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# Smart Mines Helmet System

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## ABSTRACT

Coal mines are considered one of the most dangerous working environments because miners are continuously exposed to toxic gases, poor ventilation, high temperature conditions, and unexpected fire hazards. Many accidents occur due to delayed detection of unsafe environmental conditions and the absence of real-time warning systems near workers. This paper presents an Internet of Things (IoT) based Smart Mines Helmet System that continuously monitors parameters such as temperature, humidity, toxic gas concentration, flame presence, and miner body temperature. A GPS module is integrated to provide real-time location tracking during rescue operations. Sensor readings are displayed on an LCD and uploaded to an IoT monitoring platform for remote supervision. Whenever hazardous conditions exceed safety limits, the system activates a buzzer and relay-based emergency alert mechanism and can also support ventilation through a fan system. The proposed helmet system is a low-cost, reliable, and efficient safety solution that improves worker protection and reduces accident risks in underground coal mines.

**Keywords**: IoT, Smart Helmet, Coal Mine Safety, MQ-135, Flame Sensor, GPS, DHT11, DS18B20, ESP8266, Miner Tracking.

## 1.INTRODUCTION

Coal mining is one of the most important industries for meeting energy demand and supporting industrial development. However, underground mining remains a highly dangerous working environment. Miners often face life-threatening conditions due to low oxygen levels, high temperature, increased humidity, and the presence of poisonous and combustible gases. Gases such as carbon monoxide (CO), methane ($CH_4$), and carbon dioxide ($CO_2$) may accumulate in confined mine areas and lead to suffocation, explosions, or serious fire accidents.

Coal dust can also ignite easily and cause sudden fire hazards. Traditional mine safety systems mainly depend on manual inspection or centralized monitoring systems, which may fail to provide immediate alerts to workers in underground tunnels. Therefore, a portable and real-time monitoring system is required to continuously monitor mine conditions and provide instant alerts during emergencies.

With the growth of the Internet of Things (IoT), smart monitoring systems can now be developed using sensors, microcontrollers, and wireless communication technologies. IoT

systems support continuous data collection, remote monitoring, and fast emergency alert generation.

## 2. PROBLEM STATEMENT

Coal mine workers face several safety challenges such as:

- Leakage of harmful gases leading to suffocation or explosions.
- Fire accidents caused by methane ignition or coal dust combustion.
- Poor ventilation affecting air quality.
- High temperature and humidity causing health problems.
- Difficulty in locating miners during rescue operations.
- Lack of real-time monitoring for supervisors.

Due to these problems, mining accidents continue to occur. Therefore, a Smart Mines Helmet System is required to provide immediate alerts and real-time safety monitoring information.

## 3. PROPOSED SYSTEM

The proposed system is an IoT-based Smart Mines Helmet designed to improve miner safety in underground coal mines. The helmet continuously monitors environmental conditions using multiple sensors. Sensor readings are processed using a microcontroller and compared with predefined safety threshold values.

The system measures temperature and humidity using a DHT11 sensor, detects harmful gases using an MQ-135 sensor, identifies fire hazards using a flame sensor, and monitors miner body temperature using a DS18B20 sensor. A GPS module provides the real-time location of miners. The sensor data is displayed on an LCD screen attached to the helmet and also uploaded to an IoT dashboard using wireless communication.

If unsafe conditions are detected, the system activates a buzzer alarm and relay output to warn miners and trigger emergency actions such as ventilation fan operation. This system improves worker safety through early warning alerts and continuous monitoring.

## 4. SYSTEM ARCHITECTURE

The proposed Smart Mines Helmet System consists of different functional units working together for monitoring and alerting.

### A. Sensing Unit

The sensing unit contains:

- DHT11 sensor for temperature and humidity monitoring.
- MQ-135 sensor for harmful gas detection.
- Flame sensor for fire detection.
- DS18B20 sensor for body temperature monitoring.

### B. Processing Unit

The processing unit uses ESP8266 NodeMCU or Arduino to read sensor data, check safety conditions, and control outputs.

### C. Display Unit

An LCD display is used to show real-time sensor readings to miners.

### D. Alerting Unit

The alerting unit includes:

• Buzzer for warning alerts.
• Relay module for controlling safety devices.
• Fan system for ventilation support.

**E. IoT Monitoring Unit**

Sensor readings are uploaded to a web-based dashboard for remote monitoring by supervisors.

V. HARDWARE REQUIREMENTS

The major hardware components used in the system are
• ESP8266 NodeMCU / Arduino
• DHT11 Temperature and Humidity Sensor
• MQ-135 Gas Sensor
• Flame Sensor
• DS18B20 Temperature Sensor
• GPS Module (NEO-6M)
• LCD Display
• Relay Module
• Buzzer
• Ventilation Fan

## 5. SOFTWARE REQUIREMENTS

The software tools required are:
• Arduino IDE for coding and programming.
• Embedded C for microcontroller programming.
• IoT dashboard platforms such as Firebase, ThingSpeak, or Blynk.
• Google Maps interface for location tracking.

## 6. WORKING METHODOLOGY

The operation of the proposed system is as follows:

1. The system is powered on and sensors are initialized.
2. Sensors continuously monitor temperature, humidity, gas concentration, flame presence, and body temperature.
3. The microcontroller processes sensor readings and compares them with safety limits.
4. Sensor readings are displayed on the LCD in real time.
5. Data is uploaded to the IoT dashboard for remote monitoring.
6. If gas concentration exceeds the threshold, the buzzer and relay are activated.
7. If flame is detected, the alarm is triggered immediately.

## 7. ALGORITHM

Step 1: Start the system.
Step 2: Initialize DHT11, MQ-135, flame sensor, DS18B20, and GPS module.
Step 3: Read temperature and humidity from DHT11.
Step 4: Read gas sensor values from MQ-135.
Step 5: Read flame sensor status.
Step 6: Read body temperature from DS18B20.

Step 7: Read GPS coordinates.
Step 8: Display sensor values on LCD.
Step 9: Upload data to IoT monitoring platform.
Step 10: If gas level exceeds threshold, activate buzzer and relay.
Step 11: If flame is detected, activate emergency alert immediately.
Step 12: Repeat the process continuously.

## 8. RESULTS AND DISCUSSION

The proposed IoT-based Smart Mines Helmet System was tested under different environmental conditions. The system successfully monitored air temperature, humidity, gas concentration, flame presence, and miner body temperature. Sensor readings were displayed on the LCD and uploaded to the IoT dashboard.The MQ-135 sensor detected smoke and harmful gases effectively, while the flame sensor generated immediate alerts during fire detection. The GPS module provided real-time location tracking, and the relay module successfully activated the ventilation fan. The results show that the proposed system provides reliable monitoring and early hazard warning in underground coal mines.

## 9. ADVANTAGES OF PROPOSED SYSTEM

• Continuous real-time monitoring of mine conditions.
• Early detection of harmful gases and fire hazards.
• Immediate warning alerts using buzzer and relay.
• IoT-based remote monitoring for supervisors.
• GPS tracking for rescue operations.

## 10. APPLICATIONS

The proposed system can be used in:
• Underground coal mine safety monitoring.
• Chemical and industrial gas detection systems.
• Fire detection systems in hazardous areas.
• Oil refinery and petrochemical industries.

## 11. CONCLUSION

This paper presented an IoT-based Smart Mines Helmet System designed to improve miner safety. The helmet continuously monitors gas concentration, temperature, humidity, flame presence, and miner body temperature. The system also provides GPS-based location tracking for rescue operations. Sensor readings are displayed locally and transmitted to an IoT dashboard for remote supervision. In hazardous situations, the system activates buzzer and relay alerts and can also support ventilation. The developed system is cost-effective, reliable, and capable of reducing accident risks in coal mines.

## 12. FUTURE SCOPE

The proposed system can be improved further by:
• Adding MQ-4 methane sensor for advanced gas detection.
• Integrating GSM module for SMS alerts when Wi-Fi is unavailable.
• Using LoRa communication for long-distance.

## REFERENCES

1. S. R. Rupanagudi, R. R. K. Babu, and V. G. Bhat, “IoT based smart mining safety system for underground applications,” International Journal of Advanced Research in Computer Science, vol. 8, no. 4, pp. 115–120, 2017.
2. Espressif Systems, “ESP8266EX Datasheet,” 2020.
3. Hanwei Electronics, “MQ-135 Gas Sensor Datasheet,” 2018.
4. Aosong Electronics, “DHT11 Temperature and Humidity Sensor Datasheet,” 2016.
5. u-blox, “NEO-6M GPS Module Datasheet,” 2019.