BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

# EEE 416 (July 2023)

Microprocessor and Embedded System Laboratory

# Final Project Report

## Section: B2; Group: 02

## IOT Based Patient Health Monitoring System Using ESP 32

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# 1 Abstract

This abstract presents a real-time health and condition monitoring solution for patients, leveraging IoT technology. It incorporates various sensors that measure temperature, pressure, humidity, gas levels, heart rate, and oxygen levels in the blood, with the data being sent via radio frequency communication. Should any of the environmental or physiological metrics surpass predefined limits, an alert system is triggered, facilitating prompt action. The objective of this holistic approach is to enhance patient care by constantly monitoring these critical parameters.

# 2 Introduction

In the landscape of modern healthcare, technological advancements have become a cornerstone for enhancing patient care and operational efficiency. The integration of Internet of Things (IoT) technology into health monitoring systems represents a significant leap forward, enabling of patient observation and data analysis. This project report introduces a IoT-based health monitoring system designed with the dual aim of ensuring patient comfort and facilitating the early detection of potential health issues. The system stands out for its ability to provide real-time monitoring of both environmental conditions and vital health parameters, ensuring a holistic approach to patient care. Below are the key features of this innovative health monitoring system:

**Key Features:**

**Real-Time Environmental Monitoring:**
**Humidity Monitoring:** Tracks ambient humidity levels to ensure they remain within comfortable and healthy ranges for the patient.
**Temperature Monitoring:** Monitors ambient temperature to maintain a conducive environment, safeguarding patients against the risks associated with extreme temperature conditions.

**Vital Health Parameters Monitoring:**
**Pulse Rate Monitoring:** Continuously measures the patient's heart rate, offering critical data for assessing cardiovascular health.
**Body Temperature Monitoring**: Provides real-time tracking of the patient's body temperature, enabling the detection of fever or other health issues.
Oxygen Saturation Monitoring: Measures the oxygen levels in the patient's blood, a vital parameter for assessing respiratory and overall health.

**Alarm System Based on Threshold Values:**
An advanced alarm system that automatically activates when any of the monitored environmental or health parameters deviate from predefined safe threshold values. This feature is crucial for ensuring that timely interventions can be made, potentially preventing the escalation of health issues.

The development of this IoT-based health monitoring system is guided by the principle of integrating advanced technology to enhance patient care quality. Through the deployment of a network of sensors and the utilization of real-time data analytics, this system aims to offer a comprehensive solution for monitoring patients in various settings, ranging from hospitals to home care. As we progress through this report, we will delve into the technical architecture of the system, discuss its implementation process, and evaluate its impact on improving patient outcomes. The project not only highlights the potential of IoT in revolutionizing healthcare but also sets a new standard for proactive patient monitoring and care.

# 3 Design

## 3.1 Problem Formulation

### 3.1.1 Identification of Scope

- Within the scope of our project, we try to evaluate the importance of real time monitoring of a patients condition to ensure the best possible healthcare service.
- We identify the potential of IoT technology to revolutionize monitoring practices, providing real-time insights into patients well-being and environmental conditions.

### 3.1.2 Literature Review

- Extensive literature research is conducted to understand existing safety monitoring systems in mining contexts.
- We delve into the latest advancements in IoT platforms and precision of sensors for health and safety monitoring.

### 3.1.3 Formulation of Problem

- Our project entails the integration of health and environment parameter sensors for continuous data collection of a patients overall condition.
- We tried to introduce an alarm system so that concerned can be notified when any of the health or environment parameters are exceeded.

### 3.1.4 Analysis

- Data interpretation involves analyzing information gathered by IoT sensors, including temperature, smoke, pulse rate, and oxygen saturation.
- Patterns and trends in the data are interpreted to anticipate potential risks to workers' health and safety.
- We analyze factors such as environmental conditions, physiological responses, and equipment reliability to develop comprehensive solutions.

- Insights from natural and engineering sciences inform the design and optimization of the IoT sensor network and machine learning models.

## 3.2 Design Method

An overall workflow of the project is as follows-

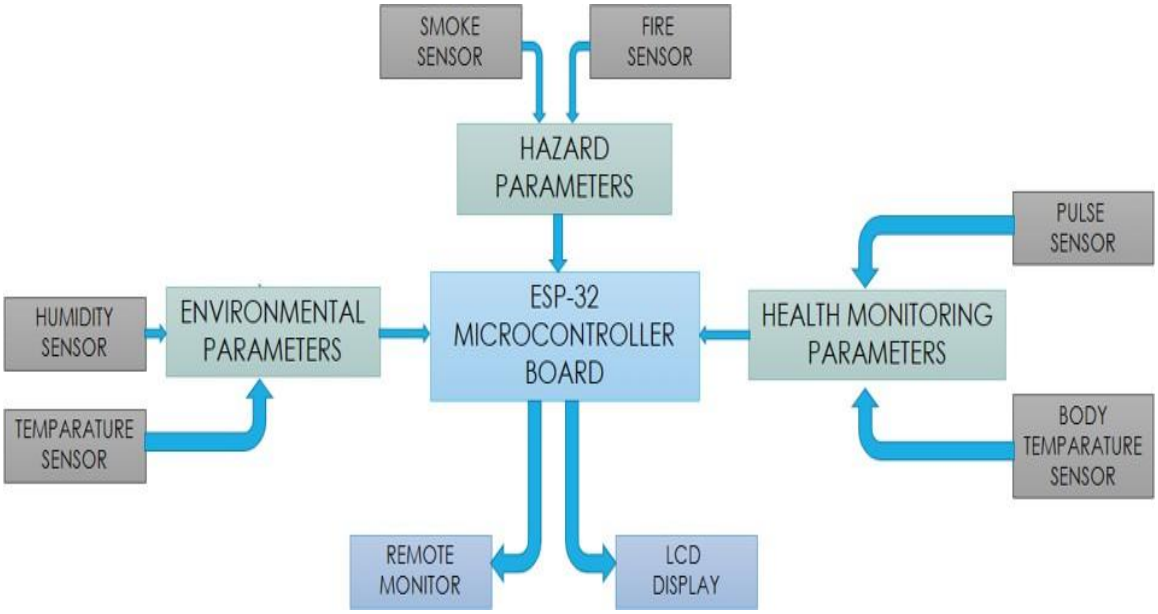
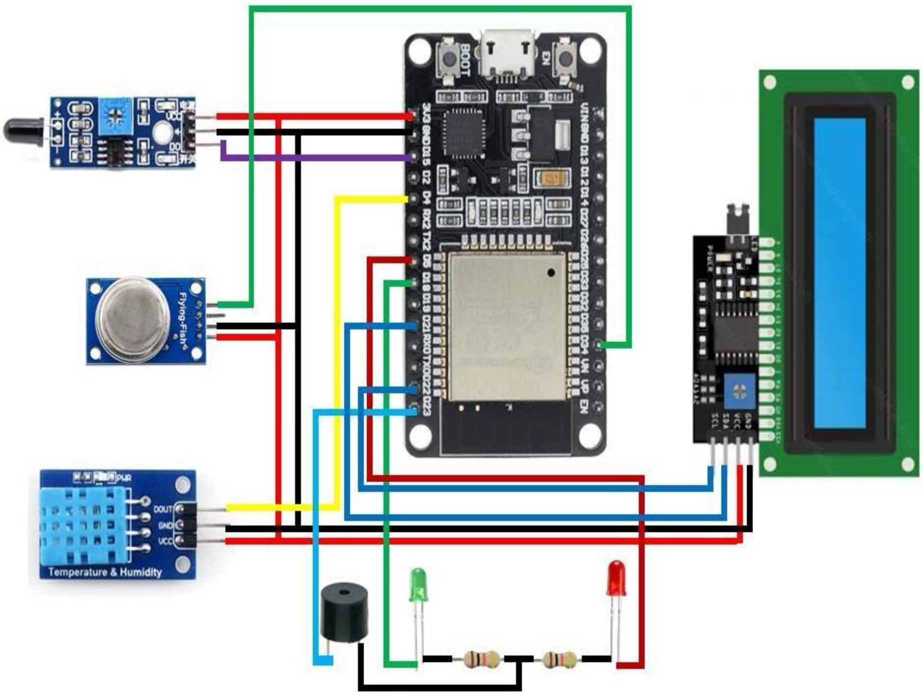


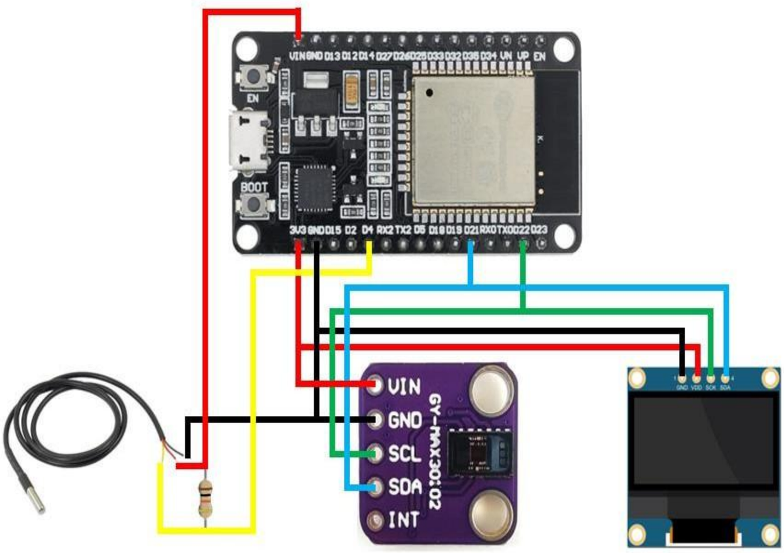

Figure-1:Workflow Diagram

## 3.3 Circuit Diagrams

The circuit diagram for the environment monitoring system is as follows-

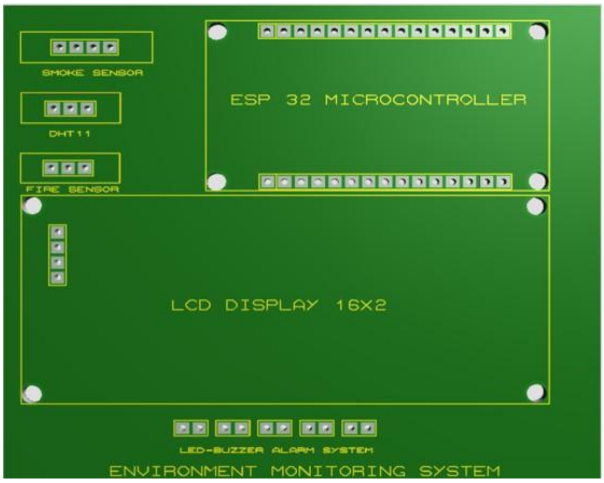


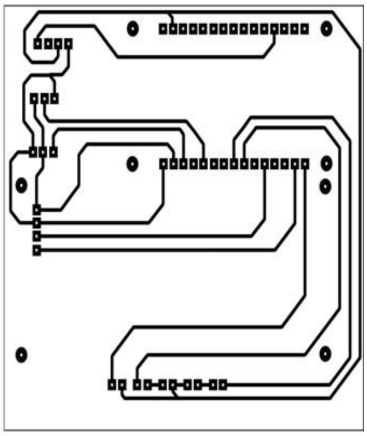

The circuit diagram for the health monitoring system is as follows-



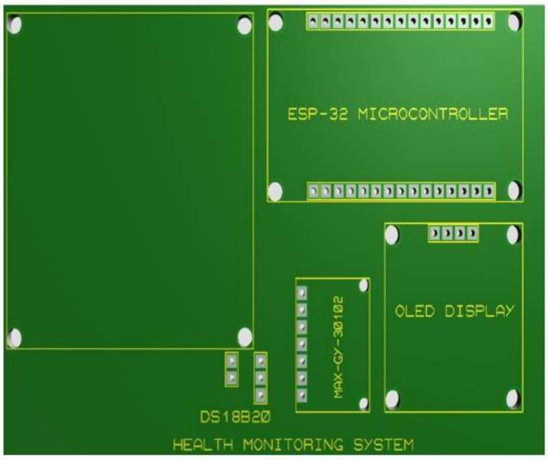
## 3.4 PCB Design

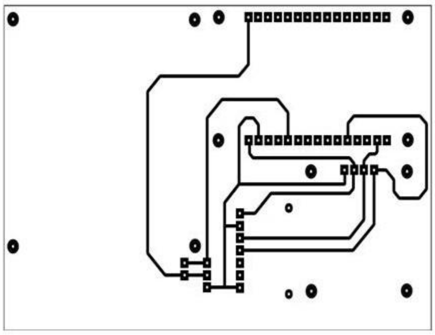
PCB layout and 3D rendering of Environment Monitoring system



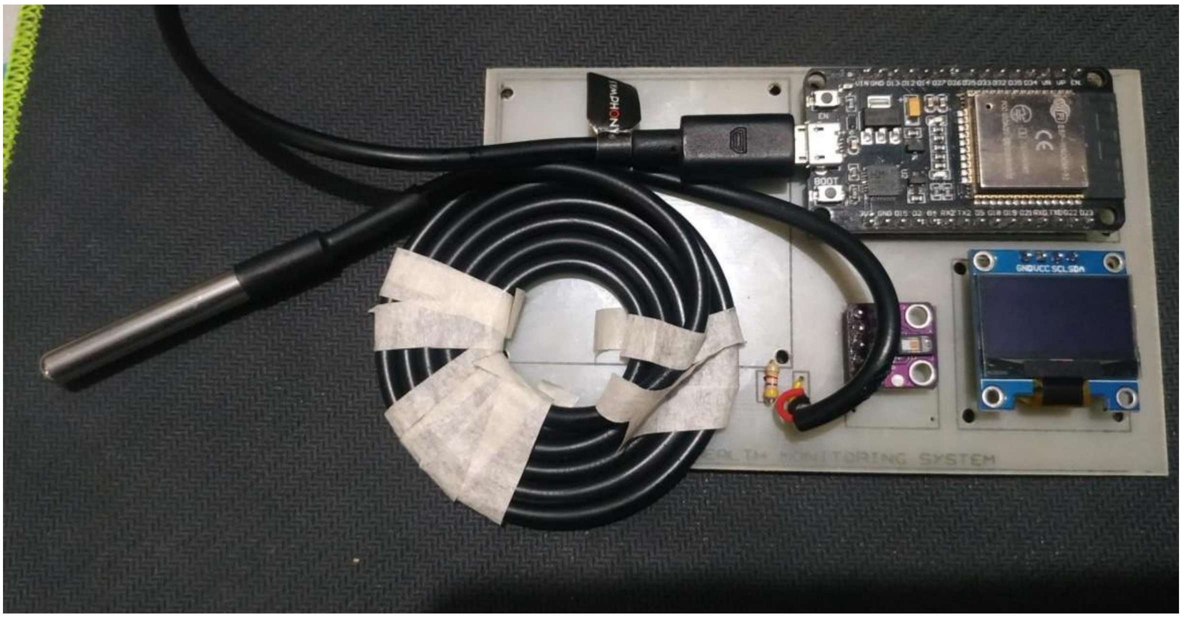
PCB layout and 3D rendering of Health Monitoring system



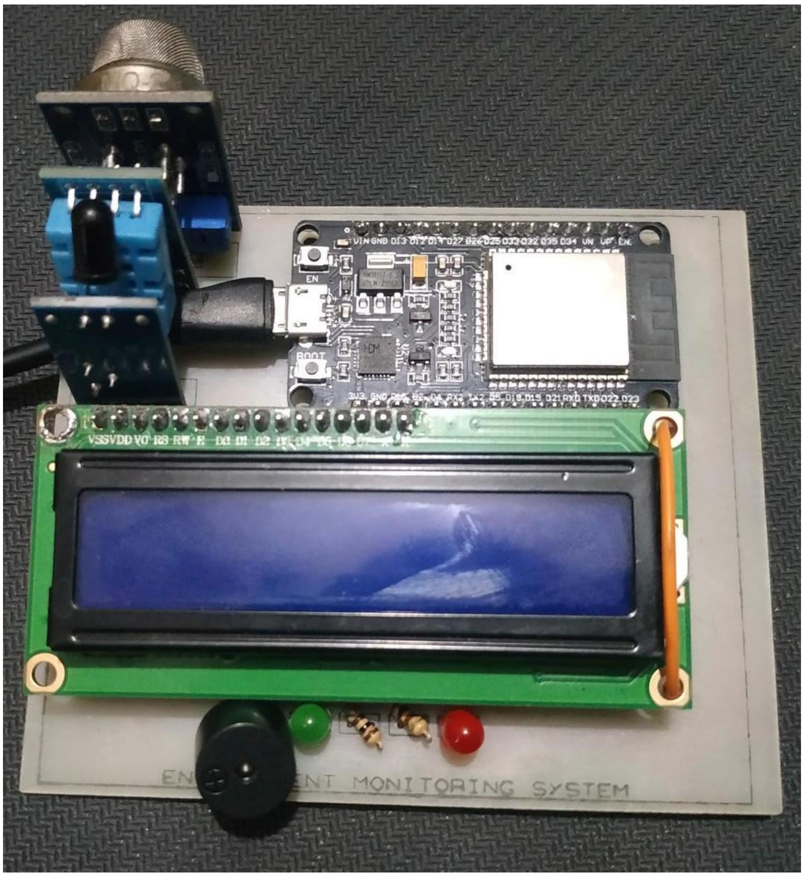



## 3.5 CAD/Hardware Design

The hardware circuit for health monitoring system-




The hardware circuit for environment monitoring system-



**HEALTH PARAMETERS:**

```
#include "DHT.h"
#include
#include
#include
#include
#include

LiquidCrystal_I2C lcd(0x27, 16, 2);

#define DHTPIN 4                                                    // Digital pin connected to the DHT
sensor
#define DHTTYPE DHT11                                               // DHT 11

const int flamepin = 15;                                            // Digital pin connected to flame
sensor
const int redled = 5;                                               // Digital pin connected to RED LED
const int greenled = 18;                                            // Digital pin connected to GREEN LED
const int buzzerpin = 23;                                           // Digital pin connected to BUZZER
int smokeA0 = 34;                                                   // Analog pin connected to smoke sensor
int flame = HIGH;                                                   // presence of flame
int sensorThres = 1000;                                             // Threshold for smoke detection
int x = 0;
int y = 0;

const char* ssid = "caution 101";                                   //wifi name
const char* password = "caution101";                                //wifi password
const char* serverName = "http://api.thingspeak.com/update";        //server name
String apiKey = "W4QCLASE7LIN3ALQ";                                 //apikey for thingspeak
String phoneNumber = "+8801788240334";                              //doctor's number
String apiKey1 = "3702186";                                         //apikey for whatsapp

DHT dht(DHTPIN, DHTTYPE);                                           //DHT11 initialization

void setup() {
  // LCD setup
  lcd.init();
  lcd.backlight();
  // Pin setup
  pinMode(redled, OUTPUT);
  pinMode(greenled, OUTPUT);
  pinMode(buzzerpin, OUTPUT);
  pinMode(flamepin, INPUT);
  pinMode(smokeA0, INPUT);

  Serial.begin(9600);
  // DHT11 setup
  dht.begin();
  // wifi setup
  WiFi.begin(ssid, password);
  Serial.println("Connecting");
  // wait until get connected
  while(WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.print("Connected to WiFi network with IP Address: ");
  Serial.println(WiFi.localIP());
}

// function for sending SOS to whatsapp
void sendMessage(String message){
  String url = "https://api.callmebot.com/whatsapp.php?phone=" + phoneNumber + "&apikey=" + apiKey1 + "&text=" +
urlEncode(message);
  HTTPClient http;
  http.begin(url);
  http.addHeader("Content-Type", "application/x-www-form-urlencoded");
  int httpResponseCode = http.POST(url);
  if (httpResponseCode == 200){
    Serial.print("Message sent successfully");
    Serial.println();
  }
  else{
    Serial.println("Error sending the message");
    Serial.print("HTTP response code: ");
    Serial.println(httpResponseCode);
  }
  http.end();
}
void loop() {
  delay(5000);
  lcd.clear();
  // data reading from DHT11
  float h = dht.readHumidity();
  float t = dht.readTemperature();
  // If DHT11 doesnot work
  if (isnan(h) || isnan(t)) {
    Serial.println(F("Failed to read from DHT sensor!"));
```

```
    return;
  }
  // data reading from fire sensor
  flame = digitalRead(flamepin);
  // alarm system for fire
  if (flame == LOW) {
    digitalWrite(redled, HIGH);
    digitalWrite(greenled, LOW);
    digitalWrite(buzzerpin, HIGH);
    lcd.clear();
    lcd.setCursor(5, 0);
    lcd.print("FIRE!");
    delay(2000);
    x = 15;
  }
  else {
    digitalWrite(redled, LOW);
    digitalWrite(greenled, HIGH);
    digitalWrite(buzzerpin, LOW);
    lcd.clear();
    lcd.setCursor(4, 0);
    lcd.print("NO FIRE");
    delay(2000);
    x = 5;
  }
  // data reading from smoke sensor
  int analogSensor = analogRead(smokeA0);
  // alarm system for smoke
  if (analogSensor > sensorThres) {
    digitalWrite(redled, HIGH);
    digitalWrite(greenled, LOW);
    digitalWrite(buzzerpin, HIGH);
    lcd.setCursor(5, 0);
    lcd.print("SMOKE");
    y = 15;
  } else {
    digitalWrite(redled, LOW);
    digitalWrite(greenled, HIGH);
    digitalWrite(buzzerpin, LOW);
    lcd.setCursor(4, 0);
    lcd.print("NO SMOKE");
    y = 5;
  }
  Serial.println("::Humidity::");
  Serial.println(h);
  Serial.println("::Temperature::");
  Serial.println(t);
  delay(2000);
  lcd.clear();
  lcd.setCursor(2, 0);
  lcd.print("::Humidity::");
  lcd.setCursor(5, 1);
  lcd.print(h);
  lcd.print("%");
  delay(2000);
  lcd.clear();
  lcd.setCursor(1, 0);
  lcd.print("::Temperature::");
  lcd.setCursor(5, 1);
  lcd.print(t);
  lcd.print(F("C"));
  delay(2000);
  lcd.clear();
  lcd.setCursor(3, 0);
  lcd.print("::EEE-416::");
  lcd.setCursor(1, 1);
  lcd.print("Measuring. ... ");
  // Sending data to IOT dashboard
  if(WiFi.status()== WL_CONNECTED){
      WiFiClient client;
      HTTPClient http;
      http.begin(client, serverName);
      http.addHeader("Content-Type",  "application/x-www-form-urlencoded");
      // field1 = room temperature, field2 = humidity, field3 =  fire, field4 = smoke
      String httpRequestData1 = "api_key=" + apiKey + "&field1=" + String(t) +"&field2=" + String(h) +"&field3=" +
String(x) + "&field4=" + String(y);
      int httpResponseCode1 = http.POST(httpRequestData1);
      Serial.print("HTTP Response code1: ");
      Serial.println(httpResponseCode1);
      http.end();
    }
    else {
      Serial.println("WiFi Disconnected");
    }
  // messages for different critical situations
  if(t>45){
```

```
    sendMessage("EMERGENCY!!!! Room temperature is HIGH.");
  }
  if(t<20){
    sendMessage("EMERGENCY!!!! Room temperature is LOW.");
  }
  if(h>60){
    sendMessage("EMERGENCY!!!! Humidity is HIGH.");
  }
  if(h<20){
    sendMessage("EMERGENCY!!!! Humidity is LOW.");
  }
  if(x == 15){
    sendMessage("EMERGENCY!!!! FIRE! FIRE! FIRE!.");
  }
  if(y == 15){
    sendMessage("EMERGENCY!!!! SMOKE! SMOKE! SMOKE!.");
  }
}
```

**ENVIRONMENTAL PARAMETERS**

```
#include
#include
#include
#include
#include "MAX30105.h"
#include "heartRate.h"
#include
#include
#include "OneWire.h"
#include "DallasTemperature.h"
#include

#define ONE_WIRE_BUS 4                                                    //DS18B20 sensor's
yellow pin
#define OLED_RESET 4                                                      //OLED reset value
Adafruit_SSD1306 display(OLED_RESET);

OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature sensors(&oneWire);
MAX30105 particleSensor;                                                   //MAX30102 sensor
declaratioin

const byte RATE_SIZE = 4;                                                  //We can increase
this for more averaging
byte rates[RATE_SIZE];                                                     //Array of heart
rates
byte rateSpot = 0;
long lastBeat = 0;                                                         //Time at which
the last beat occurred
float beatsPerMinute;
float beatAvg;
float BPM = 0;
int count = 0;

const char* ssid = "caution 101";                                          //Wifi name
const char* password = "caution101";                                       //Wifi password
const char* serverName = "http://api.thingspeak.com/update";
String apiKey = "W4QCLASE7LIN3ALQ";                                        //API key for
thingspeak server
String phoneNumber = "+8801788240334";                                     //WhatsApp phone
number
String apiKey1 = "3702186";                                                //API key for Bot
that is sending messages


void setup(){
  Serial.begin(9600);
  Serial.println("Initializing...");
  // OLED display setup
  display.begin(SSD1306_SWITCHCAPVCC, 0x3C);
  display.clearDisplay();
  // Testing max30102
  if (!particleSensor.begin(Wire, I2C_SPEED_FAST)){
    Serial.println("MAX30102 was not found. Please check wiring/power. ");
    while (1);
  }
```

```
  Serial.println("Place your index finger on the sensor with steady pressure.");
  // MAX30102 Setup
  particleSensor.setup();                                                   //Configure sensor
with default settings
  particleSensor.setPulseAmplitudeRed(0x0A);                                //Turn Red LED to low
to indicate sensor is running
  particleSensor.setPulseAmplitudeGreen(0);                                 //Turn off Green LED
  // Wifi Setup
  WiFi.begin(ssid, password);
  Serial.println("Connecting");
  while(WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.print("Connected to WiFi network with IP Address: ");
  Serial.println(WiFi.localIP());
  // body temperature sensor setup
  sensors.begin();
}

// function for sending message
void sendMessage(String message){
  String url = "https://api.callmebot.com/whatsapp.php?phone=" + phoneNumber + "&apikey=" + apiKey1 +
"&text=" + urlEncode(message);
  HTTPClient http;
  http.begin(url);
  http.addHeader("Content-Type", "application/x-www-form-urlencoded");
  int httpResponseCode = http.POST(url);
  if (httpResponseCode == 200){
    Serial.print("Message sent successfully");
    Serial.println();
  }
  else{
    Serial.println("Error sending the message");
    Serial.print("HTTP response code: ");
    Serial.println(httpResponseCode);
  }
  http.end();
}
void BeatPM(float x){
  // temperature measurement
  sensors.requestTemperatures();
  float tempF = sensors.getTempFByIndex(0);
  // serial printing
  Serial.print("Temperature: ");
  Serial.print(tempF);
  Serial.print("F    ");
  Serial.print("BPM:  ");
  Serial.print(x);
  Serial.print("bpm    ");
  Serial.println();
  // sending to IOT
  if(WiFi.status()== WL_CONNECTED){
    WiFiClient client;
    HTTPClient http;
    http.begin(client, serverName);
    http.addHeader("Content-Type",  "application/x-www-form-urlencoded");
    String httpRequestData2 = "api_key=" + apiKey + "&field5=" + String(x) + "&field6=" + String(tempF);
    int httpResponseCode2 = http.POST(httpRequestData2);
    Serial.print("HTTP Response code2: ");
    Serial.println(httpResponseCode2);
    http.end();
  }
  else {
    Serial.println("WiFi Disconnected");
  }
  // message for critical situations
  if(x>100){
    sendMessage("EMERGENCY!!!! Patient's BPM is Critical.");
  }
  if(tempF>100){
    sendMessage("EMERGENCY!!!! Patient's Body Temperature is Critical.");
  }
  // displaying in OLED display
```

```
  display.clearDisplay();
  display.setTextSize(1.9);
  display.setTextColor(WHITE);
  display.setCursor(45,0);
  display.println("EEE-");
  display.setCursor(65, 0);
  display.println("-416");
  display.setCursor(30, 10);
  display.println("BPM ");
  display.setCursor(75,10);
  display.println(x);
  display.setCursor(30,20);
  display.println("TEMP");
  display.setCursor(75,20);
  display.println(tempF);
  display.display();
}
void loop(){
  // measuring average BPM
  long irValue = particleSensor.getIR();
  if (checkForBeat(irValue) == true){
    long delta = millis() - lastBeat;
    lastBeat = millis();
    beatsPerMinute = 60 / (delta / 1000.0);
    if (beatsPerMinute < 255 && beatsPerMinute > 20){
      rates[rateSpot++] = (byte)beatsPerMinute;
      rateSpot %= RATE_SIZE;
      beatAvg = 0;
      for (byte x = 0 ; x < RATE_SIZE ; x++)
        beatAvg += rates[x];
      beatAvg /= RATE_SIZE;
    }
  }
  count++;
  BPM = beatAvg;
  if (irValue < 50000){
    beatsPerMinute = 0;
    beatAvg = 0;
    if(count>1500){
      BeatPM(BPM);
      count = 0;
    }
  }
  else{
    if(count>1500){
      BeatPM(BPM);
      count = 0;
    }
  }
}
```

# 4 Implementation

## 4.1 Description

Here we see the results of the health monitoring system being displayed on screen. In presence of fire and smoke, the RED LEDs light up and shown on screen.

## 4.2 Results

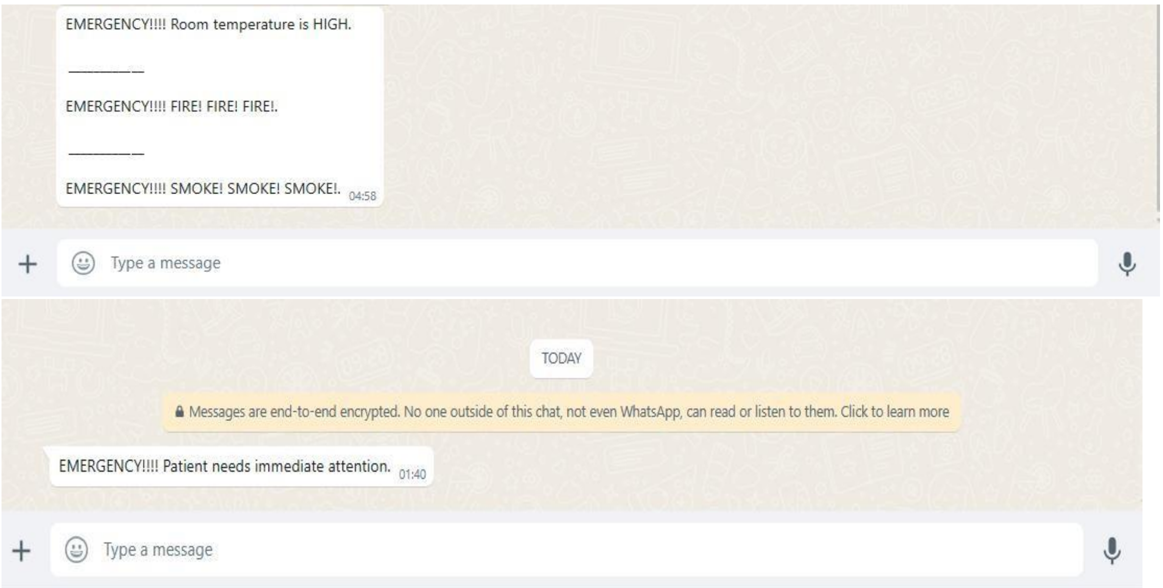
The overall outputs of the sensors are seen in the IoT platform as follows-

# 5 Design Analysis and Evaluation

## 5.1 Novelty

We introduced a couple of novel features to further enhance our design. These features include-

- The health monitoring system was made mobile, so that the patients vitals could be checked in real time while they were moving.
- An SOS message was sent to the doctor when the health parameters crossed a certain defined threshold.
- No extra Wi-Fi module was used.
- An LED buzzer system was introduced to notify when the environment parameters crossed the threshold.




## 5.2 Design Considerations

### 5.2.1 Considerations to public health and safety

Our project places paramount emphasis on ensuring the safety and well-being of patients. Through the deployment of our IoT-based monitoring system, our primary focus is on early detection and prevention of potential health hazards. Utilizing real-time monitoring capabilities and predictive analytics, we aim to proactively mitigate the risk of patient’s health deteriorating suddenly. Ensuring all patient data collected and transmitted by the IoT system is encrypted and securely stored to prevent unauthorized access. This was done in accordance of concerned authority to protect patients’ privacy. Depending on the jurisdiction, the IoT system may need to comply with specific regulations governing medical devices. The design and deployment of the system should consider ethical implications, including informed consent from patients being monitored.

### 5.2.2 Considerations to environment

In addition to prioritizing public health and safety, our project is deeply committed to environmental stewardship throughout its lifecycle. We aim to minimize environmental impact by integrating eco-friendly practices, such as using energy-efficient sensors and reducing waste generation. Thorough environmental assessments guide our efforts to identify and mitigate potential risks. Moreover, we support sustainable resource management and conservation initiatives. By considering environmental factors in our project framework, we aim to achieve a balance between mining activities and ecological preservation, fostering a more sustainable future for all stakeholders.

### 5.2.3 Considerations to cultural and societal needs

The advent of IoT-based health monitoring systems heralds a transformative shift in the delivery of healthcare services, particularly through the facilitation of remote monitoring capabilities. This innovation enables the extension of healthcare services to remote and underserved locations, effectively democratizing access to medical care. Real-time monitoring functions serve as a continuous update mechanism for patients about their health condition, enhancing their awareness and enabling early detection of potential health issues. Furthermore, the integration of emergency alarms in these systems plays a crucial role in swiftly communicating critical health conditions, thereby potentially saving lives through timely medical intervention. The efficiency of continuous monitoring lies in its ability to reduce human effort significantly, as it meticulously tracks every change in health parameters, proving to be a more efficient and reliable process compared to traditional health monitoring methods. Beyond individual health benefits, IoT in healthcare acts as a catalyst for societal innovation, driving the adoption of modern advancements that promise to reshape the healthcare landscape. Through these contributions, IoT-based health monitoring systems are not just technological innovations but pivotal societal interventions that enhance public health, safety, and wellbeing..

## 5.3 Investigations

### 5.3.1 Literature Review

The literature review on IoT-based patient health monitoring systems reveals a multifaceted approach to enhancing safety in hazardous environments. Studies highlight the potential of IoT technologies to revolutionize monitoring practices through real-time environmental tracking, wearable sensors for physiological data collection, and predictive maintenance utilizing data analytics. Additionally, machine learning algorithms are identified as powerful tools for predicting equipment failures, while sensor technologies offer versatile solutions for monitoring various environmental parameters in mining operations. Wearable devices emerge as valuable tools for tracking patients vital signs, with considerations for accuracy and user acceptance. Moreover, the integration of IoT and data analytics is recognized as a means to improve risk assessment and management in mines, offering insights from case studies and best practices. These reviews collectively provide a comprehensive overview of current technologies, methodologies, and challenges in mine safety monitoring, laying a foundation for further advancements in the field.

### 5.3.2 Data Analysis and Interpretation

The data that we obtained from our sensors were fairly accurate. All the environment parameters were signaling with LEDs and also on display if any of the fire or smoke sensor was excited. The health parameters worked accordingly, and all these information was successfully uploaded on IoT platform. And for the critical cases, an SOS text was sent on WhatsApp for both environment and health parameters. As for the environment one, the alarm system also functioned properly.

## 5.4 Limitations of Tools

Despite facing limitations such as low-quality sensors, PCB boards, and budget constraints, our team remained dedicated to delivering a functional and reliable IoT-based patient monitoring system. Adapting to the challenges posed by these limitations, we focused on maximizing the efficiency and effectiveness of available resources. While the use of low-quality sensors and PCB boards presented obstacles in terms of data accuracy and device reliability, we implemented rigorous testing and calibration procedures to mitigate these issues to the best of our ability. Additionally, the shortage of budget necessitated careful prioritization of expenses, leading to creative solutions and cost-saving measures in various aspects of the project. In terms of PCB design, while constrained by simplicity, we leveraged available design tools and expertise to optimize functionality within the limitations.

## 5.5 Impact Assessment

### 5.5.1 Assessment of Societal and Cultural Issues

The implementation of an IoT-based health monitoring system marks a significant societal and cultural shift towards embracing digital health solutions. It fosters greater health awareness, accessibility, and equity, bridging gaps in healthcare provision, especially for remote communities. This shift also cultivates a culture of proactive health management and technological trust among the population.

### 5.5.2 Assessment of Health and Safety Issues

The project's impact on health and safety is profoundly positive, offering numerous benefits. By enabling real-time monitoring of vital health parameters and environmental conditions, it ensures early detection of potential health issues, allowing for prompt intervention. This can significantly reduce emergency incidents and hospital readmissions, leading to better overall health outcomes. The alarm system further enhances patient safety by alerting caregivers to critical changes in health status, facilitating immediate response. Additionally, the continuous monitoring capability reduces the need for physical consultations, lowering the risk of exposure to infectious diseases in healthcare settings. Overall, the project promotes a safer and more efficient approach to health management, potentially transforming patient care practices and improving public health standards.

### 5.5.3 Assessment of Legal Issues

The project's legal assessment involves ensuring compliance with health data protection regulations, such as HIPAA or GDPR, to safeguard patient information. It requires adherence to medical device regulations, obtaining necessary approvals, and addressing ethical considerations, ensuring that the project aligns with legal frameworks governing healthcare and data privacy.

## 5.6 Sustainability and Environmental Impact Evaluation

When examining the sustainability and environmental impact of our project, we undertake a The sustainability and environmental impact evaluation of the IoT-based health monitoring system encompass several facets. It involves assessing the energy efficiency and ecological footprint of the devices, promoting sustainable manufacturing practices, and implementing proper disposal and recycling methods for electronic components. Additionally, the system's capacity to reduce the need for physical visits contributes to lower carbon emissions, fostering a more sustainable approach to healthcare delivery. Overall, the project's commitment to eco-friendly practices aligns with broader environmental sustainability goals.

## 5.7 Ethical Issues:

Addressing Ethical Issue we practiced in the Project:

1. **Data Privacy and Security:** We implemented robust measures to protect the privacy and security of personal data collected from patients home through IoT devices. This included encryption, anonymization, and restricted access to sensitive information.

2. **Informed Consent:** We obtained informed consent from patients regarding the collection and use of their data, ensuring transparency about how their information would be utilized.

3. **Community Engagement:** We engaged in meaningful dialogue with local communities and indigenous groups to understand their concerns and perspectives. We sought their input and feedback, respecting their rights and cultural heritage throughout the project.

By adhering to these ethical principles and proactively addressing ethical challenges, we strive to conduct our project in a responsible, equitable, and respectful manner, fostering trust and collaboration among all stakeholders.

# 6 Reflection on Individual and Teamwork

## 6.1 Mode of Teamwork

The sustainability and environmental impact evaluation of the IoT-based health monitoring system encompass several facets. It involves assessing the energy efficiency and ecological footprint of the devices, promoting sustainable manufacturing practices, and implementing proper disposal and recycling methods for electronic components. Additionally, the system's capacity to reduce the need for physical visits contributes to lower carbon emissions, fostering a more sustainable approach to healthcare delivery. Overall, the project's commitment to eco-friendly practices aligns with broader environmental sustainability goals.

## 6.2 Diversity Statement of Team

We distributed the tasks within ourselves to ensure most efficiency.
ID-1906101- worked on sensing health parameters for health monitoring system.
ID-1906103- worked on IoT and SOS implementation.
ID-1906120- worked on hardware implementation and PCB design
ID-1906121- worked on sensing environmental parameters for environment monitoring system

## 6.3 Logbook of Project Implementation

| Date | Milestone achieved | Individual Role | Team Role | Comments |
|---|---|---|---|---|
| 10/12/2023 | Project assigned | - | - | - |
| 14/12/2023 | Work distribution | - | All members decided | |

| | | | | |
|---|---|---|---|---|
| 23/12/2023 | Components listed and bought | - | Everyone went for shopping | All components bought for shopping |
| 27/12/2023 | Environment sensors checked | 121 | - | successful |
| 04/01/2023 | Sending message to IoT | 103 | - | |
| 06/01/2023 | Working on health sensors | 101 | | Partially successful, sensor was faulty |
| 09/01/2024 | Trying to display environment parameters on screen | 121 | - | |
| 16/01/2024 | PCB design on proteus | 120 | - | successful |
| 18/02/2024 | Finalizing working of health sensors | 101 | - | |
| 25/02/2024 | Soldering of the hardware components to PCB | 120 | - | |
| 26/02/2024 | Trying to find fault in PCB design | 120,121 | | |
| 28/02/2024 | Sending sensor information to IoT | 103 | - | Successful |
| 02/03/2024 | Sending SOS message | 120,121 | - | |
| 05/03/2024 | Demo presentation | - | Meeting for all members | Upcoming work and plan decided |

# 7 Communication

## 7.1 Executive Summary

The project introduces an innovative IoT-based health monitoring system designed to enhance patient care through real-time monitoring of environmental conditions and vital health parameters. By integrating sensors to track humidity, temperature, pulse rate, body temperature, and oxygen saturation, coupled with an alarm system triggered by deviations from preset thresholds, the system offers comprehensive monitoring, particularly valuable for remote patient care. Emphasizing legal compliance, data protection, and sustainability, this project addresses crucial health, safety, and environmental impacts. Its implementation showcases the potential of IoT technology in revolutionizing healthcare delivery, improving accessibility, and promoting proactive health management.

# 8 Project Management and Cost Analysis

## 8.1 Bill of Materials

| Serial number | Component name | Quantity | Cost(BDT) |
|---|---|---|---|
| 1 | DHT11 sensor | 1 | 100 |
| 2 | MQ sensor | 1 | 100 |
| 3 | Flame IR sensor | 1 | 60 |
| 4 | MAX 30102 | 1 | 150 |
| 5 | DS18B20 | 1 | 120 |
| 6 | ESP 32 microcontroller | 2 | 380×2=760 |
| 7 | OLED display | 1 | 210 |
| 8 | LCD display | 1 | 130 |
| 9 | I2C driver | 1 | 80 |
| 9 | PCB board | 2 | 768 |
| 10 | Buzzer & LED | 1+2 | 15 |
| | | Total | 2493 |

## 8.2 Calculation of Per Unit Cost of Prototype

As all the components mentioned above was used , the cost of a prototype would be around 2500tk

## 8.3 Calculation of Per Unit Cost of Mass-Produced Unit

As the project transitions to mass-production, there is potential for a slight reduction in the per unit cost. However, accurately determining the total cost of installing our device hinges upon several factor such as regularity compliance, quality control and testing, market demand, government incentives and subsidies wtc.

# 9 Future Work

The future works and prospects of the IoT-based health monitoring system project are promising, with potential avenues for further development and expansion. Some key areas for future exploration include:

**1. Enhanced Sensor Integration:**
- Explore the integration of additional sensors and health monitoring devices to broaden the scope of monitored parameters, providing a more comprehensive health profile for patients.

**2. Machine Learning and Predictive Analytics:**
- Implement machine learning algorithms and predictive analytics to analyze historical health data. This can enable the system to anticipate potential health issues and proactively suggest interventions.

**3. Telemedicine Integration:**
- Integrate telemedicine functionalities to facilitate remote consultations between healthcare providers and patients, fostering a more holistic approach to virtual healthcare.

**4. User-Friendly Interfaces:**
- Develop intuitive and user-friendly interfaces for both healthcare providers and patients, promoting better engagement and understanding of health data.

**5. Global Expansion and Accessibility:**
- Explore opportunities for global expansion, ensuring the system's accessibility in diverse healthcare settings and addressing health disparities in various regions.

**6. Interoperability with Healthcare Ecosystem:**
- Work towards seamless interoperability with existing healthcare information systems and electronic health records, enhancing collaboration between the IoT system and broader healthcare infrastructure.

**7. Continuous Improvement in Security Measures:**
- Stay at the forefront of cybersecurity measures to safeguard patient data and the integrity of the system, adapting to evolving threats and compliance standards.

**8. Community Health Monitoring Initiatives:**
- Extend the project's impact by exploring community-based health monitoring initiatives, allowing for broader population health assessments and preventive measures.

**9. User Education and Adoption Programs:**
- Implement educational programs to enhance user understanding and acceptance, promoting the adoption of IoT-based health monitoring systems among both healthcare professionals and patients.

**10. Integration with Wearable Devices:**
- Explore integration with wearable devices and smart accessories to enhance the ease of health parameter monitoring, encouraging continuous and unobtrusive data collection.

By pursuing these future works and prospects, the IoT-based health monitoring system can evolve into a dynamic and adaptable solution that not only addresses current healthcare needs but also stays at the forefront of technological innovation, contributing to the ongoing improvement of patient care and public health outcomes.

# 10 References


- https://youtu.be/xPlN_Tk3VLQ?si=RcdE7Tic2yG1n5Fy
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