

## REMOTE PATIENT HEALTHCARE MONITORING SYSTEM USING ARDUINO AND RASPBERRY PI

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**Abstract:** Now a days continuous patient health monitoring is becoming a key concern for the doctors since it can help them save patient's life. So our main objective is to design a patient monitoring system which can monitor various physiological data of patient who is remotely placed and make available this real time data to the doctor. The data is made available over the internet so that doctor can access this data from anywhere in the world. Remote patient monitoring reduces the need of doctor's visit to the patient. This saves doctor's time which they can devote to other patient. The advantages of a patient monitoring system are it can reduce the risk of infection and other complication in order to make the patients comfortable. Furthermore, implement of patient monitoring in hospitals might reduce the costs in terms of installation and also maintenance of wiring. In this entire system IOT plays a major role in providing many applications and services and Raspberry Pi used here is not just a sensor node but also a controller. It is a smart device which can sense, gather and publish this data over the internet. Paper proposes a generic health monitoring system as a step forward to the progress made in this department till now.

**Keywords:** Raspberry pi, IoT, pulse rate monitor, body temp sensor, Healthcare system

### I. INTRODUCTION

This system is a combination of a hardware and software. The hardware consists of arduino uno, raspberry pi 3 model B, sensors (temperature sensor, pulse rate sensor, PIR motion sensor), sd card. The software includes Arduino IDE for programming in arduino and Putty software for raspberry pi. The programming languages needed for this system are C Language, Python and Javascript. C language is used to program all these sensors while Python is used to collect data from these sensors. The role of Javascript here is to make available all the sensor data over the cloud. Arduino Uno is a widely used microcontroller board based on Atmega328P microcontroller board. Raspberry Pi uses a very powerful operating system. Its operating system is Raspbian which is a distribution of Linux called Debian. It supports Python programming environment. Raspbian provides more than a pure OS: it comes with over 35,000 packages; pre-compiled software bundled in a nice format for easy installation on your Raspberry Pi [1]. Putty configuration and VNC viewer are needed to install Raspbian OS. Putty configuration is SSH and Telnet client. It is open source software that is available with source code.

### II. SYSTEM ARCHITECTURE

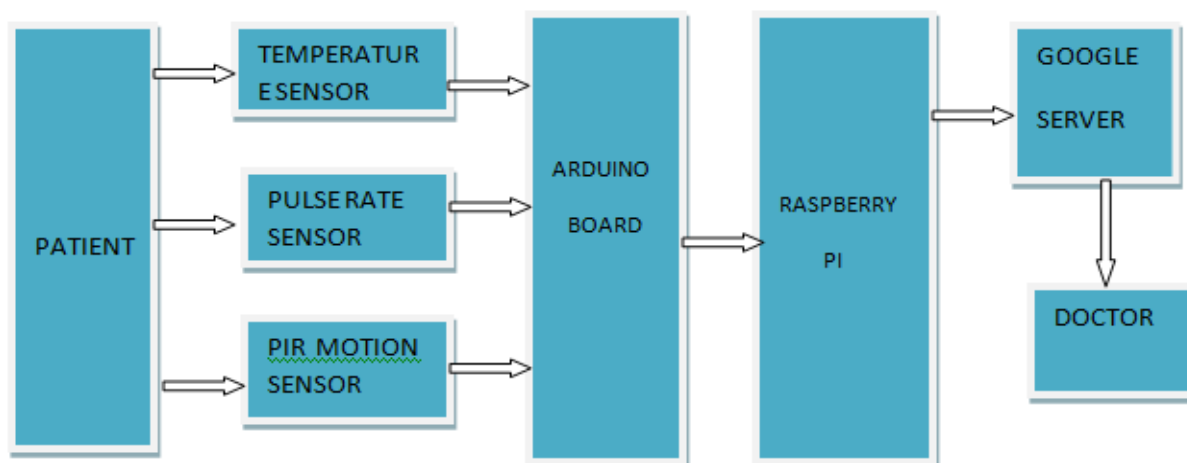


Fig 1: Block diagram of the remote patient monitoring system.

In this architecture three sensors are used to monitor patient such as temperature sensor, pulse rate sensor and motion sensor. These sensors are connected to the arduino board as shown in fig1. Arduino in turn is connected to the raspberry pi. Raspberry Pi is a smart device which has a built-in wifi so it collects the sensed data from the arduino board and send it to the google server from where the doctor can access the data.

#### **Hardware Design:**

**1. Arduino board** (ATmega 328P microcontroller): It is a single-chip microcontroller created by Atmel in the mega AVER family [2]. The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz [3]. The ATmega328 is commonly used in many projects and autonomous systems where a simple, low-powered, low-cost micro-controller is needed. Perhaps the most common implementation of this chip is on the popular Arduino development platform, namely the Arduino Uno and Arduino Nano models.

**2. Sensors:** The sensors used here are temperature sensor(DS18B20),Pulse Rate Sensor,PIR Motion Sensor

**Temperature Sensor(DS18B20):** DS18B20 is 1-Wire digital temperature sensor from Maxim IC which means that require only one pin to communicate with the microcontroller. Reports degrees in Celsius with 9 to 12-bit precision, from -55 to 125 (+/-0.5). Each sensor has a unique 64-Bit Serial number etched into it - allows for a huge number of sensors to be used on one data bus.

**Pulse Rate Sensor:** Pulse Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart rate data into their projects. The sensor clips onto a fingertip or earlobe and plugs right into Arduino. It also includes an open-source monitoring app that graphs your pulse in real time.

**PIR Motion Sensor:** PIR sensors are more complicated than many of the other sensors because there are multiple variables that affect the sensors input and output. The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected. This sensor may be used for patient who are in coma.

**Raspberry Pi 3 Model B:** The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. There are different types of raspberry pi model available, such as Model A, Model B, Model B+ out of which I have used Raspberry Pi 3, Model B. The board contains a processor, graphics chip, RAM memory, interfaces to other devices and connectors for external devices. It has 1.2 GHz 64-bit quad-core ARMv8 CPU, 1 GB RAM. It uses an SD card for booting and storage. It has Bluetooth 4.1, bluetooth low energy and wireless LAN[5]. The main advantage of Raspberry Pi is that it has a large number of applications. It also has 4 pole stereo output and composite video port. Video processing applications are also possible using raspberry pi like video compression. Compressed video can successfully decrease the bandwidth required to transmit the video through terrestrial broadcast, cable TV, or satellite TV services. Its Operating System are Ubuntu Mate, RISC OS, Arch Linux, Raspbian, Pidora out of which I have used Raspbian operating system.

#### **Software used:**

**Arduino IDE:** The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. The Arduino IDE supports the languages C and C++ using special rules of code structuring.

**Putty Software and VNC Viewer:** Putty Software is installed to run Raspberry Pi and VNC viewer is used to view Raspberry Pi window. Putty is an SSH client that one can use to connect to a machine running that service – it's relatively

secure but you only have a CLI and no GUI.VNC is like a Windows Remote Desktop feature secure where one can actually see the desktop environment on which you are working [4].The problem with this is that it is relatively resource heavy and eats up a substantial portion of bandwidth(network dependent of course).What I do when I need to actually see my desktop is I open up an SSH session and then use VNC to connect via that secure session.

### Connecting Arduino to Raspberry Pi

Step1: Firstly we have to install python serial package.

The following step explains how to communicate external devices serially using serial communication

Step A: initially we have to download and install python serial package called py serial from

<https://pypi.python.org/pypi/pyserial>

Step B: unzip the file and enter into that folder using command

**cd "package name"**

Step C: inside that there will be setup file known as setup.py. install software by running command

**sudo python setup.py install**

Step2: Next we have to install arduino raspberry, which can be done by using command

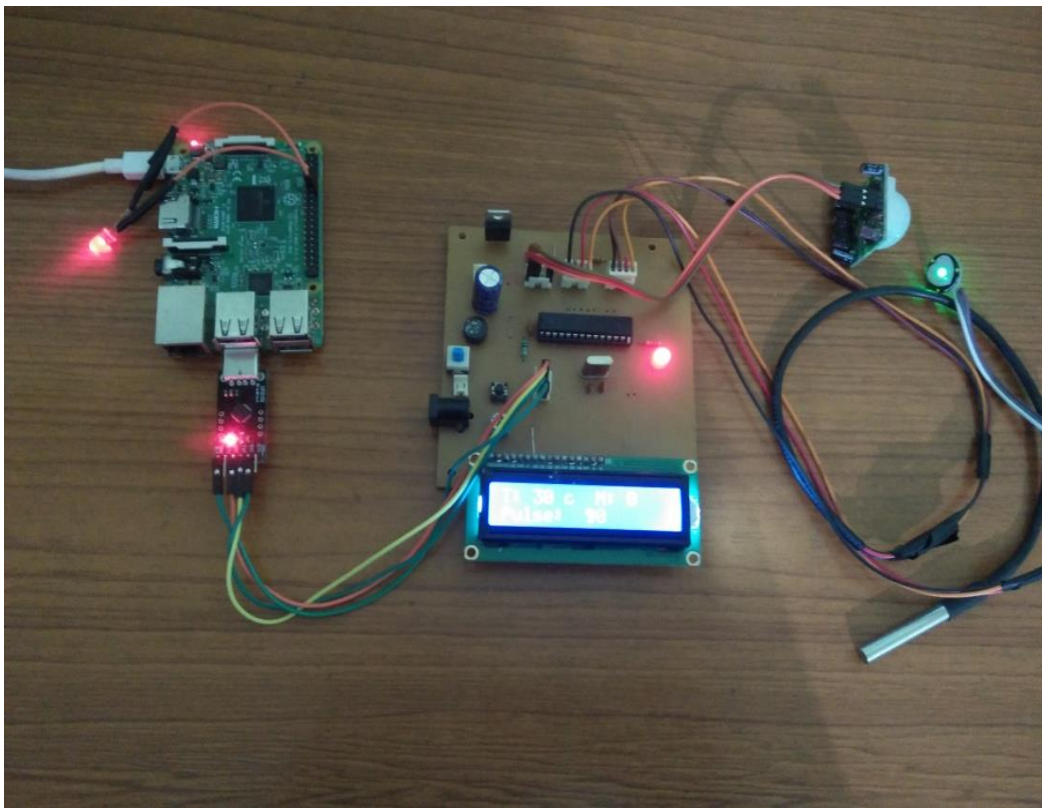
**Sudo apt-get install arduino**

Step3: open a sketch and type following program in it

```
void setup(){ Serial.begin(9600); }  
void loop(){ Serial.println("Hello Pi"); delay(2000); }
```

This program prints hello pi in raspberry serial terminal.

### III. DESIGN OF PROTOTYPE

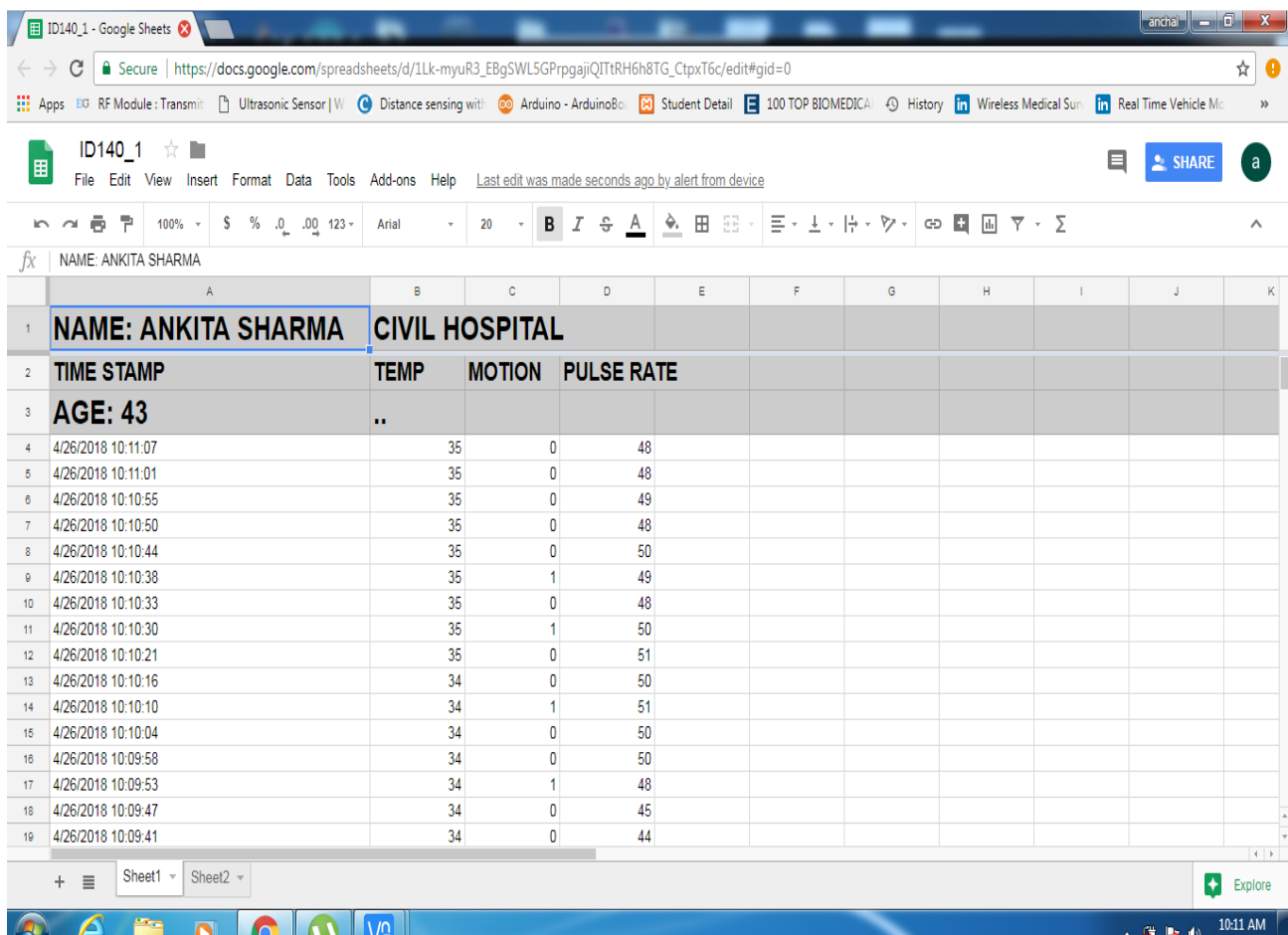


In the given system required sensors are attached to the patient. The sensors are connected to the arduino board. These sensors then measure the various physiological data of the patient such as body temperature, pulse rate and motion of the patient. Arduino IDE is used as a platform to do all the programming for sensors.The programming here is done in C

language. The sensed data is then collected from arduino unit. These sensors signals are send to the Raspberry Pi . Raspberry pi is a Linux based operating system works as a small pc processor system. Python programming is done here to collect data from the sensor. This data is then send and displayed over the internet. The google server is used to collect this data and display it to the doctor. Java Script is used to make available this data over the internet. The patient data can be monitored in the monitor screen of computer using Raspberry Pi as well as it can be monitored anywhere in the world using internet source. We have created a excel sheet as a database and shared the same sheet to the doctor and the patient. Both the doctor and the patient can continuously monitor the collected data from the patient. This system give access to the real time monitoring of the patient. 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 send alert mail to the doctors .

#### IV. RESULT:

##### Real time data on the google sheet:



|    | A                   | B              | C      | D          | E | F | G | H | I | J | K |
|----|---------------------|----------------|--------|------------|---|---|---|---|---|---|---|
| 1  | NAME: ANKITA SHARMA | CIVIL HOSPITAL |        |            |   |   |   |   |   |   |   |
| 2  | TIME STAMP          | TEMP           | MOTION | PULSE RATE |   |   |   |   |   |   |   |
| 3  | AGE: 43             | ..             |        |            |   |   |   |   |   |   |   |
| 4  | 4/26/2018 10:11:07  | 35             | 0      | 48         |   |   |   |   |   |   |   |
| 5  | 4/26/2018 10:11:01  | 35             | 0      | 48         |   |   |   |   |   |   |   |
| 6  | 4/26/2018 10:10:55  | 35             | 0      | 49         |   |   |   |   |   |   |   |
| 7  | 4/26/2018 10:10:50  | 35             | 0      | 48         |   |   |   |   |   |   |   |
| 8  | 4/26/2018 10:10:44  | 35             | 0      | 50         |   |   |   |   |   |   |   |
| 9  | 4/26/2018 10:10:38  | 35             | 1      | 49         |   |   |   |   |   |   |   |
| 10 | 4/26/2018 10:10:33  | 35             | 0      | 48         |   |   |   |   |   |   |   |
| 11 | 4/26/2018 10:10:30  | 35             | 1      | 50         |   |   |   |   |   |   |   |
| 12 | 4/26/2018 10:10:21  | 35             | 0      | 51         |   |   |   |   |   |   |   |
| 13 | 4/26/2018 10:10:16  | 34             | 0      | 50         |   |   |   |   |   |   |   |
| 14 | 4/26/2018 10:10:10  | 34             | 1      | 51         |   |   |   |   |   |   |   |
| 15 | 4/26/2018 10:10:04  | 34             | 0      | 50         |   |   |   |   |   |   |   |
| 16 | 4/26/2018 10:09:58  | 34             | 0      | 50         |   |   |   |   |   |   |   |
| 17 | 4/26/2018 10:09:53  | 34             | 1      | 48         |   |   |   |   |   |   |   |
| 18 | 4/26/2018 10:09:47  | 34             | 0      | 45         |   |   |   |   |   |   |   |
| 19 | 4/26/2018 10:09:41  | 34             | 0      | 44         |   |   |   |   |   |   |   |

Fig 4.2. Real time data on the google sheet

Fig. shows the output of the sensor that is temperature of the patient ,pulse rate and patient motion detection which is represented as 0 and 1(0 for no motion and 1 for motion).The data here is displayed at the delay of every 5 sec.So there is a lot of data flowing per minute.The displays the name and age of the patient.

##### Alert Mail Send to the doctor:

Fig. shows the alert mail send to the doctor in case where the patient data goes abnormal.This data can be accessed through mobile and laptop .

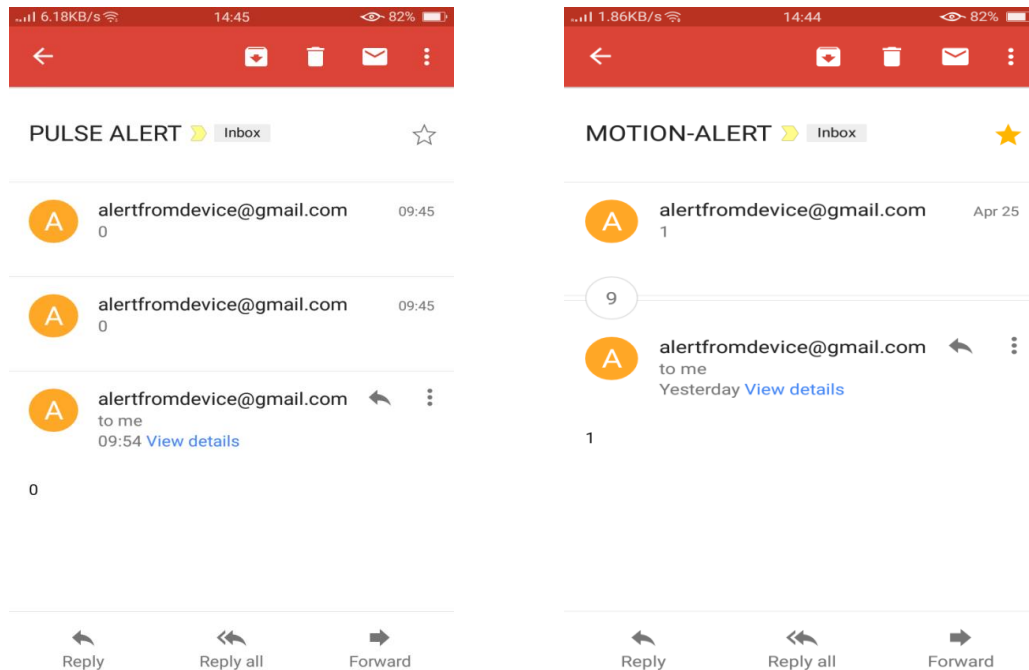


Fig: Pulse Rate and Motion alert mail send to the doctor

### CONCLUSION AND FUTURE SCOPE:

As a conclusion, a prototype of patient monitoring system using wireless sensor network has been successfully developed. Based on the results obtained from the project, it showed that the project achieved the first objective. A wireless communication is successfully created between sensors to the Arduino Board and Raspberry Pi. The system is able to process the information and display real time data on the internet. The sensor data can be monitored through laptop or personal computer wirelessly.

In order to commercialize the device to the public usage, some improvements need to be considered. Therefore, for the future works, more vitals parameters should be added to make it more valuable to the patients. For example, pulse oximeter and blood pressure are added to monitor oxygen concentration and blood pressure of patients.

Another improvement that can be made in this project is replacing the used sensors with some good quality sensors. This might help to make it more functional to the users.

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