmia it is. The projected method accomplishes an overall accuracy of 80%, when evaluated with various other existing approaches. It projects a method for the prophecy of type of cardiac arrhythmia by

assembling the use of DBSCAN clustering and multi class logistic regression algorithms. By balancing PCACRA with other methods, this method is found to be 80% accurate.

Banu et.al.proposed [9] intends that large data existing from medical diagnosis is scrutinized by means of data mining tools and valuable information known as knowledge is hauling out. Mining is a method of investigating colossal sets of data to acquire the patterns which are hidden and formerly unknown associations and knowledge detection to facilitate the enhanced understanding of medical data to thwart heart disease. There are several DM techniques available namely Classification techniques concerning Naïve bayes (NB), Decision tree (DT), Neural network (NN), Genetic algorithm (GA), Artificial intelligence (AI) and Clustering algorithms like KNN, and Support vector machine (SVM). Numerous studies have been conceded out for mounting prophecy model by accessing entity technique and also by coalescing two or more techniques. This paper offers a rapid and simple evaluation and perceptive of obtainable prophecy models by means of data mining from 2004 to 2016. In this paper, a survey conducted from 2004 to 2015 gives the scheme of various models obtainable and the various data mining methodologies used. The exactness gained with these models is also specified. It is pragmatic that all the techniques accessible have not use big data analytics. Exploiting of big data analytics along with data mining will offer talented results to get the finest precision in manipulating the prophecy model.
Mane, Tejaswini U proposed [10] recommends that heart disease is one of the diseases due to that fatality will occur mostly, and according to the world health organization the percentage is high for that. So Heart disease is determined for the big Data approach, and as Big Data is measured so use Hadoop Map diminish platform. For clustering improved K-Means and for the classification principle decision tree algorithm i.e. ID3 can be accessed in the hybrid approach. As second estimation is too better, the system is very helpful for the facilitating the forecast methods, based on the some restrictions like chest pain, cholesterol, age, resting Bp, Thalac and many more. Due to this system medical decision making will be enhanced as well as being rapid. It's also will impact on the humanizing the treatment process. In such way it will be very helpful in the prophecy of the heart disease. In such way authors had cultured about the big data and its properties, with its disputes and concerns. In the medical field the various parameters individuals are affecting to the heart. Improved K-Means is the algorithm which is viewing the precision in the centroid assortment more than the simple K-Means.

III. Proposed System Overview

In our proposed system there are two phases training as well as testing modules, in training system first creates the rules or policies .

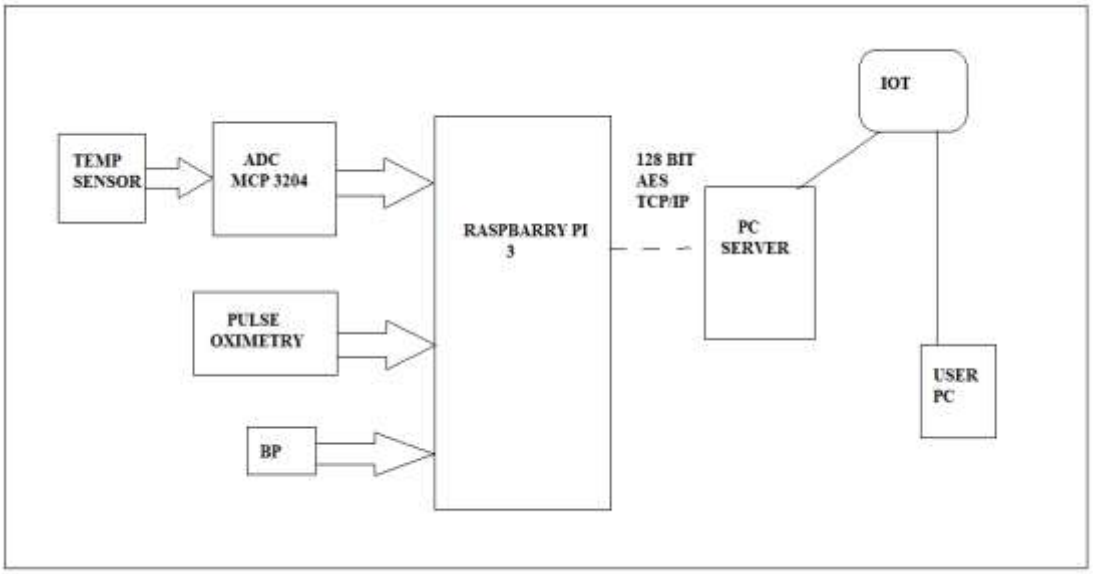

Figure 1: Proposed system architecture

Fig. 1 The patients having sensors attached to their body and the other end of the sensors is attached with Raspberry Pi. The information procured by sensors is kept in the Raspberry pi B+. The information esteems (i.e. Biometric information) are appeared on LCD show and in the meantime if the qualities surpass the typical range, the alert triggers. The qualities put away are sent to server with the support of GSM. Every qualities are put away on the server and the latest esteem is shown on webpage. The specialist alongside their login accreditations can login and see the patient information. Specialists can see every single past record of a patient

and recommend solutions and changes in remedy. Likewise, patients are given one of a kind client id and watchword to see their records. The outline of the framework is separated into two sections:

Hardware components and software components:

A. Hardware components

1) Temperature sensor (LM35): It is a sensor used to quantify temperature. The LM35 series are exactness incorporated circuit temperature sensors, whose yield voltage is directly corresponding to the Celsius (Centi-grade) temperature. It gauges temperature more pre-cisely than indoor regulators. It is fixed and does not experience oxidation. It doesn't require yield voltage to be amplified.
2) ECG sensor: ECG electrode attached to the chest to pick up ECG signals. At that point wires are associated with AD8232. This sensor is a savvy board used to quantify the electrical action of the heart. ECGs can be amazingly loud, the AD8232 Single Lead Heart Rate Monitor goes about as an operation amp to help get a reasonable flag from the PR and QT Intervals effortlessly.
3) Heart Rate sensor: The sensor gives the advanced yield of warmth beat when a finger is put on it. At the point when the sensor sensing something, the LED flashes as one with beat. This is generated in Beats per Minute (BPM) rate.

Raspberry Pi: The Raspberry Pi is a minimal effort, credit-card size PC that attachments into a PC screen or TV, and utilizations a standard console and mouse. The Raspberry Pi Model B+ has dual core ARM11 processor with 512MB SDRAM and powers through Micro USB socket of 5V. Sensors are attached with the Raspberry Pi Model B+. Raspberry Pi sends the data to servers through GSM module.

5) GSM module: It requires a SIM (Subscriber Identity Module) card simply like cell phones to enact correspondence with the system. The usage of GSM to send health data to webpage. This enables patient to leave the healing center yet at the same time he needs to remain in some known spots to guarantee the capacity to contact him in crisis cases. Indeed, even with this arrangement the patient can't move uninhibitedly and be a long way from his home.
6) Max232: The MAX232 IC is utilized to change over the TTL/CMOS logic levels to RS232 logic levels amid serial communication of microcontrollers with PC. This makes it difficult to set up an immediate connection between them to communicate with each other. The middle of the road connect is given through MAX232. Low Supply Current 8 mA.

IV. Algorithms Design

Algorithm 1 : Naïve Bayes

Input: User input file data record which contains all body parameters sensor values, Patient id Pid, Timestamp T.

Output: Classified label

Step 1: Read R {All attributes} from current parameters.

Step 2: Map with train features with each sample.

Step 3 :calculate average weight of train DB with same evidences

$$\mathbf{AvgTScore} = \sum_{\mathbf{k=0}}^{\mathbf{n}} (\mathbf{Sc})$$

Step 4 :evaluate AvgTScore> threshold

Step 5: ReturnAvgTScore

Algorithm 2 :Q- Learning Algorithm

Input: inp[1…..n] all input parameters which is generated by sensors, Threshold group TMin[1…n] and TMax[1…n] for all sensor, Desired Threshold Th.

Output: Trigger executed for output device as lable.

Step 1 : Read all records from database (R into DB)

Step 2: Parts [] ← Split(R)

$$\mathrm{CVal} = \sum_{k=0}^{n} \mathbf{Parts[k]}$$

Step 3:

Step 4: check (Cval with Respective threshold of TMin[1…n] and TMax[1…n] **)**

Step 5: T← get current state with timestamp

Step 6 : if(T.time> Defined Time)

Read all measure of for penalty TP and reward FN

Else continue. Tot++

Step 7: calculate penalty score = (TP *100 / Tot)

Step 8 : if (score >= Th)
Generate event
end for

V. Results and Discussions

The result analysis is the final phase of research which includes Experiments, results obtained and its analysis and discussions to come to conclusion. The research is conducted by conducting different experiments to check the efficiency of proposed algorithm in terms of various parameters like Size of dataset, Type of dataset, different input of algorithms. In above experiment we have collected the data from various health care sources, and partial experiment analysis has done for a proposed system. We have stored whole healthcare data on cloud platform which is generated from IoT environment. Basically we have design the propose system UI on mobile application where user can easily access or get the information of patients within a single click. The system prefer the authentication for user using cloud virtual machine the below figure 1 shows the performance evaluation of proposed system with some existing algorithms. Various machine algorithms has done to predict the disease as well as patient body status according to normal, abnormal, disease etc..

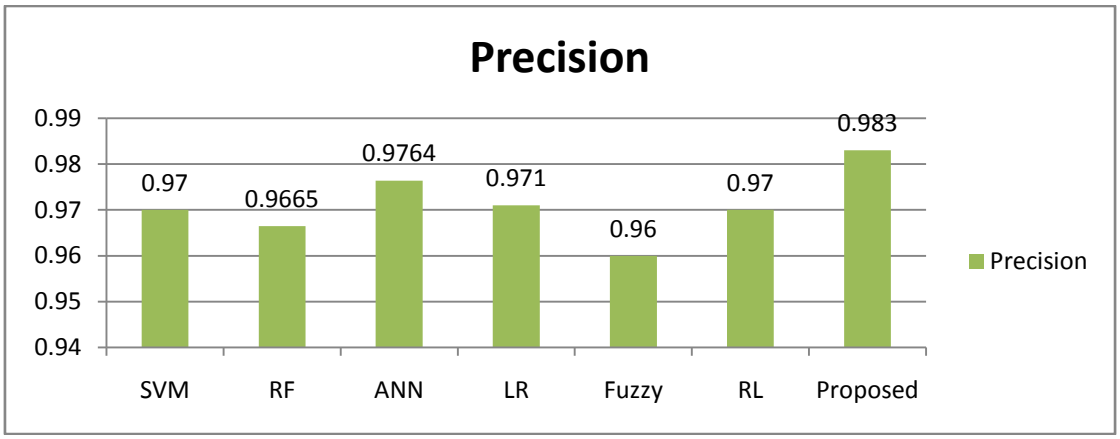

Figure 1:Performance evaluation of proposed systemvs existing systems

The above figure 1 shows the performance evaluation of system, overall analysis shows each attack type of system. This prediction system provides better results than existing approaches.The proposed framework has conveyed with various java and in addition Mobile base android platform. Beneath figure demonstrates that the recognize component really builds information loss for the ECG sensor (it could be helpful for bring down information rate sensors), while pressure emphatically expands the quantity of ECG gadgets that can be all the while utilized for a given packet loss rate.

VI. Conclusion

In traditional approach what we found is most of the tests are invasive which gives irritation to the patients and this makes disappointment or carelessness towards their health. It's very impossible for them to manage with such conditions. Hence aim of this research is to provide them platform where each needy patient will get their vitals with proposed non-invasive approach. In this scenario, patient can get in touch with the doctor 24X7 with internet technology and alerted in case of emergency situations the implementation of machine learning algorithm provides the efficiency to the system, the system has implement on various health care dataset. it is important to give constant health monitoring administration at home. The important objective is to build up a perfect patient monitoring system with the goal that the health-care specialists can observe the patients, who are in the hospital or executing their ordinary everyday work life. As of late, the patient monitoring systems is the real progressions due to its enhanced innovation. This framework estimates patient's parameters (Temperature, ECG, Heart rate etc.) using 3 distinctive available sensors. These sensors gathered information i.e. bio-metric data is given to raspberry pi and afterward it is exchanged to server

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