PROJECT REPORT ON

"IOT BASED COAL MINE MONITORING SYSTEM"

Submitted in partial fulfillment of the requirements for the award of the degree of

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C E R T I F I C A T E

This is to certify that, the report titled ***"IOT BASED COAL MINE MONITORING SYSTEM"*** is a bonafide account of the **ECD 334: PROJECT** presented by **Mr.BINEESH M B** ,(Reg.No: LMDL20EC131), **Mr. ANANDHU NANDAKUMAR**, (Reg.No: LMDL20EC130), **Ms. MARIA JOY** , (Reg.No: LMDL20EC134), **Mr. MITHUN M**, (Reg.No: LMDL20EC135), Sixth Semester B. Tech in Electronics and Communication, in partial fulfillment of the requirements for the award of the Bachelor's degree, **B. Tech in Electronics and Communication Engineering** from APJ Abdul Kalam Technological University during the academic year 2023-2024.

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ABSTRACT

The IoT-based Coal Mine Monitoring System is an innovative project aimed at enhancing safety and efficiency in coal mining operations. Leveraging the power of the Internet of Things (IoT), the system employs a network of interconnected sensors to a controller to continuously collect real-time data on crucial parameters like gas levels, temperature, humidity, equipment status, and device location. The data is processed and analyzed using advanced algorithms, by promptly identifying potential hazards, such as gas leaks and high temperature, the system improves worker safety. It also optimizes resource usage by enabling predictive equipment maintenance, minimizing downtime, and enhancing operational efficiency. The IoT-based Coal Mine Monitoring System sets a new standard for safe, sustainable, and technologically advanced mining practices.

ACKNOWLEDGEMENT

First and foremost we thank God Almighty for his blessings without which we would not have been able to complete our work in time. We express our sincere gratitude to Dr. Jacob Thomas V, Principal,Govt Model Engineering College, for giving us this opportunity. Now we express our heartfelt gratitude to Dr. Mini M G, HOD, Department of Electronics and Communication Engineering, for her constant support and valuable advice. We also extend our sincere gratitude to our project coordinators. Mr.Jayadas and Mrs.Farisha, Department of Electronics and Communication Engineering, for allowing us to use the resources available and giving us valuable suggestions. We would also thank all other faculty members who encouraged and helped us to complete this project successfully. Last but not the least we would like to thank all fellow classmates who gave us constant support and encouraged us to complete this venture on time.

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List of Abbreviations

IoT	Internet Of Things
GPS	Global Positioning System

Chapter 1

INTRODUCTION

The introduction of the IoT-based Coal Mine Monitoring System marks a significant advancement in the coal mining industry, addressing critical challenges related to safety, efficiency, and sustainability. Traditional coal mining operations have been fraught with various risks, including worker safety hazards, equipment failures, and environmental concerns. The IoT-Based Coal Mine Monitoring System is a cutting-edge solution designed to enhance safety and efficiency in coal mining operations. Coal mining is a critical industry for energy production, but it poses significant risks to the workers and the environment. To address these challenges, this system leverages the power of the Internet of Things (IoT) technology to create a comprehensive and real-time monitoring platform.

By employing sophisticated data analytics and machine learning algorithms, the system can identify potential safety hazards and abnormal conditions promptly. If any hazardous situation or deviation from standard operating conditions is detected, the system automatically triggers immediate alerts to relevant personnel, enabling them to take appropriate actions in a timely manner.

Moreover, this IoT-based coal mine monitoring system also facilitates remote monitoring and management, allowing mine supervisors and safety personnel to access the data and insights from a web or mobile interface. This capability helps decision-makers stay informed, make data-driven decisions, and implement proactive safety measures.

The key benefits of the IoT-Based Coal Mine Monitoring System include improved safety, reduced accidents, early detection of potential hazards, better resource utilization, and increased operational efficiency. By providing real-time insights and empowering swift response to critical situations, the system aids in preventing accidents and mitigating environmental impacts associated with coal mining.

In conclusion, the IoT-Based Coal Mine Monitoring System represents a crucial advancement in the coal mining industry, revolutionizing traditional safety practices and operational approaches. Its implementation promises to enhance safety standards, protect.

Chapter 2

LITERATURE SURVEY

1. Yongping Wu and Guo Feng implement coal mine monitoring using the Bluetooth wireless transmission system. As a standard of unified global short-range wireless communication, Bluetooth technology is to establish a common low-power, low-cost wireless air interface and controlling software opening system. This paper describes the development background, technical features and the structure of the protocol stack of Bluetooth technology, and proposed the solutions of the Bluetooth host controller interface (HCI) wireless communication for the complexity of its development .

2. its development [1]. Zhenzhen Sun proposed DCS Coal Mine Monitoring System Based on RS485 Bus, RS485 bus structure supports multi-point and two-way communication. So, this type of monitoring system can be developed using common 8-bit microcontrollers. It has the advantages of simple circuit structure and low costs. However, due to the adoption of master-slave structure network, it is difficult to guarantee the reliability of the network structure. Furthermore, the data transmission distance is limited with a poor realtime performance .

3.Abhijeet Dhule, Neha Sangle, Supriya Nagarkar, Asmita Namjoshi. This project is based on a micro-controller and IOT concepts. Where we are using Arduino , Servo motors, car chassis, camera module, sensors and mechanical arm to build this surveillance robot setup. The Jingjiang Song, Yingli Zhu proposed automatic monitoring system for coal mine safety based on wireless sensor network. This system design monitoring for coal mine safety constructed by MSP430F and nRF2401. The sensor groups of the system intensively monitor temperature, humidity and other parameters in the underground mine, parameters measured are sent to wireless communication module by the microcontroller. The collected information is sent to long-distance monitoring center by cable. The problem of this implementation is that hardware is placed inside the coal mines, when a natural calamity or a roof fall occurred, the system is damage. So the reliability and long life of conventional communication system is poor. Due to the harsh environment inside the mine, the installation and maintenance of the system if the distance of miner and system is long, miner not get proper message is very difficult.

Chapter 3

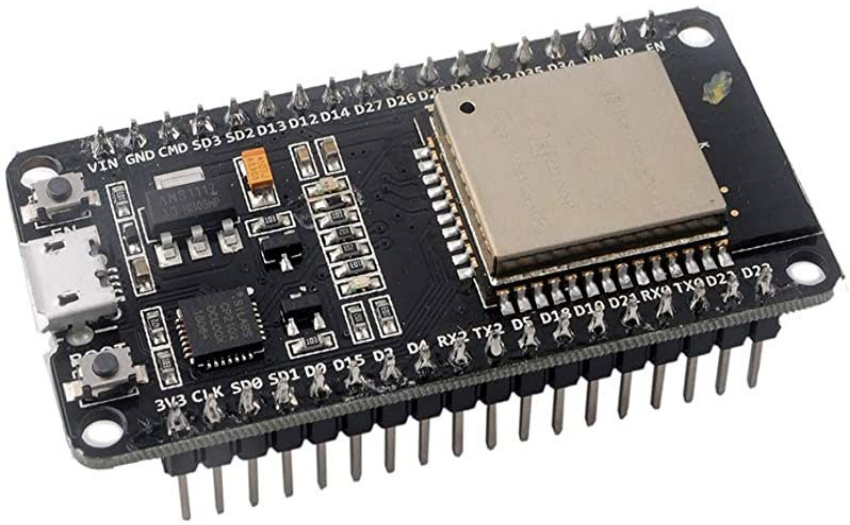
RELATED THEORY

3.1 HARDWARE

This surveillance robot requires numerous important hardware components for proper functioning. The main components used in our project and their specifications are as follows,

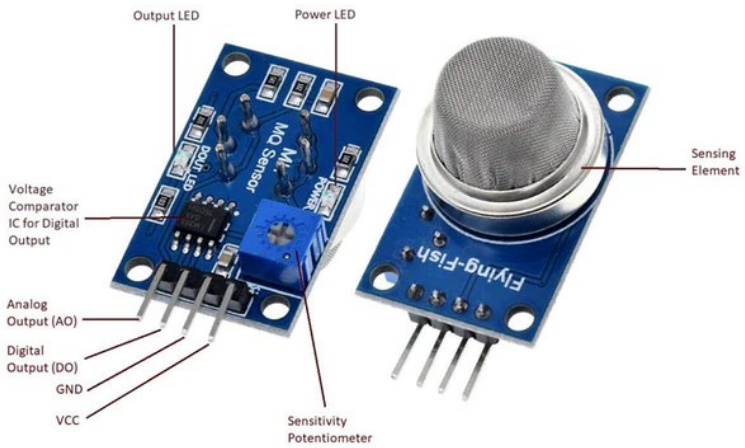
3.1.1 ESP32 MODULE

ESP32 is a single 2.4 GHz Wi-Fi-and-Bluetooth combo chip designed with the TSMC low-power 40 nm technology. It is designed to achieve the best power and RF performance, showing robustness, versatility and reliability in a wide variety of applications and power scenarios. Esp32 can perform as complete standalone system or as a slave device to host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality. This uses serial communication that is using the I2C protocolfor communication with other modules connected to it. Here the ESP32 module has connection with MQ2 gas sensor, DHT11 humidity and temperature sensor,I2c 16*2 lcd display, led and buzzer.



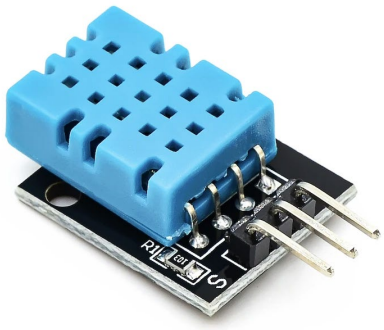
3.1.2 MQ 2 GAS SENSOR

The MQ-2 sensor is a small gas sensor module commonly used for detecting and measuring various combustible gases in the air. It is popularly utilized in gas leakage detectors, fire alarms, and other safety systems. The sensor is sensitive to gases like LPG (liquefied petroleum gas), propane, methane, alcohol, hydrogen, and smoke. The MQ-2 sensor operates on the principle of chemical reaction between the target gas and the sensing material inside the sensor. When the target gas comes into contact with the sensing material, it causes changes in the sensor's conductivity. These changes are then converted into electrical signals, which can be read and processed by a microcontroller or other electronic devices. This makes the MQ2 Gas Sensor Module an excellent choice for building an indoor air quality monitoring system, a breathalyzer, or an early fire detection system.



3.1.3 DHT11

The DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. DHT11 is a small, low-cost temperature and humidity sensor module widely used in electronics projects and applications that require basic environmental monitoring. It is commonly utilized in home automation, weather stations, and other projects that involve measuring and controlling temperature and humidity level.



3.1.4 I2C 16*2 LCD DISPLAY

The I2C 16×2 Arduino LCD Screen is using an I2C communication interface. It is able to display 16×2 characters on 2 lines, white characters on blue background. An I2C adapter is directly soldered right onto the pins of the display. So all you need to connect are the I2C pins, which shows a good library and little of coding.
The I2C is a type of serial bus developed by Philips, which uses two bidirectional lines, called SDA (Serial Data Line) and SCL (Serial Clock Line). Both must be connected via pulled-up resistors. The usage voltages are standard as 5V and 3.3V

3.1.5 LED

A light-emitting diode (LED) is a semiconductor device that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device. Light-emitting diode (LED) is a widely used standard source of light in electrical equipment. It has a wide range of applications ranging from your mobile phone to large advertising billboards. They mostly find applications in devices that show the time and display different types of data.

3.1.6 BUZZER

An audio signaling device like a beeper or buzzer may be electromechanical piezoeletric or mechanical type. The main function of this is to convert the signal to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren. The main function of this is to convert the signal to sound.

3.2 SOFTWARE

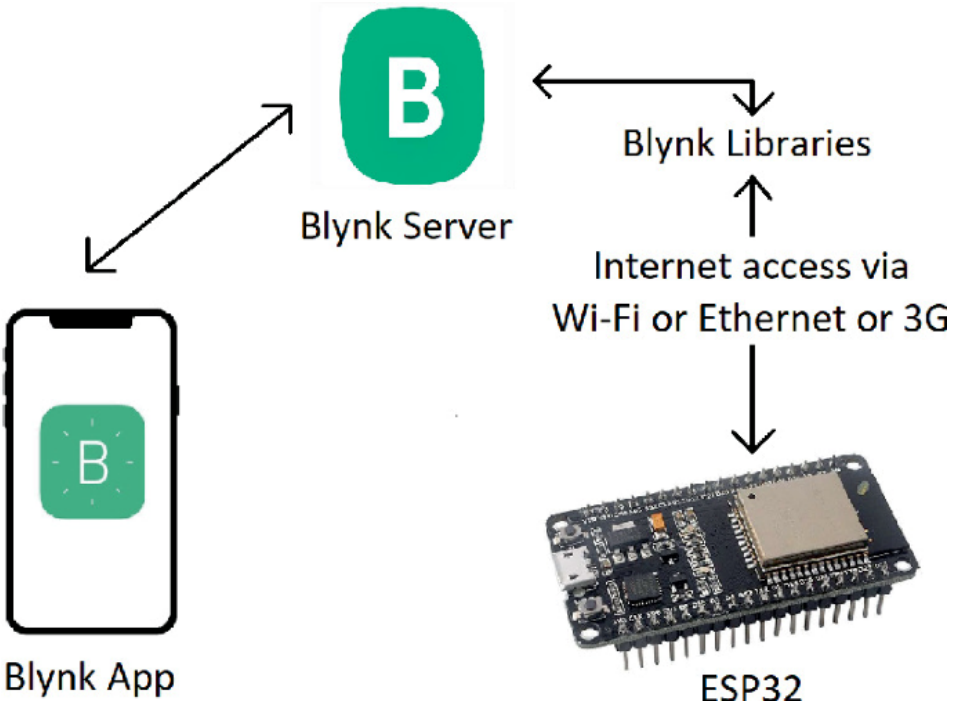
3.2.1 Arduino Software (IDE)

It is open source software that is used to write codes and upload it to the Arduino board. The Arduino IDE contains a text editor for writing codes, a message area, a text console, a series of menus along with toolbar with buttons. The programming codes are known as sketch. The sketches are saved with the file extension .ino. It runs on Windows, MAC and LINUX. Thus through this software we can code for the robotic movements and also for the sensors interfaced with the arduino board. There are currently two versions of the Arduino IDE, one is the IDE 1.x.x and the other is IDE 2.x. The IDE 2.x is new major release that is faster and even more powerful to the IDE 1.x.x. In addition to a more modern editor and a more responsive interface it includes advanced features to help users with their coding and debugging.

3.2.2 BLYNK CLOUD

Blynk is an IoT platform for iOS or Android smartphones that is used to control Arduino, Esp 32, Raspberry Pi and NodeMCU via the Internet. This application is used to create a graphical interface or human machine interface (HMI) by compiling and providing the appropriate address on the available widgets. Blynk is a low-code IoT software platform for connecting devices to the cloud, building mobile apps to remotely control and monitor them, and managing thousands of users and deployed products.


Blynk


Blynk Server
Blynk Libraries
Internet access via
Wi-Fi or Ethernet or 3G
Blynk App
ESP32

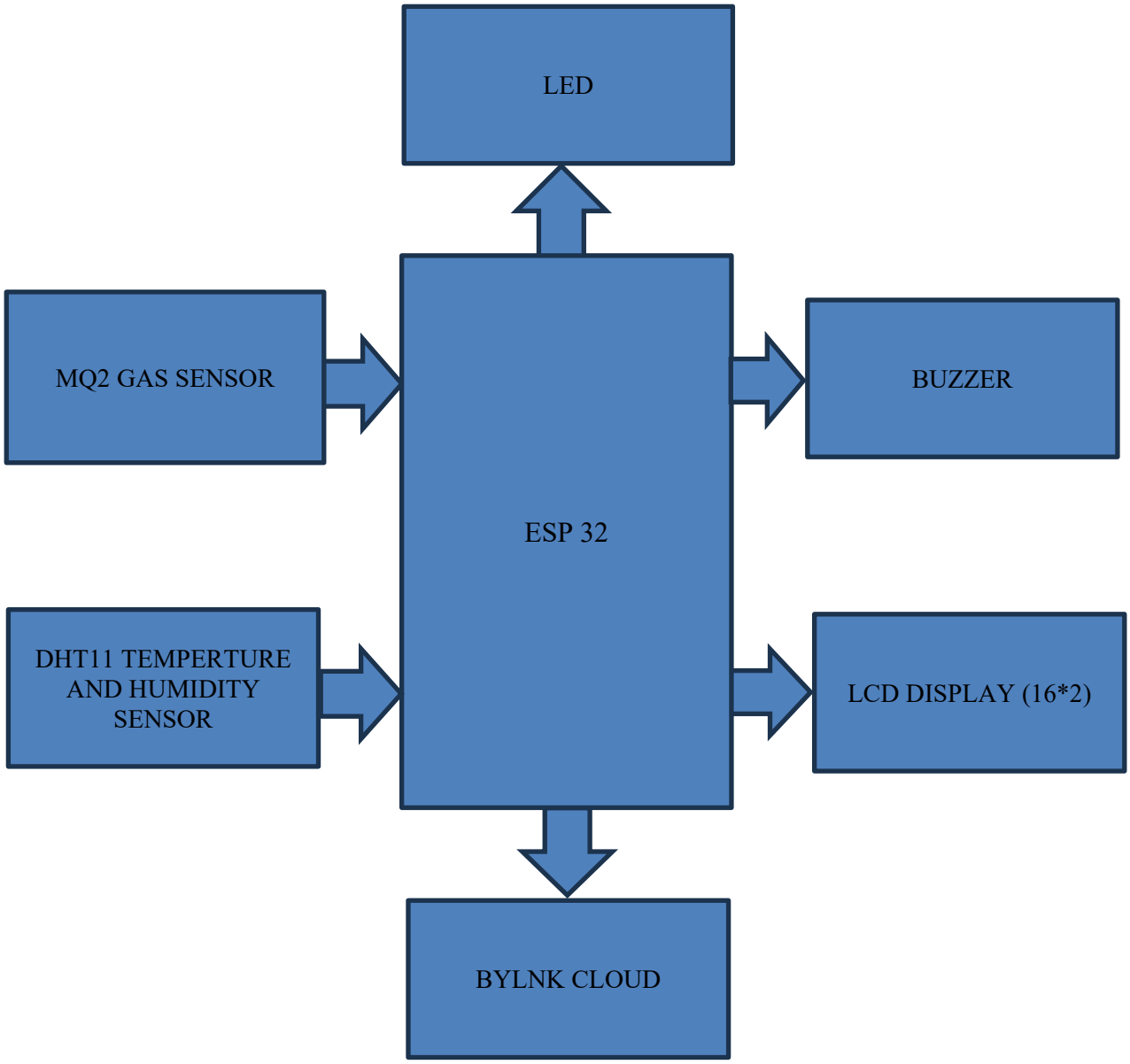
Chapter 4

DESIGN OF PROJECT

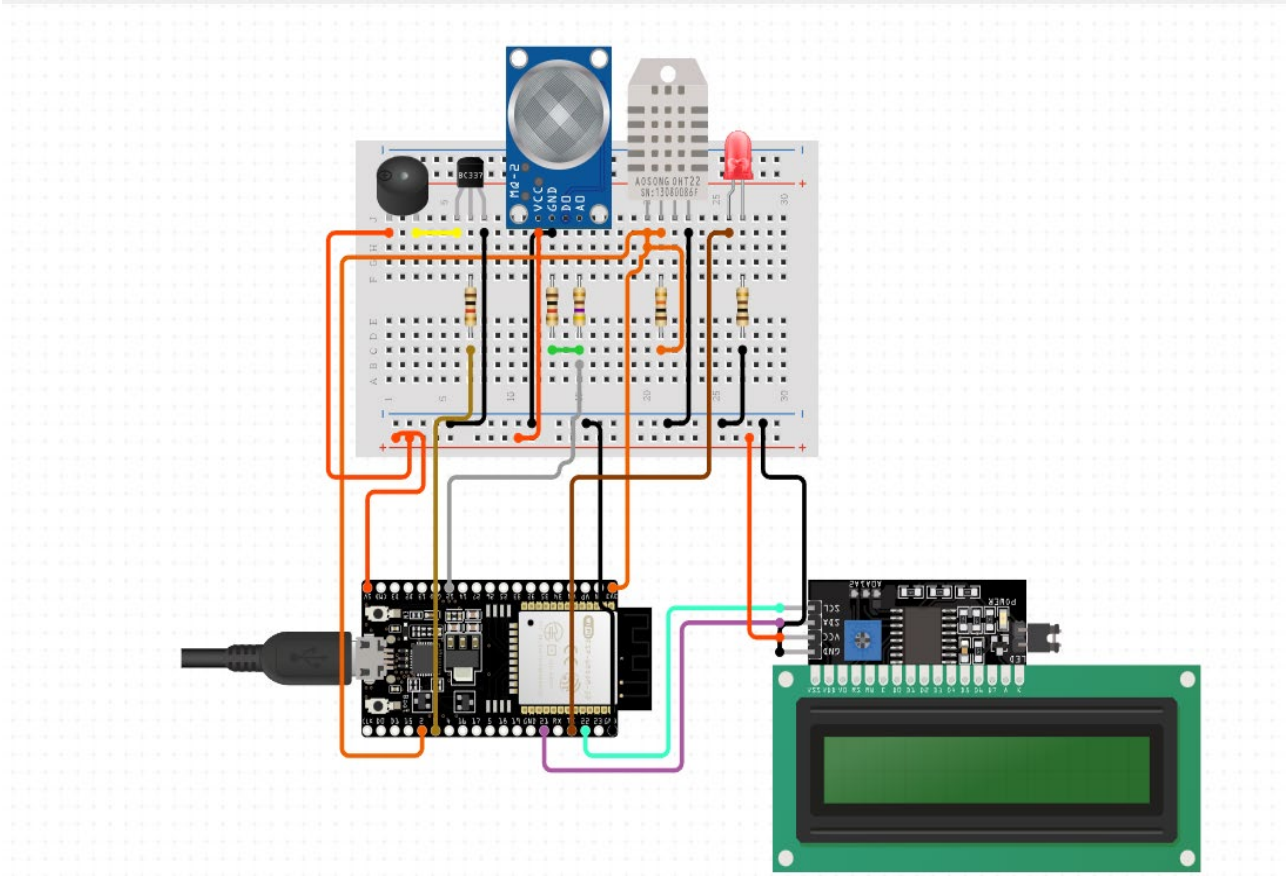
4.1 SYSTEM DESIGN

The IoT-based coal mine monitoring system is designed to enhance safety by continuously monitoring crucial environmental parameters, such as smoke, temperature, and humidity, inside the coal mine. It utilizes various hardware components, including an ESP32 microcontroller, an MQ2 gas sensor, a DHT11 humidity and temperature sensor, an I2C LCD display, LED and buzzer. The system integrates with the Blynk cloud platform to provide real-time monitoring and alerts to the mine owner. The MQ2 gas sensor and DHT11 sensor are connected to the analog and digital input pins of the ESP32, respectively. The I2C LCD display is connected to the ESP32's I2C pins to visualize the current sensor readings. The LED and buzzer are connected to specific output pins of the ESP32.The ESP32 reads data from the MQ2 gas sensor to detect the presence of smoke or flammable gases in the coal mine. The MQ2 sensor outputs an analog voltage, which the ESP32 converts to a digital value for processing. Simultaneously, the DHT11 sensor provides the temperature and humidity readings, which are directly read by the ESP32 from its digital output. The ESP32 processes the sensor data, converting the analog reading from the MQ2 sensor into meaningful smoke concentration values. It then checks whether the smoke level exceeds the predetermined threshold set for safe operations inside the coal mine. The system provides a local display using the I2C LCD. The ESP32 shows the real-time readings of smoke, temperature, and humidity on the LCD screen. Additionally, it continuously monitors the smoke level. If the smoke concentration surpasses the defined threshold, the LED is activated to blink rapidly, indicating the hazardous condition. Simultaneously, the buzzer is activated to produce an audible warning, alerting the on-site personnel to the potential danger. The ESP32 is connected to the internet via Wi-Fi and integrated with the Blynk cloud platform. The system uses the Blynk app or platform for remote monitoring and alerts. The sensor readings (including smoke level, temperature, and humidity) are continuously sent by the ESP32 to the Blynk cloud. The mine owner can access these real-time readings through the Blynk app on their smartphone or web interface. The data is updated periodically, ensuring the owner has up-to-date information about the mine's environmental conditions. When the smoke concentration exceeds the threshold level, the ESP32 triggers an alert on the Blynk platform. The Blynk app can be configured to send notifications to the mine owner's mobile device or email address. The alert message includes the current sensor readings, such as the smoke level, temperature, and humidity, indicating the severity of the situation. Additionally, the GPS location of the monitoring system inside the coal mine, helping the owner pinpoint the hazardous area precisely.

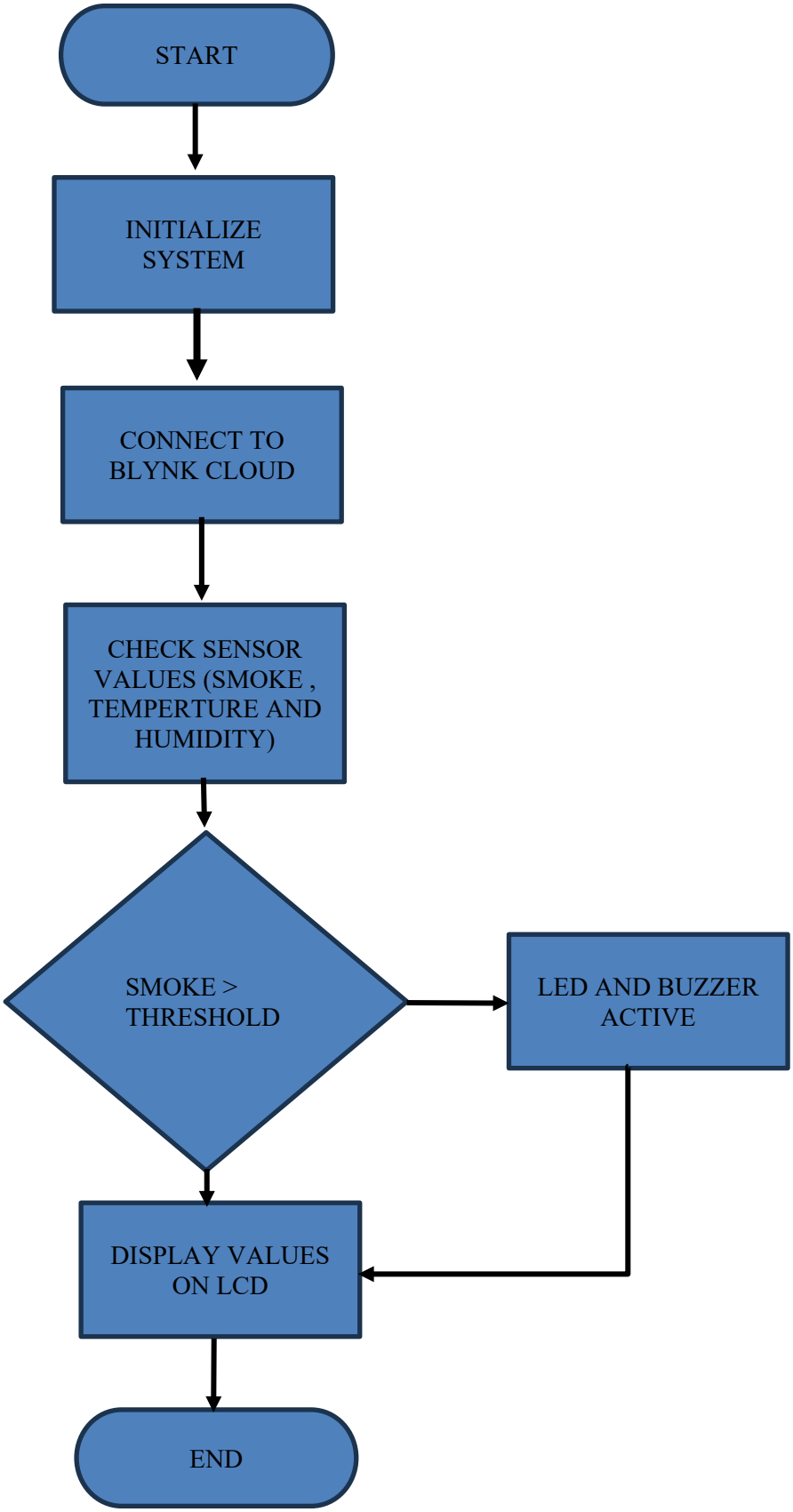
BLOCK DIAGRAM



CIRCUIT DIAGRAM



FLOW CHART


START
INITIALIZE SYSTEM
CONNECT TO BLYNK CLOUD
CHECK SENSOR VALUES (SMOKE , TEMPERTURE AND HUMIDITY)
SMOKE > THRESHOLD
LED AND BUZZER ACTIVE
DISPLAY VALUES ON LCD
END

Chapter 5

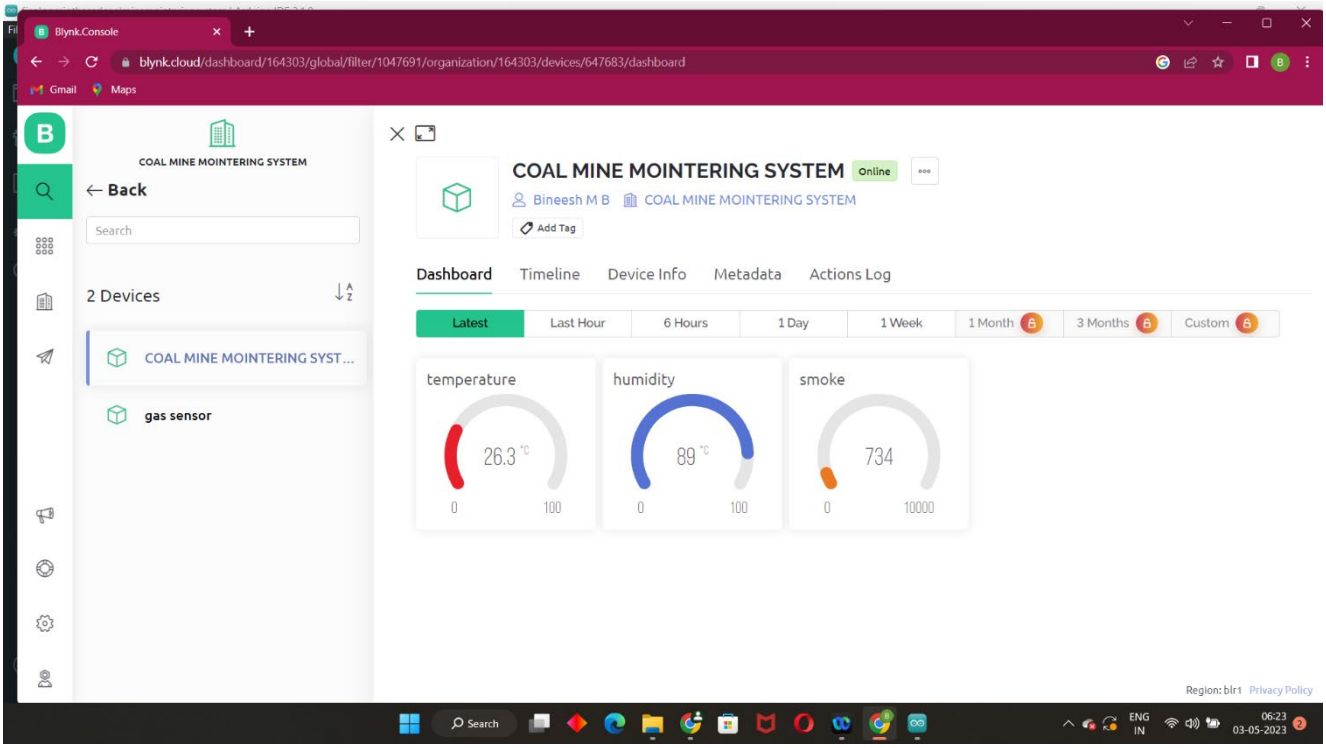
RESULTS

Achieved all the objectives that were stated above which includes the following:

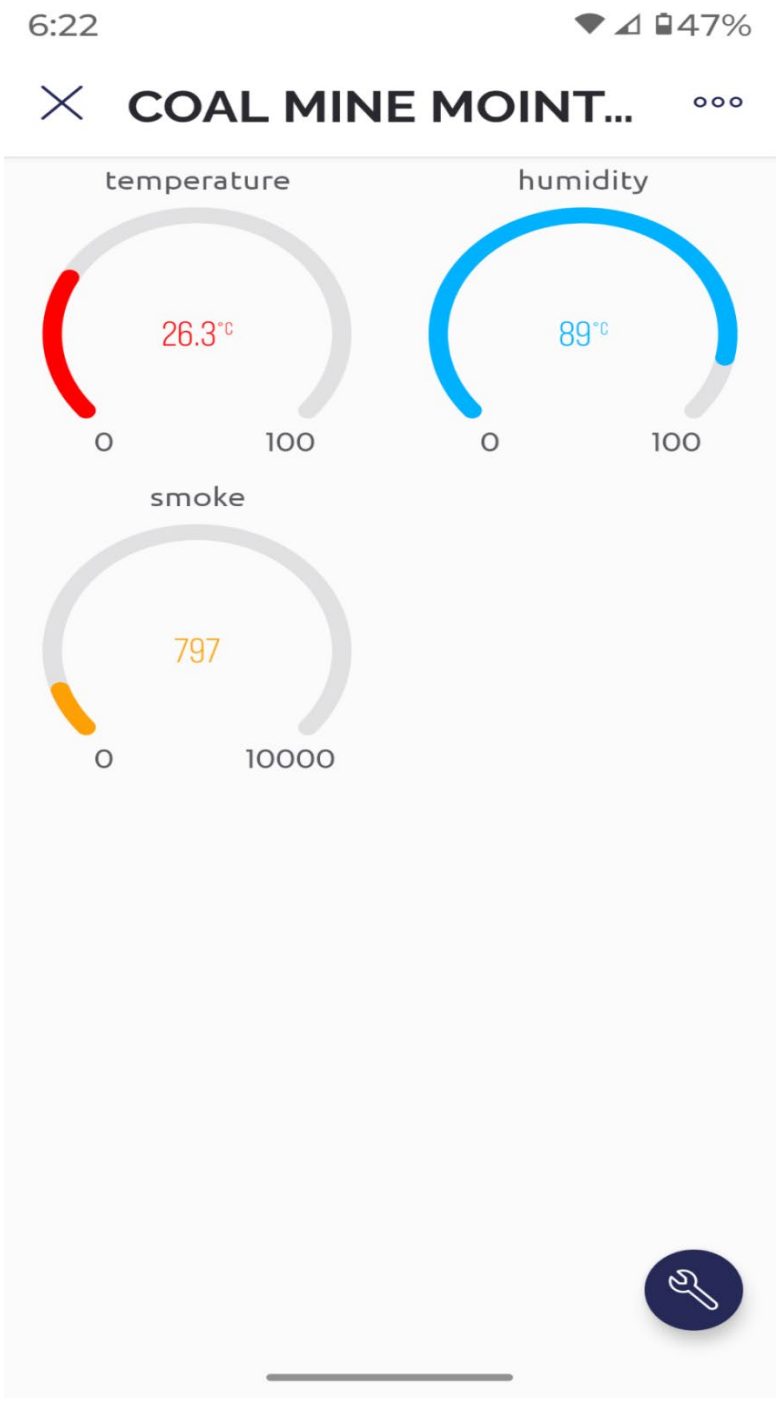
- The ESP32 continuously gathers data from the MQ2 gas sensor and DHT11 sensor to monitor smoke, temperature, and humidity levels.
- The I2C LCD display provides on-site visibility of the current sensor readings, including smoke level, temperature, and humidity.
- When the smoke level exceeds the set threshold, the LED starts blinking, and the buzzer activates to alert mine workers about potential danger.
- The system owner can use the Blynk mobile app to monitor real-time data from the coal mine, including smoke level, temperature, humidity, and GPS location.

FRONT VIEW

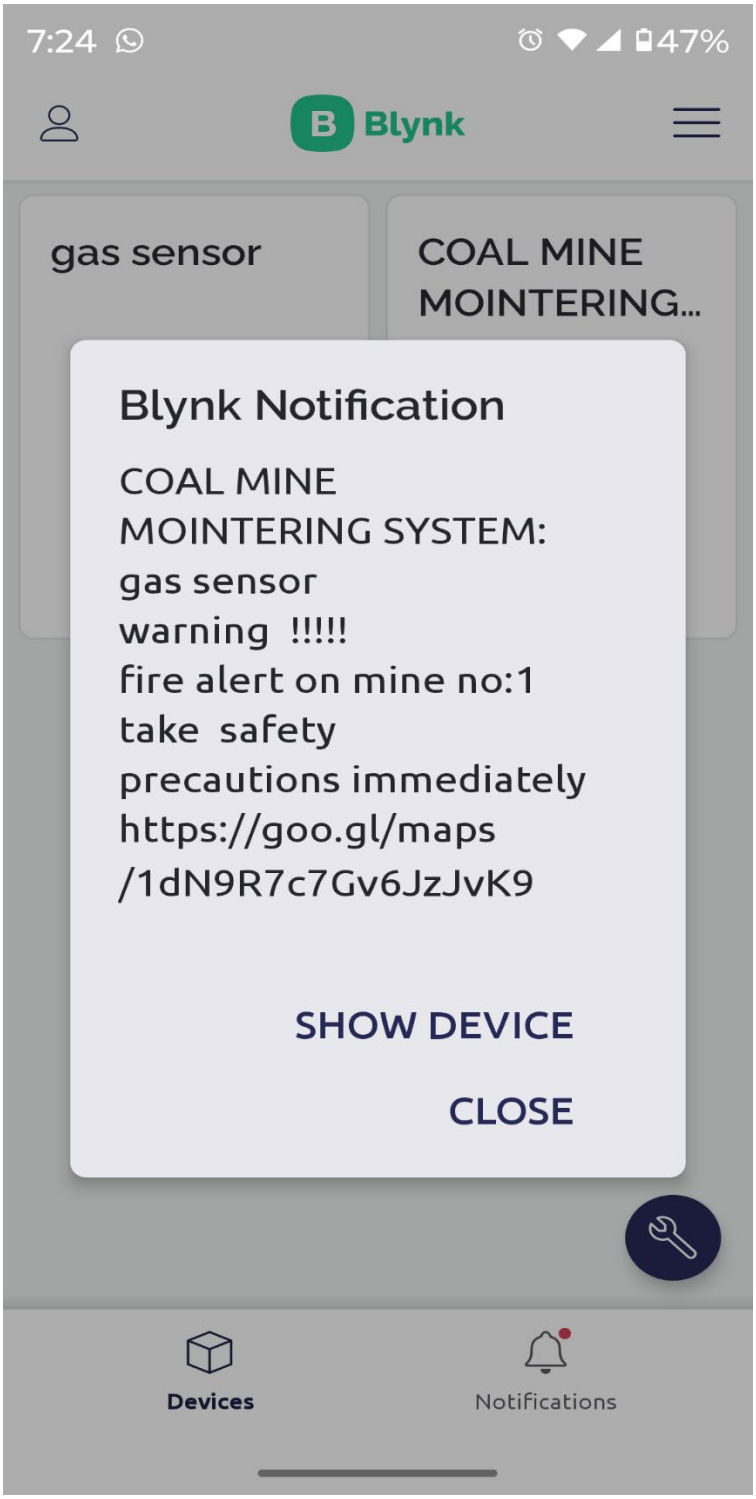
REAL TIME DATA MONITIORING



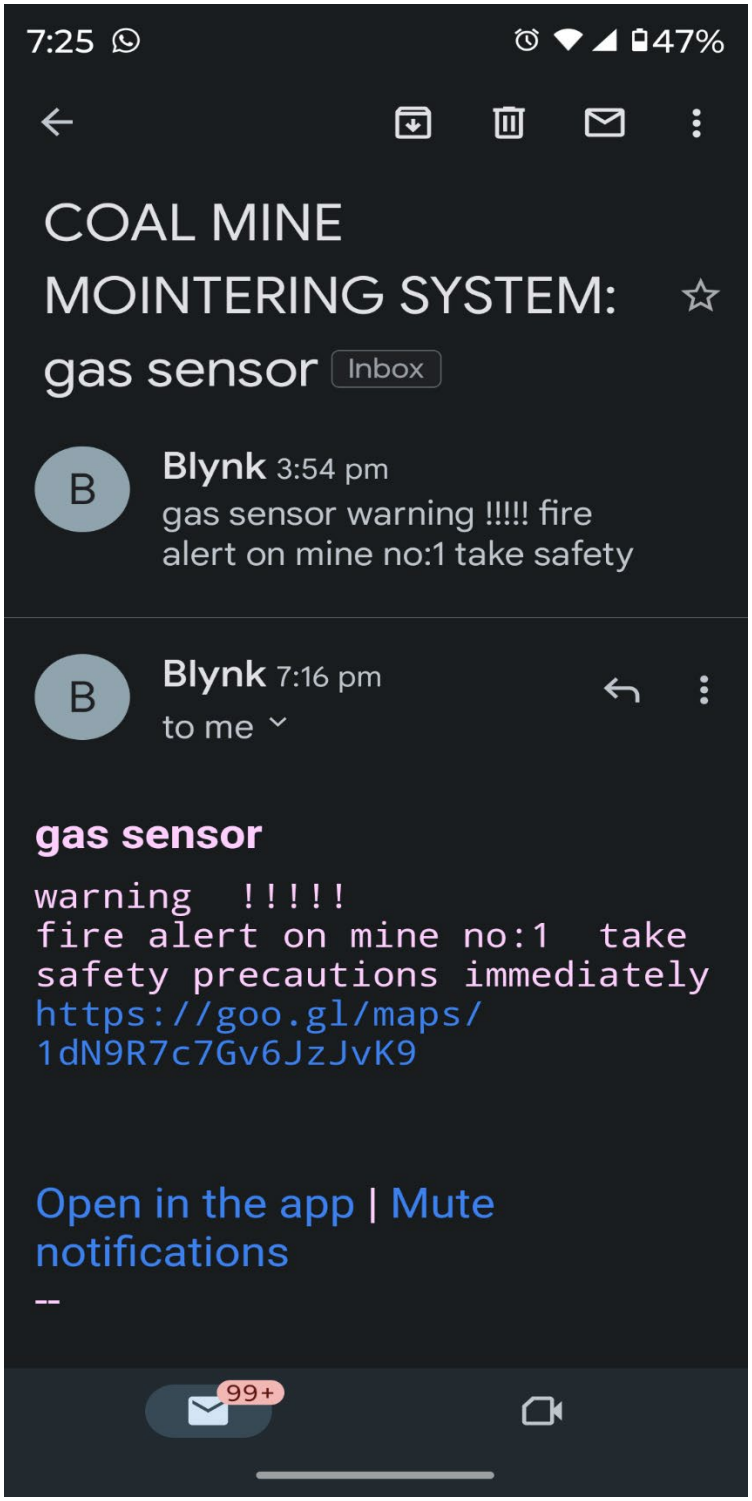
REAL TIME DATA MONITIORING



ALERT MESSAGE WHEN SMOKE IS DETECTED



ALERT MESSAGE ON EMAILWHEN SMOKE IS DETECTED



5.1 FEATURES

- The system allows remote monitoring of the coal mines critical parameters, including smoke level, temperature, and humidity, through the Blynk cloud platform.
- The ESP32 acts as the main processing unit, connecting all the components and communicating with the Blynk cloud over Wi-Fi.
- The MQ2 gas sensor detects the presence of smoke and other flammable gases, enabling the system to monitor the air quality inside the coal mine.
- The DHT11 sensor measures the humidity and temperature levels in the mine, helping assess the environmental conditions.
- The I2C LCD display provides local real-time feedback, displaying the current values of smoke, temperature, and humidity on-site for worker's reference.
- The system includes an LED that blinks or changes its color when the smoke level exceeds a specific threshold, visually alerting workers to potential dangers.
- The integrated buzzer becomes active when smoke surpasses the threshold, emitting a loud alert sound to grab immediate attention.
- The system incorporates GPS functionality to determine the location of the coal mine. In case of a smoke alarm, the owner receives an alert along with the precise GPS location.
- Through Blynk cloud, the system securely sends real-time data to a centralized server accessible from anywhere, ensuring seamless monitoring and management.
- When the smoke level reaches a critical point, the system triggers an alert to the mine owner's smartphone or computer, notifying them of the emergency.

5.2 ESP 32 CODE

```
#define BLYNK_TEMPLATE_ID "TMPL3OzhnsMrz"
#define BLYNK_TEMPLATE_NAME "COAL MINE MOINTERING SYSTEM"
#define BLYNK_AUTH_TOKEN "3r5ggvbF0odvP9iJPp4edSb4jd7e_pF4"

#define BLYNK_PRINT Serial
#include <WiFi.h>
//#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp32.h>

#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <DHT.h>


char auth[] = BLYNK_AUTH_TOKEN;

char ssid[] = "MY HOME";  // type your wifi name
char pass[] = "EDUCATION*";  // type your wifi password

BlynkTimer timer;

#define MQ2 35 // connect MQ2 sensor to ESP32 ADC pin 14
int LED = 13;
int buzzer= 23  ;
#define DHTPIN 27 //Connect Out pin to D2 in NODE MCU
#define DHTTYPE DHT11
 #define LCD_COLS 16       // Number of columns in LCD
#define LCD_ROWS 2        // Number of rows in LCD
DHT dht(DHTPIN, DHTTYPE);
LiquidCrystal_I2C lcd(0x27, LCD_COLS, LCD_ROWS); // Initialize I2C LCD


void sendSensor()
{
  float h = dht.readHumidity();
  float t = dht.readTemperature(); // or dht.readTemperature(true) for Fahrenheit
  float mq2_value = analogRead(MQ2);

  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }
  // You can send any value at any time.
  // Please don't send more that 10 values per second.
    Blynk.virtualWrite(V1, t);
    Blynk.virtualWrite(V2, h);
    Blynk.virtualWrite(V3, mq2_value);

    Serial.print("smoke  :");
    Serial.print(mq2_value);
    if(mq2_value > 700)     // Change the Trashold value
  { digitalWrite (LED, HIGH) ; /*LED set HIGH if Gas detected */
    digitalWrite (buzzer, HIGH);
```

```
    delay(1000);
    digitalWrite (buzzer, LOW);
    digitalWrite (LED, LOW) ;

    //Blynk.logEvent("test@gmail.com", "gas sensor", "Gas Detected!");
    Blynk.logEvent("gas_sensor");
  }
    Serial.print("    Temperature : ");
    Serial.print( t);
    Serial.print("    Humidity : ");
    Serial.println(h);
    lcd.clear();                        // Clear LCD display
    lcd.setCursor(0, 0);                  // Set cursor to first column of first row
    lcd.print("Temp: ");                    // Print "Temp: " on LCD
    lcd.print(t);                // Print temperature value on LCD
    lcd.print(" C");                      // Print " C" on LCD
    lcd.setCursor(0, 1);                    // Set cursor to first column of second row
    lcd.print("Humidity: ");                  // Print "Humidity: " on LCD
    lcd.print(h);                  // Print humidity value on LCD
    lcd.print(" %");


}
void setup()
{

  Serial.begin(115200);

  pinMode(MQ2, INPUT);
  pinMode(LED, OUTPUT);  /*LED set as Output*/
  pinMode(buzzer, OUTPUT);

  Blynk.begin(auth, ssid, pass);
  dht.begin();
  lcd.begin();    // Initialize I2C LCD
  lcd.backlight(); // Turn on LCD backlight
  timer.setInterval(100L, sendSensor);

  }

void loop()
{
  Blynk.run();
  timer.run();
  }
```

Chapter 6

CONCLUSION

In conclusion, the IoT-based coal mine monitoring system presents an innovative and efficient solution for enhancing safety and security in coal mining operations. By integrating components such as ESP32, MQ2 gas sensor, DHT11 humidity and temperature sensor, I2C LCD display, LED and buzzer, the system enables real-time monitoring of critical parameters, including smoke, temperature, and humidity.

The use of the Blynk cloud platform facilitates remote monitoring and management, providing coal mine owners with timely access to crucial data. When the smoke level surpasses a predefined threshold, the system responds with visual and audible alerts on-site, utilizing the blinking LED and active buzzer. Furthermore, it ensures prompt action by instantly sending alerts to the mine owner, including the GPS location, allowing for immediate response and evacuation if necessary.

This project demonstrates the practical application of IoT technology to address safety concerns in a challenging and hazardous environment like a coal mine. By employing IoT-based monitoring systems, the coal mining industry can significantly reduce the risks associated with potential disasters, safeguarding the lives of workers and protecting valuable assets. Moreover, this system can be further enhanced and scaled to address other safety and environmental monitoring needs in various industries.

6.1 APPLICATIONS

- this system is to enhance worker safety in coal mines. By continuously monitoring smoke, temperature, and humidity levels in real-time, Alert user at the time of intrusion.
- The system's ability to monitor critical parameters and promptly alert the mine owner with the GPS location in case of a smoke emergency enables quick response measures.
- The integration of the Blynk cloud platform allows remote monitoring and management of coal mine conditions.
- The IoT-based monitoring system ensures that coal mines comply with safety regulations and standards.
- While initially designed for coal mines, this monitoring system can be adapted and applied to other industrial sectors with similar monitoring requirements. Industries dealing with hazardous materials, manufacturing plants, or confined spaces can benefit from such real-time monitoring solutions to ensure the safety of their workers and premises.

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4 "Coal mines safety monitoring and modifying system" – 2020, Prof.Suresh Galve1, Abhijeet Mali Sagar Hande, Saurabh Madge, Gajanan Badade.