Project Report
On
Smart Helmet

(Safety device to Coal Miners)

(UC-BTC-631-18)

Submitted in partial fulfilment for award of degree of

BACHELOR OF TECHNOLOGY

In

Electronics & Communication Engineering

Submitted to :
Name :- Dr. Rakesh Goyal
(Assistant Professor)

Submitted by:
Name :- Dipanshu Patel
Roll No. :- 1916587

Department of Electronics & Communication Engineering
IKG Punjab Technical University Main Campus
Kapurthala

ABSTRACT

Coal is one of the non-renewable sources of energy that can't be reproduced. Coal is available underground. There are different types of mining techniques. One of its types is underground mining. Coal miners are those who bring the coal on to the ground .So underground there are many toxic gases present, temperature and humidity values are different which causes suffocation for a person who is underground. So there should be a technique where the coal miner should be in a position to know what is the range of gas that is present, whether it is more than the limit and what is the temperature and humidity levels so that the coal miners can be protected to some extent. The project that is presented is a smart helmet. We all know that the coal miner will wear a helmet in order to protect themselves from objects or rocks or mud when they fall on them. So in this project we are going to make that helmet into a smart helmet. smart helmet can sense the temperature ,humidity, toxic gas, oxygen levels and give the output in the form of buzzer and as in the form of vibration to their body so that they get alerted and can be protected .in this project we are going to sense the values with the help of temperature sensor, humidity sensor, oxygen level sensor, gas sensor and an alert is given with the help of buzzer and a vibration sensor is used to which is attached to their neck so that they get vibrated when the limit of the sensor exceeds. The main part of this system is an arduino which senses the input and gives the output according to the input. In this way the coal miners get protected.

ACKNOWLEDGEMENT

I am thankful to all the faculties who imparted the lectures on various subjects/topics and took us to a new world of technologies. An Electronics student mainly focuses on practical applications of concepts learned projects like the one provided to us. I acknowledge the valuable inputs provided by ECE faculty.

This experience is the beginning of learning that could occur only with the support of our teachers: **Dr Avtar Singh Buttar**, **Dr Satvir Singh**, **Dr Amit Gupta** , **Dr Rakesh Goyal** and **Dr Dalveer Kaur Department** of Electronics and Communication, I. K. Gujral Punjab Technical University. I acknowledge their support and teachings from the depths of my heart. I express my great regards and gratitude for my parents who gave me this opportunity to study at IK Gujral Punjab Technical University, Kapurthala. It is possible due to their sacrifices and constant blessings that kept me motivated and committed.

Table of Contents:

CHAPTERS

1. INTRODUCTION

Mining is a multifaceted industry which includes complicated operations carried within the tunnels, underground etc. This involves various risk factors which affect the health of miners. The Chasnala mining disaster that took place near Dhanbad in the Indian state of Jharkhand almost killed 372 miners. This was considered as one of the worst disasters in the mining industry. Miners may not be aware of the external conditions such as rise or fall of temperature, pressure etc. Sometimes Miners collide with heavy objects like mining objects, hard rock which risks their life. Another factor that affects the miners is the inhalation of hazardous gases that provokes them in danger. In this situation miners are not able to communicate with the outside world. In this case, the smart helmet system becomes an essential and helpful measure to protect the miners from various accidents. This project aims at designing a smart helmet for hazardous event detection, monitoring the surrounding environmental conditions and updating information like GPS location and sensor data to the central console for easy tracking and providing oxygen supplements to avoid the inhalation of poisonous gases. This secures the life of miners in mining industries.

From the Survey, various information is gathered. One death every third day in India’s most dangerous job is Mining. According to the International Labour Organization (ILO), while mining employs around 1% of the global labour force, it generates 8% of the fatal accidents. China has the largest mining industry producing up to three billion tons of coal each year. Though China accounts for 40% global coal output, it is responsible for 80% of mining deaths around the world each year. This survey clearly shows that the requirement for safety measures must be extended to save the life of miners. This survey motivated us for initialising this project

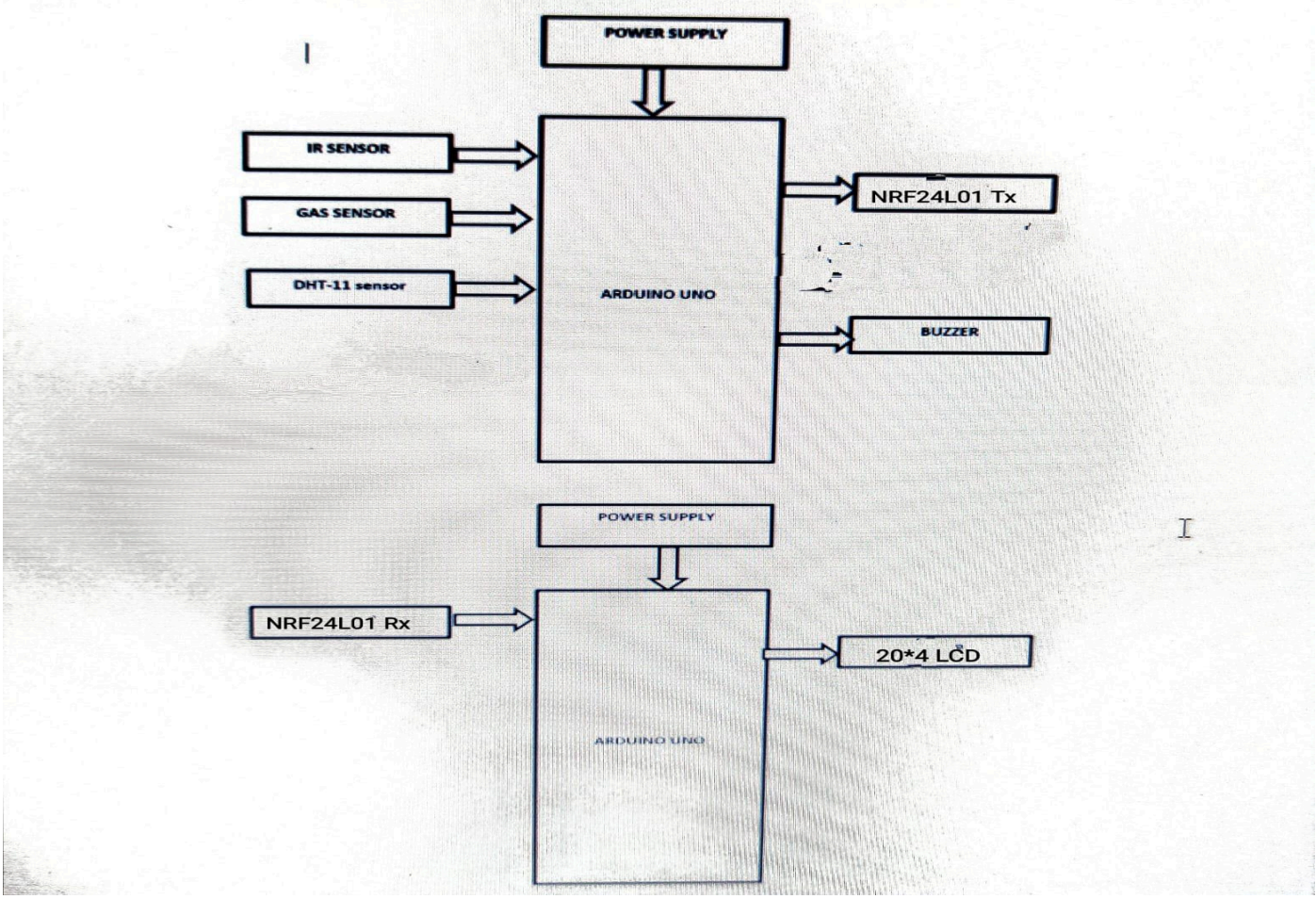
2.SYSTEM OVERVIEW

The system includes various sensors such as the temperature, pressure, force, IR sensor and gas sensor. Temperature and pressure sensor is used to monitor the surrounding environment. Whenever the miners collide with the heavy objects, a Force sensor is used. An IR sensor intimates the central console whenever the miner removes their helmet off their head. Gas sensor is used to detect the presence of poisonous gases in the atmosphere. Panic switch is manually operated by the miner to seek help from the central console in highly emergency conditions. This information is sent to the central console through wireless transmission in critical situations.

3.THEORETICAL INFRASTRUCTURE

The theoretical background of the project is examined below as main headings and subheadings.

The wireless control system consists of Node MCU (ESP8266), GPS module, Metal detector sensor, Motor Driver L298N, DC Motor, servo motor. The system is illustrated in fig below.



MQ-7 Gas Sensor

MQ7 Gas sensor is another one of Metal Oxide Semiconductor (MOS) type Gas Sensor of MQ Gas Sensors family.This sensor contains a sensing element, mainly aluminium-oxide based ceramic, coated with Tin dioxide (SnO2), enclosed in a stainless-steel mesh. Whenever CO gas comes into contact with the sensing element, the resistivity of the element changes. The change is then measured to get the concentration of the gases present. The **MQ7 Sensor** has a small heating element present which is needed to preheat the sensor to get it in the working window. It can detect **Carbon Monoxide Gas** in the range of 20 PPM to 2000 PPM in the air. It finds uses in Alarm application in case of CO gas concentration build-up in the home or your car as CO is a very harmful gas and can kill a person if present over 300 PPM.

MQ-135 Gas Sensor

The MQ-135 Gas sensor can detect gases like Ammonia (NH3), sulfur (S), Benzene (C6H6), CO2, and other harmful gases and smoke. Similar to other MQ series gas sensor, this sensor also has a digital and analog output pin. When the level of these gases go beyond a threshold limit in the air the digital pin goes high. This threshold value can be set by using the on-board potentiometer. The analog output pin, outputs an analog

voltage which can be used to approximate the level of these gases in the atmosphere.

Infrared Sensor

Infrared sensor module contains mainly an infrared transmitter and an infrared receiver. Obstacles inside the coal mine will be detected using an infrared sensor. The receiver collects the input from the surroundings and will transmit data to the transmitter then it detects the object. The object should be ranging from 20 to 60 from the input end from a few centimetres to certain feet.it required input voltage for operating around 5v.

NRF24L01

The NRF24L01 is a wireless transceiver RF module, where each module can send and receive data. Since it operates on the 2.4 GHz ISM band, the technology is approved for engineering applications in almost all countries. This module can cover 100 metres (200 feet) when operated efficiently, making it suitable for wireless remote control projects.

BUZZER

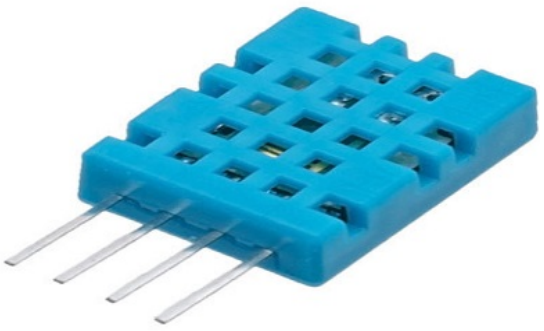
An audio signalling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical. The main function of this is to convert the signal from audio to sound

LED Light

A light-emitting diode is a semiconductor device that emits light when current flows through it.

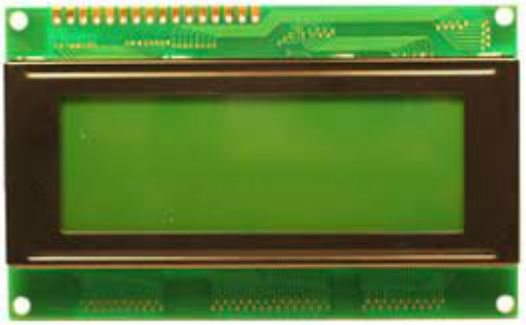
DHT11 Sensor

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc… to measure humidity and temperature instantaneously.



20*4 LCD Display

The 20x4 character LCD module is designed to display letters, numbers, symbols, dot matrix. It can display 4 lines of 20 characters.



4.SOFTWARE

Arduino compiler

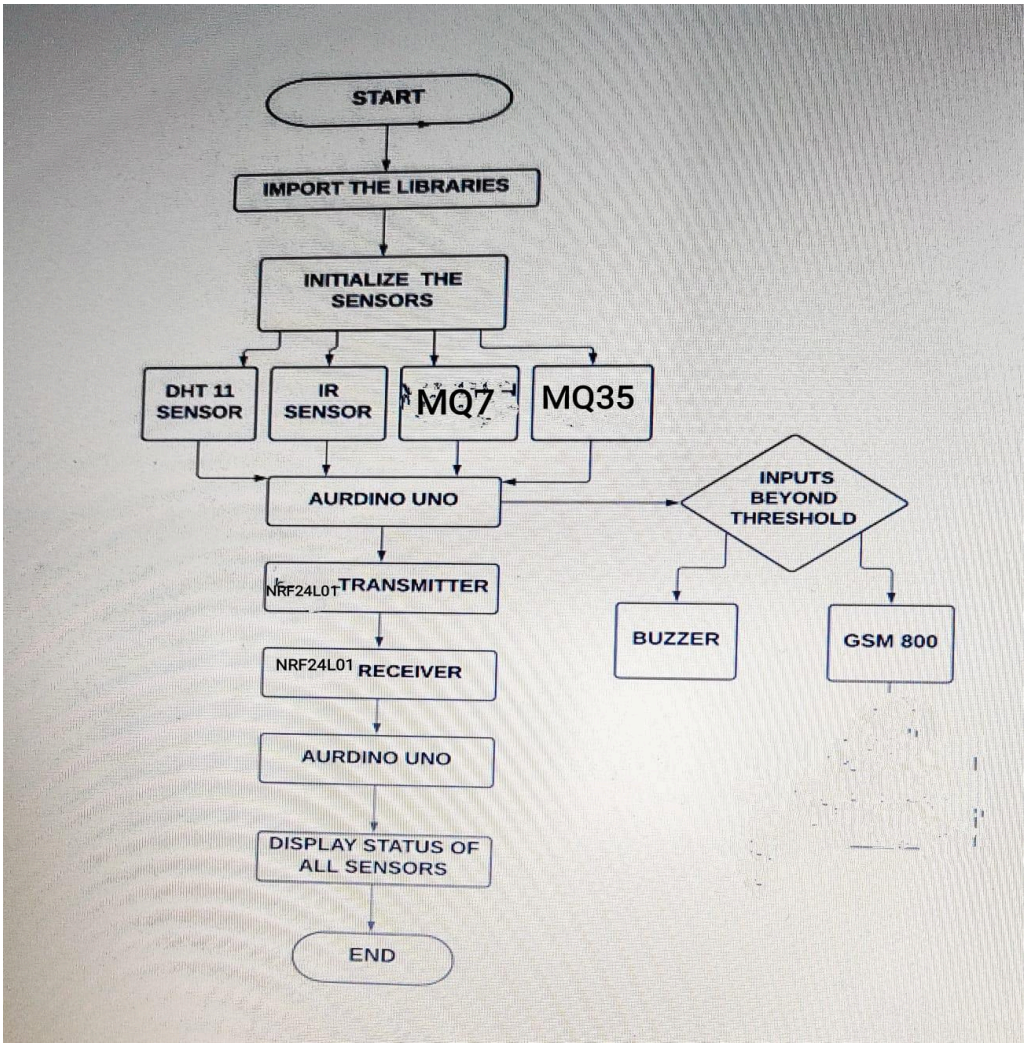
The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (for prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs. The microcontrollers can be programmed using the C and C++ programming languages, using a standard API which is also known as the Arduino language, inspired by the Processing language and used with a modified version of the Processing IDE. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) and a command line tool developed in Go. The Arduino project began in 2005 as a tool for students at the Interaction Design Institute Ivrea, Italy, [2] aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats and motion detectors. The name Arduino comes from a bar in Ivrea, Italy, where some of the founders of the project used to meet. The bar was named after Arduin of Ivrea, who was the margrave of the March of Ivrea and King of Italy from 1002 to 1014

5.METHODOLOGY

The smart system is divided into two parts. The transmitter part consists of Arduino, DHT11 sensor, MQ 02 gas sensor, LoRa communication, GSM sim800a, Vibration sensor, IR sensor, power supply, The receiver part consists of LoRa communication, Arduino, power supply, laptop. 1. MQ 02 the Gas sensor is used to detect the levels of poisonous gas in the mine. If the value is greater than 990 ppm it sends a message saying “gas alert”. 2. DHt11 detects the temperature and humidity. If the value of temperature is greater than 36 it sends a message saying “temperature alert”. If the value of humidity is greater than 94 it sends a message saying “humidity alert”. 3. Vibration sensor detects sudden changes in movements. If c==0 it sends a message saying “vibration alert”. 4. IR sensor detects the obstacles and these sensors are interfaced with Arduino. If b==1 it sends a message saying “obstacle alert”. 5. The threshold for each of the readings of these sensors is set and if any value crosses the threshold, a buzzer is activated and alerts are sent to the receiver module and the mobile phone. 6. The receiver part receives the alerts along with the mobile phone and specific action will be taken.

5.1 Flow chart



5.2 Agorithm

1. Start
2. Import DHT11 libraries and define the pins of DHTPIN as and DHTTYPE as DHT11.
3. Set the smokeA0 variable to A0, the buzzer to 11, and the light and angled to 10.
4. In the Setup, the function defines the input and output pins using pinMode and using serial begin to start the Arduino. The input pins are SmokeA0 and DHTPIN and the output pins are green led and buzzer.
5. In Loop function read the sensor value of MQ2 using analog read and if the sensor value is greater than 300 then print that smoke is detected and also keep a delay of 2 sec between two values.
6. Read the LDR as analog read and store it in a light variable if the value of light if there are fewer than 500, print Keep the light

intensity low if the light value is greater than the print value, keep the light intensity low and turn it on; if the value of light is greater than print, keep the light intensity high and turn it off.

7. In DHT11 use the inbuilt function such as readHumidityto get humidity and readTemperature to get the temperature and store them in humi and tempc variable respectively, if the value of humi is greater than 22 or tempc is greater than 33 then turn the gled on.
8. stop.

6.Working Code of Transmitter

```
#include <RF24.h>
#include <RF24_config.h>
#include <nRF24L01.h>
#include <printf.h>

#include <MQUnifiedsensor.h>


#include <DHT.h>
#include <DHT_U.h>


#define DHTPIN 3


#define DHTTYPE DHT11




DHT dht(DHTPIN, DHTTYPE);



//MQ 7
int mq7 = A0;
float co;
```

```
//MQ 135
int mq135 = A1;
float co2;
//IR
int IR1 = 2;
int IR2 = 4;
//
int LEDR = 5;
int LEDB = 6;
//BUZZER
int buzzer = 9;




RF24 radio(7,8);
const byte Address[6] = "00009";


void setup() {

  pinMode(mq7,INPUT);
  pinMode(mq135,INPUT);
  pinMode(IR1,INPUT);
  pinMode(IR2,INPUT);
  pinMode(LEDR,OUTPUT);
  pinMode(LEDB,OUTPUT);
  pinMode(buzzer,OUTPUT);
  dht.begin();

  radio.begin();
  radio.openWritingPipe(Address);
  radio.stopListening();

}

struct datapack{
  // bool toggleSwitch01 ;
  bool shock  = true ;

  float temp ;
  float humidity ;
```

```
  float caobon_monoxide ;
  float carbon_dioxide ;
};
datapack data;

void loop() {
  // Wait a few seconds between measurements.


  co = analogRead(mq7);
  co2 = analogRead(mq135);
   digitalWrite(LEDR, LOW);
   digitalWrite(LEDB,LOW);
   digitalWrite(buzzer, LOW);

  if(digitalRead(IR1)==1){
    digitalWrite(LEDR, HIGH);
    digitalWrite(buzzer, HIGH);
  }
  if(co>150||co2>500){
    digitalWrite(LEDR, HIGH);
    digitalWrite(buzzer, HIGH);
  }
  if(digitalRead(IR1)==0){
    digitalWrite(LEDB,HIGH);
  }

  // data.toggleSwitch01 = digitalRead(toggleSwitch01pin);
  // data.toggleSwitch02 = digitalRead(toggleSwitch02pin);

  data.temp = map(dht.readTemperature(), 0, 1023,0,255);
  data.humidity = map(dht.readHumidity(), 0, 1023,0,255);

  data.caobon_monoxide = map(analogRead(mq7) , 0, 1023,0,255);
  data.carbon_dioxide = map(analogRead(mq135) , 0, 1023,0,255);
  data.shock = map(digitalRead(IR2) , 0, 1023,0,255);

  radio.write(&data, sizeof(data));

}
```

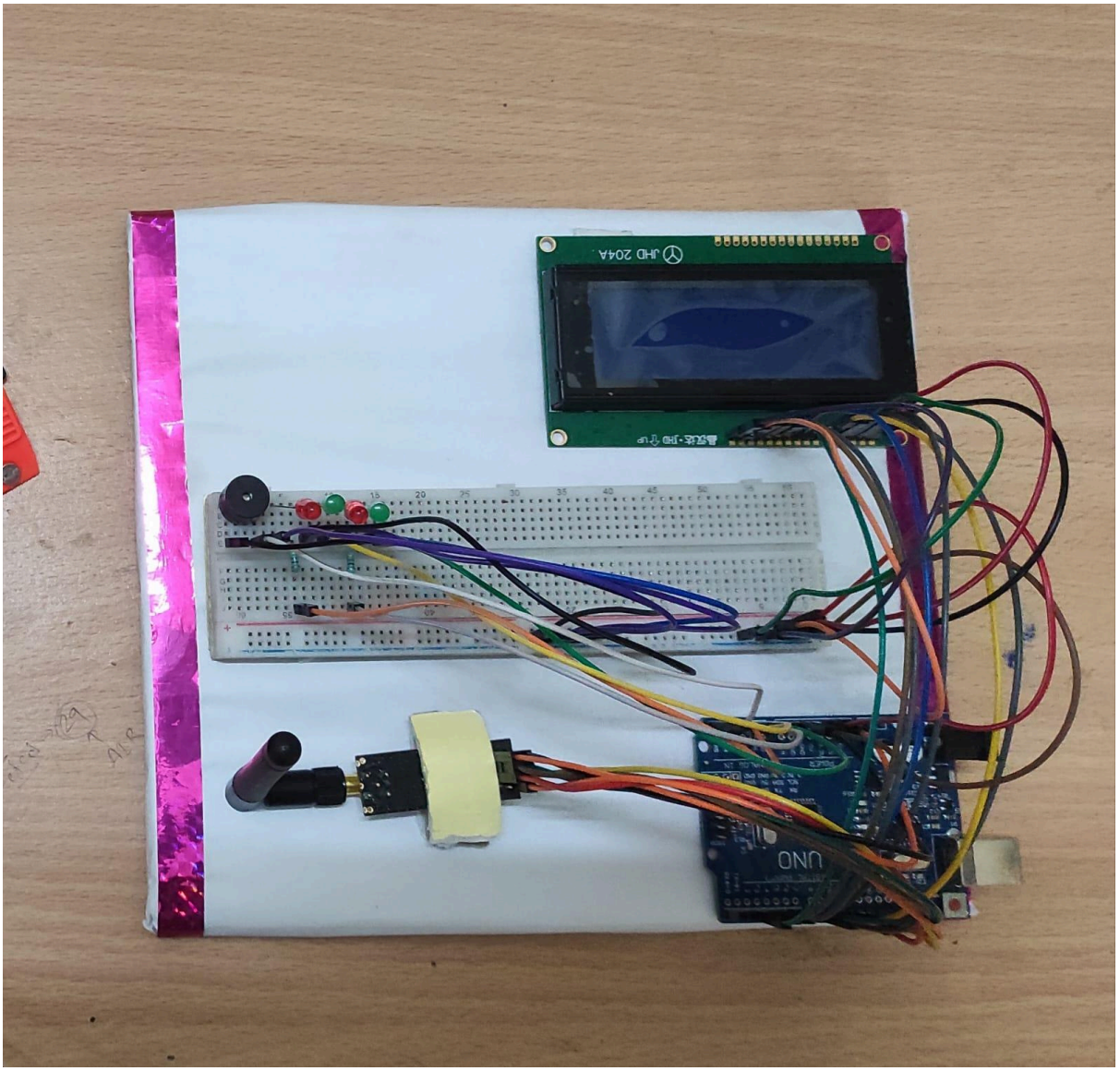
7.Working code of Receiver

```
#include <LiquidCrystal.h>
#include <RF24.h>
#include <RF24_config.h>
#include <nRF24L01.h>

#define buzzer A5
#define LEDR1 A4
#define LEDB1 A3
#define LEDR2 A2
#define LEDB2 A1

RF24 radio(7,8);
const byte Address[6] = "00009";

int Contrast=145;
LiquidCrystal lcd(10, 9, 5, 4, 3, 2);



 void setup()
 {
    analogWrite(6,Contrast);
    lcd.begin(20, 4);
    radio.begin();
    radio.openReadingPipe(0,Address);
    radio.startListening();
    pinMode(buzzer,OUTPUT);
    pinMode(LEDR1,OUTPUT);
    pinMode(LEDB1,OUTPUT);
    pinMode(LEDR2,OUTPUT);
    pinMode(LEDB2,OUTPUT);
  }

struct datapack{
  // bool toggleSwitch01 ;
  bool shock ;

  float temp ;
  float humidity ;
```

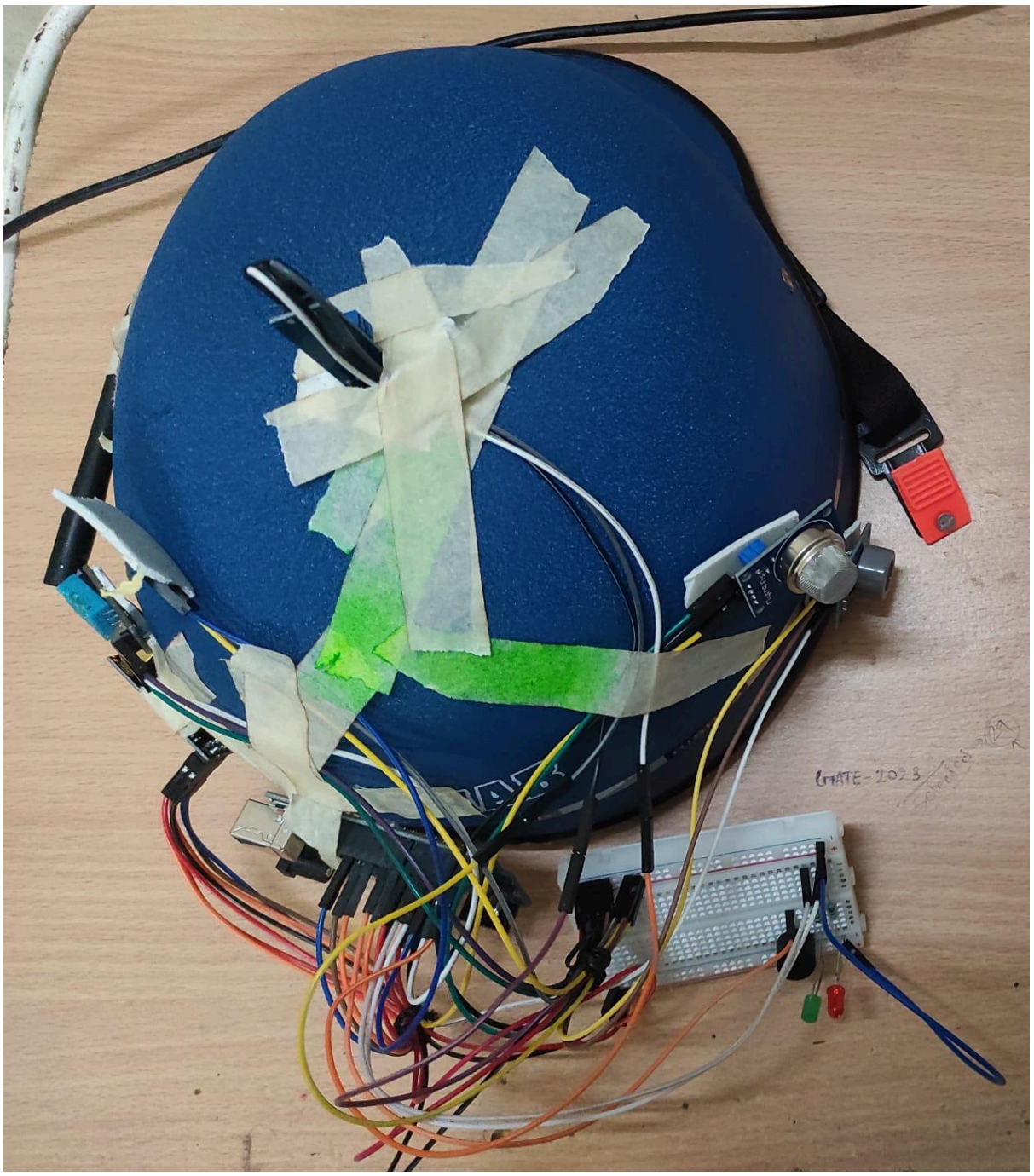
```
  float caobon_monoxide ;
  float carbon_dioxide ;
};
datapack data;

  void loop()
 {

    while(radio.available()){
    radio.read(&data, sizeof(data));
    if(){
      digitalWrite(LEDR1,HIGH);
      digitalWrite(LEDB1,LOW);
    }else{
      digitalWrite(LEDR1,LOW);
      digitalWrite(LEDB1,HIGH);
    }

    if(data.temp>45){
      digitalWrite(LEDR2,HIGH);
      digitalWrite(LEDB2,LOW);
    }else{
      digitalWrite(LEDB2,HIGH);
      digitalWrite(LEDR2,LOW);
    }
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("    SMART HELMET");
    delay(1000);
    lcd.setCursor(0, 1);
    lcd.print("Tem.=");
    lcd.print(int(data.temp+15));
    lcd.print("*C");
    delay(1000);
    lcd.setCursor(10, 1);
    lcd.print("Humi.=");
    lcd.print(int(data.humidity+41));
    lcd.print("%");
    delay(1000);
    lcd.setCursor(0,2);
    lcd.print("CO.=");
    lcd.print((data.caobon_monoxide*10)/10000);
```

```
    lcd.print("%");
    delay(1000);
    lcd.setCursor(10,2);
    lcd.print("CO2.=");
    lcd.print((data.carbon_dioxide*10)/10000);
    lcd.print("%");
    delay(1000);
    lcd.setCursor(5, 3);
    lcd.print("THANK YOU");
    delay(1000);
   }

}
```

8.RESULTS AND DISCUSSION



Receiver



Transmitter (helmet)

We have successfully made a smart helmet for miners that can detect gases, humidity, temperature, and light. The threshold values have been manually set but can be updated as per the normal scenario of the mining sites. In case of any unpredictable scenarios the changes will be detected by the sensors and if hazardous the notification can be received in the form of change in LED color and alarm from buzzer so that the miner can act accordingly. We have

also integrated a GPS module which can give real time position of miners in case they are unreachable.

1. This system has built a monitoring system for the underground environmental of coal mine based on wireless sensor network, which can monitor data in real time.
2. It can realise information interaction between mine terminal and mine and alarm abnormal environmental parameters.
3. This system has the advantages of convenient networking, good flexibility and extensibility, low installation and maintenance cost.

9.Conclusion

In this proposed work, smart helmet had for mining industry using LoRaWAN had developed, which comprises a quality device that keeps the user alert on his/her air quality. When the air quality changes, the device is capable of informing its user with the appropriate data and by that they can take some preventive measures to avoid those hazards.The obtained results figure out that the proposed system performs good for the people working in mining industry

10.Future Scope

The plan is to include a wi-fi module that can collect all the necessary info and update it in the database. The data will be sent continuously, therefore the database will contain the real-time on-site environment details. The database will then be made available remotely so that the supervisors and higher authorities can take care of it in case of any hazardous condition and the medical help can be made available sooner. The GPS module will help the emergency department to locate the miners in case of dangerous situations and to send help sooner.

References:

- https://rb.gy/4amwxq
- https://rb.gy/racwlb
- https://rb.gy/qp5rbq