PATIENT HEALTH MONITORING SYSTEM USING IOT

Submitted in partial fulfillment of the
Requirements for the degree of

BACHELOR OF ENGINEERING
By

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PROJECT REPORT APPROVAL

This project report entitled **"PATIENT HEALTH MONITORING SYSTEM USING IOT"** by **Mohammad Aamir, Faraz Khan** and **Manthan Kudtarkar** is approved for the degree of **BACHELOR OF ENGINEERING** in **ELECTRONICS AND TELECOMMUNICATION.**

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College Stamp	Principal

Date: 10/07/20

Place: Mumbai

DECLARATION

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misinterpreted or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ACKNOWLEDGEMENT

We take this opportunity in representing the report on our project **"PATIENT HEALTH MONITORING SYSTEM USING IOT".** The completion of any project brings with it a sense of satisfaction, but it is never complete without the appreciating those people who made it possible and whose constant support crowned each effort with success. One cannot even imagine the power of the force that guides us and neither can we succeed without acknowledging it.

We place on record and warmly acknowledge the continuous encouragement, invaluable supervision, timely suggestions, and inspired guidance offered by our Project Guide, **Prof. Neeru Pathak,** in bringing this report to a successful completion. We also thank her for showing keen interest and for providing all the facilities as and when we needed them.

It gives us immense pleasure to express our deepest sense of gratitude and sincere thanks to our esteemed Head of the Department **Dr. Ashwini Kunte** and respected Principal, **Mr. G. T. Thampi** for their revered guidance throughout our dissertation work, which made this task a pleasant job. It was a real delight to work under their guidance.

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ABSTRACT

In this project we have planned to design a compact wireless Patient Health Monitoring System. The idea is to use a Raspberry Pi 3, Arduino Uno,Heartbeat sensor, monitoring circuit, temperature sensor and Wifi module, also a USB to Serial converter to directly get the data on the Doctor's computer. These components play a vital role in monitoring the patient health status. Since time plays a key role in saving a person's life, the device aims at saving time required by the doctor to monitor each and every patient.

The process starts by monitoring of physical parameters like heart beat and temperature readings sending the measured data directly to a Doctor's computer through radio frequency. Radio frequency proves to be a promising in rural areas as internet connection and wifi module facility is not available.

The devices used in this project are very cheap and cost effective and can be widely used for wireless communication within indoor management. It is very easy to assemble and very less errors are introduced. An advantage is there for NRF24L01 transceiver is that by using a antenna the range is increased to more than 100 to 200 meters.

CONTENT AND LIST OF FIGURES

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CHAPTER 1.

INTRODUCTION

A Patient Health Monitoring System is an extension of a hospital medical system where a patient's vital body state can be monitored remotely. Traditionally the detection systems were only found in hospitals and were characterized by huge and complex circuitry which required high power consumption. Continuous advances in the semiconductor technology industry have led to sensors and microcontrollers that are smaller in size, faster in operation, low in power consumption and affordable in cost. According to research, we found that approximately 2000 people died monthly due to the only carelessness of their health.
This is because they don"t have time for themselves and forget about their health management due to a heavy workload. The reason behind to make this project is the growing world of technology and people forget their health checkup which is needed to be done monthly or quarterly. As we all know that internet of things make our life easier. So, we have decided to make an internet of things based healthcare project for people who provide them all the personal information about their health on their mobile and they can check their all historical health data.

The best part of this project is that it can be used by everyone and make our health management easier than available systems. It provides a solution for measurement of body parameters like ECG, Temperature, Moisture, and Heartbeat. It also detects the body condition and location of the patients. This system also generates an alert when it required that means at the time of any critical conditions and notifications about the medicines, location change, conditions etc.

CHAPTER 2.

PROBLEM DEFINITION & OBJECTIVE

Patient Health Monitoring can provide useful physiological information in the home. This monitoring is useful for elderly or chronically ill patients who would like to avoid a long hospital stay. Wireless sensors are used to collect and transmit signals of interest and a processor is programmed to receive and automatically analyze the sensor signals. In this project you are to choose appropriate sensors according to what you would like to detect and design algorithms to realize your detection. The objective of the project was to come up with a system that can monitor and provide physiological information remotely in the home. The monitoring system would be useful for elderly or chronically ill patients who would like to avoid a long costly hospital stay. Wireless sensors would be used to collect and transmit signals of interest and a microcontroller was programmed to receive and automatically analyze the sensor signals. For the devices that require instant intervention by a specialist doctor it was important that they be autonomous, non-invasive to the patient/users everyday life activities. In this way they were to be easy to use, minimal in size and weight, consume less power for maximum use on a single charge, and functional – able to withstand physical shock in the case of fall detection.

In both cases for accurate physiological signal detection, the circuitry in the detection system was crucial. To be able to accurately collect and manage the signal information Integrated circuits and microprocessors were implemented. This was done to minimize the drift voltages and any white noise that could be picked by the detection system.

CHAPTER 3.

LITERATURE SURVEY

1.) Patient-Monitoring Systems, Reed M. Gardner & M. Michael Shabot , Year 2014
To meet the increasing demands for more acute and intensive care required by patients with complex disorders, new organizational units—the ICUs—were established in hospitals beginning in the 1950s. The earliest units were simply postoperative recovery rooms used for prolonged stays after open-heart surgery. Intensive-care units proliferated rapidly during the late 1960s and 1970s. The types of units include burn, coronary, general surgery, open-heart surgery, pediatric, neonatal, respiratory, and multipurpose medical-surgical units. Today there are an estimated 75,000 adult, pediatric, and neonatal intensive care beds in the United States.

2.) IoT-Based Health Monitoring System for Active and Assisted Living, Ahmed Abdelgawad , School of Engineering and Technology, Central Michigan University, Mt. Pleasant, MI 48859, USA , Year 2017. The Internet of Things (IoT) platform offers a promising technology to achieve the aforementioned healthcare services, and can further improve the medical service systems [1]. IoT wearable platforms can be used to collect the needed information of the user and its ambient environment and communicate such information wirelessly, where it is processed or stored for tracking the history of the user [2]. Such a connectivity with external devices and services will allow for taking preventive measure (e.g., upon foreseeing an upcoming heart stroke) or providing immediate care (e.g., when a user falls down and needs help). Recently, several IoT systems have been developed for IoT healthcare and assisted living applications.

3.) IOT based health monitoring systems , Nayna Gupta & Sujata Pandey , Year 2012.

In this fast placed world, managing work and health simultaneously have become a matter of concern for most people. Long waiting hours at the hospitals or ambulatory patient monitoring are well known issues. The issues demand for a health monitoring system which can monitor the daily routine health parameters and heart rate monitoring seamlessly and can report the same to the concerned person with the help of GSM module. With progressing in technology various monitoring systems have come up and provided ease to the individuals. This paper portrays the current research and development in the field of health. Different implemented systems have been compared and evaluated to identify the concerned lacking areas and what can be done in order to provide better throughput than the current scenario systems.

CHAPTER 4.

METHODOLOGY

MEASUREMENT OF RESPIRATORY RATE:

Thermistor is used for the measurement of body temperature and respiratory temperature. This thermistor is a passive transducer and it's resistance depends on the beat being applied on it. We have arranged the sensor in the potential divider circuit. This sensor exhibits a large change in resistance with a change in body temperature. The respiratory rate is determined by holding the sensor near the nose. The temperature sensor part is attached to the patient whose temperature has to be measured, which changes the values and thus the corresponding change in the temperature is displayed on the monitor graphically. Also all temperature measurements are updated in the patients database. Here in our project we use bead temperature sensor.

HEARTBEAT MONITOR:

The patient's heart beat rate is monitored using photoelectric sensor which can sense the patient's pulse rate. This method of tracking the heart rate is more efficient than the traditional method which derives the same from ecg graph.

ECG SENSOR:

ECG SENSOR (piezoelectric sensor) is device that piezoelectric effect to measure pressure, acceleration, strains or force by converting them to an electrical signal. Modes of operation can be distinguished: transverse, longitudinal, and shear.

MEASUREMENT OF BODY TEMPERATURE:

TEMPERATURE SENSOR (LM35) series are precision integrated circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 does not require any external calibration or trimming to provide typical accuracies of +-1/4 degree Celsius at room temperature and +-3/4 degree Celsius over a full -55 to +150 degree Celsius temperature range. Less to operates from 4 to 30 volt. Less than 60uA current drain

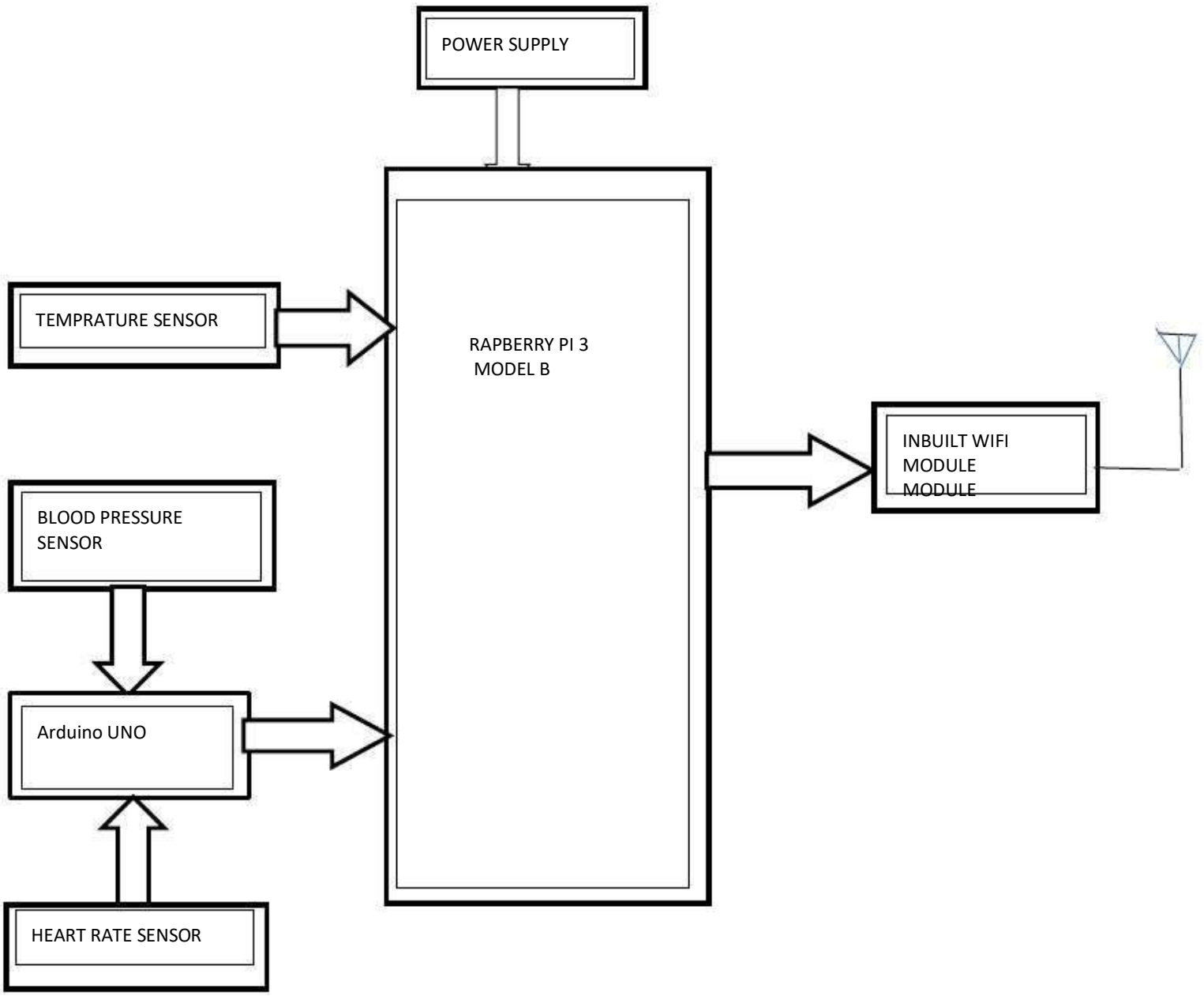
CHAPTER 5.

PROPOSED SYSTEM

A health monitoring system consists of several sensors connected to a patient and they communicate the data through the processing unit. In the project, Raspberry Pi is used as a data aggregator as well as a processor. The patient and doctor smartphone/computer are used as a monitoring system.as in figure 1, the sensors system is used to obtain the information or readings from the patient and the reading which is read are converted into signals. These signals are provided for processing to Raspberry Pi, which is the IoT module. The Pi then displays the information on a Monitor and also stores the information over the cloud. This information can be accessed by the doctor on his phone/computer and get the information. If any emergencies, the patient is sent an alert automatically through the mail for medical medication.

CHAPTER 6.

BUILDING BLOCKS



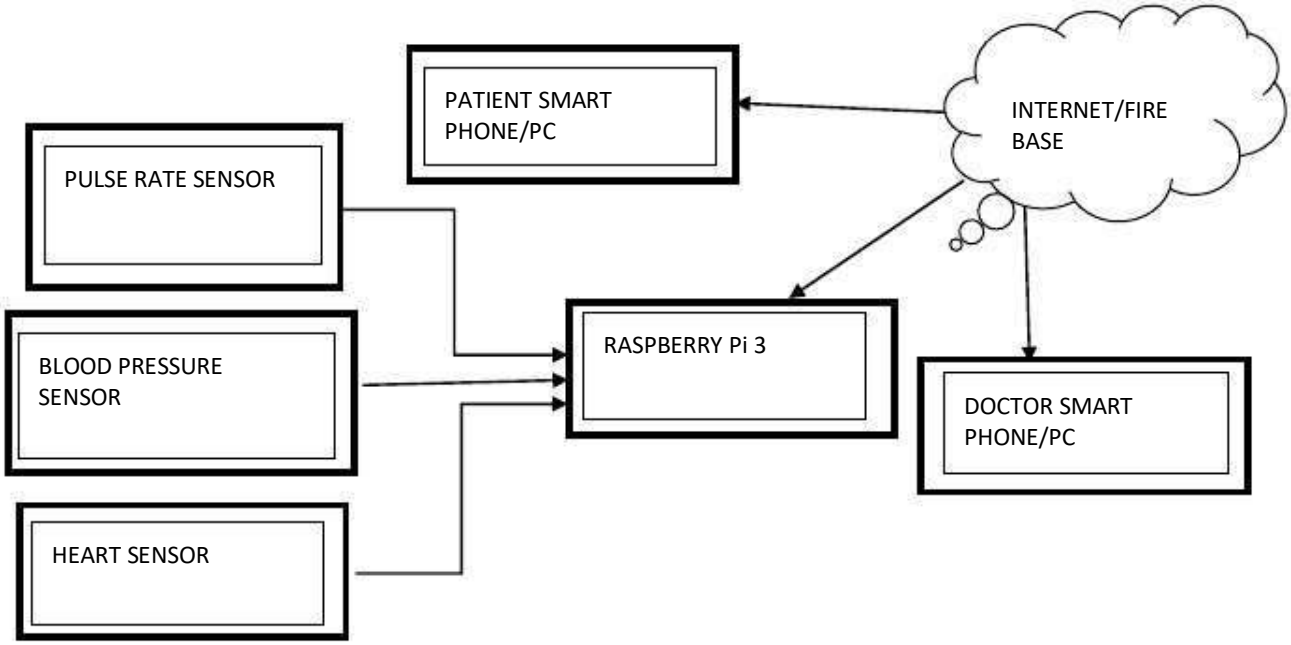


FIG 6.1: BASIC BLOCK DIAGRAM OF IOT BASED PATIENT MONITORING SYSTEM

Temperature and Humidity Sensor: In this IOT based ICU patient monitoring system, temperature and humidity sensor is used for measuring the patient's body temperature with humidity level in the surrounding environment. It is a 3pins integrated circuit module, for using this pin 1is configured as VCC pin, pin 2 is configured as data pin and pin 3 is configured as an output pin. It is powered up with 5V dc supply and is interfaced with microcontroller.

Blood Pressure Sensor: In this IOT based ICU patient monitoring system, blood pressure sensor is used for sensing the patient's blood pressure. Here for blood pressure measurements aneroid device is used which depends on oscillations. This device consists of artery wall, vibration is produced in this artery wall due to systolic and diastolic pressures when blood is flowing through this wall. This vibration is transduced into electrical signal for appropriate measurements. It is interfaced with microcontroller.

IOT system: In this IOT based ICU patient monitoring system, the IOT system is used for sending the information data such as temperature or blood pressure to dedicated website. This system consists of WIFI module, which is interfaced with microcontroller and is powered up with 5V dc supply.

CHAPTER 7.

COMPONENTS

7.1. HARDWARE REQUIREMENTS

- Raspberry pi 3 model B
- Arduino UNO
- Temperature Sensor DS18B20
- Heart Beat sensor
- Blood Pressure sensor

7.2. SOFTWARE REQUIREMENTS

- Raspbian OS
- Python IDLE
- Arduino compiler

7.3. COMPONENTS DESCRIPTION

7.3.1. Arduino UNO

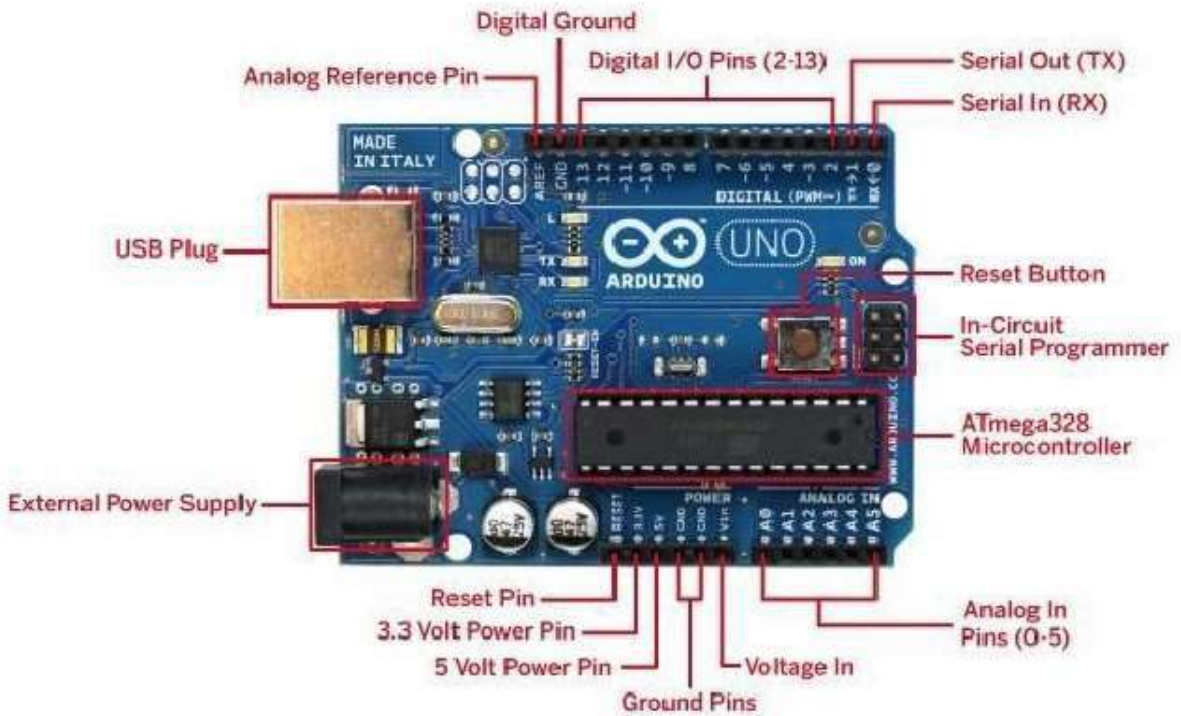


Fig 7.1:- Arduino Board

- Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. The ATmega328P also supports I2C (TWI) and SPI communication. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. There are two RX and TX LEDs on the arduino board which will flash when data is being transmitted via the USB-toserial chip and USB connection to

the computer (not for serial communication on pins 0 and 1). The Arduino software includes a Wire library to simplify use of the I2C bus. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button. The 14 digital input/output pins can be used Write () functions in Arduino programming. Each pin operate at 5V and can provide or 10 receive a maximum of 40mA current.

Pin Description

Pin Category	Pin Name	Details
Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 5V: Regulated power supply used to power microcontroller and other components on the board. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. GND: ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Input/Output Pins	Pins 0 - 13	Can be used as input or output pins.Digital
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.

PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication.
AREF	AREF	To provide reference voltage for input voltage.

Arduino Uno Technical Specifications

Microcontroller	ATmega328P – 8 bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7-12V
Input Voltage Limits	6-20V

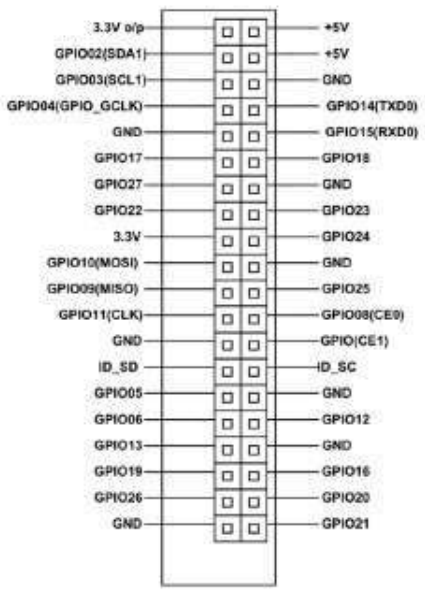
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

7.3.2. Temperature Sensor DS18B20:

Fig7.2:- Temperature Sensor

The DS18B20 Digital Thermometer provides 9 to 12-bit (configurable) temperature readings which indicate the temperature of the device.The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18B20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply.

7.3.3. Raspberry Pi 3:



Raspberry Pi 3 model b

Fig 7.3:-Raspberry pi 3

RASPBERRY PI 3 is a development board in PI series. It can be considered as a single board computer that works on LINUX operating system. The board not only has tons of features it also has terrific processing speed making it suitable for advanced applications. PI board is specifically designed for hobbyist and engineers who are interested in LINUX systems and IOT (Internet of Things).

Raspberry Pi-3 Pin Configuration

PIN GROUP	PIN NAME	DESCRIPTION
POWER SOURCE	+5V, +3.3V, GND and Vin	+5V -power output +3.3V -power output GND – GROUND pin
COMMUNICATION INTERFACE	UARTInterface(RXD, TXD) [(GPIO15,GPIO14)]	UART(Universal AsynchronousReceiver Transmitter) used for interfacing sensors and other devices.
SPI Interface(MOSI, MISO, CLK,CE) x 2 [SPI0-(GPIO10 ,GPIO9,GPIO11 ,GPIO8)] [SPI1--(GPIO20 ,GPIO19,GPIO21 ,GPIO7)]	SPI (Serial Peripheral Interface) used for communicating with other boards or peripherals.	
TWI Interface(SDA, SCL)x 2[(GPIO2, GPIO3)] [(ID_SD,ID_SC)]	TWI (Two Wire Interface) Interface can be used to connect peripherals.	

INPUT OUTPUT PINS	26 I/O	Although these some pins havemultiple functionstheycanbe considered as I/O pins.
PWM	Hardware PWM available on GPIO12, GPIO13, GPIO18, GPIO19	These 4 channels can provide PWM (Pulse WidthModulation) outputs. *Software PWM available on all pins
EXTERNAL INTERRUPTS	All I/O	In the board all I/O pins can be used as Interrupts.

Raspberry Pi 3 Technical Specifications

Microprocessor	Broadcom BCM2837 64bit Quad Core Processor
Processor Operating Voltage	3.3V
Raw Voltage input	5V, 2A power source
Maximum current through each I/O pin	16mA
Maximumtotal 54mA **current drawn from all I/O pins**	

FlashMemory (Operating System)	16Gbytes SSD memory card
Internal RAM	1Gbytes DDR2
Clock Frequency	1.2GHz
GPU	Dual Core Video Core IV® Multimedia Co-Processor. Provides Open GLES 2.0, hardware-accelerated Open VG, and 1080p30 H.264 high-profile decode. Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure.
Ethernet	10/100 Ethernet
Wireless Connectivity	BCM43143 (802.11 b/g/n Wireless LAN and Bluetooth 4.1)
Operating Temperature	-40ºC to +85ºC

Board Connectors

Name	Description
Ethernet	Base T Ethernet Socket
USB	2.0 (Four sockets)
Audio Output	3.5mm Jack and HDMI

Video output	HDMI
Camera Connector	15-pin MIPI Camera Serial Interface (CSI-2)
Display Connector	Display Serial Interface (DSI) 15 way flat flex cable connector with two data lanes and a clock lane.
Memory Card Slot	Push/Pull Micro SDIO

RASPBERRY PI platform is most used after ADRUINO. Although overall applications of PI are less it is most preferred when developing advanced applications. Also the RASPBERRY PI is an open source platform where one can get a lot of related information so you can customize the system depending on the need.

Here are few examples where RASPBERRY PI 3 is chosen over other microcontrollers and development boards:

1. Where the system processing is huge. Most ARDUINO boards all have clock speed of less than 100MHz, so they can perform functions limited to their capabilities. They cannot process high end programs for applications like Weather Station, Cloud server, gaming console etc. With **1.2GHz clock speed** and **1 GB RAM RASPBERRY PI** can perform all those advanced functions.

2. Where wireless connectivity is needed. RASPBERRY PI 3 has wireless LAN and Bluetooth facility by which you can setup WIFI HOTSPOT for internet connectivity. For **Internet of Things** this feature is best suited.

3. RASPBERRY PI had dedicated port for connecting touch LCD display which is a feature that completely omits the need of monitor.

4. RASPBERRY PI also has dedicated camera port so one can connect camera without any hassle to the PI board.

5. RASPBERRY PI also has PWM outputs for application use.

There are many other features like HD steaming which further promote the use of RASPBERRY PI.

7.3.4. Heart Rate Sensor

Fig 7.4:- Heart Rate Sensor

The **Pulse Sensor** is a 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 essence is an integrated optical amplifying circuit and noise eliminating circuit sensor. Clip the **Pulse Sensor** to your earlobe or fingertip and plug it into your Arduino, you can ready to read heart rate. Also, it has an Arduino demo code that makes it easy to use.

The pulse sensor has three pins: VCC, GND & Analog Pin.

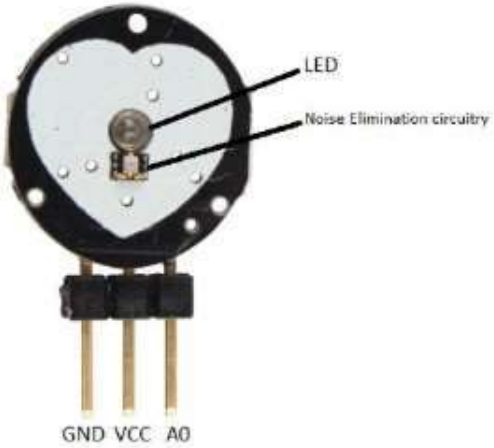


Fig 7.4.1:- Heart Sensor(2)

There is also a LED in the center of this sensor module which helps in detecting the **heartbeat.** Below the LED, there is a noise elimination circuitry that is supposed to keep away the noise from affecting the readings.

The working of the **Pulse/Heart beat sensor** is very simple. The sensor has two sides, on one side the LED is placed along with an ambient light sensor and on the other side we have some circuitry. This circuitry is responsible for the amplification and noise cancellation work. The LED on the front side of the sensor is placed over a vein in our human body. This can either be your Finger tip or you ear tips, but it should be placed directly on top of a vein. Now the LED emits light which will fall on the vein directly. The veins will have blood flow inside them only when the heart is pumping, so if we monitor the flow of blood we can monitor the heart beats as well. If the flow of blood is detected then the ambient light sensor will pick up more light since they will be reflect ted by the blood, this minor change in received light is analysed over time to determine our heart beats.

Principle of Heartbeat Sensor :
The principle behind the working of the Heartbeat Sensor is Photoplethysmograph. According to this principle, the changes in the volume of blood in an organ is measured by the changes in the intensity of the light passing through that organ.

Usually, the source of light in a heartbeat sensor would be an IR LED and the detector would be any Photo Detector like a Photo Diode, an LDR (Light Dependent Resistor) or a Photo Transistor.

With these two i.e. a light source and a detector, we can arrange them in two ways: A Transmissive Sensor and a Reflective Sensor.

In a Transmissive Sensor, the light source and the detector are place facing each other and the finger of the person must be placed in between the transmitter and receiver.

Reflective Sensor, on the other hand, has the light source and the detector adjacent to each other and the finger of the person must be placed in front of the sensor.

Working of Heartbeat Sensor :

A simple Heartbeat Sensor consists of a sensor and a control circuit. The sensor part of the Heartbeat Sensor consists of an IR LED and a Photo Diode placed in a clip.

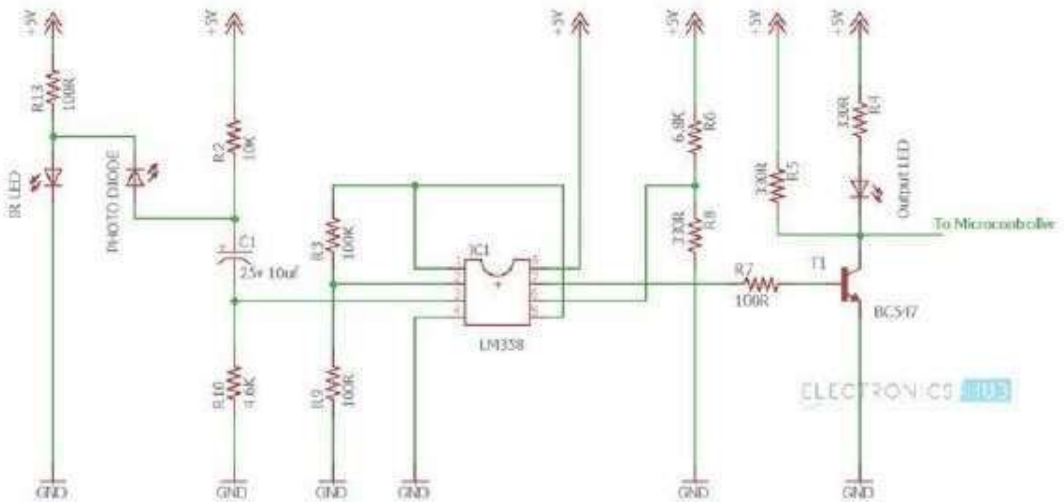
The Control Circuit consists of an Op-Amp IC and few other components that help in connecting the signal to a Microcontroller. The working of the Heartbeat Sensor can be understood better if we take a look at its circuit diagram.

The above circuit shows the finger type heartbeat sensor, which works by detecting the pulses. Every heartbeat will alter the amount of blood in the finger and the light

from the IR LED passing through the finger and thus detected by the Photo Diode will also vary.

Fig

Fig :-7.5 Circuit Diagram



The output of the photo diode is given to the non – inverting input of the first op – amp through a capacitor, which blocks the DC Components of the signal. The first op – amp cats as a non – inverting amplifier with an amplification factor of 1001.

The output of the first op – amp is given as one of the inputs to the second op – amp, which acts as a comparator. The output of the second op – amp triggers a transistor, from which, the signal is given to a Microcontroller like Arduino.

The Op – amp used in this circuit is LM358. It has two op – amps on the same chip. Also, the transistor used is a BC547. An LED, which is connected to transistor, will blink when the pulse is detected.

7.3.5. Blood Pressure Sensor

Blood Pressure (BP) is one of the important vital signs. It is the pressure exerted by the circulating blood on the walls of blood vessels. Blood Pressure is expressed as the ratio of the systolic pressure over diastolic pressure. Mercury sphygmomanometer is being used for measuring blood pressure. In this, the height of the column of mercury is considered for measuring the blood pressure. The

oscillometric method is used for automated blood pressure measurements since 1981. With the advance in technology devices for measuring blood pressure through the non-invasive oscillometric method are being developed. One such device is the Blood Pressure Sensor.

What is a Blood Pressure Sensor?

Blood Pressure can be measured both by invasive and non-invasive methods. In the non-invasive method, no piercing is required and is easy to use. Blood Pressure Sensor is used to measure the blood pressure using the non-invasive method. It is similar to sphygmomanometer but instead of the mercury column, a pressure sensor is used to detect the blood pressure.

Working Principle

Usually, pressure cuff linked to a mercury column is used to measure the blood pressure. Here, the doctor manually pumps the cuff to increase the pressure on the artery. Then using stethoscope the noise of the blood rushing through the artery.

Blood-Pressure-Sensor
In automatic Blood Pressure measurement system, instead of mercury a pressure sensor is used to detect the pressure in the artery and give output. This digital output is displayed on the monitor. This monitor has an onboard processor to process the output given by pressure sensor, record results and display them on the digital read-out screen.

Advantages

Fig No:- 7.6 Blood Pressure Machine

Being non-invasive, this Sensor is safe to use. It is easier to use and can be monitored by any individual. Instead of watching the mercury levels and calculating pressure, this sensor makes the task easier by giving results automatically.

Applications of Blood Pressure Sensor

This sensor is very important for High Blood Pressure patients, as it is also available as ‘at-home’ solid-state Blood Pressure Monitor. This system is portable. It is easy to carry and operate and highly useful in remote areas where medical facilities are not available.

Specifications

- Pressure range: 0 mmHg to 258 mmHg
- Maximum pressure without permanent damage: 1550 mmHg
- Typical accuracy: ±1 mmHg
- Temperature compensated: -20°C to 85°C
- Sensing element: SSCMRRN005PGAA5
- Combined linearity and hysteresis: typical ±0.25%
- Response time: 1 millisecond
-

CHAPTER 8.

WORKING

This IOT based ICU patient monitoring system works on the principle of monitoring patient body temperature and blood pressure. When this system is installed in ICU room then blood pressure device cuff is inflated permanently around the patient arm or wrist and temperature sensor is also attached with patient body. Temperature sensor is the resistance base sensor whose resistance is changed by changing the patient body temperature, Similarly the blood pressure sensor is the oscillation or vibration base sensor whose value is transduced into electrical signal. when blood oscillation or vibration is changed then this electrical signal value is changed. Both sensors measurements values are received by the pic controller which is the main or intelligent controller of this whole system. After receiving these values, the microcontroller displays these values on LCD display as well as these values are also send toward IOT system using programmed algorithms. The IOT system which consists of Wi-Fi module, which displays these values on doctors dedicated website using Wi-Fi sources and here for this purpose Gecko website has been used. Using this website, the doctor's society can easily know the blood pressure and temperature of their respective patient any time form anywhere With the development in the integrated circuit industry, Micro Electro Mechanical Systems (MEMs) and microcontrollers have become affordable, have increased processing speeds, miniaturized and power efficient. This has led to increased development of embedded systems that the healthcare specialists are adopting. These embedded systems have also been adopted in the Smartphone technology. And with increased internet penetration in most developing countries through mobile phones, and with use of Internet of things (IoT) will become adopted at a faster rate. The Patient Health Care system utilizes these concepts to come up with a system for better quality of life for people in society. From an engineering perspective, the project has seen concepts acquired through the computer science and embedded study period being practically applied. The Electric circuit analysis knowledge was used during design and fabrication of the individual modules. Electromagnetic fields analysis used in the wireless transmission between microcontrollers and Software programming used during programming of the microcontrollers to come up with a final finished circuit system. The whole health monitoring system, which we have proposed can be integrated into a small compact unit as small as a cell phone or a wrist watch. This will help the patients to easily carry this device with them wherever they go. The VLSI technologies will greatly come handy in this regard.

CHAPTER 9.

SOFTWARE

Arduino Code :-

```
har sbuffer[30], ch;
unsigned char pos;
unsigned char read1, read2, read3;
int a=0;
String val[2];



void setup(){
 Serial.begin(9600); // Serial is used for output on PCs "Serial Monitor"
 Serial1.begin(9600); // Serial1 is used for serial input from connected sensor
}
char mygetchar(void)
{ //receive serial character from sensor (blocking while nothing received)
 while (!Serial.available());
 return Serial.read();
}
void loop()
{
 ch = mygetchar(); //loop till character received
 Serial.print(ch);}
// end loop
```

//Code to upload data from Raspberry pi 3 to Firebase server //

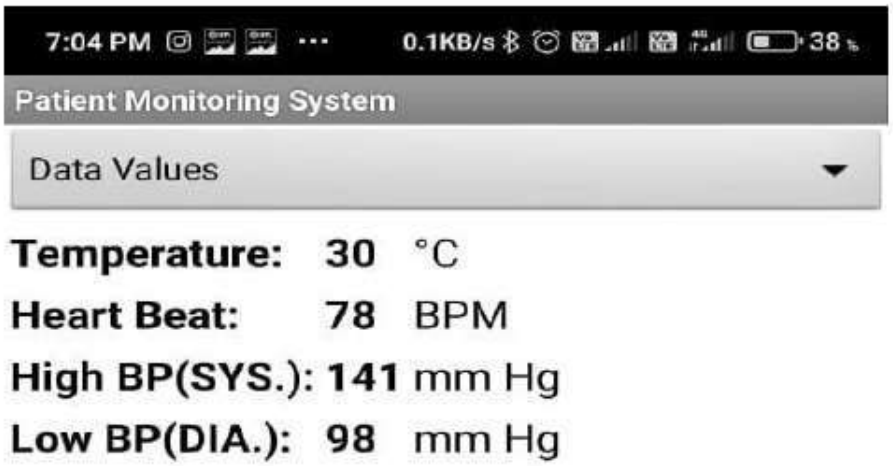
```
import serial
import RPi.GPIO as GPIO
import time
import sys
import Adafruit_DHT
from picamera import PiCamera
from time import sleep
from google.cloud import storage
from firebase import firebase
import os
```

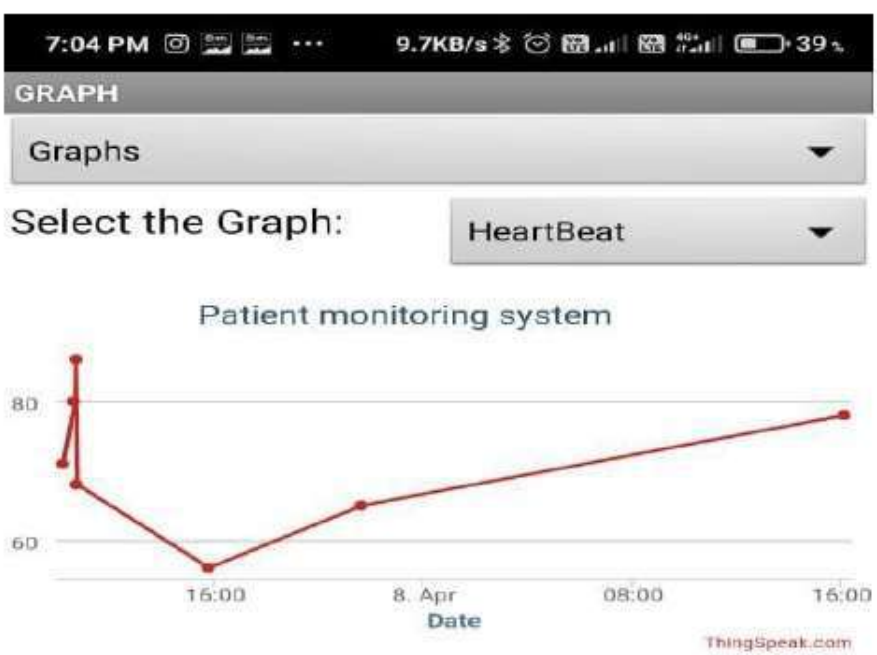
```
import pyrebase
import urllib2



imageBlob = bucket.blob("/")
imagePath = "/home/pi/Desktop/image.jpg"
imageBlob = bucket.blob("image.jpg")


camera = PiCamera()
camera.resolution = (480, 480)


try:
  while True:


       ser = serial.Serial('/dev/ttyACM0', 9600)
       val=ser.readline(100)
        val=val.strip()
        x=val.split(",")
        hbp=x[0]
        lbp=x[1]
        bpm=x[2]
        hbp=int(hbp)
        lbp=int(lbp)
        bpm=int(bpm)
        humidity, temperature = Adafruit_DHT.read_retry(11, 4)



         #writing data in thinkspeak
       finalURL = URL +"&field1=%s"%(temperature, bpm, hbp, lbp)#thinkspeak
         a = urllib2.urlopen(finalURL)
         a.read()
         a.close()


    data={"Temperature":temperature,"High_BP":hbp,"Low_BP":lbp,"Heart_B
eat":bpm}
    db.update(data)


       print ('Temp: {0:0.1f} C ').format(temperature)
       print('High BP : %d' %hbp)
```

```
        print('Low BP : %d' %lbp)
       print('Heart Beat is : %d' %bpm)

          camera.start_preview()
          sleep(5)
          camera.capture('/home/pi/Desktop/image.jpg')
          camera.stop_preview()
          imageBlob.upload_from_filename(imagePath)


except KeyboardInterrupt:
 GPIO.cleanup()
 exit()


#database: https://patient-monitoring-syste-8702b.firebaseio.com/
#storage: gs://patient-monitoring-syste-8702b.appspot.com
```

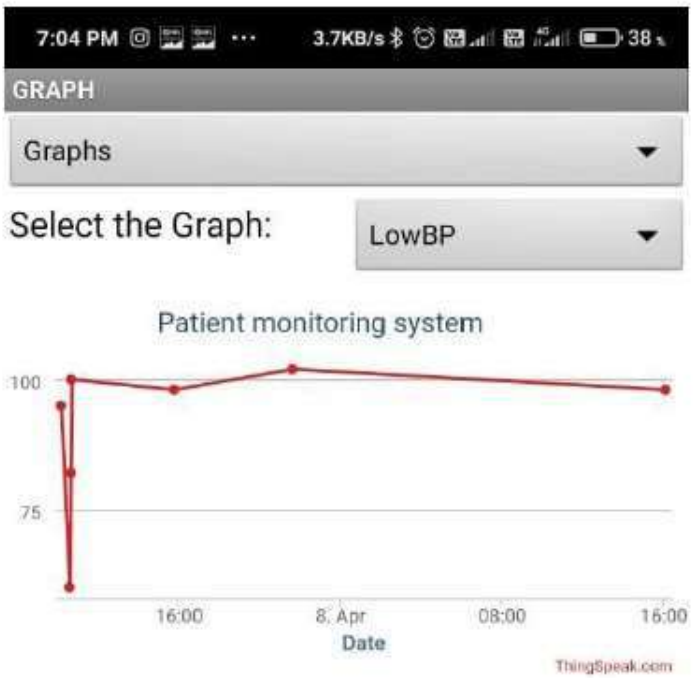
Real time data on Android App :

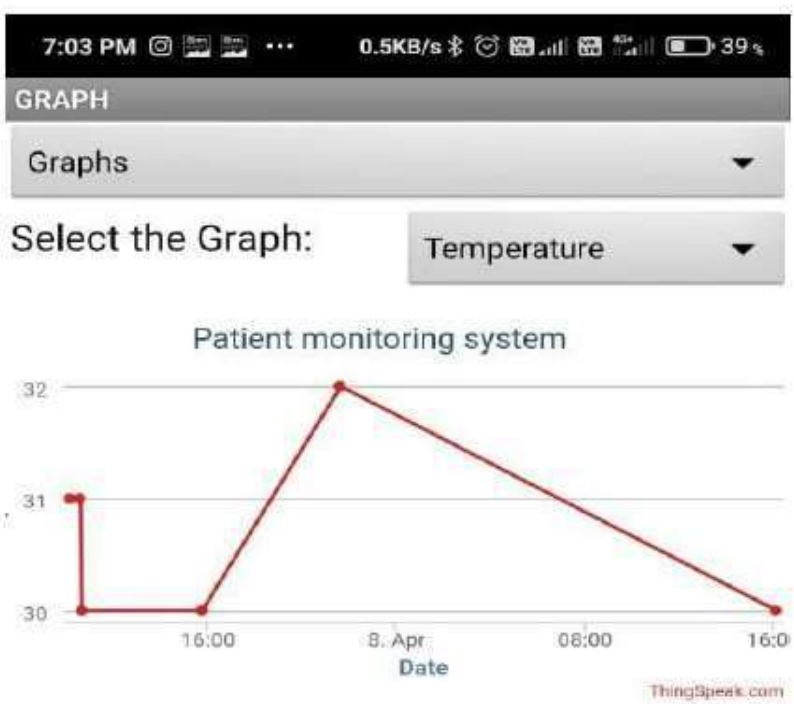
The real time data of the patient's vital parameters are displayed on the app made using android studio.
The app name is PMS aka Patient Monitoring System.
Below are the real time values of the parameters being monitored :


7:04 PM
0.1KB/s
38
Patient Monitoring System
Data Values
Temperature: 30 °C
Heart Beat: 78 BPM
High BP(SYS.): 141 mm Hg
Low BP(DIA.): 98 mm Hg


7:04 PM
9.7KB/s
39
GRAPH
Graphs
Select the Graph:
HeartBeat
Patient monitoring system
80
60
16:00
8. Apr
08:00
16:00
Date
ThingSpeak.com


7:04 PM 3.4KB/s 39
GRAPH
Graphs
Select the Graph:
HighBP
Patient monitoring system
150
125
16:00
8. Apr
08:00
16:00
Date
ThingSpeak.com


7:04 PM 3.7KB/s 38
GRAPH
Graphs
Select the Graph:
LowBP
Patient monitoring system
100
75
16:00
8. Apr
08:00
16:00
Date
ThingSpeak.com


7:03 PM 0.5KB/s 39
GRAPH
Graphs
Select the Graph:
Temperature
Patient monitoring system
32
31
30
16:00
8. Apr
08:00
16:0
Date
ThingSpeak.com

9.1. Firebase Server

Fig No 9.1.1:- Firebase Server

Google Firebase Google Firebase is a Google-backed application development software that enables developers to develop iOS, Android and Web apps. Firebase provides tools for tracking analytics, reporting and fixing app crashes, creating marketing and product experiment. Firebase offers a number of services, including: • Analytics – Google Analytics for Firebase offers free, unlimited reporting on as many as 500 separate events. Analytics presents data about user behavior in iOS and Android apps, enabling better decision-making about improving performance and app marketing. • Authentication – Firebase Authentication makes it easy for developers to build secure authentication systems and enhances the sign-in and onboarding experience for users. This feature offers a complete identity solution, supporting email and password accounts, phone auth, as well as Google, Facebook, GitHub, Twitter login and more. • Realtime database – the Firebase Realtime Database is a cloud-hosted NoSQL database that enables data to be stored and synced between users in real time. The data is synced across all clients in real time and is still available when

an app goes offline. • Cloud messaging – Firebase Cloud Messaging (FCM) is a cross-platform messaging tool that lets companies reliably receive and deliver messages on iOS, Android and the web at no cost. 46 • Crashlytics – Firebase Crashlytics is a real-time crash reporter that helps developers track, prioritize and fix stability issues that reduce the quality of their apps. With crashlytics, developers spend less time organizing and troubleshooting crashes and more time building features for their apps.

CHAPTER 10.

ADVANTAGES & DISADVANTAGES

Advantages of IoT in healthcare:

- All-around technological enhancement. Rendering hospital visits unnecessary, passively accumulating and deeply analyzing important health data, etc. We've already pondered on all these advanced tech capacities galore enough. The IoT provides space for fantastic long-term innovations.

- Cost savings. One of the greatest advantages of IoT in healthcare is that efficient autonomous systems will cost less to manage and 'employ' in the long run. Things are even better when it comes to patient cost savings due to fewer hospital journeys as well as accelerated diagnostics and treatment.

- Accessibility. Doctors can view all the necessary data on command and check real-time patient conditions without leaving their office.

Disadvantages of IoT in healthcare:

- Privacy can be potentially undermined. As we've already mentioned, systems get hacked. Lots of attention will need to be focused on data security, which requires significant additional sending.

- Unauthorized access to centralization. There is a chance that dishonest interlopers may access centralized systems and realize some cruel intentions.

- Global healthcare regulations. International health administrations are already issuing guidelines that must be strictly followed by governmental medical establishments integrating the IoT in their workflow. These may restrict possible capacities to some extent.

CHAPTER 11.

IOT APPLICATIONS IN HEALTHCARE

- The Internet of Things allows setting up a centralized network of interconnected devices that can generate and exchange data within a single framework. All that data can also be tracked and gathered in real time, which provides a passive accumulation of analytics materials. In terms of enhancement for medical facilities, this means that a regular hospital can be turned into a smart hospital.

- It is an advanced facility where everything is tracked and managed simultaneously while all the data is collected in a centralized database. Such tech features open a myriad of possibilities to improve the convenience, efficiency, and even budget-saving options of modern hospital.

Tracked ingestible sensors:

- The World Health Organization conducted a study in 2003 to find out that about 50% of prescribed medicines aren't taken the right way or completely ignored. A prominent example of resolving this issue is the ingestible sensors solution developed by Proteus. These tiny sensors take place of a prescription and send a signal a receiving device upon dissolution in the stomach. An amazing advanced creation, Proteus' 'smart pills' will surely help reduce the rates of incorrect, senseless consumption of highly important medical prescriptions. Now, this is what one can call a truly advanced drug management.

Mobile health:

- Also called mHealth, it's the way of watching and taking care of one's health via mobile can be a true life-saver for modern patients, practically all of whom use smartphones regularly. Mobile health is an emerging field that contributes heavily to both critical medical situations and regular treatment instances.

- As we've already mentioned in the 'Remote patient monitoring' section, mobile apps can serve as the management means for health tracking devices. graphic with the names of healthcare startup applications. This is only a small portion of startups who are trying to gain market share with their mobile app.

Such apps can be used as your full-blown healthcare hub where you can access valuable medical info, analyze your organism behavior trends, manage other body-inserted IoT sensors, and contact your doctor with a single tap.

- This is an especially valuable solution for underdeveloped countries of the world where people can't afford regular visits to hospitals yet, most probably, have smartphones. And governments, in turn, get a capability to see how the population is doing in terms of health, accumulating massive statistics.

Smart hospitals:

- The dissatisfaction with flawed, difficult to manage hospital infrastructures is a common issue of a vast majority of the planet's countries (even the developed ones). Colossal loads of paperwork, long and frustrating lines, and working overload most nurses and doctors experience – this is where the problem stems. Practically all such situations can be turned around with the integration of IoT solutions. Huge, cumbersome paper registers can be replaced with an automated, centralized database, which can be additionally enhanced in terms of reliability with blockchain and smart contracts; a single management system can receive submissions, help optimally control queues, and track staff members via their smartphones; all the equipment can also be remotely monitored and managed (e.g., shut down in unprecedented cases).Such innovations can help greatly reduce in-house costs for hospitals, preserve forests, and make both patients' and medical staff's lives easier.

- The overall productivity will also increase due to the automated smart solutions' capability to immediately recognize health issues which would otherwise take months of live doctor diagnostics.

Enhanced chronic disease treatment:

- With IoT-powered wearables, sensors, data analytics, and mobile opportunities, battling chronic diseases becomes more efficient and accessible. The thing is, recurring health issues must be monitored and analyzed over long periods of time. That way, trends in the disease fluctuations can be defined and juxtaposed in order to be most efficiently treated.

- There are many apps already available on the market, ranging in functionality and purpose:
  1. Body, activity, & sleep tracking apps
  2. Pregnancy monitoring apps
  3. Individual health recording apps

CHAPTER 12.

CONCLUSION

The project work has been studied and implemented a complete working model using an Arduino board. The programming is done on the Arduino software and interfering of NRF24L01 module and RF Modem has been studied during the implementation. This project elaborates the design and construction of patient health monitoring system. Circuit works properly to transmit and receive correct readings of the heart pulse and temperature of the patient. If the conditions are satisfied, the circuit does the desired work according to the specific program. Each sensor does its specified work resulting in the state switch of the LED. The readings are being successfully received by the Arduino and raspberry pi.

This work could be a life saving thing for many people and can be very handy for the doctors to monitor the patient health. The design and verification of a Patient Health Monitoring System was done successfully. The main advantage of the present system is reducing human efforts and to get correct value. The only drawback factor is that if there are more numbers of RF frequencies rather than 2.4GHz of NRF24L01 interference can result into losses of data. Hence, such systems are very useful in hospitals as there is no any interference of any other frequencies. Therefore, such systems, if once, implemented on a large scale can bring significant reduction in the amount of human efforts and time saving to save a patient life. This initiative will help us save more life. Other advantages of the circuit may include its simplicity in design, avoids constant supervision of time and flexibility in design.

CHAPTER 13.
FUTURE SCOPE OF IOT IN HEALTHCARE

Full-blown smart hospitals by 2020, mHealth as a regular, common thing on a global scale, and reduced physical visits to hospitals– this is only an approximate picture of the IoT success. With that being said, as young as the concept is, it isn't really regarded to be that novel by progressive hospitals of the now. Most of them are either implementing major IoT techniques and capabilities or already have enhanced parts that are in their calibration stage.

CHAPTER 14.

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PATIENT HEALTH MONITORING SYSTEM USING IOT

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[2,3,4]B.E. Student, Department of Electronics and Telecommunication Engineering
[1,2,3,4]Thadomal Shahani Engineering College Bandra(w), Mumbai, Maharashtra, India.

Abstract - *In this project we have planned to design a compact wireless Patient Health Monitoring System. The idea is to use a Raspberry Pi 3, Arduino Uno, Heartbeat sensor, monitoring circuit, temperature sensor to directly get the data on the Doctor's computer. These components play a vital role in monitoring the patient health status. Since time plays a key role in saving a person's life, the device aims at saving time required by the doctor to monitor each and every patient. The process starts by monitoring of physical parameters like heart beat and temperature readings sending the measured data directly to a Doctor's computer through a server database. The devices used in this project are very cheap and cost effective and can be widely used for wireless communication within indoor management. It is very easy to assemble and very less errors are introduced.*

Key Words: **IOT, Health monitoring, Blood Pressure, Heart rate, Sensor, Temperature.**

1. INTRODUCTION

A Patient Health Monitoring System is an extension of a hospital medical system where a patient's vital body state can be monitored remotely. Traditionally the detection systems were only found in hospitals and were characterized by huge and complex circuitry which required high power consumption. Continuous advances in the semiconductor technology industry have led to sensors and microcontrollers that are smaller in size, faster in operation, low in power consumption and affordable in cost. According to research, we found that approximately 2000 people died monthly due to the only carelessness of their health.

This is because they don"t have time for themselves and forget about their health management due to a heavy workload. The reason behind to make this project is the growing world of technology and people forget their health checkup which is needed to be done monthly or quarterly. As we all know that internet of things made our life easier. So, we have decided to make an internet of things based healthcare project for people who provide them all the personal information about their health on their mobile and they can check their all historical health data.

The best part of this project is that it can be used by everyone and make our health management easier than available systems. It provides a solution for measurement of body parameters like, Temperature Sensor and Heartbeat, Blood Pressure. It also detects the body condition and location of the patients. This system also generates an alert when it required that means at the time of any critical conditions and notifications about the medicines, location change, conditions etc.

2. LITERATURE REVIEW

1.) Patient-Monitoring Systems, Reed M. Gardner & M. Michael Shabot , Year 2014 To meet the increasing demands for more acute and intensive care required by patients with complex disorders, new organizational units—the ICUs—were established in hospitals beginning in the 1950s. The earliest units were simply postoperative recovery rooms used for prolonged stays after open-heart surgery. Intensive-care units proliferated rapidly during the late 1960s and 1970s. The types of units include burn, coronary, general surgery, open-heart surgery, pediatric, neonatal, respiratory, and multipurpose medical-surgical units. Today there are an estimated 75,000 adult, pediatric, and neonatal intensive care beds in the United States.

2.) IoT-Based Health Monitoring System for Active and Assisted Living, Ahmed

Abdelgawad, School of Engineering and Technology, Central Michigan University, Mt. Pleasant, MI 48859, USA , Year 2017. The Internet of Things (IoT) platform offers a promising technology to achieve the aforementioned healthcare services, and can further improve the medical service systems [1]. IoT wearable platforms can be used to collect the needed information of the user and its ambient environment and communicate such information wirelessly, where it is processed or stored for tracking the history of the user [2]. Such a connectivity with external devices and services will allow for taking preventive measure (e.g., upon foreseeing an upcoming heart stroke) or providing immediate care (e.g., when a user falls down and needs help). Recently, several IoT systems have been developed for IoT healthcare and assisted living applications.

3.) IOT based health monitoring systems, Nayna Gupta & Sujata Pandey, Year 2012.

In this fast placed world, managing work and health simultaneously have become a matter of concern for most people. Long waiting hours at the hospitals or ambulatory patient monitoring are well known issues. The issues demand for a health monitoring system which can monitor

the daily routine health parameters and heart rate monitoring seamlessly and can report the same to the concerned person with the help of GSM module. With progressing in technology various monitoring systems have come up and provided ease to the individuals. This paper portrays the current research and development in the field of health. Different implemented systems have been compared and evaluated to identify the concerned lacking areas and what can be done in order to provide better throughput than the current scenario systems.

3. PROPOSED METHOD

Raspberry pi 3 model B is a development board in PI series. It can be considered as a single board computer that works on LINUX operating system. The board not only has tons of features it also has terrific processing speed making it suitable for advanced applications. PI board is specifically designed for hobbyist and engineers who are interested in LINUX systems and IOT (Internet of Things).

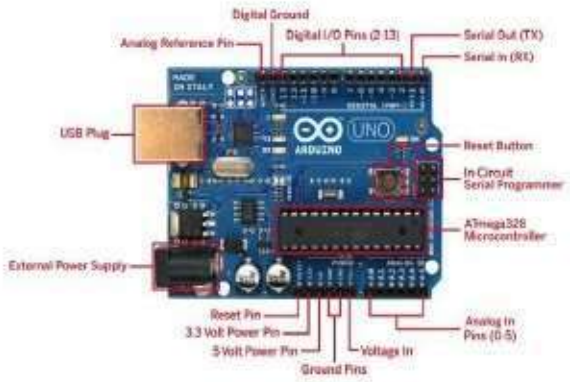
We can connect the Raspberry pi to any TV or computer with Display and keyboard and hence perform any computing task like sending emails, monitoring data, playing games, etc.

Temperature Sensor DS18B20:

The DS18B20 Digital Thermometer provides 9 to 12-bit (configurable) temperature readings which indicate the temperature of the device. TheDS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18B20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply.

Arduino Board

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. The ATmega328P also supports I2C (TWI) and SPI communication. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. There are two RX and TX LEDs on the arduino board which will flash when data is being transmitted via the USB-toserial chip and USB connection to.



Heart Rate Sensor

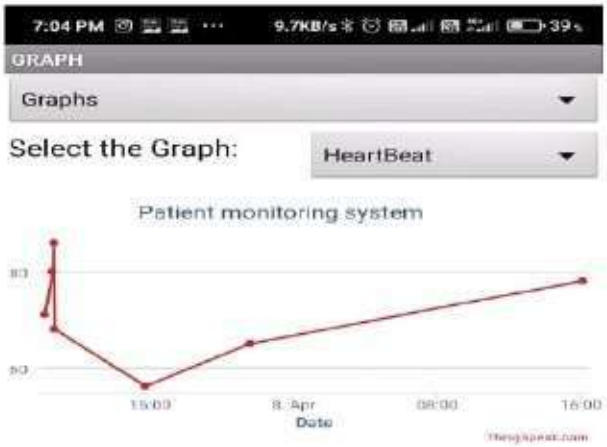
The Pulse Sensor is a plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects. The essence is an integrated optical amplifying circuit and noise eliminating circuit sensor. Clip the Pulse Sensor to your earlobe or fingertip and plug it into your Arduino, you can ready to read heart rate. Also, it has an Arduino demo code that makes it easy to use. The pulse sensor has three pins: VCC, GND & Analog Pin.

Blood Pressure Sensor

Blood Pressure (BP) is one of the important vital signs. It is the pressure exerted by the circulating blood on the walls of blood vessels. Blood Pressure is expressed as the ratio of the systolic pressure over diastolic pressure. Mercury sphygmomanometer is being used for measuring blood pressure. In this, the height of the column of mercury is considered for measuring the blood pressure.

Real time data on Android App

Below are the real time values of the parameters being monitored. The real time data of the patient's vital parameters are displayed on the app made using MIT app inventor.

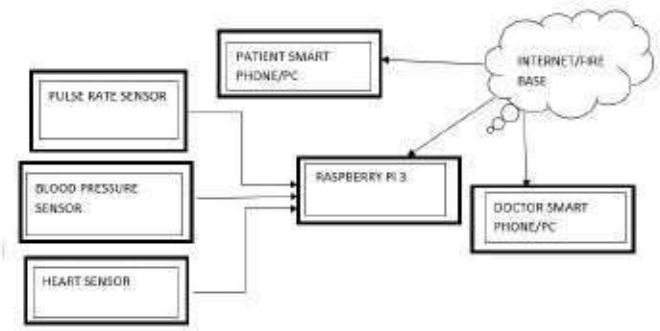


Firebase Server

Google Firebase Google Firebase is a Google-backed application development software that enables developers to develop iOS, Android and Web apps. Firebase provides tools for tracking analytics, reporting and fixing app crashes, creating marketing and product experiment. Firebase offers a number of services, including: • Analytics – Google Analytics for Firebase offers free unlimited reporting on as many as 500 separate events. Analytics presents data about user behavior in iOS and Android apps, enabling better decision-making about improving performance and app marketing. • Authentication – Firebase Authentication makes

it easy for developers to build secure authentication systems and enhances the sign-in and onboarding experience for users. This feature offers a complete identity solution, supporting email and password accounts, phone auth, as well as Google, Facebook, GitHub, Twitter login and more. • Realtime database – the Firebase Realtime Database is a cloud-hosted NoSQL database that enables data to be stored and synced between users in real time.

4. WORKING



This IOT based ICU patient monitoring system works on the principle of monitoring patient body temperature and blood pressure. When this system is installed in ICU room then blood pressure device cuff is inflated permanently around the patient arm or wrist and temperature sensor is also attached with patient body. Temperature sensor is the resistance base sensor whose resistance is changed by changing the patient body temperature, Similarly the blood pressure sensor is the oscillation or vibration base sensor whose value is transduced into electrical signal. when blood oscillation or vibration is changed then this electrical signal value is changed. Both sensors measurements values are received by the pic controller which is the main or intelligent controller of this whole system. After receiving these values, the microcontroller displays these values on mobile display as well as these values are also send toward IOT system using programmed algorithms. The IOT system which displays these values on doctors dedicated website using Wi-Fi sources and here for this purpose Firebase database has been used. Using this database and app the doctor's society can easily know the blood pressure and temperature of their respective patient any time form anywhere With the development in the integrated circuit industry, Micro Electro Mechanical Systems (MEMs) and Raspberry pi system have become affordable, have increased processing speeds, miniaturized and power efficient. This has led to increased development of embedded systems that the healthcare specialists are adopting. These embedded systems have also been adopted in the Smartphone technology. And with increased internet penetration in most developing countries through mobile phones, and with use of Internet of things (IoT) will become adopted at a faster rate. The Patient Health Care system utilizes these concepts to come up with a system for better quality of life for people in society. From an engineering perspective, the project has seen concepts acquired through the computer science and embedded study period being practically applied. The Electric circuit analysis knowledge was used during design and fabrication of the individual modules. Electromagnetic fields analysis used in the wireless transmission between microcontrollers and Software programming used during programming of the microcontrollers to come up with a final finished circuit system. The whole health monitoring system, which we have proposed can be integrated into a compact unit as small as a cell phone or a wrist watch. This will help the patients to easily carry this device with them wherever they go. The VLSI technologies will greatly come handy in this regard.

5. CONCLUSIONS

The project work has been studied and implemented a complete working model using an Arduino board. The programming is done on the Arduino software and Raspbian OS. This project elaborates the design and construction of patient health monitoring system. This work could be a life saving thing for many people and can be very handy for the doctors to monitor the patient health. The design and verification of a Patient Health Monitoring System was done successfully. In this paper, we found the importance and fruitful benefits of implementation of IoT in remote health monitoring systems.

The compact sensors with IoT will make a huge impact on every patient's life, that even though they are away from home and physician, this helps them to reduce the fear of danger. The sensory data can be acquired in home or work environments. Also, the challenges in sensing, analytics and prediction of the disease are also highlighted and those can be addressed to provide a seamless integraton into the medical field.

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