

Internet of Things-Based Intelligent Health Monitoring System

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ABSTRACT

IoT in health monitoring is the main key in providing better medical facilities to patients and facilitating doctors and hospitals as well. The system proposed here consists of various medical devices such as sensors and web-based or mobile-based applications that communicate via a network of connected devices and help monitor and record health data and medical information. The proposed result of this mini research is to build a system to provide a medical monitoring system to patients even in remote areas without a hospital in their area by connecting via the internet and retrieving information via their health status through the wearable device provided in the kit using raspberry pi microcontroller which can record patient's heart rate, blood pressure. The system will provide information to the patient's family members and doctors about the patient's current health status and this system has complete medical information in case of an emergency. Information retrieval can be used to analyze and predict chronic disorders or other diseases such as heart attack at its initial stage using data mining techniques which will also provide a profitable approach to decision making.

Keyword : IoT, Raspberry Pi, Microcontroller



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1. INTRODUCTION

Internet of Things is a concept that aims to expand the benefits of continuously connected internet connectivity. As for capabilities such as data sharing, remote control, and so on, this also includes objects in the real world. For example, foodstuffs, electronics, collections, any equipment, including living things, all of which are connected to local and global networks through sensors that are embedded and always active. In this mini research we will discuss the Health Monitoring system in monitoring patients through devices that conclude the results of various tool parameters in the internet of things. At present Many devices are equipped with medical sensors in the ICU but there are instances where doctors cannot be alerted in the event of an emergency, despite 24 hour monitoring. There may also be constraints in sharing data and information with medical specialists and family members and relatives of patients. The technology that provides this feature is already available but not accessible and affordable to most people in developing countries like Indonesia. This mini research demonstrates a Remote Health Monitoring System controlled by a Raspberry pi.

The Raspberry Pi is a small payment card sized single board microcontroller created to enhance basic computer science education in colleges and developing countries. In this paper, a system is designed to continuously monitor vital parameters such as heart rate, blood pressure and body temperature. The information is then stored on a cloud server database and can be displayed via online websites or mobile applications only by people who have access to it. The idea may not be very new, but we propose an absolute and cheap method for systems using Raspberry pi. The main purpose of this system is to update data online and send alerts to doctors for any changes in the patient's condition and also predict if the patient has other diseases. The former is accomplished by using the MySQL db module to connect the Raspberry pi to the database while the latter is accomplished by a combination of Raspberry Pi and GSM modules and a web interface. This system has a lot of scope in the future because the data collected through monitoring is very valuable and can be used for all kinds of research by the medical community.

The main objectives of this research are as follows:

1. To get real-time medical information about patients via IoT.
2. Processing and classification of information collected about patients.
3. To interpret and predict any illness or disease. In the early stages itself using data mining techniques which will also provide a profitable approach to decision making
4. To provide Internet of Things-based healthcare solutions anytime and anywhere.

2. RESEARCH METHOD/MATERIAL AND METHOD/LETTERATURE REVIEW

In this study, we propose an automated system to monitor a patient's body temperature, heart rate, body movement and blood pressure. We further extend the existing system to predict whether a patient has a chronic disorder or disease using various health parameters and various other system-acquired symptoms.

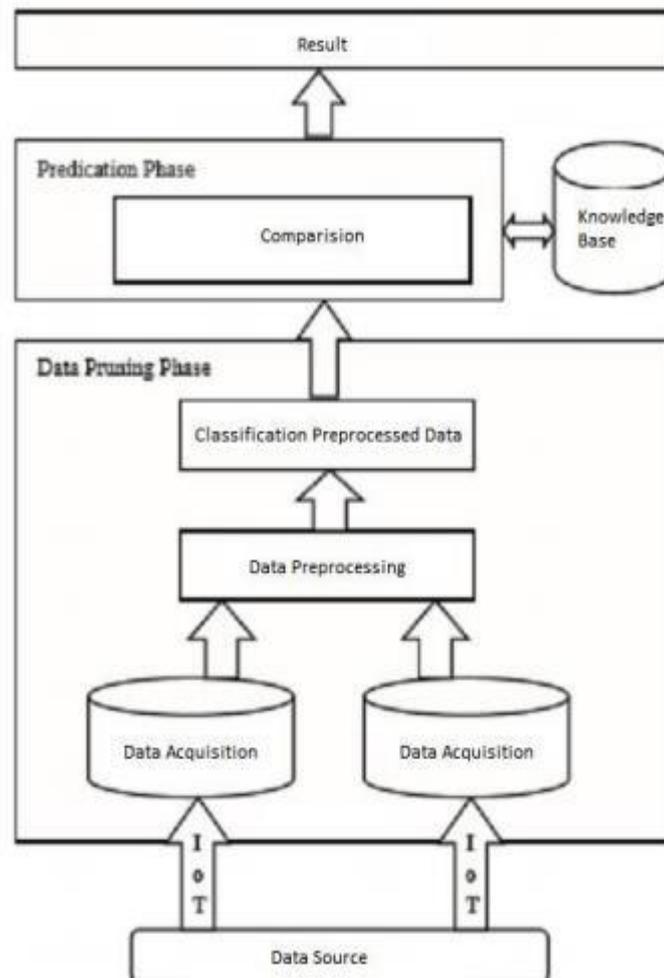


Figure 1. Monitoring System

In Part One

Unprocessed data from various IoT devices is acquired and stored on servers. The device includes various sensors such as temperature sensors, vibration sensors, BP sensors and pulse sensors. Since some sensors provide analog outputs that the raspberry pi cannot use, we first convert those analog values to digital form and use a converter IC. Then using a raspberry pi on which the Linux OS is installed, we write code in python that reads the values from the sensors and updates them into the database periodically.

Second Part

When the information we need we get by filtering, classifying and categorizing the data. *The information obtained is patient health data in real time and the symptoms experienced by the patient*. This information will then be used at the next level to predict whether the patient is suffering from a type of disease. This helps make the system smart and efficient.

Explaining research chronological, including research design, research procedure (in the form of algorithms, Pseudocode or other), how to test and data acquisition [1-3]. The description of the course of research should be supported references, so the explanation can be accepted scientifically [2, 4]. Tables and Figures are presented center, as shown in Table 1 and Figure 1, and cited in the manuscript and should appeared before it.

Third Part

This section is the analysis/predication phase, we use data mining techniques to predict the type and nature of the disease or disorder for which the system is designed. If we use artificial intelligence we can further improve the system by making it smarter. Hence we can infer the disease or disorder by using the existing knowledge base and categorize the results in different categories with Symptoms etc.

System Module :

- 1) Health Monitoring
- 2) Emergency Alert
- 3) Health Status Prediction

1. Health Monitoring

This module consists of the hardware components of the system that make it possible for IoT and is used to record patient health parameters using various sensors. Here, the Raspberry pi acts as a central server where all sensors are connected via GPIO pins or using the MCP3008 analog-to-digital converter if the output is in analog form because the raspberry pi only works on digital signals. The pi reads real-time values and updates them into a mySQL db which can then be used to display them in a web interface.

2. Emergency Alert

This module specifically discusses steps to be taken once an abnormality is detected in a patient's health such as informing family members as well as the hospital. We have defined certain threshold values in our program which if crossed will trigger a warning in the form of email/SMS to the patient's family/doctor.

The various base values used are:

Table 1. Basic Value

Component	Normal Distance
Blood Pressure	80 – 120 mm Hg
Body Temperature	36,5 – 37,5 C
Heart Rate	60 – 100 beats/min

3. Prediction of Health Status

In this module, we use the patient's health data as recorded by our system along with the symptoms they may be experiencing by asking some simple questions and comparing it with the existing knowledge base to predict whether there are diseases/disorders that the patient may be experiencing thereby making it an efficient Expert System. with appropriate data mining techniques.

3. RESULTS AND DISCUSSION

In this study, we have proposed a system in which the patient's body temperature, heart rate, body movements and blood pressure readings are monitored by the system. Various sensors are placed on the patient's body and they take readings and send appropriate signals to the raspberry pi. The Raspberry Pi is a credit card sized single board computer that runs on the Linux OS. Here, various sensors are used to measure the patient's body temperature, heart rate, blood pressure and their

respective results are sent to the database via the Raspberry Pi and can be monitored from anywhere in the world via the internet which is facilitated via the GSM module.

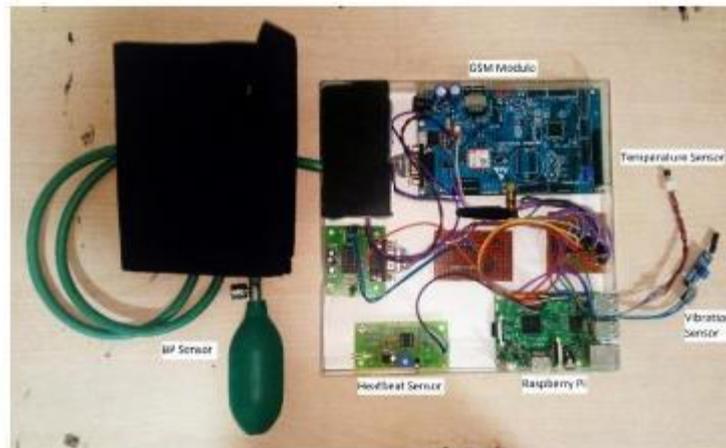


Figure 2. Raspberry Pi

Programming on the Raspberry Pi is done in python and sends data related to patient health to a server that is connected via the internet. The details can be easily accessed online with proper authentication and the patient's health status can be monitored.

The results of the Smart Health Monitoring system are very beneficial for patients and doctors. Patients can check their health status anytime from the comfort of home and visit the hospital only when necessary. This can be done using our system where the results are displayed online and can be viewed from anywhere in the world. Since this is a prototype model, our system shows near real-time values of various health parameters and mimics how the same can be applied in the real world. The doctors can also use the patient's body condition records to study and find out the effects of drugs or other things like that.

SERIAL NO.	TEMPERATURE	BLOOD PRESSURE	HEART RATE	VIBRATION	DATE TIME
1	30.94	60	Normal	N	2017-04-10 13:11:20
2	30.94	61	Normal	N	2017-04-10 13:11:11
3	31.26	68	Normal	N	2017-04-10 13:11:03
4	30.94	70	Normal	N	2017-04-10 13:10:52
5	30.94	67	Normal	N	2017-04-10 13:10:43
6	30.94	69	Normal	N	2017-04-10 13:10:34
7	30.62	41	Normal	N	2017-04-10 13:10:26
8	30.94	41	Normal	N	2017-04-10 13:10:18
9	30.94	41	Normal	Y	2017-04-10 13:10:07
10	30.94	42	Normal	Y	2017-04-10 13:09:58
11	30.94	40	Normal	Y	2017-04-10 13:09:48
12	30.94	40	HS	N	2017-04-10 13:09:38

Figure 3. Smart Healthcare Monitoring System

4. CONCLUSION

In this mini research, we have presented and proven a prototype for an automated system that guarantees constant monitoring of various health parameters and prediction of any kind of disease or disorder preventing patients from feeling sick due to frequent hospital visits. The proposed system can be set up in a hospital and a large amount of data can be obtained and stored in an online database. Even the results can be made to be accessed from the cellphone via the application. The system can be further enhanced by adding components of an artificial intelligence system to make it easier for doctors and

patients. The data, which consists of the medical history of many patient parameters and the corresponding results, can be explored using data mining, to look for consistent patterns and systematic relationships in the disease. For example, if a patient's health parameters change in the same pattern as the previous patient in the database, the consequences can also be estimated. If a similar pattern is found repeatedly, it will be easier for doctors and medical researchers to find a solution to the problem.

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