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SMART MINE SAFETY SYSTEM

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ABSTRACT: - *Security is the most important element in every industry. Security and safety are the only factors in the mining industry. The mining sector employs numerous safety measures to stave off accidents of all kinds, including those using steel. Methane gas leaks and rising water levels in underground mines are both a result of rising temperatures. Workers are protected here. We activate the panic switch protection when the worker can neutralize the threat. A reliable communication system needs to be put in place to increase safety for workers in underground mines and between the fixed landmine system. The communication network shouldn't ever go down. To overcome this we have used wireless technology to send sensor data to users and display them on their device prior.*

Keywords: Nodemcu, Gas sensor, Dht-11, Ultrasonic, TFT, nrf24l01

1. INTRODUCTION: -

A mining accident is a mishap that happens when extracting minerals or metals. Tens of thousands of miners perish in mining accidents every year, with which occurred in underground coal mining, however accidents do occur in the mining industry. Coal mining is seen as being substantially more risky than hard rock mining because of the plain, frequently ineffective rock strata, availability of CH4 gas, and coal powder.Nowadays, when safety procedures are not effectively enforced, most deaths take place in rural areas of wealthy countries and poor countries, thus more valuable to the user, have been made possible by the introduction of vision technology.

To ensure the safety of people, it is crucial to keep track of any factors that can cause an accident. In this research, a device that monitors coal mine conditions that could endanger human life is presented. In this system, the sensors and transmitters are used for monitoring.This solution also includes a smart helmet with a panic button that may be used independently by each worker. All sensors are connected to particular applications, and when a certain value is exceeded, an alert signal is sent. The control room receives the alert message so that swift action can be taken. Coal mining accidents could cause a significant number of fatalities if they are not carefully controlled.

Coal mining has been seen to have a substantial impact on the nation's quick economic and social development over time. Globally recognised academics have conducted extensive research to raise the level of safety. For human development, coal mines are a vital source of energy.A multi-dimensional statistical analysis was used to examine the human factors involved in the trajectory of China coal mine accidents over the last ten years.

The number of fatal coal mine accidents and the number of fatalities were steadily declining, although the majority of fatalities were still caused by rare incidents. Human factors were responsible for 94.09 percent of these occurrences' causes, accounting for 35.43 percent, 55.12 percent, and 3.54 percent, respectively, of purposeful violations, poor management, and defective designs.

In order to look for concealed structures or anomalies, a coal pillar-penetrating synthetic pulse radar instrument was used. Direct matrix inversion was used to create a velocity image of the pillar's interior. The image that was rebuilt showed the existence and location of a low-velocity material. The low-velocity material displayed in the tomogram matched a clay vein in the cores.

In order to monitor the safety of mine roof integrity and hazardous gases in coal mines, fibre optic sensors have been created and put into use. The FOS-based mine hazard warning system is unparalleled in terms of its built-in safety, multi-location, and multi-parameter monitoring capabilities. They could be used to develop systems with expertise in the early detection and mitigation of mining dangers.

2. EXISTING TECHNIQUE: -

There are many existing techniques for the communication inside the underground mines. The communication schemes include GSM, GPS, RFID, Zigbee, Radar sensor network, etc. These techniques are used for the communication inside and outside the

underground mines. By integration with other techniques, the efficiency of the selected method can be improved. Each technique has its own merits and demerits.

GPS SYSTEM

The communication system with the largest coverage area is the Global Positioning System. Worldwide commercial users can get crucial positioning from GPS. GPS has a wide coverage area, which is a benefit, but it is less effective for underground mining, which is a drawback.

GSM TECHNOLOGY

The GSM communication technique also covers a large area. Even though it is used in underground mines, communication delay stands as a major disadvantage. Hence this technique is found to be less effective for a critical environment like underground mines.

RFID TECHNOLOGY

For placing or localising underground mine employees and the locomotive equipment inside mines, RFID technology is significantly superior. It does not require Line-of-Sight communication, unlike IR. Although RFID tracking systems are theoretically sound, it has been discovered that maintaining RFID tags is a disadvantage.

RADAR TECHNOLOGY

For the assessment of environmental factors in underground mines, radar sensor technology is more efficient. The dust has little to no impact on the sensors. Any kind of abrasive environment with dust and mist can be penetrated by it. However, the biggest issue that causes it to lag is the expensive expense of the equipment and upkeep.

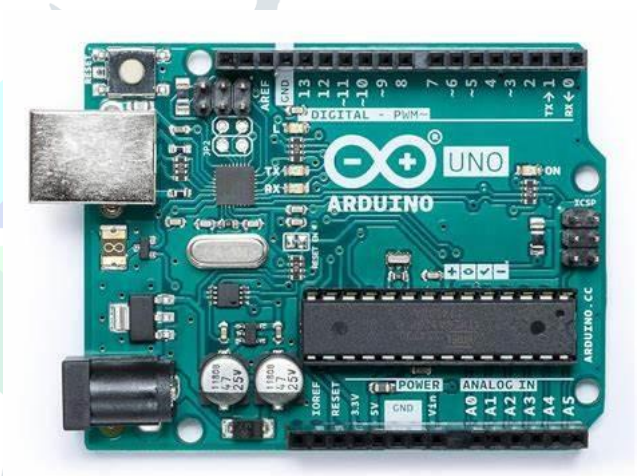
3. SYSTEM HARDWARE: -

3.1. Nodemcu

Nodemcu is an Internet of Things (IoT) application-specific open-source Lua firmware. This software is operated by the ESP-12E module, which is based on the 32-bit ESP8266 MCU. It has WPA/WP2 compatible 2.4 GHz Wi-Fi. A 3.3v SMPS unit and a programmer are included with the ESP-12E. Thus, you may easily run this board straight on 5V via USB without a requirement for an extra programmer.

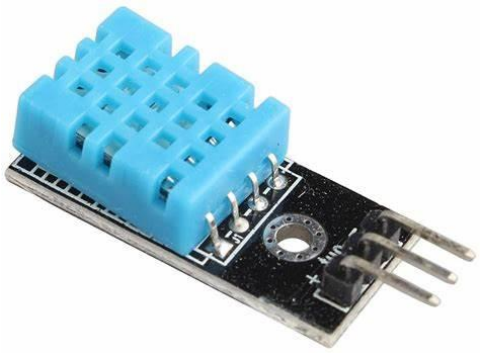
3.2. Arduino

Arduino is built on simple hardware and software. A motor can be started, an LED can be turned on, and something may be published online by using an Arduino board to receive inputs like light on a sensor, a finger on a button, or a tweet. Sending a set of instructions to the board's microcontroller will instruct your board what to do. You achieve this by using the Arduino Software (IDE), which is based on Processing, and the Wiring-based Arduino Programming Language.



3.3. TFT DISPLAY

A liquid crystal display version known as a thin-film-transistor liquid crystal display (TFT LCD) makes use of thin-film transistor technology[1] to enhance visual attributes like addressability and contrast. In contrast to passive matrix LCDs and simple, direct-driven (i.e., with segments directly connected to electronics outside the LCD) LCDs with a few segments, a TFT LCD is an active matrix LCD.



3.4 GAS SENSOR

One of the MQ sensor series' most widely used gas sensors is the MQ2. As the detection is dependent on a change in the resistance of the sensing material when the Gas comes into contact with the material, it is a Metal Oxide Semiconductor (MOS) type Gas Sensor, also known as Chemiresistors. Concentrations of gas can be found using a straightforward voltage divider network.

3.5. DHT-11

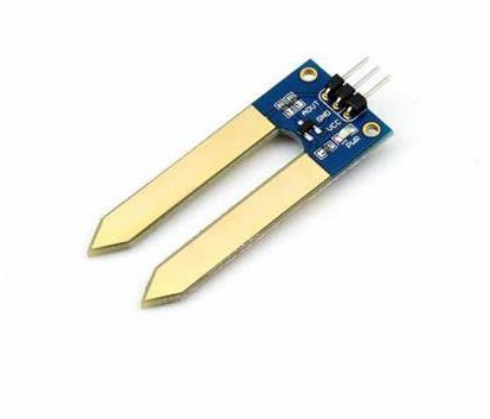
A cheap digital sensor for detecting humidity and temperature is the DHT11. To instantly detect humidity and temperature, this sensor may be simply interfaced with any micro-controller, including Arduino, Raspberry Pi, etc. Both a sensor and a module are available for the DHT11 humidity and temperature sensor. The pull-up resistor and a power-on LED distinguish this sensor from the module. A relative humidity sensor is the DHT11. This sensor employs a capacitive humidity sensor and a thermistor to measure the ambient air.

3.6. ULTRASONIC SENSOR

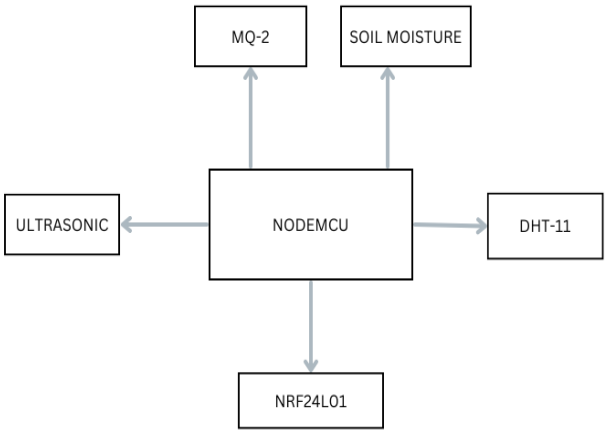
Ultrasonic sensors use ultrasonic waves to measure distance, as the name suggests. An ultrasonic wave is sent by the sensor head, which then picks up the wave that the target reflects back to it. The time elapsed between the emission and reception is measured by ultrasonic sensors to determine the target's distance.

3.7. MOISTURE SENSOR

The moisture sensor is used to determine how much water (or moisture) is present in the soil. The module output is at a high level when there is a water shortage in the soil; otherwise, it is at a low level. This sensor monitors the moisture level of the soil and serves as a reminder for the user to water their plants. Agriculture, agricultural irrigation, and botanical gardening have all made extensive use of it.



TRANSMITTER



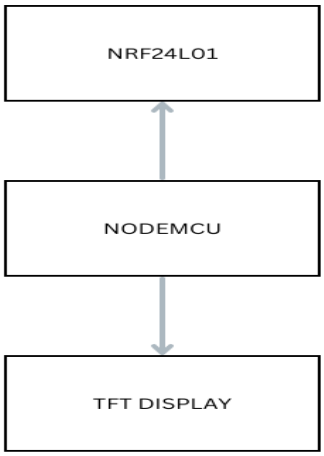
4.WORKING OF PROPOSED METHOD: -

The potential for a significant change in the underground environment can put the miners operating there in danger. As a result, a minimal level of safety is offered. To increase the safety of the mine staff, a better sensing system and localization are designed. These can be achieved with the use of an effective communication strategy.It has been suggested that radio frequency technology would improve communication inside underground mines.

The main part is an Arduino Uno, which uses an NRF module to transmit data over the internet. Voltage is supplied to the circuit using a DC power supply. This is a schematic of the monitoring and warning system. This system will be constructed using Arduino, NRF modules, and sensors such MQ-2, the DTH11 humidity and humidity sensor, ultrasonic and soil moisture sensor.Our sensors will be able to spot changes in the coal miner's surroundings and will keep an eye on things like temperature, gas concentration. The display with microcontroller will be given to the individual miners who are all entering into the mine.

Additionally, the control room will receive data from the sensors that will be relayed via the NRF module so that the correct actions may be made quickly and effectively.

RECEIVER

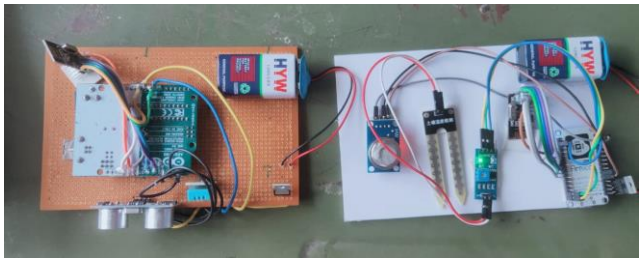


5. RESULT: -

The real-time sensing and localising mine monitoring system is utilised to ensure the safety of the mine workers. Numerous sensors that measure temperature, humidity, vibration, and soil moisture level and improve real-time sensing.

DHT-11 sensors are used to gauge air temperature and humidity, LDR sensors to gauge light intensity. Sensing elements' measured values are transmitted to the control room, where the appropriate steps are made to ensure mineworkers' security. The location of the working personnel can be traced using RSSI data.

If metrics like temperature and humidity readings exceed their threshold values, the voice alarm system issues a warning. Thus, the technique can avert catastrophes in underground mines all around the world.



6. CONCLUSION: -

In the mining industry, safety has always been a concern, particularly in sub-underground mining. Even though mining is safer now than it was in earlier decades, accidents still happen. According to official statistics, 5,000 Chinese miners perish in accidents every year. Worldwide, accidents related to underground mining continue to occur, often resulting in multiple fatalities. Two recent examples are the 2009 Heilongjiang mine explosion in China and the 2010 Upper Big Branch Mine catastrophe in the United States. The market offers a wide variety of safety equipment. However, the prototype we created stands out from the crowd thanks to its advantageous design and potential. Because, in contrast to other safety devices, it facilitates ongoing worker monitoring in mines.

By using this technology, variations in the environment may be tracked and the appropriate safety measures can be implemented. Additionally, it offers a method for tracking the worker's location, allowing the rescue team to offer timely assistance under difficult circumstances. The control room module can be planned and executed for the aforementioned uses in the future. By adding more sensors to this system, the smart helmet's level of safety could be increased in the future. RF technology is inexpensive compared to other communication methods. Therefore, radio frequency technology is the world's underground miners' saviour.

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