

Healthcare Monitoring System for Palliative Care

Shandry K K, Arun Krishnan, Athira Rajendran, Athulya Sabu, Haritha P S

Abstract- The project proposes an efficient implementation for IoT (Internet of Things) used for monitoring the health of a patient via a mobile application. IoT in healthcare is the key player in providing better medical facilities. The proposed system here consists of various medical devices such as sensors and mobile based applications. After detecting an abnormal condition an alert notification is triggered. The system would be smart to intimate the patient's family members and their doctor.

1. INTRODUCTION

The project proposes an efficient implementation for IoT (Internet of Things) used for monitoring the health of a patient via a web or mobile application. The Internet of things is the inter-connection of devices, apps, sensors and network connectivity that enhances these entities to gather and exchange data. The distinguishing characteristic of Internet of Things in the healthcare system is the constant monitoring a patient through checking various parameters and also infers a good result from the history of such constant monitoring. There could be instances where the doctor couldn't be alerted in time when there is an emergency, despite of 24 hours of monitoring. Also there might be hurdles in sharing the data and information with the specialist doctors and the concerned family members and relatives. The technology that enhances these features is already available but is not accessible and affordable by most of the people.

This project demonstrates a Remote Health Monitoring System controlled by Raspberry pi. The Raspberry Pi is a very cheap computer that runs Linux, but it also provides a set of GPIO (general purpose input/output) pins that allow you to control electronic components for physical computing and explore the Internet of Things (IoT). In this project, 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 database and can be displayed through a mobile application. The main objective of this system is to update the data online and send an alert to the doctors for any abnormality. 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.

Health monitoring with wearable sensor and implantable body sensor networks will increase detection of emergency conditions in at risk patients. Also, this system is useful to operate remotely because of in built Wi-Fi in raspberry pi that we are using in system, hence sensors and software system can remotely work because of integration of all components. In this system, we are using sensor to detect biological parameters and it processes along with raspberry pi and that all hardware component is integrated with software system to display data to user and user can able control system.

2. LITERATURE SURVEY

A. Real Time Wireless Health Monitoring Application using Mobile Devices

Patient monitoring system and control using feedback and GSM technology is used to monitor the different parameters of an ICU patient remotely and also control over medicine dosage is provided. This system enables expert doctors to monitor vital parameters viz body temperature, blood pressure and heart rate of patients in remote areas of hospital as well as he can monitor the patient when he is out of the premises.

B. A Multi-Alert Patient Health Monitoring using Zigbee

Wireless sensor network is a growing field showing tremendous applications in the areas of medical assistance in hospitals. According to the Medical Statistics, everyday many patients' lives are affected due to negligence in the part of providing immediate care to the patients. Sometimes it is difficult for the

staff in the hospitals to race against the time to reach the patient. Solution to this is a need of system that can measure patient health constantly. The main goal of this paper is to alert the staff in the hospitals in case of emergency. This system is designed using sensors and wireless technology with the help of Microcontroller. Sensors will continuously monitor the vital signs until an abnormal condition is detected. After detecting the abnormal condition, alert system comes into action which acts as a multi-alert system.

C. GSM based Tele Alert System

A module that provides mobility to the doctor and the patient, by adopting a simple and popular technique, detecting the abnormalities in the bio signal of the patient in advance and sending an alert SMS to the doctor through Global system for Mobile(GSM) thereby taking suitable precautionary measures thus reducing the critical level of the patient.

D. Automatic Health Monitoring System using Raspberry Pi

In the advancement of Internet technologies all machineries are inter related. Using the technology improvement, we can make many things in high effective and simple for human life. There are several places of Internet of Things (IOT) is used. Such as smart environment, smart home, smart city, smart parking, agriculture fields and medical fields.. In this paper, monitor patients heart rate, body temperature, Respiration rate and body movements using Raspberry Pi . After connecting Internet to the Raspberry Pi board it act as a server. If these parameters are goes to abnormal, it will automatically sends alert message to the doctor. The data send by Raspberry pi is stored on a server. The detailed information of patients and doctor is registered through website on stored on server. The website can be accessible from anywhere only for patients, it also useful for normal people to check the health status by using wearable devices with sensors. Wireless Sensor Network (WSN) for monitoring patients physiological conditions continuously using Raspberry Pi for acquiring the observed patients physiological signal.

E. Secured Smart Healthcare Monitoring System based on Internet of Things (IOT)

In modern world, technology is playing a major role in healthcare and in almost all fields not only for sensor devices but also in communication. Internet of things plays prominent role in wide range of healthcare applications and it serves as a catalyst for the healthcare. Smart devices and wireless sensor networks are used for real time analysis of various health parameters of patients, the design and implementation of an e-health monitoring network system is done. The main aim is to develop a set of modules which can facilitate the diagnosis for the doctors through tele monitoring of patients. To monitor the health parameters of the patient remotely, the set of various sensors are used. These sensors are used to sense the data and then that data will be sent to the server using wifi module. The patients are monitored by the doctor in real time on the basis of the data received through the server. For any future obstacles and for easy access and processing for planning and prediction, this architecture is used to store the medical history of the patient on cloud and hence for monitoring single patient particularly at home as well as in hospitals and public healthcare units.

F. HealthGear: A Real-time Wearable System for Monitoring and Analyzing Physiological Signals

We present HealthGear, a real-time wearable system for monitoring, visualizing and analyzing physiological signals. HealthGear consists of a set of non-invasive physiological sensors wirelessly connected via Bluetooth to a cell phone which stores, transmits and analyzes the physiological data, and presents it to the user in an intelligible way. In this paper, we focus on an implementation of HealthGear using a blood oximeter to monitor the user's blood oxygen level and pulse while sleeping. We also describe two different algorithms for automatically detecting sleep apnea events, and illustrate the performance of the overall system in a sleep study with 20 volunteers.

3. PROPOSED

SYSTEM 3.1 Product features

The project proposes an efficient implementation for IoT (Internet of Things) used for monitoring the health of a patient via a web and mobile application. We propose an automatic system to monitor patient's body temperature, heart rate, body movements and blood pressure. The health parameters are taken using the IoT kit and the result is updated automatically to

the mobile application. The patients and the doctor can view the details. The doctor can also update medicines to the system. If there is any abnormality in the health parameters an alert notification is triggered to the doctor.

3.2 System Architecture

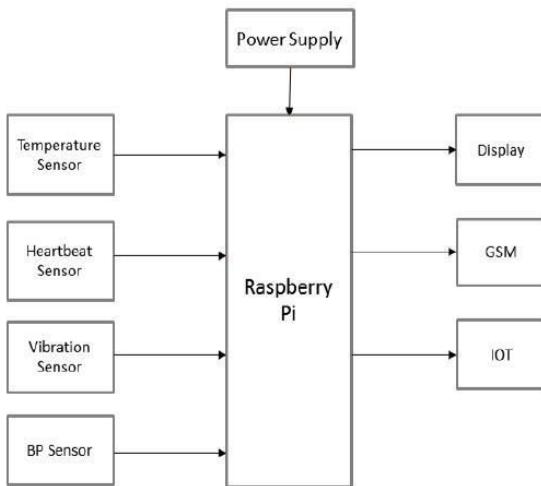


Fig 1: System architecture

3.3 System Modules

1. 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 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 database which is then used to display them on the mobile interface.

2. Health Status System

In this module, we use the patient's health data is recorded by our system. The medicines prescribed by the doctors are also contained in this module. When certain

threshold value of BP or temperature or heart rate is crossed, a notification is triggered.

Component	Normal Range
Blood Pressure	80-120 mm Hg
Body Temperature	36.5-37.5C
Heart Rate	60-100 beats/min

Table 1: Threshold Values

4. HARDWARE IMPLEMENTATION

4.1 Hardware Requirements

- *Raspberry Pi*

The Raspberry Pi is a very cheap computer that runs Linux, but it also provides a set of GPIO (general purpose input/output) pins that allow you to control electronic components for physical computing and explore the Internet of Things (IoT). For, the proposed system we'll be using Raspberry Pi board version 3. The Raspberry Pi and IoT together prove to be a pioneer innovation technology in healthcare system.

- *Temperature Sensor*

LM35 is a temperature measuring device having an analog output voltage proportional to the temperature. It provides output voltage in Centigrade (Celsius). It does not require any external calibration circuitry. LM35 gives temperature output which is more precise than thermistor output. Main advantage of LM35 is that it is linear i.e. $10\text{mv}/^\circ\text{C}$ which means for every degree rise in temperature the output of LM35 will rise by 10mv. So if the output of LM35 is $220\text{mv}/0.22\text{V}$ the temperature will be 22°C . So if room temperature is 32°C then the output of LM35 will be 320mv i.e. 0.32V .

- *Heartbeat Sensor*

Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heartbeat. This digital output can be connected to microcontroller directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

- *Vibration Sensor*

The vibration sensor used in here senses the shaking of the surrounding and hence we use it here to monitor whether the patient is shivering so that proper aid can be given.

Ideally, the two contacts of sensor don't touch each other. When by any external force these two contacts touch each other and when the force is removed the sensor terminals separate. The on-board blue LED visually indicates communication online and activation.

- *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.

- *ADC*

The MCP3008 is a low cost 8-channel 10-bit analog to digital converter. This chip is a great option if one needs to read simple analog signals, like from a temperature or light sensor.

- *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.

4.2 Hardware Implementation

The Internet of things (IoT) is a system of interrelated computing devices, mechanical and digital machines provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

Patient's body temperature, heart rate, body movements and blood pressure reading results that are being monitored by the system. The various sensors are placed on the patient's body and they take the readings and send the corresponding signal to the raspberry pi. The Raspberry Pi is a credit card-sized single-board computer that operates on 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 Raspberry Pi and can be monitored from anywhere worldwide through the internet facilitated via GSM module.

5. SOFTWARE IMPLEMENTATION

5.1 Front End

- *Flutter*

Flutter – a simple and high performance framework based on Dart language, provides high performance by rendering the UI directly in the operating system's canvas rather than through native framework.

Flutter also offers many ready to use widgets (UI) to create a modern application. These widgets are optimized for mobile environment and designing the application using widgets is as simple as designing HTML.

To be specific, Flutter application is itself a widget. Flutter widgets also supports animations and gestures. The application logic is based on reactive programming. Widget may optionally have a state. By changing the state of the widget, Flutter will automatically (reactive programming) compare the widget's state (old and new) and render the widget with only the necessary changes instead of re-rendering the whole widget.

5.2 Back End

- *Firebase*

Firebase is a backend platform for building Web, Android and IOS applications. It offers real time database, different APIs, multiple authentication types and hosting platform. Firebase can power your app's backend, including data storage, user authentication, static hosting, and more. Focus on creating extraordinary user experiences. We will take care of the rest. Build cross-platform native mobile and web apps with our Android, iOS, and JavaScript SDKs. You can also connect Firebase to your existing backend using our server-side libraries or REST API.

Firebase is a set of tools offered by Google to build excellent scalable applications in the cloud. It is a powerful service that helps in building applications quickly without reinventing the components or modules. Services like analytics, authentication, databases, configuration, file storage, push messaging are provided by firebase thereby making it easy for the developers to focus on the user experience of the application.

6. RELEVANCE

IoT in healthcare is the key player in providing better medical facilities. The main aim of the project is to obtain the real-time medical information about a patient via IoT. By this system the routine checking of the patient can be done easily. Thus the time is saved for both patients and doctor. This system is to provide Internet of Things based healthcare solutions at anytime and anywhere.

7. RESULT

The result of 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.

8. CONCLUSION

In this project, we have presented and proved the prototype for an automatic system that guarantees a constant monitoring of various health parameters 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 further by adding artificial intelligence 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.

8. REFERENCE

- B. G. Ahn, Y. H. Noh, and D. U. Jeong. Smart chair based on multi heart rate detection system. In *2015 IEEE SENSORS*, pages 1–4, Nov 2015.
- Z. Zhiao, Chnaowei, z. Nakdahira, "Healthcare application based on Internet of Things," Proc. IEET Int. ConfE. on. Technolgy. Application., pp. 661-662, Nov. 2013.
- R. Kumar, M.P. Rajasekaran, "An IoT based patient monitoring system using raspberry pi," *International Conference on Computing Technologies and Intelligent Data Engineering (ICCTIDE'16)*, pp. 1-4, Jan 2016.
- S. H. Almotiri, M. A. Khan, and M. A. Alghamdi. Mobile health (m-health) system in the context of iot. In *2016 IEEE 4th International Conference on Future Internet of Things and Cloud Workshops (FiCloudW)*, pages 39–42, Aug 2016.
- M.M. Masud, M.A. Serhani, A.N. Navaz, "Resource-aware mobile-based health monitoring", *IEEE Journal of Biomedical and Health Informatics*, vol. 21, no. 2, pp. 349-360, March 2017.