

# An IoT Based Smart Healthcare System Using Raspberry Pi

Raghavendra K K, Sharanya P S, Shaila Patil

*Assistant Professor, Department of Computer Science and Engineering,  
Vivekananda College of Engineering and Technology, Puttur, Karnataka, India*

**Abstract**— In the recent development Internet of Things (IoT) makes all objects interconnected and it has been recognized as the next technical revolution. Some of the applications of Internet of Things are smart parking, smart home, smart city, smart environment, industrial places, agriculture fields and health monitoring process. One such application is in healthcare to monitor the patient health status. The system is aimed to prevent delays in the arrival of patients medical information to the healthcare providers, particularly in accident and emergency situations, to stop manual data entering, and to increase beds capacity in hospitals, especially during public events where a large number of people are meeting in one place. The architecture for this system is based on medical sensors which measure patient's physical parameters by using wireless sensor networks (WSNs). These sensors transfer data from patient's bodies over the wireless network to the cloud environment. Thus Internet of Things in the medical field brings out the solution for effective patient monitoring at reduced cost and also reduces the trade-off between patient outcome and disease management. In this paper we discuss about, monitoring patient's body temperature, heartbeat, blood pressure, ECG and body movement using Raspberry Pi board.

**Keywords**— Raspberry Pi board; Heartbeat sensor; Temperature sensor; Blood pressure sensor; Accelerometer sensor; ECG sensor; Internet of Things.

## I. INTRODUCTION

The Internet of Things is the internetworking of physical devices, vehicles, buildings, and other items—embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. IoT can be used in monitoring patient's health parameters. The unexpected occurrence in patient's are monitored using IoT. In this paper specialized sensor is used to monitor patient's heart rate, body temperature, body movement, blood pressure and ECG.

One of the key learning platforms for IoT is the Raspberry Pi. The Raspberry Pi is a popular platform because it offers a complete Linux server in a tiny platform for a very low cost. The Raspberry Pi allows interfacing services. The combination of Raspberry Pi and IoT becomes a new innovation technology in healthcare system. Raspberry Pi is act as a small clinic after connecting these (Temperature, Blood pressure, Accelerometer, Heartbeat and ECG) sensors. Raspberry Pi collects data from sensors and then it transfer to cloud. Cloud Computing is a general expression for any technological services provided through the Internet. Cloud

computing provides compatible and on-demand network access for numerous computing resources such as networks, systems, applications, and services. Moreover, cloud computing are using modern and flexible methods to provide, manage, and pay for information technology services with minimal management effort and cost. Cloud computing technology has several advantages such as flexibility, highly auto-mated, low cost, fast services providing, and a huge storage capacity. The Cloud's features enable customers to build, test, and deploy their applications on virtual servers using different infrastructures and multiple operating systems.

In this paper, we focus on the idea of integration between wireless sensor network and cloud computing. After health sensors that are connected to patients' bodies collect and transmit data to the cloud, services which are available in this cloud are responsible for receiving, storing, processing, and distributing this data.

## II. RELATED WORK

Dohr et al [1] monitors blood pressure level using Keep In Touch (KIT) and closed loop healthcare services. In KIT method, KIT is connected to the JAVA based mobile phone with the help of near field communication. It works on magnetic, inductive coupling and then the distance is short. After touching the KIT, the data is send to mobile phone. In closed loop services, the data is getting from mobile phone, and then the data is send to the secure website. Using this website anybody can monitor patient's blood pressure level.

Junaid Mohammed et al [2] monitors patient's ECG wave anywhere in the world using IOIO- OTG Microcontroller. Android application is created for ECG Monitoring. IOIO-OTG microcontroller is connected to android phone using USB cable (or) Bluetooth dongle. After collecting data, the wave is send to android application. Monitor and store ECG waves in that android based application.

Mohammed S. Jasses et al [3] focused on body temperature monitoring using Raspberry pi board in cloud based system. In this paper, Raspberry pi monitors body temperature and then these parameters are transfer by wireless sensor networks (WSN). Then these data's are added to the cloud based websites. Using this website one can monitor body temperature.

Hasmah Mansor et al [4] monitor body temperature using LM35 temperature sensor. The LM35 temperature sensor is connected to the Arduino uno board. After that creating a website in SQL database format. Arduino uno board is connected to that website. Then sensor output is sent to the website. Using this website anybody can monitor body temperature in login process.

Deepika Agrawal et al.[5] proposed an IoT-based healthcare monitoring system that collects all the medically relevant data of patients, including patients heart rate, blood pressure and ECG and sends alerts to the patient's doctor regarding patients full medical information, providing a fast and reliable health care service.

### III. EXISTING SYSTEM

In the traditional approach the healthcare professionals play the major role. They need to visit the patient's ward for necessary diagnosis and advising. There are two basic problems associated with this approach. Firstly, the healthcare professionals must be present on site of the patient all the time and secondly, the patient remains admitted in a hospital, bedside biomedical instruments, for a period of time.

In order to solve these two problems, the patients are given knowledge and information about disease diagnosis and prevention. Secondly, a reliable and readily available patient monitoring system (PMS) is required.

### IV. PROPOSED SYSTEM

We have proposed a robust health monitoring system that is intelligent enough to monitor the patient automatically using IOT. It collects the status information through these systems which would include patient's temperature, body movement, heart rate, blood pressure and ECG and sends an emergency alert to patient's doctor as well as to the caretaker with his current status. This would help the doctor and caretaker to monitor his patient from anywhere in the world. The system uses smart sensors that generates raw data information collected from each sensor and send it to a cloud server where the data can be further analyzed and statistically maintained to be used. The proposed method of patient monitoring system monitors patient's health parameters using Raspberry Pi. After connecting internet to the Raspberry Pi it acts as a server. Then the server automatically sends data to the website. Using IP address anybody can monitor the patient's health status anywhere in the world using laptops, tablets and smart phones. If these parameters goes abnormal it will automatically sends alert SMS to the doctors and relatives. Block diagram of system is shown in below Fig- 1.

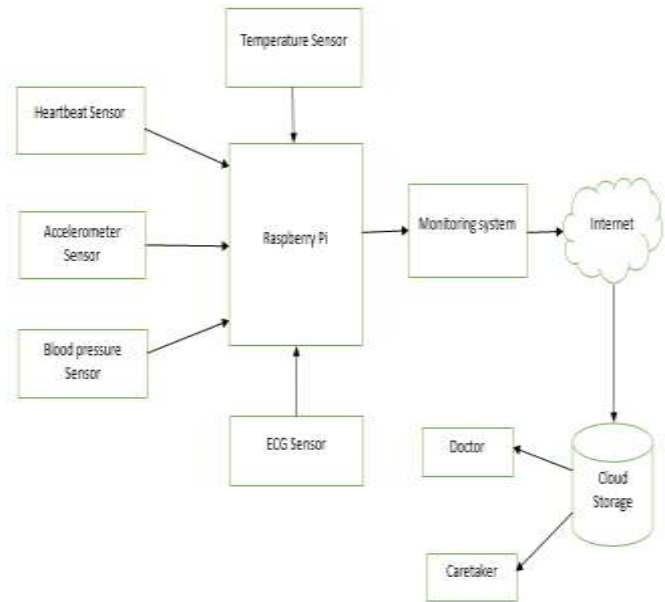


Fig- 1: Functional Block Diagram of System

### IV. METHODOLOGY

This paper uses Raspberry Pi Board as an IOT device that interfaces five sensors and read the patient health parameters.

These health parameters will be sent to cloud. Doctor and caretaker can access these values from cloud.

The figure (Fig-2 and Fig- 3) below shows hardware setup and flowchart of the system.



Fig- 2: Hardware connection setup for Remote Patient Monitoring system using Raspberry Pi

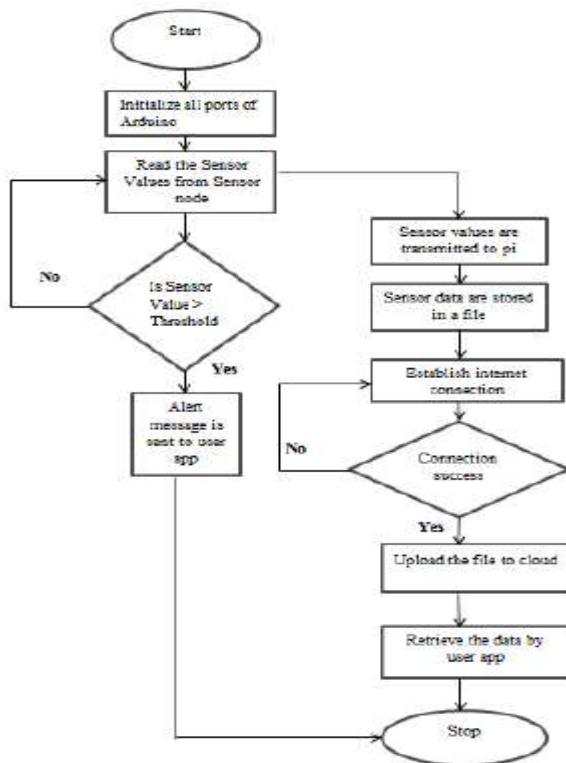


Fig- 3: shows flowchart for Remote Patient Monitoring System

### 1. Raspberry pi

It is a credit card sized computer. It is series of small single board computers. It doesn't include peripherals.

### 2. Temperature sensor

Temperature sensor DS18B20 is a one-wired sensor that can measure temperature with a minimal amount of hardware and wiring. This sensor uses a digital protocol to send accurate temperature readings directly to the development board without need of a digital to analog converter.

### 3. Heartbeat sensor

Heart rate is the speed of the heartbeat measured by the number of contractions of the heart per minute (BPM). The heart rate can vary according to the body's physical needs, including the need to absorb oxygen and excrete carbon dioxide. It is usually equal or close to the pulse measured at any peripheral point. Activities that can provoke change include physical exercise, anxiety, sleep, stress, illness, and ingestion of drugs. Many texts cite the normal resting adult human heart rate range from 60 to 100 BPM. Tachycardia is a fast heart rate, defined as above 100 BPM at rest. Bradycardia is a slow heart rate, defined as below 60 BPM at rest. Several studies, as well as expert consensus indicate that the normal resting adult heart rate is probably closer to a range between 50 to 90 BPM. During sleep a slow heartbeat with rates around 40 to 50 BPM is common and is considered normal. When the heart is not beating in a regular pattern, this is

referred to as an arrhythmia. Abnormalities of heart rate sometimes indicate disease.

### 4. Accelerometer sensor

Accelerometer sensor ADXL345 gives a digital output, 3-axis accelerometer whose low power consumption and built in features make it ideal for use in a wide variety of applications. In this paper we are using this sensor to measure both position and orientation of a patient.

### 5. ECG

ECG sensor AD8232 is the process of recording the electrical activity of the heart over a period of time using electrodes placed on the skin.

These electrodes detect the tiny electrical changes on the skin that arise from the heart muscle's electro-physiological pattern of depolarizing during each heartbeat. It is very commonly performed cardiology test.

### 6. Blood Pressure

Blood pressure sensor is a sensor designed to measure human blood pressure. It measures systolic, diastolic and mean arterial pressure utilizing the oscillometric technique.

### 7. Cloud

Cloud computing is a type of Internet-based computing that provides shared computer processing resources and data to computers and other devices on demand. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources (e.g., computer networks, servers, storage, applications and services). Cloud computing and storage solutions provide users and enterprises with various capabilities to store and process their data in third-party data centers.

## V. CONCLUSION

The integration between wireless sensor networks and cloud computing will create a new generation of technology in many aspects such as patient monitoring with minimal cost, reducing the number of occupied beds in hospitals, and improving medical staff performance. Plan to enhance the functionality of the system by adding more sensors and using it to collect data from a larger sample size of patients. Below figure shows sample output obtained.

body_temp	
Date	body_temp
April 24 2018 at 17:42:28	91.9616
April 24 2018 at 17:42:20	91.9616
April 24 2018 at 17:42:12	91.9616
April 24 2018 at 17:42:04	91.9616
April 24 2018 at 17:41:57	91.9616

Fig- 4: Sample output

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