IOT based Coal Mine Safety Monitoring And Alerting System

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Abstract:- **Coal mines are one of the most important and industries in the country, as they are used as fuel in the steel and cement industries to extract iron from the stone and create cement. Every parameter, such as methane gas, high temperature, fire incidents, etc., should be regularly checked in the underground mining business. Due to the complexity of the mining environment and the variety of activities performed in coal mines, it is important to monitor the working environment. To address this issue, there is a system that monitors basic safety measures and regulates many restrictions on coal mines, such as gas leaks, temperature and humidity conditions, and fire sensor. All the sensors are assembled into a single unit and then placed in a coal mine.**

I. INTRODUCTION

The mines are the world's most dangerous mining operation, with thousands of workers dying each year as a result of massive explosions. According to a recent study, in such mining incidents,an estimated 12,000 people have died on average. Coal is a non-human resource that can be converted; there are a few problems in the mines; and workers risked their lives by working in coal mines; and, unfortunately, some miners end up losing their lives in coal mines. Often, such problems arise as a result of outdated technology and wireless devices, the final result being the mismanagement and spillage of toxic gases in coal mines poses a serious threat to archaeologists, underground operation. If farming is done by hand, more workers are needed, and the required quality work is not achieved. Seeds and fertilizers are also wasted due to inefficiency. The manual harvesting method is time consuming and expensive. The chemicals used in pesticides are toxic and dangerous to humans, and if you are not careful during spraying, they will develop respiratory infections. The eight deadliest mines in history have occurred in China. Liaoning eruption kills 210 people, Guangdong floods kill 123 people, Xinjiang eruption kills 83 people, Shanxi eruption kills 72 people in 2015. A coal explosion at the Honkeiko Colliery in China killed 1,549 miners, making it one of the most dangerous mining disasters in history. As a result, the importance of safety for mine workers in recent days, monitoring mine employees in underground mines has become extremely challenging. Internet of Things (IOT) is a set of gadgets(objects) connected to the net. IOT implementation varies substantially on a massive scale. Internet of Things Europe group has most essential IOT gadgets. Clever apps, clever power, enterprise, fitness, and clever cities as a whole encompass smart housing, smart transportation, and clever housing to call a few net of things(IOT) is a sport-changing invention in which all sensory records is stored within the cloud and accessed fast.

II. RELATED WORK

[1] Ultra-modern mining workers have a big issue in phrases of safety. The mining protection machine ensures that the running environment is free of hazards. The undertaking's number one purpose is to save you mining injuries and decorate operating conditions. The Arduino Uno is employed for extended reliability in the IOT-primarily based mine protection gadget, which has multiple sensors for numerous functions. This machine is used inside the mining enterprise, and all sensors are considered as one unit sensors screen an expansion of characteristics from the operating area along with temperature and humidity, light intensity, hazardous gasoline levels inside the air, and flame hint.[1]

[2] Safety is the most important aspect of any industry. Safety and security are extremely important in the mining business. To avoid mishaps, the mining sector takes several fundamental safeguards. Temperature rises, water levels rise, and methane gas leaks continue to cause accidents in underground mines. It ensure worker safety here. When a worker is in danger, it can use the panic button to alert security. To improve underground mine safety, a reliable communication system between subterranean mine workers and the fixed ground mining system must be built. The verbal exchange community can not be disrupted at any time or under any occasions. This suggestion proposes a low-free Zigbee-based totally wireless mine surveillance device with early-caution intelligence. The reputation of employees may be tracked via IOT.[2]

[3] Many coal miners are involved approximately their occupational protection bad ventilation in subterranean mines exposes people to toxics gases, heat, and dirt, which could reason illness, damage, and dying. This paper affords a concept for a web of things wireless sensor community that could detect temperature, humidity, and gasoline in an underground mine the usage of an ARM controller. The Arduino UNO, Node MCU, DHT11 sensor, gas sensor, hearth sensor to hit upon hearth and send an alarm, and LDR to detect mild depending on light levels are all used in this gadget. Traditional coal mineshaft monitoring systems are frequently wired organisation systems that play an important role in ensuring coal mineshaft security.[3]

[4] It implement a safety system for coal mines and their workers in this study. Because of the dangers associated with coal mining, this method is required. For example, there is a risk of highly toxic gases being present in coal mines, and an increase in temperature inside the mine could be a serious concern, necessitating the implementation of a safety system for coal mine workers as well as to safeguard the mine's resources. It use a platform called Thing-Speak to develop such a system. Thing-Speak is a platform that displays data gathered from many sources. The source in this case is a Node-MCU, which provides inputs for connecting various sensors and will perform according to the specified code. The code was written in the Arduino IDE using the Embedded C programming language. Gas, humidity, temperature, fire, and light are all monitored by this system. This system uses Thing-Speak, MQTT, and Buzzers to warn the user in the event of any anomalies to the admin and workers.[4]

[5] Miners' safety is currently a big concern. Miners' health and lives are jeopardised by a number of serious challenges, including not just the working environment but also its consequences. The wireless sensor network totally coal mine protection tracking machine can exactly and immediately replicate the dynamic state of affairs of underground employees to the ground computer machine and mobile unit. Particulate count and gases which includes sulphur dioxide(SO2), nitrogen dioxide(NO2), and carbon monoxide(CO) are many of the pollutants launched with the aid of coal mines. Semiconductor gas sensors are used to monitor the concentration levels of hazardous gases.[5].
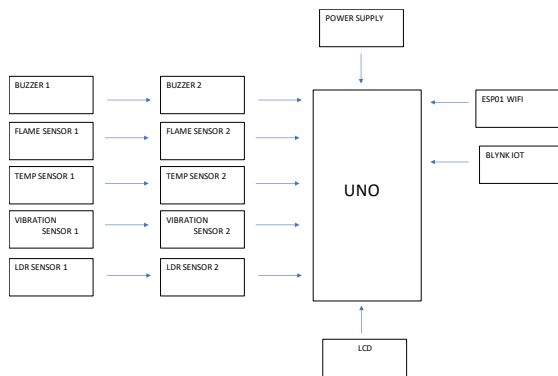
III. PROPOSAL SYSTEM

Figure 1 : Block Diagram of IOT Based Coal Mine Safety Monitoring and Alerting System

This unit is used to absorb the working environment at various locations in the mining industry. The block diagram shows, the consists of sensors and a display unit in Figure 1. The Arduino UNO absorbs the observed data and stores it in the cloud. An alarm message is issued to the control room if the mining parameters exceed the threshold level. If a hint of flame is found, the buzzer will sound to tell the miners. THD11(Temperature and Humidity sensor), MQ11(Flame sensor), gasoline sensor S. Sujitha et al, global journal of laptop technology and cellular computing, and LDR sensor make up the safety device, which monitors the mining unit's

bodily parameters, which can be tough wireless to forecast for human beings. The buzzer, lcd display, c084d04ddacadd4b97lae3d98fecfb2a module included.

Arduino UNO 3.1

Figure 2 : Uno Arduino

The Arduino UNO has a set of analogue and virtual pins that function enter and output points for connecting the boards to external components. Inboard, there are a total of fourteen I/O pins, six of that are analogue input pins. The board incorporates a USB port that can be used to hook up with a electricity supply.

3.2 Buzzer

Figure 3 : Buzzer

A buzzer is a speaking device that translates a sound signal from an audio model. It is mostly used to alert or prompt. It may produce a variety of sounds, including music, flute, buzzer, alarm, electric bell, and other noises, depending on the design and application.
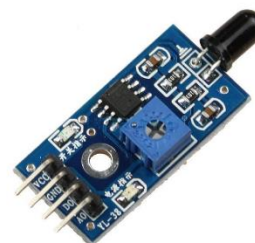
Flame sensor 3.3

Figure 4 : Flame detector

The Functioning of Flame Sensors and Their Applications. A flame sensor is a sensor this is maximum touchy to everyday light. This is why flame alarms rent this sensor module. This sensor detects flame while the light source emits among 760 and 1100nm.

Temperature sensor 3.3

Figure 5 : Temperature sensor

The Arduino temperature sensor transforms the ambient temperature to electricity. It also converts the voltage to Celsius, then to Fahrenheit, and displays the Fahrenheit temperature on the LCD panel. We'll utilise a low-voltage temperature sensor (TMP 36).

Vibration sensor (3.4)

Figure 6: Vibration sensor

The Vibration Sensor and Arduino are still connected in the same way. The Arduino's GND pin is connected to the GND pin of the Traffic LED module. The Arduino's pin number 11 is connected to the green LED. Now that our hardware is ready, let's look at example code number 3.

LDR sensor 3.5

Figure 7: LDR sensor

The LDR sensor module is a low-cost digital and analogue sensor module capable of measuring and detecting light intensity. The Photoresistor sensor is another name for this sensor. This sensor includes an LDR (Light Dependent Resistor) that aids in light detection.

3.6 ESP01 Wifi

Figure 8: ESP01 Wifi

To begin, it can use the command to see if it is already connected to one: This will show the IP address of our ESP-01 module's station. If the previous command does not return

an IP address, try the following command to connect to your network: To connect to your Wi-Fi network, type its name and password.

App Blynk 3.7

Figure 9 : Blynk app

Blynk is a popular IoT (internet of things) programme that lets you operate Tiny Circuits hardware, gather data from sensors, create unique visual dashboards, and save data to the Blynk cloud automatically. Another feature of Blynk is the ability to send push notifications or tweets when certain conditions are met. The project is built from easily available and reasonably priced components. Therefore, the cost is reasonable and maintenance is easy.
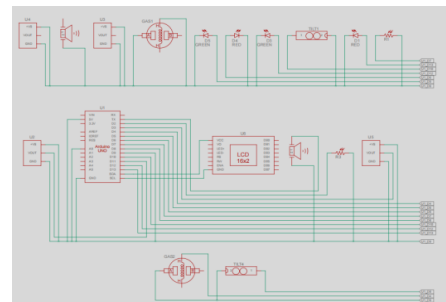
IV. DISCUSSION OF IMPLEMENTATION AND RESULT

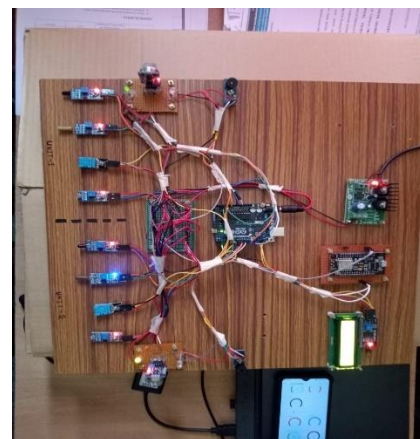Figure 10 : shows a circuit diagram.

Figure 11 : Finished Circuit

The physical traits of temperature and humidity, light depth value, and gas molecule attention are detected within the mining surroundings and saved on the cloud those outcomes may be plotted at the blynk net site or app, and that they may

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be stored for later exam. If there's any doubt, swift movement can be taken. Blynk is an open-supply net of gadgets utility and API for storing and retrieving data from matters over the net or via a local area community utilizing the HTTP and MQTT protocols. Blynk offers channels for storing statistics retrieved using IOT technologies. Every channel has eight information fields, 3 location fields, and one status field. The data is stored within the blynk channel as soon as it is allotted, and it can be stored for destiny have a look at.
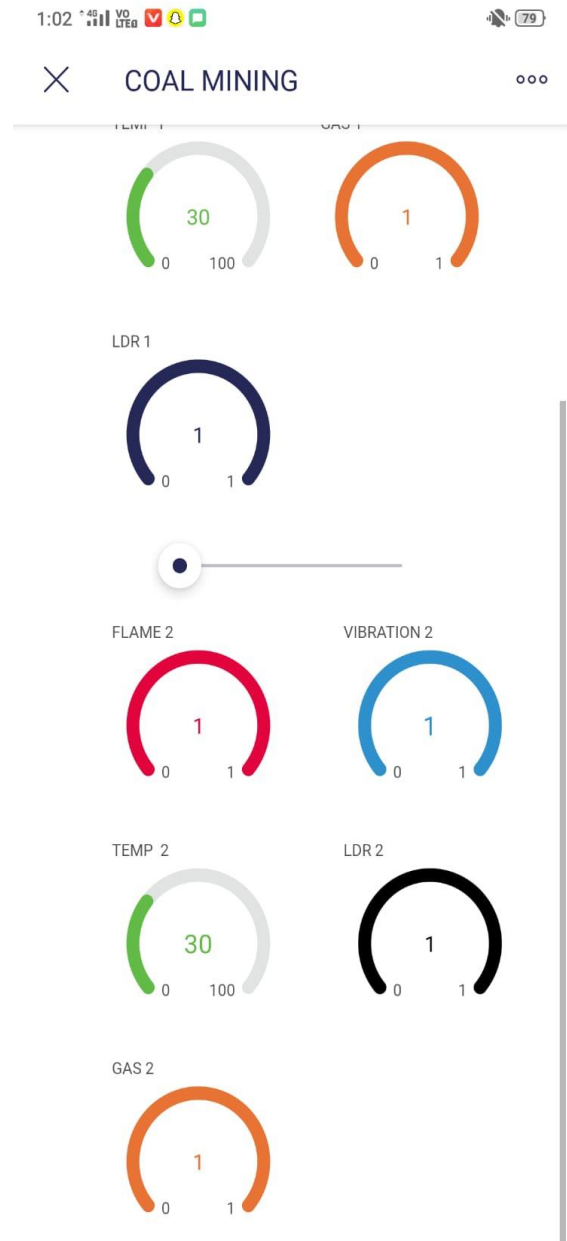

Figure 12 : Unit 1 output

Figure 13: Unit 2's Output

The outcomes of the coal mine safety system as seen through the Blynk app are shown in the figures above. In this programme, we can see two units, each with a set of sensors, with only one temperature in the range of 30,40, and so on, while the remaining data are all between 1 and 0. When the value is 1, there is no problem; however, when the value is 0, flames, falls, toxic fumes, and other hazards are recognised. When the value of the sensors reaches a certain threshold, an alarm message will be delivered to Blynk app users. It will supply the values displayed on the LCD display in each unit before sending the alarm message, as well as the buzzer sound for the alert message.
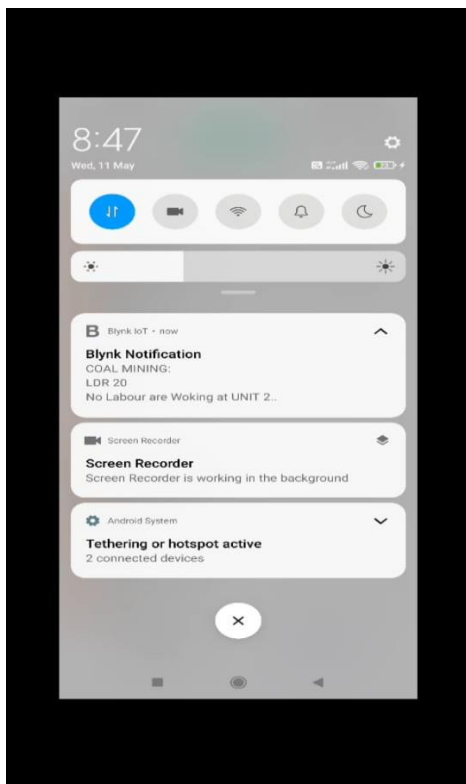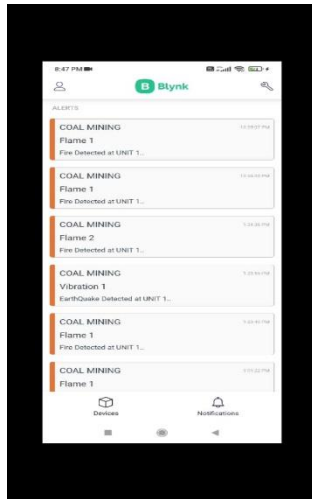
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Figure 14: The units' alert messages

V. CONCLUSION

The Arduino microcontroller is used to create a prototype for a mine safety system in this proposed method. This device is made from each hardware and software program factors. The hardware is made from several sensors, while the software program is made of an Android software that connects to the Arduino board and other hardware additives via the internet of things. The android-based totally programme consists of signals and a database in which readings from sensors are presented and inserted the usage of hardware. The use of the wireless community to growth mine safety is a solution for reaching each protection and development in mining initiatives. This look at objectives to automate the method of mining unit monitoring and handing over updates via cell networks. This gadgets hardware components talk with all the sensors. This project is used to optimise the utilisation of the mining subject without the intervention of human beings with the aid of using sensors that screen the environment and a microcontroller that switches on/off the buzzer routinely in the event of unstable condition maintaining mining operation these days necessitates ensuring the protection and well-being of employees and property. The employment of arduino, gasoline sensors, Temperature sensors, and humidity sensors inside sensors inside the improvement of coal mine security for employees maintains to screen mining protection and replace data at the IOT websites.

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