IoT Based Smart HealthCare Monitoring System

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Abstract

In the Internet of Things (IoT), devices gather and share information directly with each other and the cloud, making it conceivable to gather, record and examine new information streams quicker and all the more precisely. Poor inborn individuals have far more awful wellbeing markers than the all-inclusive community in view of drinking debased water and some others reasons, the innate face medical issues, for example, the predominance of illness like heart disease, looseness of the bowels and jaundice, issues related with lack of healthy sustenance like iron insufficiency and frailty, low degrees of future and so forth. This investigation chiefly manages different restorative gadgets, for example, sensors and electronic applications which impart by means of system associated gadgets and screens and record patients' wellbeing information and therapeutic data. The proposed result of the paper is to construct a framework to give world-class restorative guide to the patients even in the remotest regions without any clinics in their zones by associating over the web and getting a handle on data through about their wellbeing status by means of the wearable gadgets which would have the option to record the patient's pulse, circulatory strain. The framework would be savvy to suggest the patient's relatives and their PCP about the patient's present wellbeing status and full therapeutic data in the event that any health related crisis emerges.

Keywords: Internet of Things, IoT in Healthcare, Patient Monitoring, Raspberry Pi, Smart Health Monitoring.

1. Introduction

IoT was first proposed by Kevin Ashton in 1999 [1]. It is a communication network in which physical objects are interconnected with each other or with larger systems. This network collects billions of data from the very different devices we use in everyday life and transforms them into usable information [2]. Today, there are about 20 billion devices in the world that interact with each other, and by 2025 it is estimated to go up to 75 billion devices [3]. This shows that in the coming years cities that we live with IOT will become smart cities that will keep pace with the more paced and planned life [4]. This transformation will offer us many opportunities to make our life easier. One of these important opportunities is the e-health services that are closely related to all of us. IoT applications in the health sector are increasing day by day. People living in rural areas cannot benefit from preventive health services due to lack of infrastructure. As a result, deaths occur very early in these regions. In addition, with the rapid aging of the world population, the needs of the elderly for life support are increasing with the change of family structure. Devices that provide continuous monitoring of these patients are very expensive and sensitive and require trained personnel to use them. It is possible for such patients to be followed up continuously with wearable health devices while maintaining their daily lives in the social environment. These wearable devices continuously measure the patient's heart values and, when a symptom of a heart attack has occurred, may send information about the patient's health condition to the family members and the doctor [1].

This paper demonstrates a Remote Health Monitoring System controlled by Raspberry pi. Raspberry Pi is a small payment card-sized single-board microcontroller made to enhance the basic computer science education in colleges and developing nations. In this paper, a system is designed to continuously monitor the vital parameters such as heart rate, blood pressure and body temperature. The information is stored on a cloud server database and can be displayed through an online website or mobile application by authorized personnel only. The idea might not be very new, but we propose an absolute and cheap method for the system using Raspberry pi. The main objective of this system is to learning the collected data and classify and predict about patient health using machine learning algorithm. There are some class for patient’s heart rate like moderate, high and very high. When patient’s heart rate will be very high the system will alert to the patient family member and to the doctor. This thing will also work for blood pressure and body temperature of the patient. When the patient go to the doctor a health report will generate of

patient as a pdf file so that doctor can easily understand about patient health. The former is accomplished by using MySQL DB module to link Raspberry pi to the database whereas the latter is achieved by the combination of Raspberry Pi and GSM module and the web interface. This system has much future scope as the data collected by monitoring is so valuable and can be used for any kind of research by the medical community [2].

The major aim of the paper can be summarized as following:

- To obtain the real-time medical information about a patient via IoT.
- Processing and classification of information gathered about the patient.
- To interpret, classify and predict the disease using machine learning techniques that will also provide the approach advantageous for decision making.
- To provide Internet of Things based healthcare solutions at anytime and anywhere.

2. Literature Review:

Nowadays most of the people are striving against health issue but they don't get the healthcare they needed. This paper gives an overview smart healthcare technology as a helping tool to help and solve some of the issues with which the healthcare community is affecting today. In this paper it has been discussed all the possible benefits and problems of Smart Healthcare applications. Smart healthcare system only can help to decrease the problem in healthcare, make the number less and effect of medical errors attributable to a lack of critical medical information. Analysis of the benefits and limitations, provides the complexity of a system, and the privacy and security concerns it raises, is required. However, a smart healthcare entity carrying critical patient medical must always support patient empowerment. The health organization must able to secured privacy while ensuring information access and security. This in turn will encourage an environment where the patient is empowered to take care of the individual's health and will even give the opportunity to the healthcare professional to the individual work not only more efficient, with proper management and research, implementation of such smart technologies together with the backing of cloud computing and healthcare IT professionals could improve healthcare settings in all parts of the world.

3. System Model

This paper demonstrates a Remote Health Monitoring System controlled by Raspberry pi. Raspberry Pi is a small payment card-sized single-board microcontroller made to enhance the basic computer science education in colleges and developing nations. In this study, a system is designed to continuously monitor the vital parameters of such as heart rate, blood pressure and body temperature of a patient.

3.1 Previous Work:

A number of researchers have proposed various models for IoT in Healthcare of various types of diseases using various techniques. This part focuses on the work done in the same area.

A system have been implemented for measuring the physiological signals in sitting position such as ECG and BCG by using a smart chair that senses the non-constrained bio-signals and can be monitored using a monitoring system such as the one they had developed providing a classic example of the application of IOT in healthcare[1].

A system is proposed of m-health that uses mobile devices to collect real-time data from patients in and store it on network servers connected to internet enabling access only to a certain specific clients. This data can be used for the medical diagnosis of patients and is achieved by using a number of wearable devices and body sensor network [2].

A proposed framework is to prevent the threats to patient in smart ICUs. The proposed system intimates the patient's relatives and doctors about any inconsistency in their health status or their body movement send also about the atmosphere of the room so that the necessary precautionary measures can be taken [3].

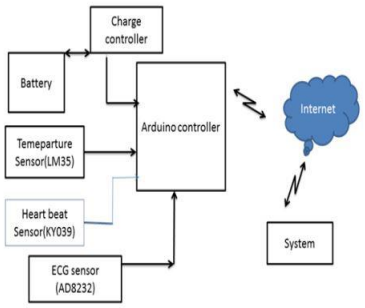

Fig.1 Block Diagram of Previous System

3.2 System Architecture:

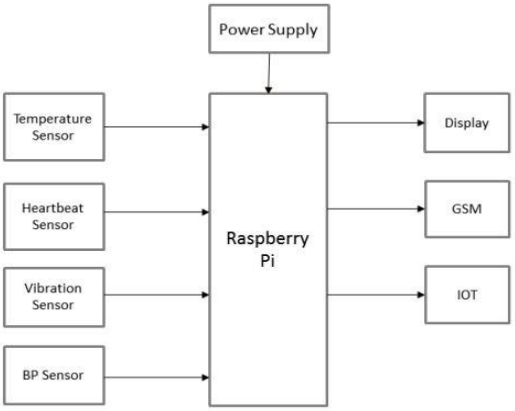

Figure 2. Our System Architecture

3.3 Proposed Approach:

In this paper, we propose an automatic system to monitor patient's body temperature, heart rate and blood pressure then the system will collect health data in different parameter of patients. After that we extend the existing system to classify and predict the patient situation using machine learning (supervised learning) algorithm if the patient is suffering from any chronic disorder or disease using the various health parameter and various other symptoms that are obtained by the system.

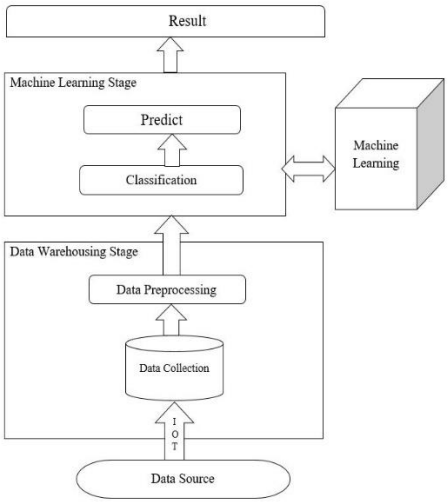

Figure 3. Proposed Methodology

3.3.1 SYSTEM MODULES

- ***Health Monitoring Section***
  This module comprises of the hardware components of the system that makes it IoT enabled and is used to record the health parameters of the patient using various sensors. Here, Raspberry pi acts as a central server to which all the sensors are connected through the GPIO pins or using MCP3008 analog-to-digital convertor if their output is in the analog form as raspberry pi works only on digital signals. The pi reads the real-time values and updates them to MySQL db which is then used to display them on the web interface.

- ***Emergency Alert Section***
  This module in particularly deals with the steps to be taken after an abnormality is detected in the health of patient such as notifying his/her family member as well as the hospital. We have set up certain class of all disease of patients in our program which if crossed will trigger an alert in the form of email/SMS to the patients family/doctor.

- **Health Status Prediction System**
  This is one of the most promising modules of our system. In this module, we use the patients' health data as recorded by our system along with any symptoms they may be learned from previous data and classify it with recorded data to predict if any disease/disorder the patient may have thus making it an efficient with proper data mining techniques.

3.3.2 System Requirements:

Raspberry-pi
The Raspberry Pi is a bank card size microcontroller with the features of a small pc and is extremely popular for development purposes because it offers the entire Linux server and peripheral device connectivity on a single chip and is very cost-effective.

Temperature Sensor
For measuring the temperature LM35 sensor has been used which is an IC sensor used to measure the temperature with the help of the analog output proportional to the temperature

Heartbeat Sensor
The heart rate is measured using a pair of LED and LDR and a microcontroller and it works on the fundamentals of optoelectronics. The infrared radiation is emitted by IR led and the infrared light is reflected by the surface. The intensity of radiation generated electron-hole pair which in turn produces leakage current. This current thus generated is sent through a resistor to obtain the proportional voltage. Thus, the greater is the intensity of the incident ray, the larger value of voltage flowing across resistor will be obtained.

BP Sensor
For measuring the blood pressure, we have used here a manual blood pressure monitor instead of a digital one as it is cheaper. It is commonly known as a sphygmomanometer and the kit consists of an arm cuff, a squeeze bulb to inflate the cuff, stethoscope and a sensor to read the pressure. Blood pressure is measure using an air pressure sensor. The readings are in the form of electrical signals. These readings are also converted to digital form to be read by the Raspberry Pi.

GSM Module
The GSM module used here in this paper is GPRS/GSM Quad band Module (SIM900) which offers GPRS connection to our system, and includes the SIM900 communication module from SIMCom. This module can accept any type of sim card having its own unique number. The same can be used to send messages, make calls or create sockets to provide internet connectivity.

4. Discussion and Analysis:

As the title says, the result of Smart Health Monitoring system is of extreme use to patients and doctors as well. The patient can check their health status anytime from the comfort of their homes and visit hospitals only when they really need to. This can be done by using our system whose result are brought online and can be seen from anywhere around the world. Since it is a prototype model, our system shows the almost real time values of various health parameters and emulates how the same can be implemented in the real world. The doctors can also use the log of the patient body condition to study and determine the effect of medicine or other such things. The smart prediction module predicts the disease that the patient is suffering from by asking them for various symptoms they may have and the options are based on the previous symptom.

All sensors are tested and shows the proposed system is capable of handling multiple works in an efficient way and reduces the energy wastage due to human laziness. Some of the basic and important safety features will also be added to the system.

We analyzed the Raspberry-based health monitoring system through IOT. There are two ways to connect and operate the raspberry device; one is directly connecting peripherals and the other way is to connect the computer after install the putty software with IP address, subnet mask, gateway to that system. If any abnormalities notice in the patient health, this will directly report to the authorized or guardian via GSM over the network. The proposed method is modelled for impressive features like easy to use; power consumption is very less and understandable. This system is a good communicator between patient and the doctor.

5. Conclusion and Future Work:

In this paper, we have presented and proved the prototype for an automatic system that guarantees a constant monitoring of various health parameters and prediction of any kind of disease or disorder that prevents the patient from the pain of paying frequent visits to the hospitals. The proposed system can be set-up in the hospitals and massive amount of data can be obtained and stored in the online database. Even the results can be made to be accessed from mobile through an application.

The system can be further improved by adding unsupervised learning approach to system components to facilitate the doctors and the patients. The data, consisting medical history of many patients' parameters and corresponding results, can be explored using data mining, in search of consistent patterns and systematic relationships in the disease. For instance, if a patient's health parameters are changing in the same pattern as those of a previous patient in the database, the consequences can also be estimated. If the similar patterns are found repeatedly, it would be easier for the doctors and medical researchers to find a remedy for the problem.

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