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IOT Based Mining Worker Safety Helmet

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A B S T R A C T

Safety is the primary concern in the coal mining industry, where numerous incidents occur. This study focuses on a wireless network connection to provide real-time data and alert the authorities about the accident so they can take the necessary measures. Since falling debris on workers is the most frequent cause of accidents in the mining industry, we decided to support this industry by developing an IoT-made helmet project. Out of all of these, the mining industry is the most antiquated. As a result, we created the concept of SMART HELMETS to bring new technologies to the mining sector and the Internet of Things. This helmet is a life preserver for the workers who toil deep within the mines. This experimental model. This project focuses on a flexible, affordable solution for the protection of underground mining workers.

The subsurface environment is monitored via a MEMS module and temperature-based sensor. To automate the progression of measurement data with high precision, reliable control, and smoothness, an IOT communication method is proposed. After gathering data and making judgments, an Arduino microcontroller is used, and a server notifies the mine worker. In order to establish a successful wireless connection with the computer at the ground control center, sensor data is transformed into a digital signal.

Keywords: Node MCU, Safety, Data monitoring, Gas, temperature, and Light Sensors.

1. Introduction

This helmet is a life preserver for the workers who toil deep within the mines. This prototype's ESP8266, accelerometer, gas, and buzzer sensors allow it to recognize the different mining hazards. Are you worried that these risks are associated with the coal industries? Consequently, in all underground mining activities, the workers' safety should always come first. The health and safety of workers may be in danger when engaging in underground mining operations. These dangers are caused by the various methods used to extract the various minerals. The risk increases with mine depth. These safety concerns are quite important, particularly in view of the coal industry. Therefore, whether mining for coal or any other mineral, worker safety should always come first. Because of ventilation issues and collapse risk, open pit coal mining is less dangerous than underground coal mining. However, mining of any form carries a risk because it involves heavy gear and excavation.

1.1 Structure

- At underground coal mining locations, the sensors are connected to an Ardunio Uno or Atmega microcontroller, which reads the value and communicates it over Wi-Fi to the helmet's installed blynk application. One can view the real-time sensor readings with the Blynk app. The Blynk program will notify the control room if there is an excess. There is also an RF transmitter and receiver to convey data in case Wi-Fi isn't available
- The helmet module also has a push button that, in the event of an accident, alerts the control room.
- In addition, the helmet contains a GPS module that, in the event of an accident, enables the control room to track the miner's location and protect them. .
- We can still convey data using RF technology even in situations when Wi-Fi is unavailable since the control room unit has an associated RF receiver and the helmet unit has an integrated RF transmitter.

1.2 Objectives

- This can be utilized for any kind of emergency, such as physical injuries, cave-ins, poisonous gas inhalation, etc. Thus, the system uses IOT to guarantee the safety of mining workers.
- The safety of the workers is the main goal of this helmet.
- To design a system that can improve worker security.
- To provide tools and techniques for locating and reporting problems.
- To ensure safety by employing technology to give users access to surrounding information and enable voice control for phone functions.

2. Literature Review

A Ventilation systems are essential to underground mining operations in order to provide adequate oxygen, preserve an atmosphere free of toxins and explosives, and operate a productive mine. Systems for ventilation in mines might aid in removing hazardous situations. Canaries and other animals were first used as early warning systems for miners when the environment became poisonous, in order to monitor the mining atmosphere. By incorporating a ventilation monitoring system and making use of the vast amounts of data it provides, I am able to make intelligent ventilation adjustments.

The mining industry's top priority is the safety of its employees.Since there is a great deal of risk for mining workers in deep mines, When miners clash with large items, their lives are in danger. Additionally, miners may breathe in dangerous gasses that endanger their lives. The miners won't be able to interact with staff or other outside mining personnel in cases like these. Back then, the mining industry did not utilize any sensors, and there was no information accessible regarding the environmental conditions surrounding mining areas.

An old-fashioned smart helmet type has been created to help miners who work in the mining sector. In the mining industry, there are a lot of hazardous situations that frequently lead to fatalities or severe injuries. Since a miner's helmet is one of their most used pieces of safety gear, it should have more modern characteristics. The smart helmet would be able to detect potentially fatal conditions, like the presence of dangerous gases like carbon monoxide, CH4, LPG, and natural gasses, by utilizing a variety of sensors.

"IOT Enabled Helmet To Safeguard The Health Of Mine Workers," was proposed by Ninni Singh et al. [1]. The proposed approach improvises the development of an IoT-enabled real-time monitoring helmet that may deliver early-warning data on the presence of dangerous gasses, fire, silicosis dust particles, and temperature.

Kumari, M. Nivetha, et al. [2] "IOT Based Smart Helmet for Construction Workers" was proposed. In the event of an emergency, this system recommends that construction workers wear a smart, flexible helmet for security and rescue purposes.The purpose of this helmet is to shield workers from potential health risks while they operate and to enable continuous observation of them.The proposed system describes a low-cost, intelligent, sensor-equipped helmet for construction workers.

The "IOT Based Smart Helmet for Ensuring Safety in Industries" was proposed by V, et al. Mangala Nandhini [3]. Possible work-related risks include gas explosions, asphyxiation, and gas poisoning. As a result, air quality and the identification of potentially dangerous situations are highly valued by industry. The suggested system offers a wireless sensor network for real-time working environment monitoring from a monitoring station in order to put such safety measures into effect.

The proposed "IOT Based Safety System For Coal Mines" mining approach, according to Kodali, R.K., et al. [4], increased the complexity and difficulty of the duties carried out by personnel in the mining industry without offering any warning of potentially harmful scenarios that they might experience in the future.

3. Problem Defination

This helmet is a life preserver for the workers who toil deep within the mines. This prototype's ESP8266, accelerometer, gas, and buzzer sensors allow it to recognize the different mining hazards.

For this project, we are employing gas and temperature sensors. When the temperature is high, the sensor instantly sends out a signal alert delivered to the main line of communication.

This work requires the Internet of Things. Likewise, the thermometer needs to provide alert messages and notify the user when the temperature changes.

A fire scene may be difficult for firefighters to access because of the explosive materials, smoke, and high temperatures present.

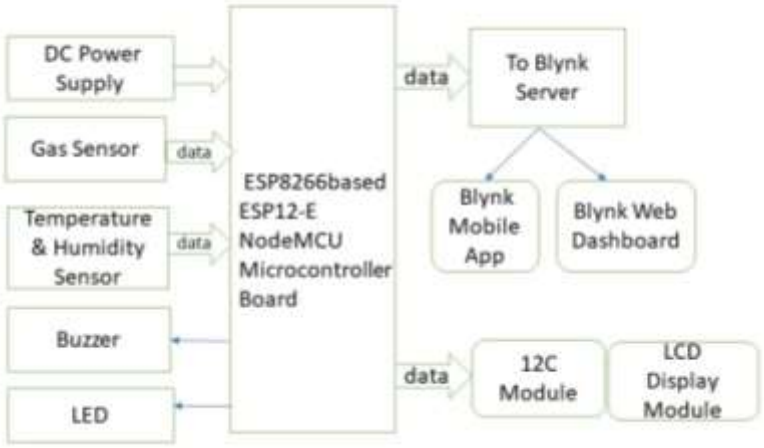
In such cases, firefighters are likewise vulnerable to injury. Such environments can benefit from the use of robots that put out fires.

The fire extinguisher robot is based on Internet of Things technology.

4. Methodology

There are numerous ways to communicate within subterranean mines now in use. Among the communication techniques are WiFi, GSM, GPS, RFID, Zigbee, and radar sensor networks, among others. These methods are employed for both internal and external communication in underground mines. The effectiveness of the chosen approach can be raised by combining it with other strategies. There are benefits and drawbacks to every method. An analog value proportional to temperature is provided to Aurdino by the DHT-11 temperature and humidity sensor. prints the temperature that is read from the DHT11 sensor on the serial monitor and activates the LED and buzzer to signal a high temperature condition if the temperature rises above 31 degrees Celsius..There are several important phases involved in making a smart helmet for miners. A comprehensive requirement analysis is initially conducted to identify the particular safety needs and challenges faced by miners. This means asking employees for input, looking into existing safety protocols, and deciding which essential features and functionalities the smart helmet should have.The helmet is then fitted with an array of sensors to monitor physiological data, impact, temperature, humidity, and gas levels, among other crucial factors. The sensors need to be accurate, trustworthy, and suitable for the mining environment.

5. Block Diagram-



6. Component Required

6.1. MQ2 Gas Sensor –

Fig (1) MQ2 Gas Sensor.

The Gas sensors are instruments that measure the concentration of gases by identifying the unique attribute of each gas, known as the ionization potential or inimitable breakdown voltage. Sensors use breakdown voltage to identify the gas molecules. The MQ2 gas sensor is a widely used sensor module for detecting various gases in the surrounding air. It is fitted with a small heating element and a gas-sensitive resistor. The sensor is susceptible to flammable gases like methane, butane, and LPG in addition to smoke and other volatile organic compounds (VOCs). Its analog output, which depends on the concentration of the gas detected, allows interacting with Arduino boards or microcontrollers easy. Applications where gas detection is essential, like gas leakage detection systems, fire detection systems, and air quality monitoring equipment, commonly use the MQ2 gas sensor.

6.2 Node MCU ESP8266 –

Fig (2) Node MCU ESP8266.

There are open source prototyping board designs available for the NodeMCU firmware. "Node" and "MCU" (micro-controller unit) are combined to form the term "NodeMCU". The firmware itself is referred to as "NodeMCU" strictly speaking, not the related development kits.

The popular development board NodeMCU ESP8266, which combines the capabilities of the ESP8266 Wi-Fi module with a programmable microcontroller, is an ideal platform for Internet of Things (IoT) projects. Developers may connect their products to the internet and communicate with other devices or online services thanks to the powerful 32-bit Tensilica L106 microcontroller and integrated Wi-Fi. Writing and uploading code using the Arduino IDE or other comparable development environments is simple for both novice and experienced developers since the NodeMCU ESP8266 supports the Arduino programming language. Using the NodeMCU ESP8266, we created Internet of Things (IoT) devices that can connect to the internet, collect sensor data, and communicate with other devices or online services.

6.3. LED-

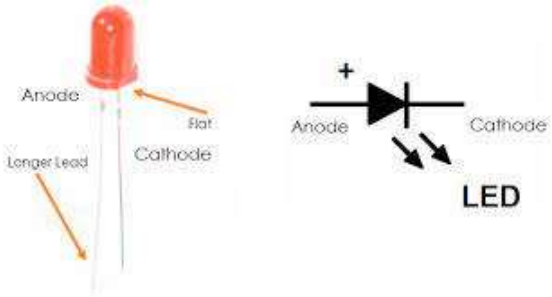


Fig (3) LED.

A semiconductor device known as a light-emitting diode (LED) releases light when an electric current passes through it. An LED emits light when current flows through it because the electrons recombine with the holes.

6.4 DHT11 Temperature Humidity Sensor –

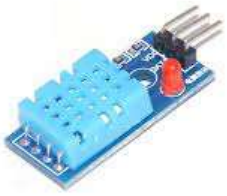


Fig (4) DHT11 Temperature Humidity Sensor.

A temperature sensor is a device that uses an electrical signal to measure temperature and present the temperature in a readable format. These devices are usually thermocouples or resistance temperature detectors. The simplest type of temperature meter for determining how hot or cold something is is a thermometer. The DHT11 is a well-liked digital temperature and humidity sensor module. Its parts include a capacitive humidity sensor and a thermocouple for temperature monitoring. It is possible for Arduino boards and microcontrollers to simply read the digital output signal that the module provides. It costs a little money and is comparatively simple to use. The DHT11 sensor monitors temperature in the range of 0°C to 50°C (32°F to 122°F) with an accuracy of ±2°C and humidity in the range of 20% to 90% with an accuracy of ±5%.

It is widely utilized in environmental monitoring systems, weather stations, HVAC applications, and other projects that require temperature and humidity sensors.

6.5 Buzzer –

Fig (5). Buzzer.

A buzzer is a tiny sound-producing gadget that is frequently seen in electronic devices and circuits. A buzzer can be included as an audio alert system in an Internet of Things safety helmet to deliver messages or warnings that can be heard. The buzzer alerts the wearer or those around them when it detects particular events or conditions, including a dangerous situation or unusual conduct. Giving real-time audio feedback in emergency scenarios can aid improve safety precautions. IoT technologies enable the buzzer to be regulated and activated wirelessly, facilitating a smooth connection with the safety helmet and the broader IoT ecosystem. An audio signaling device, often known as a buzzer or beeper, can be piezoelectric, electromechanical, or mechanical (piezo for short). Buzzers and beepers are commonly used in alarm systems, timers, training systems, and as a means of verifying user input, such as mouse clicks and keystrokes.

6.6. LCD Display –

Fig (6). LCD Display.

Liquid crystals are the main component used in the operation of one type of flat panel display known as an LCD (Liquid Crystal Display). A liquid crystal display (LCD) is a flat, thin electronic visual display that makes advantage of liquid crystals' (LCs') ability to modulate light. LCs don't directly emit light.

7. Benefits of Project-

- Helping to prevent accidents from happening.
- Defense against injuries to the head.
- It displays the current location of each worker across the whole mining site.
- To ensure the security of miners in hazardous circumstances.
- Make certain that miners are safe in dangerous situations.

8. Conclusion-

In order to lower worker health hazards, the suggested study focuses on developing a real-time monitoring helmet with IoT sensors that can rescue with early-warning intelligence on the existence of fire, toxic gasses, temperature, and silicosis dust particles.

Any emergency, such as an inhalation of hazardous gas, a cave-in, bodily harm, etc., can employ this.

This study looks at how technology can be used to shield people from dangerous gasses and other hazards to their health while working.

The complex process of putting a mine safety system in place requires the use of a range of sensors. The primary objective of the system is to ensure the safety and security of coal mine workers while reducing hazards. To do this, the system continuously monitors the mine using Internet of Things

technology. A centralized monitoring system receives critical data from the system's sensors on the mine's environmental conditions. Real-time data evaluation is done by the system's sophisticated algorithms and analytics.

To identify the dangerous CO and CO2 gases that exist in the mines, an intelligent helmet is built. With this helmet, the miner can quickly become aware of the dangerous gas. When a miner removes their helmet while working in the mining business, this system can also notify them. In this system, data from the mining industry is transmitted to the server using GPRS. One popular technique for data transmission is the Internet of Things.

9. Reference-

This helmet serves as a lifeguard for the workers who toil deep beneath the mines. This prototype's ESP8266, accelerometer, gas, and buzzer sensors allow it to recognize the different mining hazards.

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