A Study for Heart Disease Prediction using IoT and Deep Learning

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Abstract

Health is one of the very basic needs to any individual. One of the issues related with the health sector framework is the absence of therapeutic offices and systems to track the patient's history to give the viable treatment. IOT devices allow and promote healthy and free living to older individuals. Accidental injuries have been one in all the leading causes of death in older adults. as an example, each year over a 3rd of individuals over sixty-five within the U.S. expertise a fall, of that up to thirty percent lead to moderate to severe injury. Our approach tries to analyze existing wearable devices to measure heart affecting parameters and design appropriate sensors for stress hormones, heart ageing and cholesterol. Also aiming to develop an algorithm to generate an alarm in case there is any danger to human life. This study also aims to predict any heart disease by using available data as well data generated through IOT devices. For this prediction we can trying to develop machine learning and deep learning algorithms by studying existing approaches.

Keywords- *IoT, Heart disease, Machine learning, Deep learning*

I. INTRODUCTION

In today‟s fast pacing world health has become a major need of an individual. Be that as it may, the doctors are not straightforward with every single patient as far as finances are concerned. One more issue related with the health sector framework is the absence of therapeutic offices to track the patient's history to give the viable treatment. Consequently, it is important to improve the health and well-being framework to make it more proficient [1]. From a engineer‟s view-point, the human body can be defined as a mix of numerous subsystems where every segment of the subsystem must work effortlessly. This complex volatile framework that human body has, it can be considered to be organized at different logical levels, for example, cells, tissues and organs, which together add to 11 imperative organ frameworks. Discomfiture in any of these structural levels can influence the balance of the whole body. The general utilitarian effectiveness and dependability of human body is assessed as human health. The World Health Organization (WHO) describes human wellbeing as a condition of comprehensive physical, mental and social prosperity [2]. Headways in innovative and medicinal research, combined with expanded mindfulness about wellbeing and cleanliness, have brought about an expansion in life expectancy of people. As far as topographical confinements, monetary status, way of life are concerned, the ever growing medical costs and consistently exploding population are causing significant medical services imbalance. Because of these disparities, there exists a huge gap between demand for medical resources by people who are in need and people who are ready to contribute towards medical resources.

II. OVERVIEW

IoT has changed people‟s lives, especially older patients, by enabling constant tracking of health conditions. This has a major impact on people living alone and their families. On any disturbance or changes in the routine activities of a person, alert mechanism sends signals to family members and concerned health providers. With the help of IoT we are trying to develop IoT-based fall detection system for sensible home environments that not solely to channelize alerts, however additionally launches interaction models, like voice help and camera observance. Such property might enable older adults to act with the system without fear of a learning curve. The projected IoT-based fall detection system can change family and caregivers to be instantly notified of the event and remotely monitor the individual. Integrated at intervals a sensible home atmosphere, the projected IoT-based fall detection system will improve the standard of life among older adults. Deep learning is a sub domain of machine learning. It is based on learning multiple levels of abstraction and representation. Computational models are present in deep learning that consist of multiple processing layers to learn representations of data with multiple levels of abstraction.

III. LITERATURE REVIEW

The rise in number of web-connected devices has empowered us to have a home with enormous enhancements to create life of convenience. These internet-connected devices are classified as a community of devices called the internet of things (IoT) [1]. The IoT is spreading promptly these years and it" s the influence of IoT on daily life and behavior are snowballing. It is a network that connects web connected real devices, vehicles, buildings and embedded with physical science, software, sensors, actuators, and network property so these objects will collect and exchange information. it's been utilized in plenty of domains, for example: transportation and delivery domain, weather prediction, personal and social domain

[3]. It's quite foreseeable now that the IoT can comprises nearly fifty billion objects by 2020

[4].   Telemedicine is additionally another IoT application that has been gaining ground within the past few years [5]. Once patients wear special displays that are designed to assemble data concerning the whereabouts of the centre, the picked-up signals may well be sent to planted devices as insights to deliver a timely shock to correct associate degree errant rhythm. With the expansion of net, networking and computing, IoT application have a bright and limitless future. Be it engineers, doctors, entrepreneurs or scientists, it's time they thought of M2M communication as a versatile technology that uses common equipment in newer ways that to form associate degree intuitive, with-it associate degreed an intelligent system in situation

Above two issues, the growing rate of the aging population and making healthcare affordable and accessi

ble in remote areas are challenges are two fundamental challenges that healthcare industry must keep up with [6]. As an example, the service of elderly being when stroke rehabilitation for the senior is emerging challenge, which needs a long-time commitment of medical and human resources. Medical rehabilitation could be a comparatively new subject, that was introduced within the middle of the twentieth century and has been treated as a brand-new branch of medical care aiming at alleviating or action physical or mental dysfunctions by remedying or re-constructing disabilities. It's been recognized as an efficient suggests that in

up physical functions of the many kinds of patients. However, the promotion of medical rehabilitation to a wider scope. One promising methodology to alleviate the same issues of remote medical access and for recent aged patients is to adopt the internet of Things (IoT) technologies and intelligentize the medical service systems [7].

In India, a review was commanded to watch the working of various medicinal and curative centers and the enhancement in medicinal services conveyance with the presentation of modern day innovation in technology. The review uncovered that patient records in a considerable lot of the medical facilities were not taken care of properly, additionally the patient referrals among different doctor's facilities were pretty much dependent on paper documentation which are archived very often.

As offices were not accessible to exactly appraise patient's history, the human services quality was inefficient. The study uncovered that medicinal services offices can be enhanced with the assistance of Information Technology, predominantly utilizing Electronic Health Records (EHRs). As indicated by the study the utilization of EHRs is less and inclined to disappointments on account of the multifaceted nature related with it. Kopper proposed a straightforward and practically Employable EHR (EEHR) [8] approach and accordingly named as WebEHR. This methodology gives the online availability among different human services focuses, along these lines improves the up keeping and sharing of data among the various health centers.

For In-house doctor's facility patients, clinical decline in quality is also a critical issue. Chipara [9] gives the execution and organization of remote observing of in-patients inside the clinic premises. The sent remote frameworks accumulate heartbeat and oxygen immersion estimations from patients routinely. It likewise examines the likelihood of possibility for WSNs for healthcare in doctor's facilities.

The key assets of the Indian medicinal services framework are because of its all-around prepared therapeutic staff. Various endeavours have been made to enhance the nature and quality of human services provided by these facilities. Khambete [10] examines the endeavours that have been made to enhance the health framework. Accordingly, it highlights the shortcomings of medicinal gear safety issues and the prudent actions which should be taken in consideration to enhance the nature of human services in India.

Priyan Malarvizhi Kumar et al. [11] presented three-tier architecture of IOT with machine learning algorithm for heart disease early detection. They have proposed three tier architectures for store and process huge amount of data which is produced from wearable gadgets. Tier 1 focuses on collection of data from various sensors, tier 2 uses Apache HBase for storing large volume of data in cloud computing whereas tier III uses Apache Mahout for developing logistic regression-based prediction model. Finally, it does ROC analysis to get nodal analysis of heart disease.

In 2016, Mingyu Park et al. [12] implemented smart chair system which records and visualizes user" s posture through smartphone application to help the users correct their unbalanced posture. They had used pressure sensors and tilt sensing even they had used i-Beacon and Bluetooth technology for communication purpose which transmits data with low power consumption. It is an Arduino implementation which mainly detects various user postures. This implementation supplements the user to sit correctly with the recognition of their own current state by providing intuitive and visualized data in real time to smartphone application. Under visualization the left and right side shows actual vs. ideal posture with the pressure shown in circles with red/yellow/green and orange colors. This is good example of internet of things technology.

In [13], Cloud and IoT based m-healthcare application has been produced and actualized for observing the genuine severity level and diagnosing them as per the seriousness. The wearable and embedded IoT gadgets are used as IoT gadgets. These gadgets are utilized to gather the therapeutic information from remote territories. The immediate estimation can be gathered as restorative information that are gathered through IoT gadgets, connected with human body. Related medicinal information is produced by utilizing the UCI Repository dataset and the therapeutic sensors for anticipating the general population who has influenced with diabetes extremely. The resulted information will be saved safely by applying five distinct phases of a recently proposed storage method, for example, information storage, information recovery, information aggregation, information dividing and information merging.

Cloud computing is a phase that grants on-demand for organized access to preparing administrators [14]. This state works outside of anyone's ability to see and is used to get data from the smart things, look at and interpret this data and give electronic observations to the customer. This is also to a great degree captivating part for systems since this will make a market with a lot of opportunities to make an impetus for customers of IoT applications. The examination of this data in the cloud will conventionally be performed by enormous data examination and machine learning estimations. Machine learning is a sort of man-made thinking and empowers these computations to improve themselves by picking up from their data input.

A WSN is an arrangement of self-decision sensors that send their data through the framework to a central zone [15]. An IoT structure can use a WSN for the collection of data for a lot of users, hitherto few out of each odd IoT system will use one since there are various distinctive potential results. The aggregation of data is only the underlying step of an IoT system, further this data must be separated and changed into noteworthy information or bestowed to various objects. The sensors utilized for the WSN give the likelihood to make any protest brilliant and the colossal advancement in these sensors is presumably the principle development that began the IoT advancement.

Another thought related to IoT is encompassing learning; a situation with identifying and handling limits, which can collaborate with individuals. This idea isn't exactly the equivalent to IoT since it just supports some predefined capacities in a closed area (e.g., a room, a building), is based on human affiliation and the used things don't generally should be related with each other [18]. This isn't exactly the equivalent as IoT in light of the way that a fundamental piece of IoT is constraining human information.

Machine-to-machine (M2M) correspondence is an improved form of IoT. The focal point of M2M is on associating gadgets and gives the likelihood to remotely get to information from these gadgets. This information is prepared in an administration application to accomplish profitability gains, diminish expenses, and increment wellbeing or security [19]. The information isn't coordinated into different procedures, just happens on the level of the machines on the level of machines don't really need to be associated with a cloud stage. It's progressively an immediate, one-route type of correspondence. Information in IoT
applications originates from heterogeneous protests in numerous configurations and is then incorporated without human intercession, this is diverse in M2M applications. IoT can bolster indistinguishable administrations from M2M yet has considerably more abilities since information in IoT applications can be utilized for different purposes because of the electronic innovations[19].

PROPOSED SYSTEM
A. Working
The proposed system aims at putting together IoT and deep learning. IoT makes it more reliable for the user and deep learning makes the predictions efficient for individuals who are using the IoT devices. Figure 1 depicts the proposed model.
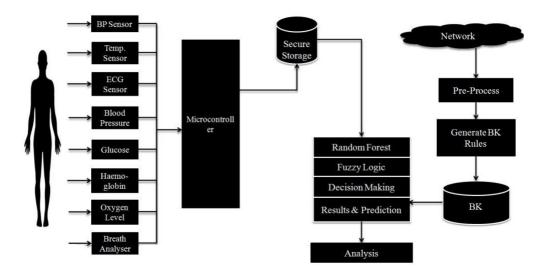

Fig 1. Overview of proposed system

IV. Recurrent Nueral Network
The RNN model of Deep learning is a simple structure but comes with a built-in feedback loop allowing it to act as a forecasting engine. RNN in essence is a regular neural network with an additional hidden state where the hidden state influences the neural network output. The hidden state is updated on each input step. RNN model learns local and temporal dependencies in data as well as can accommodate variable sequence lengths. In RNN the output of a layer is added to the next input layer and fed back into the same layer. Unlike feed-forward networks RNN can receive sequence of values as inputs and it can produce sequence of values as outputs. But in RNN problem of vanishing gradient is worse therefore it leads to exponentially small gradients and decay of information through time.

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B. Dataset

Currently, to start with we are having dataset from the UCI Machine Learning Repository having about 303 records with 75 medical attributes (factors). After preprocessing we can have nearly 270 records with 13 medical attributes. These 13 medical attributes contain about 7 discrete values and 6 continuous values. Along with that we will use following dataset:

• A real time health care data is used for this system

• The data has collected from different IoT environment like ECG sensor, temperate sensor, Pulse rate sensor etc.

• Once data has generated by sensors and send to Arduino, and it will send the same data to cloud server.

D. Expected Outcomes

Proposed system has the capability of simultaneous monitoring multi parameters integrated with single chip onto wearable devices where multiple sensors work together to obtain required data excluding noise disturbances. It works to maintain its accuracy by reducing less human interventions. It is real time diagnostic system for remotely located heart prone patients to measure heart rate, blood pressure, body temperature and many other parameters using biomedical sensors. N number of collected observations can be stored and viewed later by physicians for correct diagnosis purpose. From Table 1 we can see the various methods used for predicting heart diseases and how RNN or deep learning can be more effective.

Technique Used	Accuracy
CNN & Decision Tree[16]	82%
SVM[17]	84.2%
Naïve Bayes[18]	86.53%
KSOM[19]	88.9%
C4.5 MAFIA K-means Cluster[20]	89%
DBN[21]	90%
RNN (Expected)	Around 92%

Table 1. Performance Comparison

Machine learning approach will sensitize and analyzed the trained data for inculcating heart efficiency. Two major interfaces for doctor and patient will enable the transfer the information to each other. This framework detects underlying heart conditions in real time for sake of patient‟ s life and generates alarm in sense of SMS, Email etc. based on high and low threshold values set a right for doctor as well as for responsible registered any family member. This will enrich the system with feeling of attention, care which add value to patient‟ s health.

This approach attempts to evolve with know-how relationship between doctor and patient. Instead of purchasing different devices at different prices, this invention helps to reduce the cost. Also, hospitalization cost will also get reduced as this is one-time investment.

CONCLUSION

• System provides real time health monitoring results.

• It can work base on synthetic as well as real time training data Accuracy of final results are good than other learning approaches.

• System also would be capable to provide the alert message through email.

- With the help of deep learning algorithms as compared to machine learning algorithms the proposed system will be very useful for the patients who are the suffering from heart disease.

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