

Smart Helmet for Mining workers

July 24, 2022



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1 Introduction

Almost every aspect of our modern lives depends on minerals or mineral products, such as base metals, precious metals, coal, iron sands, aggregates, limestone, and industrial minerals. Mining Industry can be categorized as the most essential application for any developed country. It provides extraction and discovery of underground materials, from Iron, gold, coal, and diamond. In addition, mining is economically important to producing regions and countries. It provides employment, dividends, and taxes that pay for hospitals, schools, and public facilities.

The safety of mine workers is the primary objective in the underground mining industry. Therefore, every mining industry follows some basic rules and precautions to avoid mining accidents. Collapses are the leading cause of coal mine accidents. However, coal mine collapse accidents are not always so dangerous. The immediate rescue can save the miner's life. Communication is essential in the mining industry. Therefore, there should be a sound communication system to provide security in coal mining areas. Other issues can also occur in the mining areas, like encountering dangerous gas, unexpected fire conduction, etc.

Wired communication in underground mining is costly and also not so effective in communicating. On the other hand, wireless communication in underground mining is costless and effectively communicating with each other. To avoid unnecessary risks such as gas sensors and GPS trackers help us take necessary steps during coal mining. During the dangerous condition, a buzzer in the mine worker's helmet signals the worker to avoid such things.

In our project, we have implemented a system for the safety of the mining workers. The system will detect the dangerous gas in the mining area and notify the workers' mobile app. In addition, the buzzer in it will also start giving signals to the worker. And in our system, we have a GPS to track the worker's location and monitor if the worker is safe and will provide the real time data.

Our project's main aim is to positively impact the mining industry and help the workers work safely in the mining zone.

2 Related Work

Yongping Wu and Guo Feng proposed a Coal Mine Monitoring system using the Bluetooth wireless transmission system to monitor coal mines. As a standard of unified global short-range wireless communication, Bluetooth technology is to be established as a typical low-power, low-cost wireless opening system. The system uses CAN bus technology maturely and has realized the combination of wired and wireless data transmission systems. The main difficulty of this system is that Bluetooth is a short-distance wireless technology, and the use of cabling is complex.

Jingjiang Song and Yingli Zhu implemented an automatic monitoring system for coal mine safety with a wireless sensor network. The micro-controller sends sensor groups of the system temperature, humidity, and other parameters in the underground mine parameters to the wireless communication module. The collected data is sent to the long-distance monitoring center by cable.

Pranjal Hazarika proposed the implementation of the safety helmet for coal

mine workers. This helmet is equipped with methane and carbon monoxide gas sensors. This sensor senses the gas, and the data is transmitted to the control room wirelessly through a wireless module called Zigbee connected to the helmet. However, this system does not detect the falling down of the person and whether the worker is wearing a helmet or not.

3 Methodology

Use of Wireless Sensor Networking System:

Wireless Sensor Networks (WSNs) enable new applications and require unconventional paradigms for protocol design due to various constraints. Due to the requirement of low device complexity with low energy consumption, a proper balance between communication and data processing capacity is required. In this system, WSNs monitor changes in worker locations remotely. It can also help detect harmful gases during mining, such as LPG, Smoke, Alcohol, Propane, Hydrogen, Methane, and Carbon Monoxide. WSN applications will assist in the data collection process of monitoring the location of mining workers. Failure and breakdown issues such as sensor and power supply issues or data security flaws can be a significant concern in wireless sensor networking systems.

Initially, the gas layer is read, and decisions are taken accordingly. Whenever the sensor detects any harmful gas, it provides an alarm to the system, and the buzzer starts beeping to alert the worker about the existence of the gas. This sensor will send data to NodeMCU, which will be forwarded to WSN systems. GPS module is used to monitor the location of workers. Location can be accessed through the mobile app. This information can help save workers' lives in emergency situationsns.

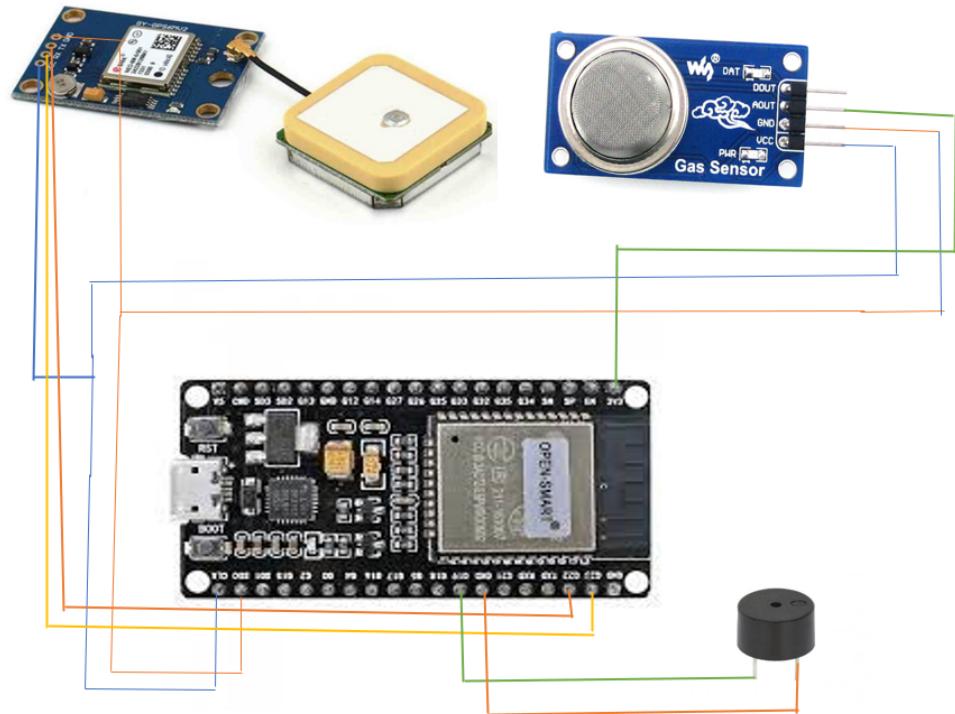
Hardware Requirements:

- NodeMCU
- MQ2 Gas Sensor
- U-blox NEO-6M GPS
- Buzzer
- Bread-board
- Jumpers
- USB cable

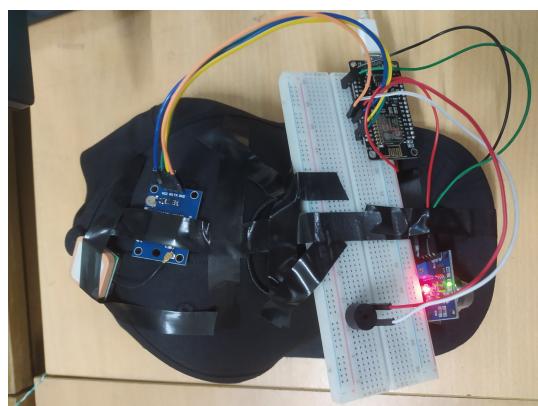
Software Requirements:

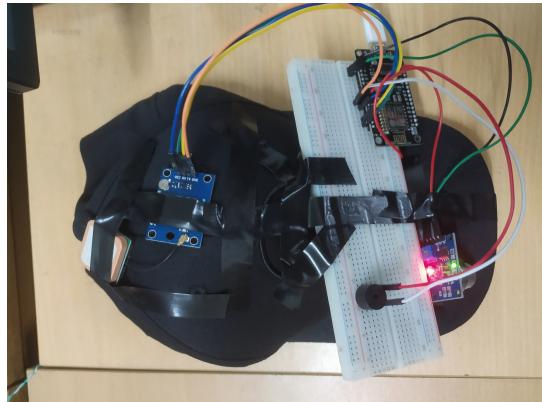
- Arduino IDE
- MIT app inventor

4 Circuit Diagram



5 Real Pictures





6 Cost

In our project, we have used budget-friendly sensors and devices.

For example, NodMCU is a low-cost microcontroller-based open source IOT platform with Better Processor & Memory. Which can connect objects and let data transfer using the Wi-Fi protocol.

MQ2 is a budget-friendly Gas sensor that is suitable for sensing LPG, Smoke, Alcohol, Propane, Hydrogen, Methane, and Carbon Monoxide concentrations anywhere from 200 to 10000ppm. It works on 5V DC and draws around 800mW.

The u-Blox NEO-6M GPS module is a popular, affordable, high-performance GPS module with a ceramic patch antenna, an onboard memory chip, and a backup battery. In addition, it can be conveniently integrated with a wide range of microcontrollers.

A buzzer is a low-cost audio signaling device. So naturally, buzzers are used for alarm devices, timers, training, and confirmation of user input such as a mouse click or keystroke.

A wire is a flexible metallic conductor. It is specially made of copper, usually insulated, and used to carry electric current in a circuit. In our project, we have used three types of wire called

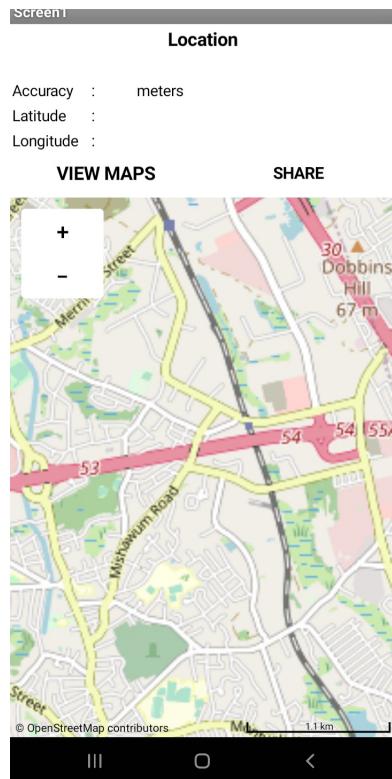
- male to male
- female to female
- male to female

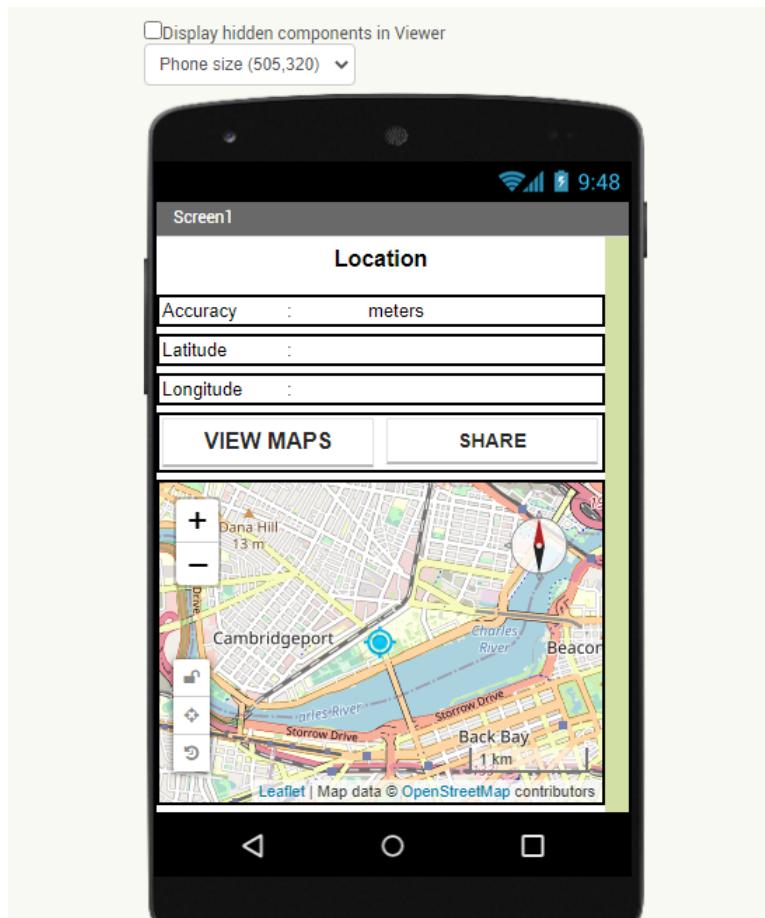
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A breadboard is used for building temporary circuits. It is helpful to designers because it allows components to be removed and replaced easily. In addition, it is beneficial for the person who wants to make a circuit to demonstrate its action, then reuse the details in another circuit.

The term USB stands for "Universal Serial Bus". USB cable assemblies are some of the most popular cable types available, used mostly to connect computers to peripheral devices such as cameras, camcorders, printers, scanners, and more. Therefore, the total cost of the system is quite low.

7 Performance Results





8 Conclusion

A mining helmet has been developed which is capable of detecting the dangerous occurrence of the presence of flammable gases. By using this helmet the miner can easily get alert about the harmful gas. This system alerts the miner by creating buzz. In this system we use firebase for transmitting the data from the mining industry to server. The IOT technology is a widely used technology for transmitting the data.

The system will offer the protection to miners and alternate the manner in their running in addition to gadget controlling the diverse environmental adjustments in mines. It is dependable gadget with brief and smooth installation.

In future this task will be farther improved with many more options. To allow the transmissions to the control station or supervisor node hopping can be implemented. The system can also be improved by adding the sensors to

detect collision inside the mines, and we can also add the devices to check the miner's heart rate and blood pressure. Other gas sensors can also be added here to detect different gases in the mining area. The temperature sensor also can be implemented in our project to detect the fire inside the mining are and notify the workers the danger rate.

9 Society and Ethics

"IoT-based Smart Helmet" Using IoT is a project created to promote miners' social development and safety. This project is not harmful or threatening to our society or the mining workers.

We think this technology is cheap, very easy to use, and does not interfere with legal and religious values. Besides, workers will not face any hassle adopting this technology as it is also user-friendly. Therefore, the system will be easily accepted by the people related to mining.

We wholeheartedly believe that our project will be very helpful and will have a positive impact on the miners without any social and moral issues.