**JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY**



**MINOR-1 PROJECT**

**HEALTH MONITORING SYSTEM BASED ON IOT**

**MENTOR Efforts by:**

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# Preface

### This project aims to employ Internet of Things as the major technology to record and send data of patients for further analysis while ensuring user privacy and data confidentiality. At the same time, this project can help people to communicate and reach out to the medical staff in case of emergency situations. Doing this project has helped us to enhance our knowledge of hardware systems, IoT, Cloud computing and its varying application. Besides, this project has contributed to an increased fluency in the IDE and its libraries

# Acknowledgement

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**INDEX**

## Page no.

[Preface 2](#_bookmark0)

[Acknowledgement 2](#_bookmark1)

[Motivation of the Project 4](#_bookmark2)

[Problem Statement 4](#_bookmark3)

Hardware and Material Required 4

[Introduction 5](#_bookmark4)

[Literature Review 6](#_bookmark5)

[Solution Proposed 10](#_bookmark6)

[Internet of Things 11](#_bookmark7)

[Methodology 11](#_bookmark8)

[Outline of the Project 12](#_bookmark9)

[Hardware Details 12](#_bookmark10)

[Circuit Diagram 13](#_bookmark11)

[Code 14](#_bookmark12)

[References 23](#_bookmark13)

# Motivation of the Project

In today’s global village, over decades, medical facilities have evolved elegantly. Different users expect instantaneous and seamless flow data. Many industries have adopted or are beginning to adopt necessary technologies to guarantee their users' expectation for instant information. Unfortunately, the healthcare industry is much behind. Furthermore, health data contained in legacy systems is isolated and difficult to share with others because of varying formats and standards. In short, the current healthcare data landscape is fragmented and ill- suited to the instantaneous needs of modern users. Therefore, we need a concrete and efficient platform where it can track real-time information of people that stays occupied in their hectic lives, their body analysis is done sitting at home and the required data is accessible to the healthcare department. This can be done with the help of IoT as one of the major technologies.

# Problem Statement

The project is to develop a Health monitoring system for monitoring the user .This Project focuses on creating a Health monitoring System using Wireless Body sensors and can help the user by providing healthcare services such as medical monitoring, medical data access, and communication with the healthcare provider .The Project contains sensors to monitor the human body temperature and Pulse Rate. The sensed information is sent to a Microcontroller through signal conditioning circuit in the patient unit. A desired amount of sensor value is set and if it is exceeded the sensor information will be transmitted from the patient unit to the Doctor.

**Hardware and Materials Required**

* Temperature Sensor
* Heartbeat Sensor
* Arduino Uno Board
* Programming Cables
* Male-Female Wires
* Breadboard
* Wi-Fi Module
* Push Button
* 10k Resistor

# Introduction

Health monitoring system is significant in various ways because in today's world, everyday many lives are affected because the patients are not timely and properly operated. Also the real time parameter values are not efficiently measured in clinic as well as in hospitals and it gives ubiquitous results. Sometimes it becomes difficult for hospitals to frequently check patient’s conditions. Also continuous monitoring of ICU patients is very difficult. To deal with these types of situations, our system is beneficial. Our system is designed to be used in hospitals and homes also for measuring and monitoring various parameters like temperature, heart rate, blood pressure. The results can be recorded using sensors and implementing it with Arduino which consequently, can be made accessible to the doctors via website/app. The system will also generate an alert notification which will be sent to doctor. Our system is useful for monitoring health parameters of every person as it is an easily attached device which is more accurate and efficient. Even during emergency situations, doctors can analyse patient’s condition through their past data, and recommend medicines or some other form of treatment if required.

# Literature Review

##### Paper 1

**Title of the Paper**: Health Monitoring system using IOT

**Author**: Swaleha Shaikh

Vidya Chitre

**Year of Publication**: 2017

##### Summary

This Model explains how the entire model has to be built and implemented in the simplest way possible. There are different sensors, like, body temperature sensors, heartbeat sensors and so on, which have been used to measure and record the data so that it can be available to the healthcare department by using an Integrated Development Environment. The data after being recorded from the wearable sensors is transmitted to the processor (which is Raspberry Pi; in this case), it processes the information dynamically which further takes the data on cloud storage to make it available to implement the further process. One of the main advantages of this kind of health-monitoring system is that it can send required information wirelessly and this too increases the accuracy of data. However, the aim of the model would be to process any patient’s data to the healthcare department in less time and most importantly during emergency situations. In [1], the design methodology and complete web architecture is given in order to explain how sensors would be placed and will be connected to patient’s body. Apart from the hardware architecture, it also gives the brief of software development process. The recorded data has to be made available to the medical practitioner which can be done with the help of cloud computing in which the processed information is stored on various servers which furthermore can be made available to the doctors through a website. This majorly includes Internet of Things as one of the main technologies. The major goal of building such an effective and promising model is to facilitate the correct analysis of patient’s data and made it accessible to each class of people. Such kind of development would surely enhance the nature of healthcare.

##### Paper 2

**Title of the Paper**: Application for Health Monitoring, Consultancy And Alarm System.

**Author**: Emre Oner Tartan Cebrail Ciflikli

**Year of Publication**: 2018

##### Summary

Mobile applications have great potential in health monitoring. This monitoring system can also be benefited in an emergency alarm system for people who have potential risks while doing sports or elderly people. This concept covers the utilization of telecommunication technology

.It has the potential to reduce workload of health experts and costs for health system. Involving geolocation tracking in a e-health system is realized by utilizing the built-in GPS sensor in the smart phones. We use Google’s Firebase Database which is real-time database based oncloud technology. The proposed mobile application includes three applications as doctor, patient and caregiver apps. The major difference between the applications is in authentication. Doctor is authenticated to access all patients’ status while patient and caregiver/relative can access only the related patient’s status. In the proposed system to measure the heart rate we use a plug-and- play pulse sensor compatible with Arduino. The sensor can be used with an ear clip or a velcro finger strap. We also use HC-05 Bluetooth Shield for wireless transmission of sensor data to the phone. This shield is mounted on Arduino Uno board When Bluetooth is enabled application discovers the devices nearby and selects the sensor module. Then by starting connection data is plotted in real-time and beat per minute is displayed.. The Arduino Bluetooth module can be used with USB cable. In the alarm mechanism two cases are considered which are tachycardia and bradycardia. Bradycardia is a condition wherein an individual has a slow heart rate. Conversely in tachycardia the heart beats faster than normal. Referred model is proposed for describing the cardiovascular response in various exercise conditions. However some patients can have specific conditions such as having surgical operation or having severe cardiovascular diseases. Therefore alarming mechanism can be customized for individual monitoring by adapting thresholds on the basis of cardiac status of the patient.

##### Paper 3

**Title of the Paper**: Health Monitoring system for coma sufferers

**Author**: Tamilselvi V

Sribalaji S Vigneshwaram P

**Year of Publication**: 2020

##### Summary

The device is specially designed for actual time monitoring of the health parameters of the coma sufferers. It has more suitable by means of the use of GSM and IoT to recognize the status or condition of the patient.This proposed method consists of numerous smart sensors like Temperature, Heartbeat, Eye blink and SPO2 (Peripheral Capillary Oxygen Saturation) sensors for fetching the patient’s body temperature, coronary heart rate, eye movement and oxygen saturation percentage of the patient. This system use ARDUINO-UNO board as a microcontroller and Cloud computing concept. Here the accelerometer sensor used to display the body movement of the coma sufferers. The patient’s vital parameters are transmitted to smart telephones and laptops of the legal individual by the use of a cloud server. These records may be saved and analyzed for further evaluation and selection making.

##### Paper 4

**Title of the Paper**: Smart watch based Health Monitoring system.

**Author**: Yang Gu

Jianfei Shen Yiqiang Chen

**Year of Publication**: 2019

##### Summary

In this paper, a user-friendly smart watch, which can sense personal physiological data and physical activity is presented. Based on the device, a smartphone software is developed, this hardware and software system can gather data and monitor personal health from the aspects of physiological conditions and physical conditions. Compared with other systems, it has the advantage of providing raw sensing data and unobtrusively continuous sensing, which can bring new opportunity to pervasive personal health monitoring, and promote wearable computing research in health monitoring and disease prevention.

##### Paper 5

**Title of the Paper**: Information system for women Health Monitoring

**Author**: Mrs. Rashika Mallya

Dr.Snehalata Kothari

**Year of Publication**: 2018

##### Summary

The paper suggests adaptive information system based on organizational model for Woman Health Monitoring System.Such Woman Health Monitoring System can be developed u- healthcare approach with the help of wearable devices.The wearable devices can monitor i) Fetus movements (fetus heart rate, movements, embryotic fluid level, uterine contractions) if the woman is pregnant ii) Ovulation patterns if woman is trying to conceive. These patterns will be useful for gynecologist to give further treatment to woman iii) Normal body parameters like heart rate, pulse rate, sleep pattern, body heat, menopause hormonal imbalance etc. These parameters monitoring will help to improve woman’s health.

##### Paper 6

**Title of the Paper**: Health Monitoring system for five parameters

**Author**: Vaishnavi Patil

Sanjay Singh Thakur Vaibhav Kshirsagar

**Year of Publication**: 2018

##### Summary

This paper proposes health monitoring system using non-intrusive biomedical sensors that measure five parameters like ECG, heartbeat, respiration, temperature and blood pressure. Proposed method makes use of Arduino Mega Controller to which non-invasive biomedical sensors are connected. The output is displayed on any digital monitoring system using Arduino Mega. The data obtained from the sensors is uploaded to the ThingSpeak cloud to store and to access patient’s information by their doctors or by the concerned for necessary follow-ups in real-time.

##### Paper 7

**Title of the Paper**: Health Monitoring system using Raspberry Pi

**Author**: Ashwini Gutte

Ramkrishna Vadali

**Year of Publication**: 2018

##### Summary

This health monitoring system is based on concept of internet of things with implementation of it on raspberry pi is proposed. It follows the basic MQTT protocol of IoT and it is an application of remote health monitoring. It helps for better diagnosis of the patients with chronic diseases. This system helps to monitor health of elderly people who cannot visit the hospitals on regular basis. Hence Primary health checkups are also made easy. Patients’ history is saved on the server hence it benefits the follow-ups. As it uses information technology for the assessment human errors are removed hence gives better performance.

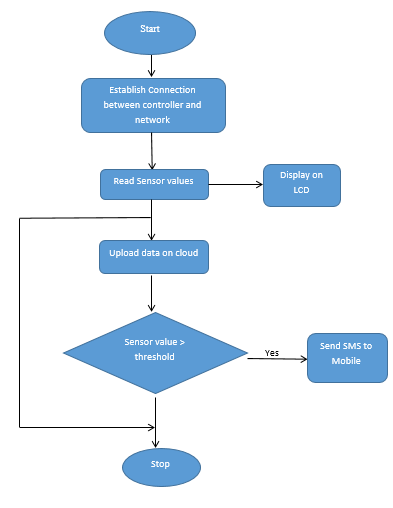
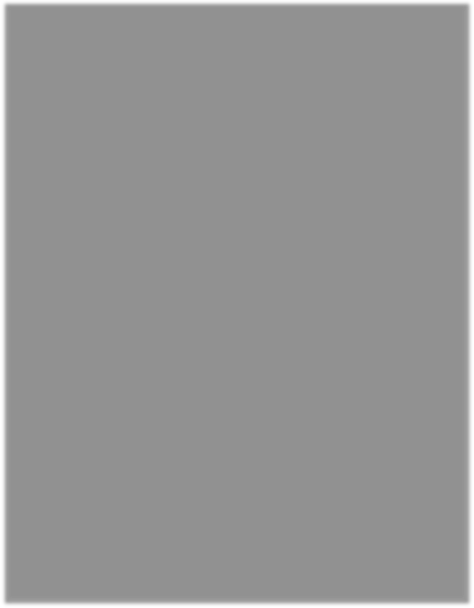
# Solution Proposed

We have used Internet of Things and cloud computing to execute the project by implementing it with some of the basic hardware. IoT primarily exploits standard protocols and networking technologies. However, the major enabling technologies and protocols of IoT are low-energy Bluetooth, low-energy wireless, low-energy radio protocols and Wi-Fi-Direct. These technologies support the specific networking functionality needed in an IoT system in contrast to a standard uniform network of common systems. In IoT based monitoring systems, in which we are aiming to send the data to the hospitals, there exists a bridging point (i.e., gateway) between a sensor network and the Internet which often just performs basic functions such as translating between the protocols used in the Internet and sensor networks. These gateways have beneficial knowledge and constructive control over both the sensor network and the data to be transmitted through the Internet.

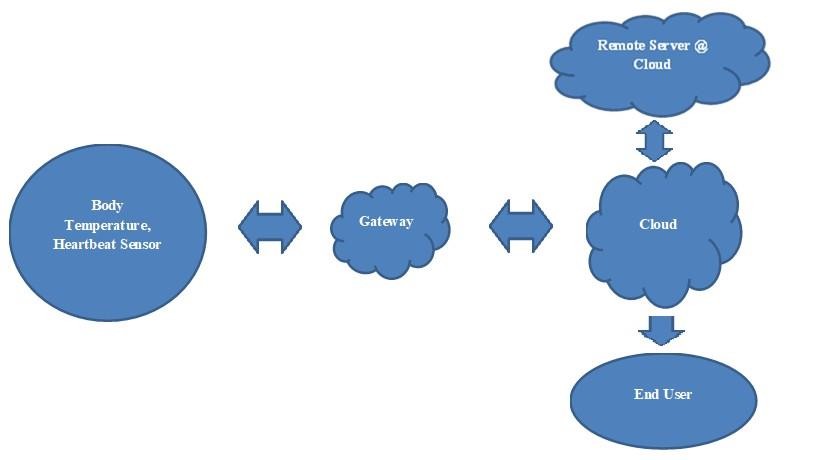
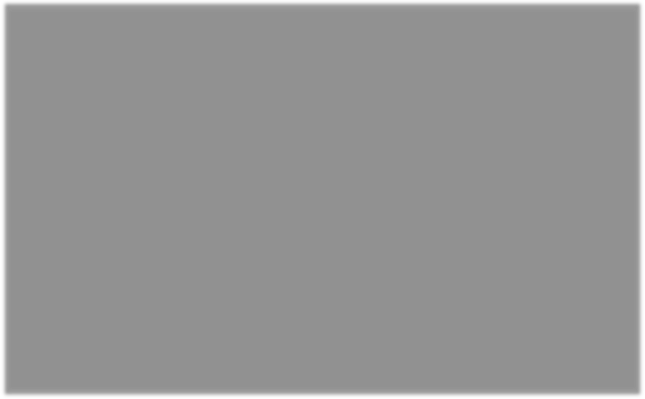
# Internet of Things

The Internet of Things, or "IoT" for short, is about extending the power of the internet beyond computers and smartphones to a whole range of other things, processes, and environments. IoT makes once "dumb" devices "smarter" by giving them the ability to send data over the internet, allowing the device to communicate with people and other IoT-enabled things. Far from being restricted to just the home, the Internet of Things can be found in an array of devices, industries and settings. IoT is rapidly making the world smarter by connecting the physical and the digital. By connecting physical and digital things that contain embedded technology to communicate and sense or interact with their internal or the external environment, data can be leveraged from physical objects and machines. The recorded data gets aggregated, analysed, and leveraged for intelligence, decisions, and applications, including autonomous actions by the connected devices themselves.

# Methodology



# Outline of The Project



# Hardware Details:

Pulse 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.

#### LM 35 Temperature Sensor: LM35 Temperature Sensor:

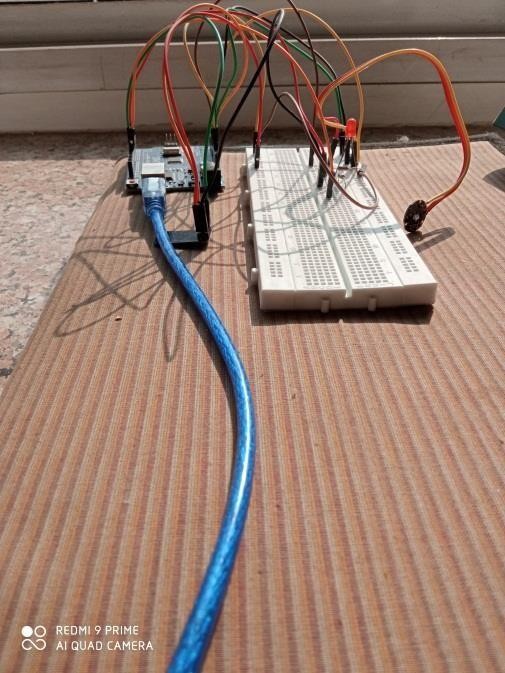
The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range.

#### ESP8266 WIFI MODULE:

The **ESP8266** is a very user-friendly and low-cost device to provide internet connectivity to your projects. The module can work both as an Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making the Internet of Things as easy as possible. It can also fetch data from the internet using API’s hence your project could access any information that is available on the internet, thus making it smarter

# Circuit Diagram :

1. Connect Pulse Sensor output pin to A0 of Arduino and other two pins to VCC & GND.
2. Connect LM35 Temperature Sensor output pin to A1 of Arduino and other two pins to VCC & GND.
3. Connect the LED to Digital Pin 7 of Arduino via a 220-ohm resistor.
4. The RX pin of ESP8266 works on 3.3V and it will not communicate with the Arduino when we will connect it directly to the Arduino. So, we will have to make a voltage divider for it which will convert the 5V into 3.3V. This can be done by connecting the 2.2K & 1K resistor. Thus the RX pin of the ESP8266 is connected to pin 10 of Arduino through the resistors.
5. Connect the TX pin of the ESP8266 to pin 9 of the Arduino.



# Code:

#include <SoftwareSerial.h> #include <ESP8266WiFi.h> float pulse = 0;

float temp = 0; SoftwareSerial ser(9,10);

String apiKey = "OO707TGA1BLUNN12"; int pulsePin = A0;

int blinkPin = 7 ; int fadePin = 13; int fadeRate = 0; volatile int BPM; volatile int Signal;

volatile int IBI = 600;

volatile boolean Pulse = false; volatile boolean QS = false; static boolean serialVisual = true; volatile int rate[10];

volatile unsigned long sampleCounter = 0; volatile unsigned long lastBeatTime = 0; volatile int P = 512;

volatile int T = 512; volatile int thresh = 525; volatile int amp = 100;

volatile boolean firstBeat = true; volatile boolean secondBeat = false;

void setup()

{

pinMode(blinkPin,OUTPUT); pinMode(fadePin,OUTPUT); Serial.begin(115200); interruptSetup();

void loop()

{

serialOutput(); if (QS == true)

{

fadeRate = 255; serialOutputWhenBeatHappens();

QS = false; // reset the Quantified Self flag for next time

}

ledFadeToBeat(); delay(20); read\_temp(); esp\_8266();

}

void ledFadeToBeat()

{

fadeRate -= 15;

fadeRate = constrain(fadeRate,0,255); analogWrite(fadePin,fadeRate);

}

void interruptSetup()

{

TCCR2A = 0x02; TCCR2B = 0x06; OCR2A = 0X7C; TIMSK2 = 0x02;

sei();

}

void serialOutput()

{

if (serialVisual == true)

{

arduinoSerialMonitorVisual('-', Signal);

}

else

{

sendDataToSerial('S', Signal);

}}

void serialOutputWhenBeatHappens()

{

if (serialVisual == true)

{

Serial.print("\*\*\* Heart-Beat Happened \*\*\* "); Serial.print("BPM: ");

Serial.println(BPM);

}

else

{

sendDataToSerial('B',BPM); sendDataToSerial('Q',IBI);

}}

void arduinoSerialMonitorVisual(char symbol, int data )

{

const int sensorMin = 0; const int sensorMax = 1024; int sensorReading = data;

int range = map(sensorReading, sensorMin, sensorMax, 0, 11); switch (range)

{

case 0: Serial.println(""); break;

case 1: Serial.println("---"); break;

case 2:

Serial.println(" ");

break; case 3:

Serial.println(" ");

break; case 4:

Serial.println(" ");

break; case 5:

Serial.println(" |-");

break; case 6:

Serial.println("--------------| -- "); break;

case 7:

Serial.println("--------------| ");

break; case 8:

Serial.println(" | "); break;

case 9:

Serial.println(" | "); break;

case 10:

Serial.println(" | "); break;

case 11:

Serial.println(" | "); break;

}}

void sendDataToSerial(char symbol, int data )

{

Serial.print(symbol); Serial.println(data);

} ISR(TIMER2\_COMPA\_vect)

{

cli();

Signal = analogRead(pulsePin); sampleCounter += 2;

int N = sampleCounter - lastBeatTime;

if(Signal < thresh && N > (IBI/5)\*3)

{

if (Signal < T)

{

T = Signal;

}}

if(Signal > thresh && Signal > P)

{

P = Signal;

}

if (N > 250)

{

if ( (Signal > thresh) && (Pulse == false) && (N > (IBI/5)\*3) )

{

Pulse = true; digitalWrite(blinkPin,HIGH);

IBI = sampleCounter - lastBeatTime; lastBeatTime = sampleCounter; if(secondBeat)

{

secondBeat = false;

for(int i=0; i<=9; i++)

{

rate[i] = IBI;

}}

if(firstBeat)

{

firstBeat = false; secondBeat = true; sei();

return;

}

word runningTotal = 0; for(int i=0; i<=8; i++)

{

rate[i] = rate[i+1]; runningTotal += rate[i];

}

rate[9] = IBI; runningTotal += rate[9]; runningTotal /= 10;

BPM = 60000/runningTotal; QS = true;

pulse = BPM;

}}

if (Signal < thresh && Pulse == true)

{

digitalWrite(blinkPin,LOW);

Pulse = false; amp = P - T;

thresh = amp/2 + T; P = thresh;

T = thresh;

}

if (N > 2500)

{

thresh = 512;

P = 512;

T = 512;

lastBeatTime = sampleCounter; firstBeat = true;

secondBeat = false;

}

sei();

}

void esp\_8266()

{

String cmd = "AT+CIPSTART=4,\"TCP\",\"";

cmd += "184.106.153.149"; // api.thingspeak.com cmd += "\",80";

ser.println(cmd); Serial.println(cmd); if(ser.find("Error"))

{

Serial.println("AT+CIPSTART error");

return;

}

String getStr = "GET /update?api\_key="; getStr += apiKey;

getStr +="&field1="; getStr +=String(temp); getStr +="&field2="; getStr +=String(pulse); getStr += "\r\n\r\n";

cmd = "AT+CIPSEND=4,";

cmd += String(getStr.length()); ser.println(cmd); Serial.println(cmd); delay(1000);

ser.print(getStr); Serial.println(getStr); delay(3000);

}

void read\_temp()

{

int temp\_val = analogRead(A1); float mv = (temp\_val/1024.0)\*5000; float cel = mv/10;

temp = (cel\*9)/5 + 32; Serial.print("Temperature:"); Serial.println(temp);

}

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