MineSafe : IOT Based Smart Helmet for Mining Workers

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Abstract

Mining is recognized as one of the most hazardous occupations in the world. The mining industry has the highest incidence of occupational deaths. In order to reduce these risks and make mining safer, we are focusing on improving the helmets used by workers.

Therefore, the main aim is to make the helmet even safer by adding an array of sensors to monitor environmental conditions, an emergency switch to trigger an alert in case of emergencies, GPS location tracking, along with a WiFi module for IoT communication. Additionally, the helmet incorporates an Mems Sensor for fall detection, as well as a pre-recorded voice provided by a voice processor for alerts. The developed helmet system is primarily intended to improve the working environment in mines and ensure worker safety.

Keywords : Smart Helmet, Sensors, GSM, GPS, Voice Processor.

Problem Statement

- In underground mining there is a concern about the safety of the workers due to its highly changing environment. Thousands of miners die from mining accidents every year.
- To save the workers life and to improve safety in mining environment it is important to take some safety measures and to improve communication between workers and control stations to avoid life threatening situations.
- With the help of the smart helmet we can provide security and rescue measures in case of any emergency conditions.

Review -0 Comments

- Could you specify the types of mines for which this smart helmet system is being developed?

- In mining areas where there will be lack of signal, how the WiFi module manages to work and help with communication?

Objectives of Project

- To develop an advanced smart helmet system with a diverse set of sensors, including environmental sensors (such as gas, temperature, and humidity), Mems sensor for fall detection, IR sensor for helmet usage verification and Heart Rate sensor to measure the heart pulse rate.

- To Implement an intelligent alert system using voice notifications through the APR33A3 voice playback module.

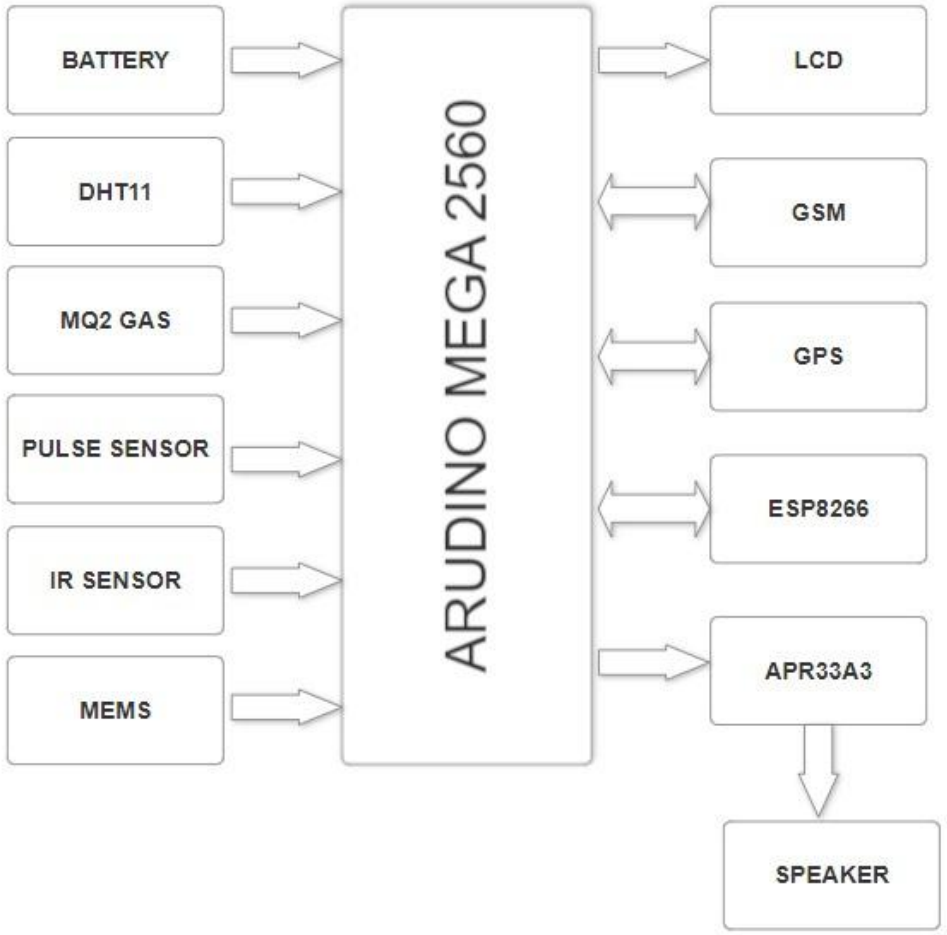
Literature survey for first objective

- [1]. This system uses sensors to monitor the workplaces.
  - It incorporated sensors like MQ2 Sensor for detecting hazardous gases, DHT11 sensor keeps track of the environment's temperature and humidity.
  - Smart helmet also integrated with a GSM modem to send emergency SMS messages to predefined numbers, GPS location tracking, and an ESP8266 WiFi module for IoT communication.
  - This system is particularly used for detecting safety at workplaces but not for the workers.

- [2]. This paper consists of sensors to monitor the workplaces as well as worker but it is lacking in fall detection. Fall Detection sensor is important because no one comes to know if the worker get unconscious. Because there is no such sensor to detect and send request to control room.

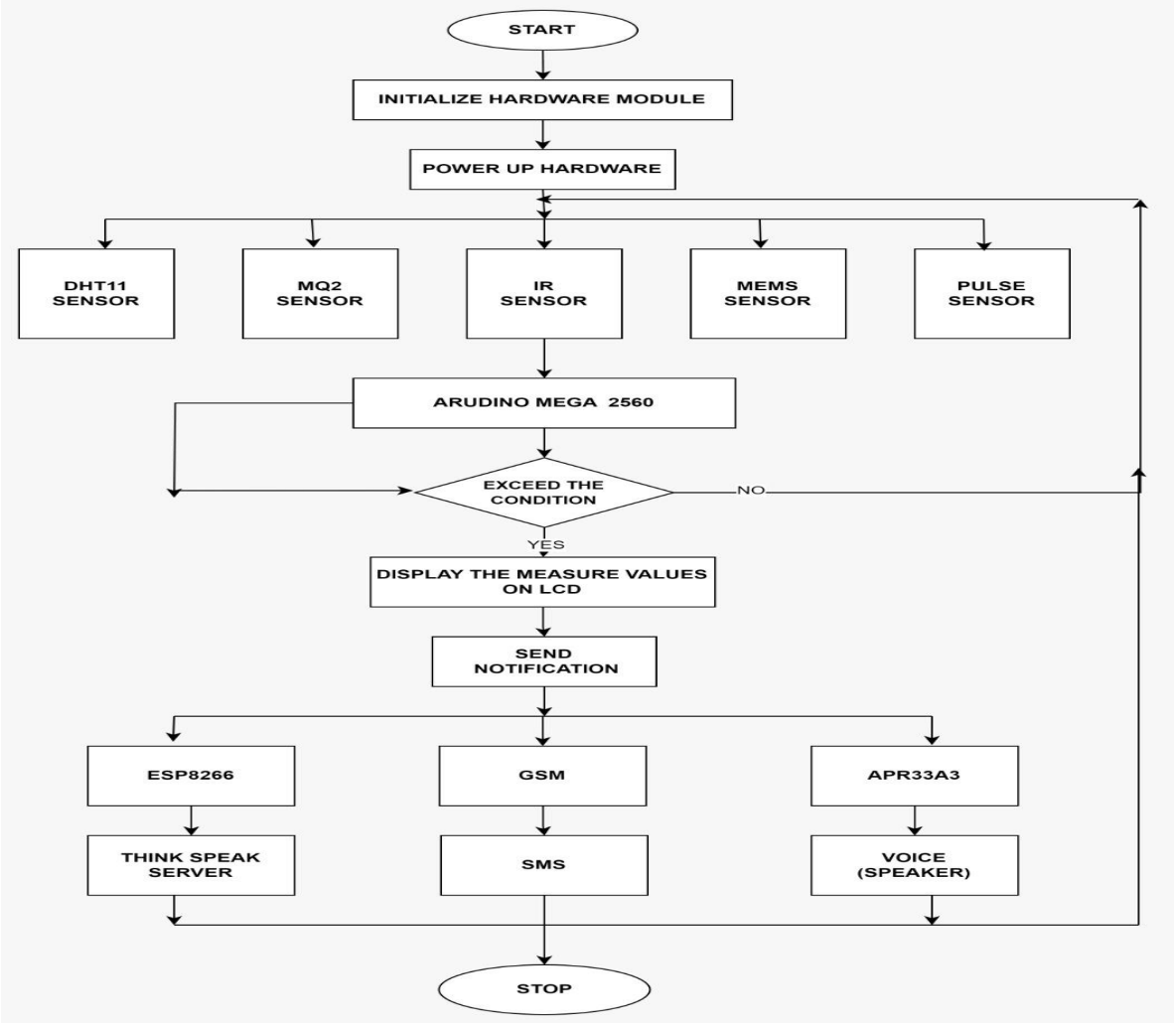
Design and Implementation of First Objective

Block Diagram



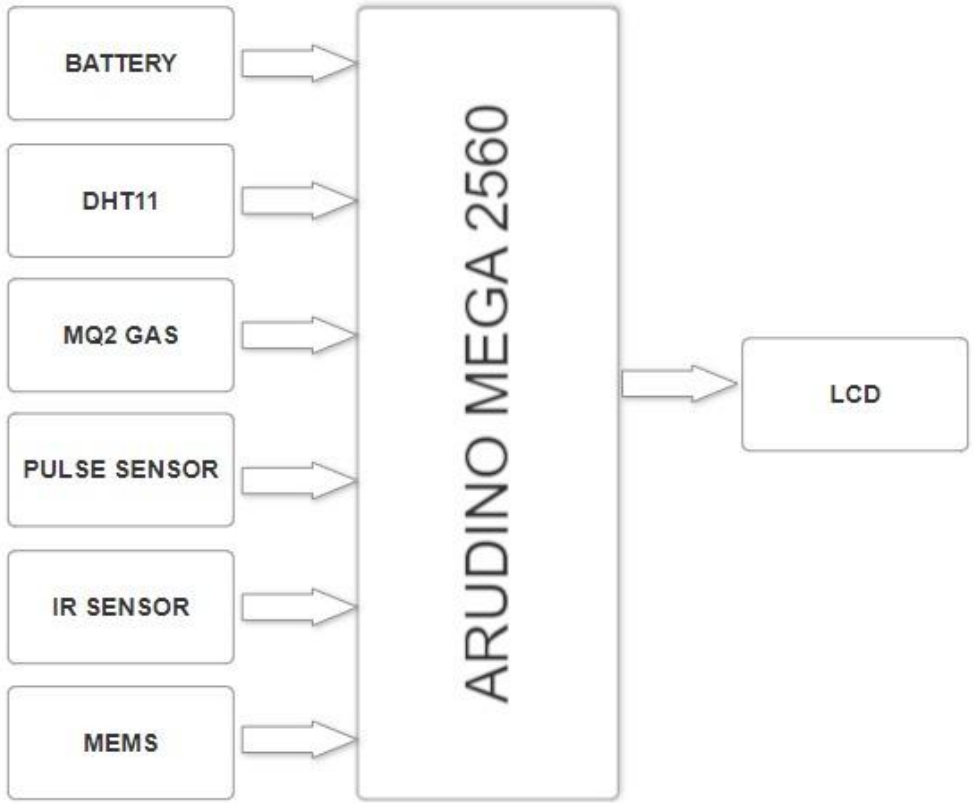
Design and Implementation of First Objective

Flow Chart



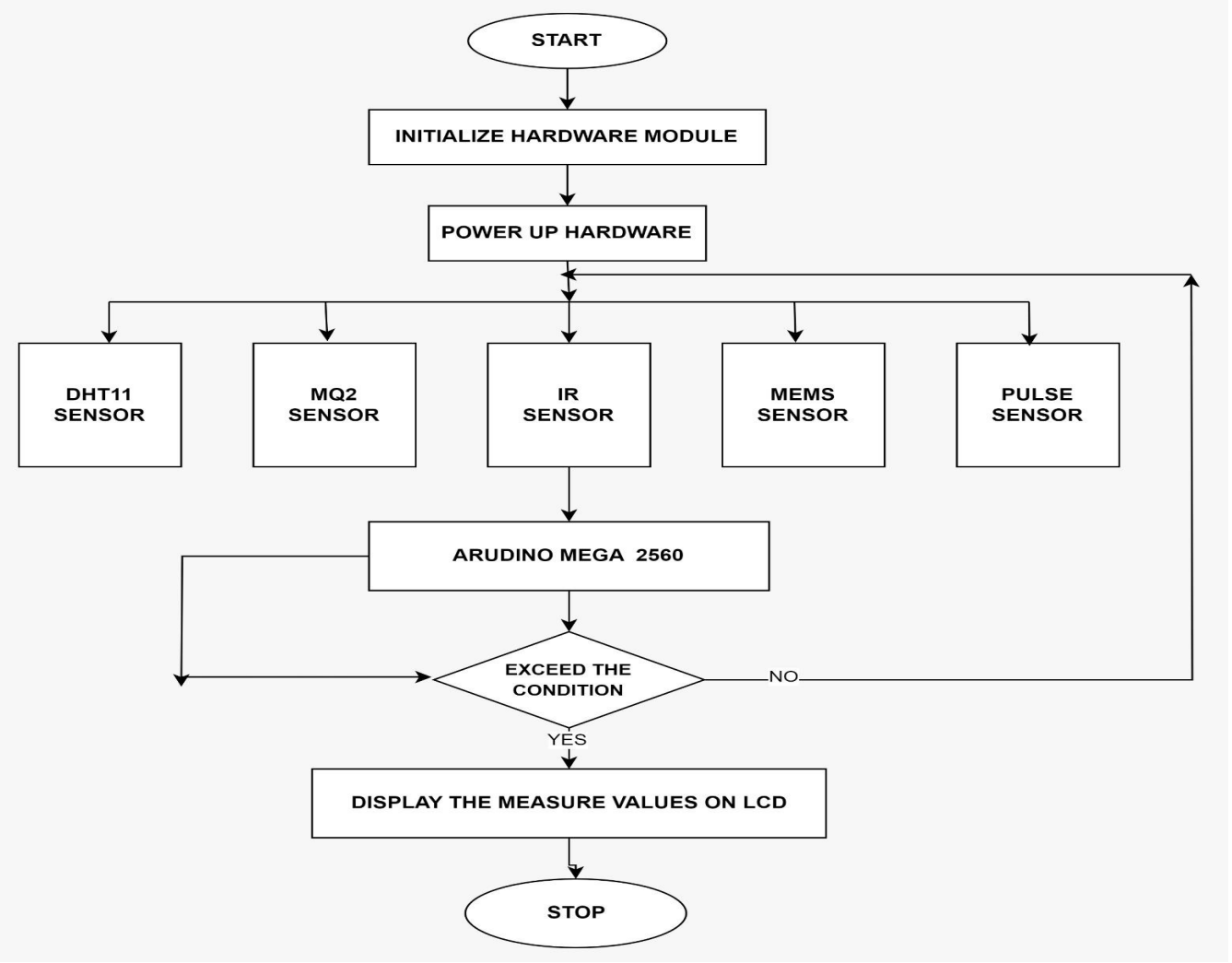
Design and Implementation of First Objective

Block Diagram for First Objective



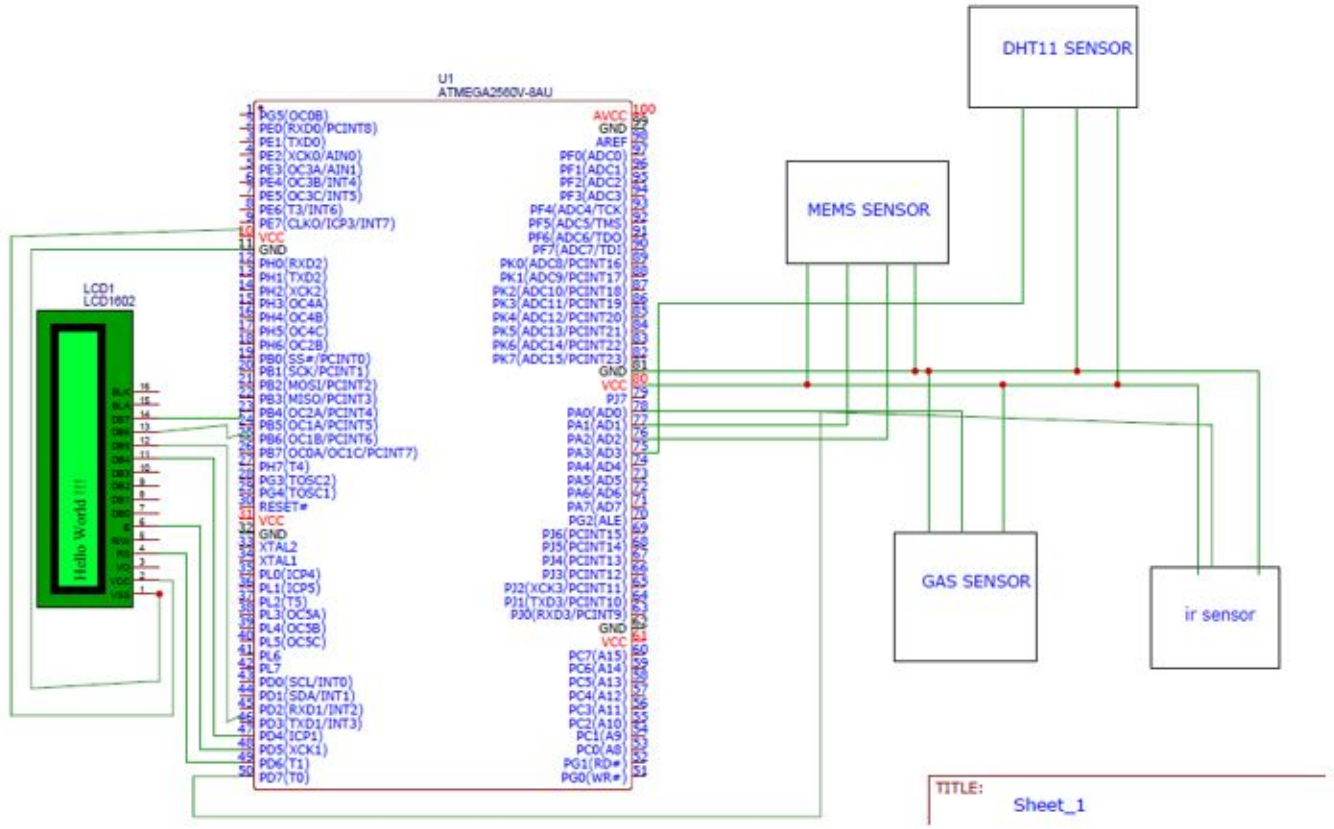
Design and Implementation of First Objective

Flow Chart for First Objective



Design and Implementation of First Objective

Circuit Diagram for First Objective



Design and Implementation of First Objective

Implementation

```
//#include <DHT11.h>
#include "DHT.h"
#include<SoftwareSerial.h>
#include <LiquidCrystal.h>
// Create an instance of the DHT11 class and set the digital I/O pin.
#define DHTPIN 8
#define DHTTYPE DHT11
//DHT11 dht11(8);
DHT dht(DHTPIN, DHTTYPE);
LiquidCrystal lcd(2,3,4,5,6,7);
const int pulse = A0;
const int gas = A2;
const int xaxis = A3;
const int yaxis = A4;
const int ir = 9;
float millivolt,voltage;
float tempertureC,temp;
int p,i,cl,x,y,p1;
float val;
int gas1;
```

Design and Implementation of First Objective

```
void setup()
{
// Initialize serial communication at 115200 baud.
  Serial.begin(115200);
  lcd.begin(16,2);
  lcd.clear();
  lcd.setCursor(0,0);
  pinMode(xaxis,INPUT);
  pinMode(yaxis,INPUT);
  pinMode(pulse,INPUT);
  pinMode(gas,INPUT);
  pinMode(ir,INPUT);
  lcd.begin(16,2);
  lcd.print("SMART HELMENT");
  lcd.setCursor(0,1);
  lcd.print("FOR MINING ");
  delay(1000);
  welcome_note();
}
void welcome_note()
{
  lcd.clear();
   lcd.setCursor(0,0);
   lcd.print("T:  H:  P:  G:");
   lcd.setCursor(0,1);
   lcd.print("X:   Y:    HEL: ");
}
```

Design and Implementation of First Objective

DHT11 Sensor Implementation

```
void loop()
{
  //Dht11 ( Read the humidity from the sensor. )
  float humidity = dht.readHumidity();
  float temperature = dht.readTemperature();

// If the temperature and humidity readings were successful, print them to the serial monitor.
  if (temperature != -1 && humidity != -1)
  {
    lcd.setCursor(2,0);
    lcd.print(temperature);
    lcd.setCursor(6,0);
    lcd.print(humidity);

  }
  else{
    // If the temperature or humidity reading failed, print an error message.
    Serial.println("Error reading data");
  }
  //Wait for 2 seconds before the next reading.
```

Design and Implementation of First Objective

Pulse Sensor Implementation

```
//pulse Sensor
p = analogRead(pulse);
 if(p < 50){
   p1 = 0;
}
else
{
 p1 = p;
}
p1 = map(p1,0,1023,0,120);

lcd.setCursor(10,0);
lcd.print(p1);
```

Ir Sensor Implementation

```
// IR Sesnor
  i = digitalRead(ir);
  if(i == LOW){
  lcd.setCursor(15,1);
   lcd.print("Y");
   delay(500);
  }
 else
 {
  lcd.setCursor(15,1);
   lcd.print("N");
   delay(500);
 }
```

Design and Implementation of First Objective

Mems Sensor Implementation

```
// Mems Sesnor
x = analogRead(xaxis);
 y = analogRead(yaxis);
 lcd.setCursor(2,1);
  lcd.print(x);
  lcd.setCursor(7,1);
  lcd.print(y);
```

Gas Sensor Implementation

```
// Gas Sensor
   gas1 = analogRead(gas);
  lcd.setCursor(13,0);
   lcd.print(gas1);
   delay(1000);
```

Design and Implementation of First Objective

Code Implementation

helment | Arduino IDE 2.2.1

File Edit Sketch Tools Help

Arduino Mega or Mega 2560

helment.ino

```
1
2   //#include <DHT11.h>
3   #include "DHT.h"
4   #include<SoftwareSerial.h>
5   #include <LiquidCrystal.h>
6   // Create an instance of the DHT11 class and set the digital I/O pin.
7   #define DHTPIN 8
8   #define DHTTYPE DHT11
9   //DHT11 dht11(8);
10  DHT dht(DHTPIN, DHTTYPE);
11  LiquidCrystal lcd(2,3,4,5,6,7);
12  const int pulse = A0;
13  const int gas = A2;
14  const int xaxis = A3;
15  const int yaxis = A4;
16  const int ir = 9;
17  float millivolt,voltage;
18  float tempertureC,temp;
19  int p,i,cl,x,y,p1;
20  float val;
21  int gas1;
22
23
24  void setup()
25  {
26  // Initialize serial communication at 115200 baud.
```

Output

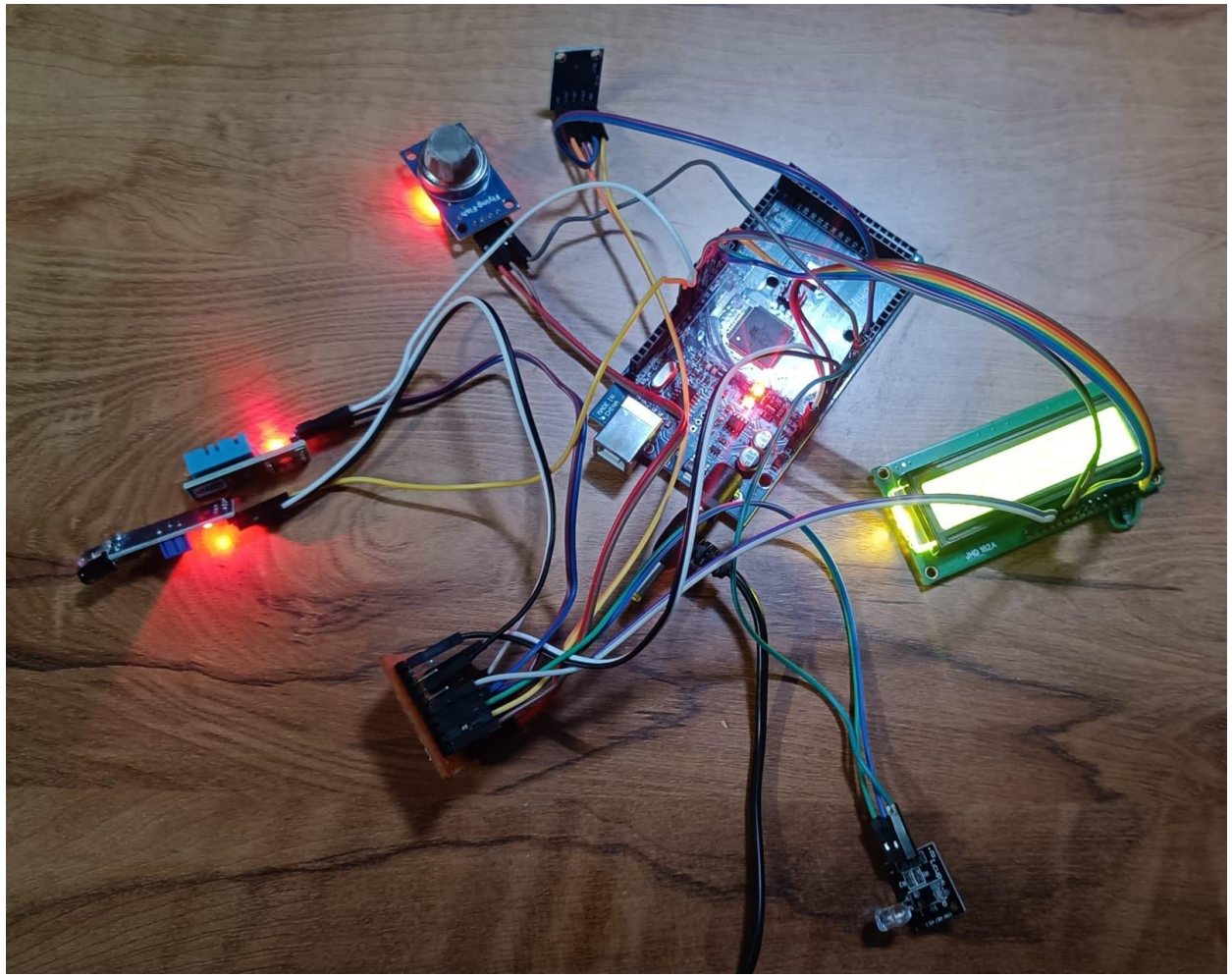
Done compiling.

Ln 88, Col 4 Arduino Mega or Mega 2560 [not connected] 1

32°C Sunny Search ENG IN 11:40 AM 18-10-2023

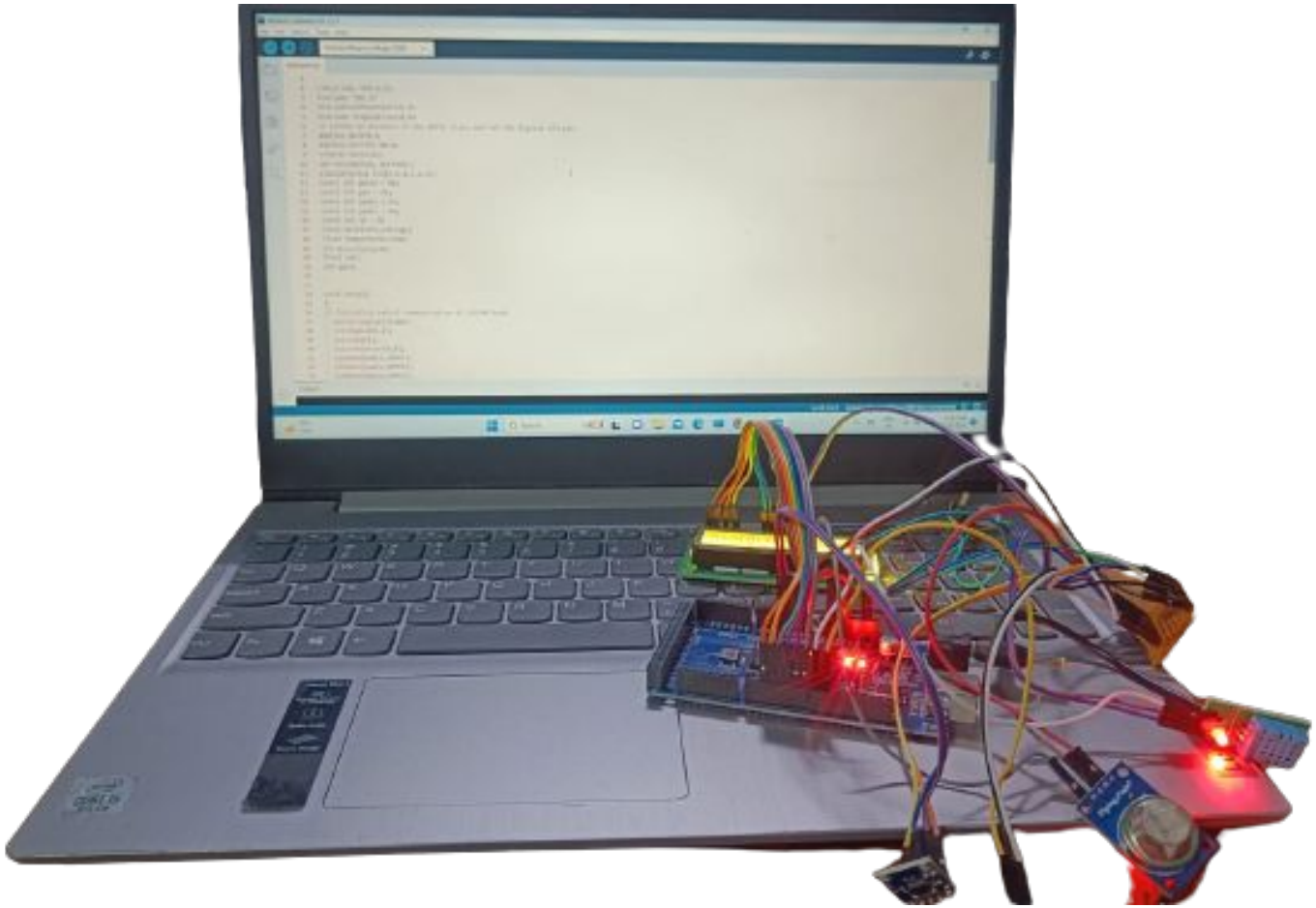
Design and Implementation of First Objective

Hardware Implementation



Design and Implementation of First Objective

OUTPUT



Literature survey for second objective

- [3]. In this system, They are just detecting the hazardous event but there is no proper alerting system for the workers and co-workers. And also there is no GPS to locate the worker in case of emergency detected.

- [4]. Usually, they used a Buzzer here to warn the user when things are dangerous. But the buzzer only makes a noise without telling exactly what's wrong, so it doesn't really tell the user to be careful about the specific situation.

Proposed System

- To improve the safety in existing system, we will add some additional sensors to provide extra safety to workers and to further reduces the risk of losing lives. In addition to the existing gas sensor, temperature and humidity sensor, we are adding Mems sensors which is used for fall detection, IR sensor which is used to detect whether the worker is wearing helmet or not and Heart Rate sensor to measure the heart pulse rate.

- Along with the additional sensor we are also prioritizing worker alerts through voice notifications instead of using a buzzer. This upgrade aims to provide a more detailed understanding of the reasons behind each alert.

- For producing voice notifications we are using APR33A3 voice playback module.

References

- [1].Sowmya T, SrinivasaRao G, Sruthi Ch, Tanuja , I.Bhavya, M.Sindhu Priya, "Smart Helmet For Mining Workers", Journal of Engineering Sciences, Volume. 14, pp. 0377-9254, 2023.

- [2].Jeya Seelan S, Krittika J, Cerene Eunice Getsiah C, Arunachalam B, "IoT Based Intelligent Helmet For Miners", International Journal of Electrical Engineering and Technology, Volume. 12, pp. 123-128, March. 2021.

- [3].Manikandan S, Arun Francis G. Mithya V, Kamal C, Dhilip Kumar S, Harriprasath R , Sankar P, "A Smart Helmet for Air Quality and Hazardous Event Detection for the Mining Industry", International Journal of Innovative Technology and Exploring Engineering, Volume. 8, pp. 2278-3075, October. 2019.

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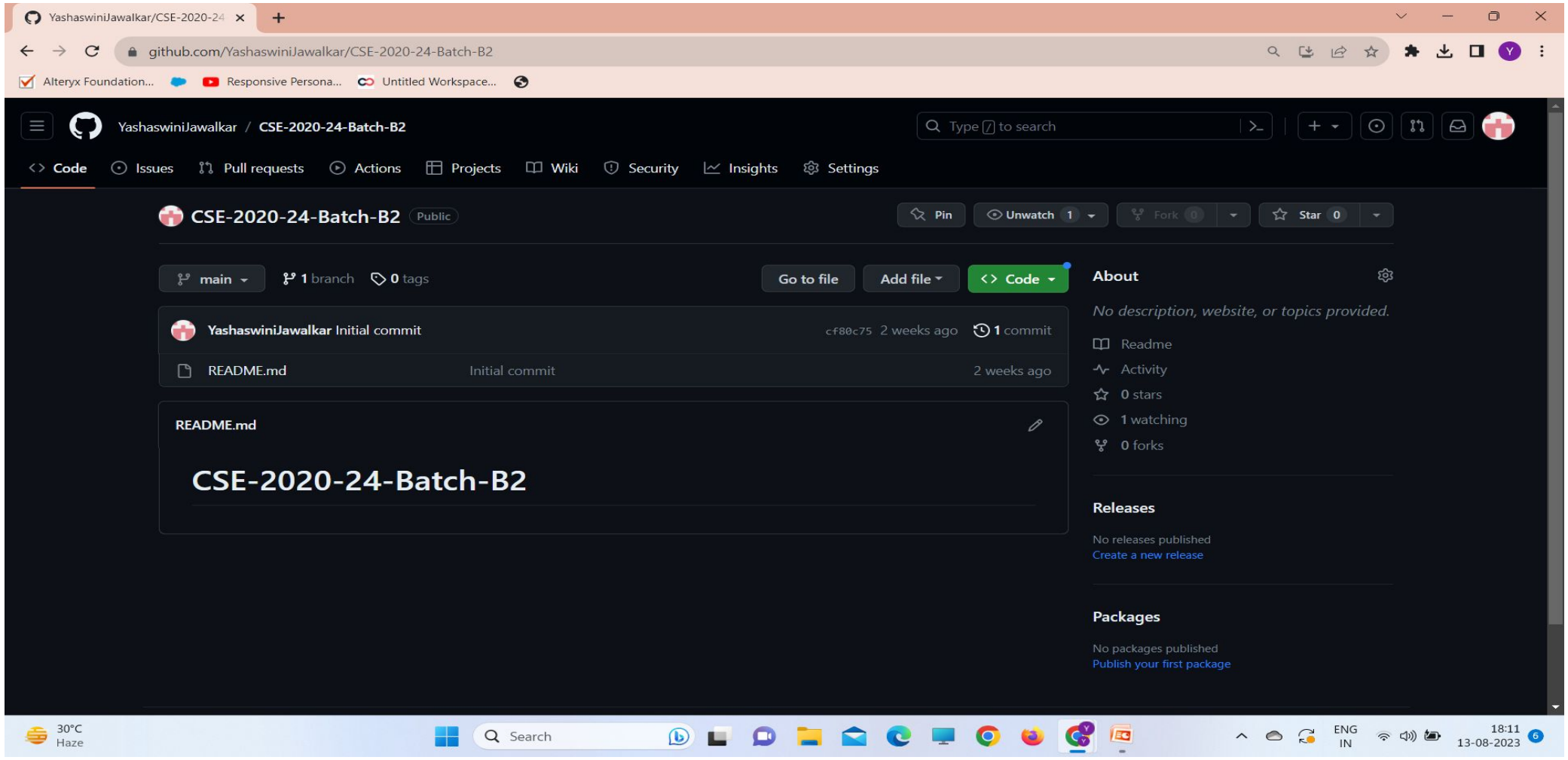
- [4].Shruti P. Borkar1 , V. B. Baru, "IoT Based Smart Helmet for Underground Mines", International Journal of Research in Engineering, Science and Management, Volume. 1, pp. 2581-5782, September. 2018

Git Hub Dashboards of each student

https://github.com/YashaswiniJawalkar/CSE-2020-24-Batch-B2.git



Any Queries?