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SMART E-HEALTH CARE USING IOT AND MACHINE LEARNING

Sunil S. Sonawane[1] ,Prof.Sunil Rathod[2]

Dr. D.Y. Patil School of Engineering & Technology, Charholi(BK), Lohegaon Pune, Maharashtra.[1,2]

Abstract: Advances in information and communication technologies have led to the emergence of Internet of Things (IoT). In the modern health care environment, the usage of IoT technologies brings convenience to physicians and patients since they are applied to various medical areas (such as real-time monitoring, patient information and healthcare management). The body sensor network (BSN) technology is one of the core technologies of IoT developments in healthcare system, where a patient can be monitored using a collection of tiny-powered and lightweight wireless sensor nodes. However, development of this new technology in healthcare applications without considering data security risks makes patient privacy vulnerable. In this project all these aspects are covered to implement smart and secured healthcare monitoring system. At first, an IoT based healthcare monitoring system is proposed using various body sensor networks. In next stage, various Machine learning algorithms are used for disease prediction based on the input parameters received from the sensor network. In the last stage, a necessity of secured IoT system is highlighted and a solution is proposed for the same.

Keywords—*BSN, IoT, Machine Learning, Heart Disease, Data Privacy*

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I INTRODUCTION

During recent years, there has been 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, etc. were analyzed. Also, diabetes is becoming a fatal threat now a days. 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.

II LITERATURE SURVEY

Doubtlessly that stress can apply genuine physiologic impacts on the body—including the heart. This is most valid on account of serious and sudden (intense) push [2,3]. A portion of these unpleasant reactions can prompt endocrine issue like Graves' illness, gonadal brokenness, psychosexual dwarfism and obesity. Numerous author referenced that reasoning about stressful events, notwithstanding encountering them straight forwardly, can delay BP recuperation [2]. In [3], author have structured and manufactured a stress sensor dependent on Galvanic Skin Response (GSR) and controlled by ZigBee. In [4] author connected relationship investigation to discover measurably huge highlights related with pressure and utilized machine learning to group whether the members were stressed or not.

Static patient monitoring systems using IOT devices

The mobile health-care implementation with Internet of Things (IoT) gives the different dimensionality and the on-line facilities. With IoT innovation and the associated gadgets which are utilized in medicinal field, reinforced the different highlights of these m-healthcare. The vast volume of huge information is produced by IoT gadgets in m-healthcare condition [106, 107, 108]. Distributed computing innovation is utilized to deal with the

huge volume of information and furthermore give the convenience. In this situation, a Distributed application comes in picture in this fast-growing world. These therapeutic applications are likewise utilized the Cloud Computing innovation for secured storage and availability. To give better result to the general population over the web applications, many authors suggest Cloud and IoT based m-healthcare for observing and diagnosing the genuine sicknesses.

Survey on IoT solutions applied to Healthcare [5]:

IoT presents apparatuses for engaging working regions, for example, health, construction, logistics, security, farming and condition. Author present an extensive overview of IoT advances, techniques, insights and achievement cases related to healthcare services. Author additionally considered the efforts given in this area on the Colombian setting, counting fruitful applications and current undertakings.

The objective is to feature applications, studies, insights and items that are taken from the healthcare IoT technology segment. To this reason, paper pursued the procedure introduced by [6] and [7], in which the whole IoT segment connected to healthcare has been masterminded into five classifications and three sub-classifications that enable us to distinguish potential patterns. The aftereffects of this study gives a more extensive perspective of the best applications and strategies utilized inside the healthcare services.

For this undertaking, a cloud-based framework is created, utilizing Microsoft Azure suite, and a mobile application to coordinate 3 wearables to remote measure the indispensable signs from the patient on assigned hours. This enhances the time administration, expands the measure of estimations done and diminishes the costs related to the estimation strategies. Likewise, this sort of framework permit to expand the limit of the wellbeing program without expecting to contribute on repeating costs and abatements the measure of work related to every expert.

The paper is being created from 3 fronts, the 1st, deals with the recognizable proof and association of the wearables, the application creation and cloud back-end. The 2nd one is the patient administration and morals endorsement to manage the health of any victim, ensuring that the framework won't create any hazard to the victim. The 3rd front is used as the patient trail to approve the framework uprightness and relevance on a genuine test. In this, author have considered three wearables, that measure pulse, respiration rate, skin temperature, circulatory strain and oxygen immersion.

The created application is intended to have various purposes, it services as a collecting end of the considerable number of information, is an apparatus to discuss the medicinal staff with the patient. This application additionally, assemble quantitative and subjective data on the health of the patients and have essential data related to their medicines, for example, treatments and signs of health changes that could mean an alert.

Security & Privacy Challenges in IoT-based Health Cloud [8]:

Electronic Patient Health Information (EPHI) is viewed as private for patients and medicinal services suppliers. Innovation increasing speed in a few spaces including inserted sensors, distributed computing and IoT encourage the therapeutic services and give quick and constant correspondence. But, various Wellbeing data security and protection challenges emerge [9]. For this, author talk about and study security and protection issues occur in healthcare services. Authors likewise distinguish some consistence necessities and conceivable infringement and their effect on the IoT wellbeing cloud.

The utilization of cloud for document sharing among restorative staff could present protection dangers and rebelliousness issues to medical suppliers. Truth be told, the quantity of digital assaults influencing the IoT system community is expanding. New methodologies are expected to ensure IoT gadgets, IoT applications, and EPHI. The specialized arrangements need novel research in checking human conduct, interruption identification, and information examination for security knowledge. Moreover, the investigation of differential security [10] for IoT wellbeing cloud may give a method to ensure the protection of patient wellbeing data in the cloud. But, specialized arrangements alone can't settle the issue.

The security issues in IoT-based wellbeing cloud are multi-faceted: digital security strategies, protections appropriate for cloud, human elements, insider dangers, lawful oversight and locales, and so on. Multidisciplinary explore is the answer for this kind of issue where computer researcher, psychologist, business analyst, frameworks examiner, also, programming architects can team up to giving imaginative research tending to various features of the issue.

Multi-agent-based e-health system [11]:

The paper suggests the plan of a smart incorporated framework for sending and handling customized restorative information and putting away them in the cloud as per modern norms. A mobile hardware segment will be utilized, that includes an arrangement of medicinal sensors like

tonometer, EKG, beat oximetry, temperature, accelerometer, respiratory rate, electromyography, GPS etc. and can serialize all in the standard HL7 pattern and send with the help of a web association such as 2G, 3G, 4G, wi-fi etc. to the cloud server. The hardware will permit the patient or somebody who is assisting the patient to initiating sound/video streams to the therapeutic work force.

The objective of this work is to use IoT and multi-operator frameworks and structure the design of a smart framework that sends, forms therapeutic information and settles on choices dependent on it. It includes a mobile equipment part with different sensors that can gather information from a person and a server side that integrate the information and presents it to the applicable restorative specialist.

The presented method will enable the restorative framework to assemble information in standard arrangement and the smart framework will have the capacity to bunch the information with the end goal to identify different episodes like mass accidents, infection spread, fire occurrences, and so on. The mobile customer means to be a setting mindful framework following the suggestions [12]. The following stage is to locate a superior method to process information in the cloud so the therapeutic faculty that utilizes the dashboard web application will be alarmed at the earliest with exact information about risks.

The proposed framework is versatile, so it will enable us to include or change business rationale with no major rebuild. The picked technologies are open-source and cross stage, so they will be effectively coordinated in the vast majority of the current equipment frameworks and working frameworks. The goal of the task is to identify mass accidents and risks and to choose what number of resources to dispense such as what number of emergency vehicle vehicles to send, what number of restorative faculty and so on.

IoT-Cloud based framework for patient's data collection in smart healthcare system using Raspberry-pi [13]:

The ascent of the Internet of things has possibly lifesaving application inside the human services industry by gathering information from different gadgets, seeing patient data and diagnosing continuously. By utilizing IoT innovation in medicinal services, it not just gives advantages to doctors and administrators to get to wide scopes of information sources yet additionally challenges in getting to heterogeneous IoT information, particularly in mobile network area of constant IoT application frameworks. Authors propose an edge work for IoT cloud-based healthcare framework to address the difficulties and concerns identified with healthcare observing using Internet of things which are not investigated.

In this study, author suggested a model that enables the sensor to screen the patient's side effect. The gathered information send to the passage by means of Bluetooth and after that to the cloud server through docker holder utilizing the web. A processor that is incredible to gather and process information at the same time is integrated. Sensor provides good resources, for example, the memory, CPU, and system transfer speed on interest for quicker administration of the information broadly by an assortment of interfaces, like, PC, TV, and cell phone. Along these, empowering the doctor to analyse and screen medical issues wherever the patient is at that time. Additionally, the paper points out the few difficulties identified with wellbeing checking and administration utilizing IoT.

The proposed method depends on how information is incorporated with IoT based medicinal services framework utilizing a raspberry pi and docker compartment. Raspberry Pi gathers and saves the restorative information through the sensors connected. The captured information can be exchanged to the client through mobile applications [14]. The data presented through applications enhances the wellbeing of the patients. Given below are the component of the suggested framework:

(I) The long-time health monitoring status whenever and wherever,

(II) It can encourage constructing a smart, financially savvy and adaptable information driven pervasive health benefit framework.

Health Monitoring and Management Using Internet-of-Things (IoT) Sensing with Cloud-based Processing: Opportunities and Challenges [15]:

Among the array of uses vested by the Internet of Things (IoT), smart and associated healthcare is specifically indispensable one. Organized sensors, either worn on the body or implanted in our living surroundings, make conceivable the collection of rich data characteristic of our physical and emotional well-being. Caught on a persistently, collected, and adequately mined, such data can achieve a positive transformative change in the health services scenario. Specifically, the accessibility of information up to this point at huge scales and wide longitudes combined with state of art smart algorithms can:(a) encourage huge growth in the routine medical practice, from current post facto analyse and treat responsive pattern, to a proactive structure for visualization of illnesses at a nascent stage, combined with counteractive action, fix, also, in general administration of health (b) empower personalization of

treatment and administration alternatives focused on especially to the particular conditions and needs of the individual, and (c) help diminish the expense of medicinal costs while enhanced results. In this paper, author proposes the chances and difficulties for IoT in understanding this vision of things to come for health services.

The author analyses the current state and anticipated future bearings of remote health care observing advancements into the clinical routine with regards to current medication framework. Wearable sensors, especially those outfitted with IoT, offer alluring alternatives for empowering inspection and recording of information in home and workplaces, over longer lengths than are presently done at office and research facility visits. This asset of information, when broke down and introduced to doctors in simple to-acclimatize perceptions has the potential for fundamentally enhancing medicinal services and diminishing expenses. Author featured a few of the difficulties in detecting, examination, and representation which should be concentrated upon before frameworks can be consumed seamlessly for consistent incorporation into clinical practice.

An IoT-inspired Cloud-based Web Service Architecture for e-Health Applications [16]

E-Health administrations can exploit the innovative accomplishments in the territory of the Internet of Things (IoT), what's more, of the cost decrease and expanding ease of use of wellbeing checking gadgets. Homes furnished with natural sensors, physiological parameters checking gadgets, and home mechanization gadgets, could turn into the "equipment" of a "working framework" for application designers and administration suppliers. The framework would uncover web benefits through a one of a kind cloud framework for clients' information accumulation and capacity, organization and charging, and human services benefit provisioning applications by perhaps numerous outsiders.

III PROPOSED SYSTEM DESIGN

First system collect the current input states from each sensors, then convert it from Analog to digital using ADC, once conversion has done, it will received by microcontroller, and at the same time it has stored into the database. The runtime monitoring system parallels real all events from database and show it to Graphical User Interface (GUI) then proposed machine Learning algorithm has works in the middle ware of system, It will always check all input values from desired threshold, if any time values shows below minimum support as well as maximum resistance, then it will automatically executes the output appliances. At the same time system measure the activity state of dangerous level, system also measure the time count of specific state, and whenever it cross the time scenario, it will execute the buzzer as well as GPS messaging system.

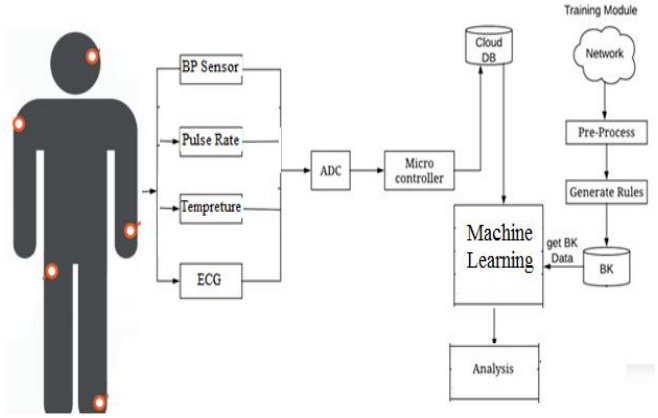

Figure 1 : Proposed System Architecture

Mainly proposed method has separated into two different phases, training and testing.

Training

1. Gather information from internet similar to artificial information also actual time tolerant audit information.
2. Concern information withdrawal approach like information pre-processing, information clean-up, information acquisition, outlier discovery also information alteration.
3. Some time ago total these phase information has keep into the record called as backdrop information, which is use at the time of time testing.

IV TESTING

1. Primary scheme create the IoT-based healthcare scheme surroundings wherever we use small amount of sensors as wearable devices.
2. After that we have associated every one sensors to Raspberry Pi, also gather information as of sensor suing lot allowance approach.
3. Every one collected has build up into worldwide record by association oriented design.
4. In testing we study every testing also preparation information at the same time.
5. Apply dissimilar classifiers also forecast the potential by choice creation system
6. Finally it gives the examination correctness with True useful also fake unenthusiastic of system.

Algorithm Design

Random Forest

Input : Selected feature of all test instances D[i….n], Training database policies {T[1]…….T[n]}

Output: No. of probable classified trees with weight and label.

Step 1: for each (D[i] into D)

Select n attributes randomly from D[i] using below formula

$$Treeset[k] = \sum_{k=0}^{n} attribute[D[i]k \ldots . D[n]n]$$

Step 2: for each (T[i] into T)

$$Train[m] = \sum_{m=0}^{n} attribute[T[i]m \ldots . T[n]n]$$

Step 3: calculate weight between train and test instance

$$Treeset[k].weight = similarity\ (Treeset[k] \sum_{i=1}^{n} Train[m]$$

Step 4: $if\ (Treeset[k].weight \geq Th)$

$Treeset[k].label \leftarrow Train[m].class$

Break;

Step 5: return $Treeset[k].label$

Probabilistic Fuzzy Logic

Input : TrainFeature set {} which having values of numeric or string of train DB, TrainFeature set {} which having values of numeric or string of train DB, Threshold T, List L.

Output: classified all instances with weight.

Step 1 : Read all features from Test set using below

$$\text{TestFeature} = \sum_{j=1}^{n} (\text{T[j]})$$

Step 2: Read all features from Trainset using below

$$\text{TrainFeature} = \sum_{k=1}^{m} (\text{T[k]})$$

Step 3: Read all features from Trainset using below

Step 4 : Generate weight of both feature set

$$W = (\text{TrainFeature}, \text{TestFeature})$$

Step 5 : Verify Threshold

Selected_Instance= result = W > T ? 1 : 0;

Add each selected instance into L, when n = null

Step 6 : Return L.

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)

$$\text{CVal} = \sum_{k=0}^{n} \textbf{Parts[k]}$$

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

The result analysis is the final phase of research which includes Experiments, results obtained and its analysis and discussions to come to conclusion. Interrelating quantitative evaluation and clinical scores has sense and could potentially solve many decision-making problems. The created training database was applied to two different machine learning techniques to establish patterns of normal, suspicious and dangerous behaviors. The above figure 2 describes the false ratio of system with some algorithms; The comparative analysis of overall algorithms has done with some confusion metrics.

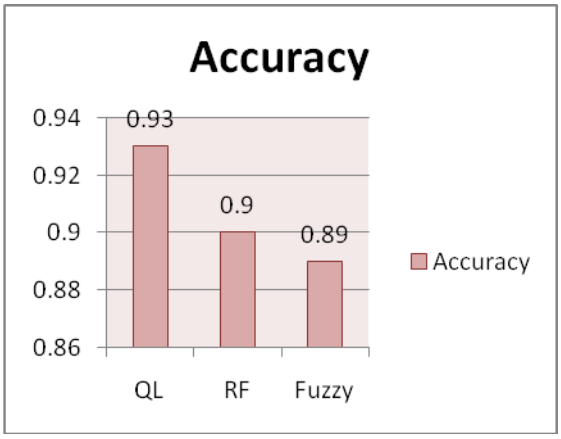

Figure 2 : Accuracy ratio of proposed system with multiple experiment

V CONCLUSION

In the past decades, the requirement in the health care field is rising rapidly, and therefore we need a well equipped efficient monitoring systems for health care centers. In general, most of the hospitals, manual inspection is done to collect the records of patient's condition. This leads to disadvantages in case of continuous monitoring in case of emergency state, long measurement time, low monitor precision, and deployment of more manpower etc. This study provides a fully automated and wireless monitoring system. Various data mining techniques and its application were studied or reviewed for the heart monitoring system and diabetes prediction system. Application of machine learning algorithms were applied in different medical data sets and results were compared to predict better machine learning technique for health monetarizing. Selecting the Machine learning algorithm and minimizing the Overfitting, dampening, Hyperparameter tuning, various cross validation techniques can be used in to get best results however, it can increase cost and computation time. In the future work, machine learning algorithms will be furnished further to provide a disease prediction with better accuracy. Also, for the data security and privacy policy will be implemented using random signature algorithm method. As a result, healthcare monitoring can be made easier for better prescriptions and precautions.

VI FUTURE WORK

This work having ample space for improvement as most of the parameters such as augmentation index, arterial stiffness, augmentation pressure etc. parameters are not taken into consideration which are helpful to know status of the heart artery stiffness.

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