A Survey on IoT Based Health Care Monitoring System for Elderly People

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Abstract: IoT is an emerging technology and it is widely used in all possible applications. IoT consists of various sensors, processors and communication interfaces which are interconnected to each other and they give a path to access the devices remotely. IoT also plays a major role in the health sector by health based smart system which monitors the patients, elderly aged people and disabled people regularly and collects all the data with the help of sensors. Those collected data are pre-processed and transferred to the cloud. By using cloud, we can retrieve the data whenever we need. By using IoT based healthcare monitoring system the distance between the patients and the doctor has been reduced. There are various sensors that are used to detect patient's health conditions, such as accelerometer sensor, gyroscope sensors, heart pulse sensors, body temperature sensors, galvanic skin response sensors, blood pressure sensors, blood glucose sensors, etc. All these sensors are connected to a microcontroller and transferred to cloud. In cloud the data get stored and processed by using various algorithms. The output is displayed to the users. This system reduces the medical cost and the burden for the care taker is reduced. Real time monitoring of the patients and updating the information to the doctor's environment, helps us to find the disease before it become a serious problem. This paper gives a detailed survey on health care monitoring systems and the various algorithms that are used. This IOT based healthcare monitoring system reduces cost; it gives result with more accuracy.

Keywords: IoT is an emerging technology, the health sector, body temperature sensors

1. INTRODUCTION

In the society, older adult's population is becoming isolated, due to smaller social circles and to physical and psychological health issues. Typically, as age increases, the need for support and medical assistance also increases. The atmosphere of the hospital itself will be a burden to the patients. The abusive nature of nurses or the next bed patient will disturb the patient and sometimes it results in the disturbance of mind. When the patient is at home the care takers find it difficult. To overcome this, The Internet of Things (IoT) is used in healthcare applications for patient care and monitoring. It represents a set of interconnected smart objects and people at any time and at any place. This is very much useful to look after the elderly and diseased people, who are dependent on others for all their activities. Activities of Daily Learning (ADL) are used to identify the limitations of the patients or the elderly. It is learnt by monitoring the daily activities of the end user. The sensors are to be placed in the room where the patient is staying, constant monitoring of the body temperature and any other symptoms leading to the detrimental of health is to be noted and the medications must be changed accordingly. When health monitoring devices are installed the burden of both the patient and the care taker decreases. The care taker need not monitor 24/7 and at the same time the patient can feel at home and enjoy his life. For Indore monitoring of the patients the CCTV video surveillance is available and the movement of a particular patient can be monitored. For the outdoor monitoring we use the smartphone cameras and GPS for monitoring and tracking purpose. When a fall incident is detected, the alarm system issues notification messages to all emergency contact person in sequence until one responds to the system. If no one responds within a predetermined time period, then the system immediately calls emergency medical services to procure timely help for that elderly individual.

Cloud storage is a key feature of IoT and all the sensors data are processed on cloud by using Machine learning. Various algorithms have been involved to reduce the time involved in processing the data. Many cloud storage providers are available and google Firebase is one of them and it is more secure and user friendly. Data from the sensors are periodically stored in this cloud. Processed data are available permanently and can be viewed at any time they want.

2. RELATED WORKS

Chandra, et.al., mainly focuses on elderly people as they may easily get injured by falling, so they are in need to be monitored. This system uses accelerometer sensors to sense the acceleration and the gyroscope sensors to find the velocity angle of the fallen person, this helps to find

whether fall had occurred or not. As there are some drawbacks in using accelerometer sensor alone so the gyroscope sensors are also used along with it. In order to predict the false detection, we are observing 4 body postures such as falling front, front backward, jumping, sitting fast. If there is change in the body posture the acceleration is noted and calculated by using,

$$X = \sqrt{XA} + XB + XC$$

This system has 4 main parts like Accelerometer and gyroscope sensor, Wi-Fi module, buzzer, snooze button. Accelerometer sensor – it is used to find the acceleration of the person and gyroscope sensor – used to find the velocity angle and if these values are below the threshold value then it is considered as a fall. These will inform to the persons nearby or the contact already saved, to inform this information they have used a Wi-Fi module and along with this information GPS is also transferred to find the persons location. The buzzer starts to buzz if this is false detection then the person can stop the buzzer by pressing the buzzer button, if so, the entire alert message will be cancelled. Here they used tri axis accelerometer sensor so the signal from all three axis is not considered at a time, only one signal is taken and converted to digital signals this is compared with threshold value. Algorithm used here is fall detection algorithm, at first serial communication ports are initialized, ADC and analog input channels configured, initialization of GPS and GSM, receives the location, all sensors values are obtained and compared to threshold value, if greater than threshold value then the system waits for some time and again check the acceleration value if again greater, then the will send notification to the persons and buzzer starts. This algorithm is called long-lie. By using this algorithm, they have achieved 95.53% of accuracy.

Mohd. Hamim, et.al., proposes the IoT Based Remote Health Monitoring System for Patients. In this system they have used heart pulse sensor, body temperature sensor and galvanic skin response sensor to measure the health conditions and these sensors are connected to the Arduino board, and this is connected to the Raspberry Pi and finally all these data are transferred to the cloud. This system uses Google Firebase as a cloud storage, which is more secure and uses encryption to secure data from unauthorized person. All the details are shown in a smartphone application. The heart rate is found by using heart pulse sensor, this uses infrared light which is passed to the human body and it follows reflection and absorption of the light, the light received is sensed by the sensors and used to find the heart rate. During single heartbeat sequence of event take place knows as cardiac cycle, during this time the volume of flow of blood is changed, this change is found by using Photo plethysmography sensor. Galvanic Skin Response (GSR) or skin conductance (SC) or electro-dermal activity (EDA) is used to detect the emotional arousal. It is based on the sweat extraction in our body, more we sweat the more the conductance and this sweat gland secrete sweat

if we get more stressed or in happy mood. All the modules are tested individually in order to check the efficiency and all these modules are integrated together. The data gathered from these sensors are converted to the standard format by using mathematical formulas and the library functions. The user gets all these details in the smartphones and for the security purpose they have used encryption with login credentials. Real time data processing is done.

Mohammed Al-Khafajiy, et.al., has developed a smart healthcare monitoring system which mainly focuses on the elderly aged people. This system uses various kind of wearable medical sensors, smart phones, actuators, wireless sensors, computer hardware, computer network, software and all these are connected to exchange the data between them to provide the healthcare system. This system uses smart phone app and wearable sensors to monitor the elderly aged people, all the data from the wearable sensors are collected and they are updated to the datacentre. From the datacentre only authorised persons are allowed to access the data. This system has three layers wearable devices or Patients layer, cloud or data layer and Monitoring platform or hospital layer. Patients layers consists of all the sensors which are used to identify the physical condition of the patients and these data collection take place regularly without any disturbance to the patients. In cloud layer, all the gathered data are transferred to the cloud. Cloud is place where all the data are stored remotely and data are available at any time whenever we need. In Hospital layer, this layer is mainly for the doctors who can analyse the patients' health condition remotely, by this the Doctor can be able to see patient's real time reports. They take two factors for this system: First, the proposed system should work 24/7 without any downtime. Second, data freshness is considered. Real time data should be shown to the user without any delay. This system network model consists of four main components, User Environment: all the wearable sensors are connected to the patients and data are collected and transferred through the gateway. Gateways: controls the interaction between the sensors and primary data process is done. Cloud Data-center: all the acquired data are stored in the cloud and by using ML some process taken place. Monitoring Platforms: it provides control over the collected data. They have used two gateways, if one gateways is loading other one will take some load and process the data so the time taken is reduced.

Deepali K Shende, et.al., focuses in their paper that concerns on the Dementia patients and it is a group of symptoms caused by specific brain disorders. Alzheimer's disease, the most common form of dementia and their symptoms are Loss of memory, Mood changes, Communication problems. This system gathers user current location, real time image processing to find fall detection and it monitors user activities. They have developed a system named, wandering path tracking and

fall detection system (PTFaD) which uses smart phones to take real-time images, in which those images are add with the time and GPS locations, then this image is get stored in the cloud. The data from the cloud can retrieved anytime and for security purpose they used RSA method. For the accuracy they used accelerometer sensors to detect the fall.Fall detection can be found using some methods, Image recognition: a camera is placed on the forehead and usual active and inactive points in his/her room is remembered, if the person is inactive before the inactive point then fall get detected and informed. Recognition by acoustic/vibration: if the person falls then the vibration is noted and checked with pre-defined vibrations, if greater alert is notified. Worn sensor devices: the worn sensors detect the fall by using the accelerometer or gyroscope. Those data are compared with the threshold value and alert message is given based on it. Recognition by acceleration threshold: this uses accelerometer to get the acceleration reading and get compared with the minimum and maximum threshold value. If any changes then fall is detected. They used algorithm for fall detection, which is based on the threshold value. The acceleration in X, Y, Z axis are taken and represented in B_x, B_y, B_z respectively. Using formula,

$$Bsum = SquareRootof (Bx2 + By2 + Bz2)$$

Compared with threshold value to detect the fall.

E T Tan, et.al., focuses on the healthcare monitoring system that uses three sensors namely body temperature sensor, pulse rate sensor and blood pressure sensor. The integrated sensors are interfaced with the Intel Edison platform, and the output readings are transferred to IBM Bluemix for cloud storage and display. The system also detects the diabetes and kidney disease, the accuracy level produced this system for diabetes is 90.54% and for kidney is 87.88%. This system is divided into two layers, frontend layer: all the sensor data are collected and by using Arduino and intel Edison we can convert the detected signal into the readable output and all the output can be view on a web-based application. Backend: here the data acquisition and storing the acquired data is concerned and analysis process is also taken place. Sensor TMP 36 is used to detect the body temperature and TMP 36 is an analog sensor, which produce a analog voltage based on the temperature of the body. These analog values are converted to a digital value by using analog to digital convertor, the output voltage range from 0.5 to 1V. heart rate is measured by using Amped sensor, it is based on the photoplethysmography (PPG) technique. This technique uses light to detect the volume of flow in the blood vessels, the light variation is depending on the change in the volume of blood vessels. Pulse is checked every 2 ms and this produces a peek and trough value, this time interval between this peek and trough is inter-beat interval (IBI).to calculate beats per minute (BPM) average of 10 IBI is concerned.

Pulse rate in BPM =60000/average of 10 IBI

The blood pressure is measured and it is represented by mean arterial pressure (MAP). This system uses blood pressure cuff, motor, valve, and pressure transducer to measure the blood pressure. The intel Edison platform is used to gather all the sensor data from the Arduino and wraps these data into JavaScript object notation format (JSON) and transferred to the server. Node-Red from IBM Bluemix act as an API and those received data are processed and stored in the cloud and displayed to the user.

SripadaSoumya, et.al., proposes a healthcare system that consists of various sensors and the communication technologies. Some of the technologies are wireless body area network (WBAN) has a wireless transceiver and it is small in size and long lasting, radio frequency identification(RFID) is a low power consumption device and it has the range of 15 to 25m, ZigBee is widely used communication device and is mess loop system and range of 100m and can transfer data at 250 kbps, ultra-high frequency (UHF), global system for mobile communication (GSM). This System measures pulse rate and the blood pressure. The pulse rate is calculated by using heartbeat sensor, the finger is placed on the sensor and the IR radiation is emitted, the change in the blood flow through the finger the heart rate is calculated. The blood pressure is monitored by using wrist blood pressure monitor device. The pressure of the blood in the arteries is the blood pressure. All the data are transferred by using the GSM module and the location is also transferred to the patients and the doctors.

3. COMPARISON OF ALGORITHMS

Various algorithms are used for monitoring health care. The neural network algorithm plays vital role in classification. Convolutional Neural Networks (CNN) gives most accurate results in solving real world problems. CNN is better than other deep learning methods. It gives better accuracy of 92.65 and boosts performance of system.3D CNN model is most effective than 2D CNN model. K means method is an effective method to cluster CNN. Back propagation method is used to train the deep network. Algorithms such as k-nearest neighbors (KNN) is easy and simple to implement but it becomes slower when huge date is used. The prediction accuracy is low when compared to other algorithms. When Artificial Neural network (ANN) algorithm is used the accuracy of result is not obtained. It does not produce optimum results.

Support vector machine (SVM) is powerful than all other classifier. It can classify even unstructured data. It gives better accuracy than all other classifier. Random forest algorithm is very stable and it handles missing values. It is most powerful algorithm like support vector machine. SVM and random forest algorithm are better than all other algorithms. They both gives maximum prediction accuracy of 99.89%.

4. CONCLUSION

This review showed that Health is an important thing for the human beings. The patients and the older people health should be monitored in all the time. It is impossible to say the doctor to care for only single patients even there are caretakers of patients they may not have a sufficient knowledge to monitor them. This study demonstrates the techniques available for monitoring patients 24/7 in both Indoor and outdoor. For monitoring the older people and the patients, various sensors are attached to their body. These systems help them to be safe even if they are alone and the emergency situation are avoided. This healthcare system is provided with various sensors, these sensors has its own advantages and disadvantages. The sensors collect the data without disturbing the patients and processed and information is displayed in smartphones and web. It enables doctors to monitor the patients regularly and real-time data are stored in cloud. For processing various algorithms are implemented and their efficiency are compared, from which Support vector machine (SVM) and Random forest algorithms are the best and they provide data with more accuracy. For Cloud storage Google Firebase is considered and it is more secure system. As everyone has a smartphone, these healthcare monitoring systems can also be implemented, todays smartphone has various sensors such as accelerometer, gyroscope sensors, etc. Many applications are developed to monitor elderly patients and disabled patients, which gives peace of mind for those patients and freedom to do what they to do.

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