

Coal Mine Safety using IOT

Jyothsna Bhagirathi^{*1}, Vemisetty Harshitha², Thoudoju Akshayasree³

^{*1}Associate Professor, Department of Electronics and Communication Engineering, Bhoj Reddy Engineering College for Women, Hyderabad, India

^{2,3}U. G. Scholars, Department of Electronics and Communication Engineering, Bhoj Reddy Engineering College for Women, Hyderabad, India

ARTICLE INFO

Article History:

Accepted: 05 April 2023

Published: 28 April 2023

Publication Issue

Volume 10, Issue 2

March-April-2023

Page Number

696-702

ABSTRACT

Today, safety of miners is a major challenge. Miner's health and life is vulnerable to several critical issues, which includes not only the working environment, but also the after effect of it. To increase the productivity and reduce the cost of mining along with consideration of the safety of workers, an innovative approach is required. Coal mine safety monitoring system based on wireless sensor network can timely and accurately reflect dynamic situation of staff in the underground regions to ground computer system and mobile unit. The air pollution from coal mines is mainly due to emissions of particulate matter and gases include Sulphur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO) etc. To monitor the concentration level of harmful gases, semiconductor gas sensors are used. Due to any reason miners falls down and lose consciousness also proper treatment is not provided them at that time, so number of miners is died. To overcome this problem the system, provide emergency alert to the supervisor if person fall down by any reason. Such that we have designed a protection system for the coalminers to figure out solution considering problems facing in coalmine.

Keywords :- Arduino Uno, power supply, Wi-Fi module, DHT11(Digital Humidity and Temperature) sensor, MQ2 gas sensor, LCD (Liquid Crystal Display) and alarm.

I. INTRODUCTION

Mines are the world's most dangerous and risky place to work because in the mines, explosion often happens and thousand people are dying. Thus, a recent report state that in such mine accidents an average of around 12,000 people have died. Coal is a non-sustainable origin that can't be widely replaced by humans, there are several mishaps of coalmines occurring in the mines, and the diggers are putting their lives at risk, by

working in the coal mines, even once in a while they end up losing their lives in the coal mines that are an unfortunate part. Mainly such mishaps happen as a direct result of the old equipment and wired devices, resulting in the end, mishandling, spillage of the noxious gases in the coal mines, pose tremendous hazards to the excavators inside the coal mines. Deeper the mine there is rise of risk. These safety issues are of last resting place especially in coal industries.

Utilization of heavy machinery and the methods implemented reveals safety risk in mining.

Latest mines often accomplish several safety measures, acquiring knowledge in workers at training about health and safety standards leads to viable changes as well as improvement in both opencast and underground mining. One of the primary resources of energy in India is coal, it plays a major role in rapid industrial development of a country. As 70% of power generation is dependent on coal thus, the importance of coal in energy sector is crucial. We tackled the issues in our research by testing each of the information collected by the sensors, we use and finishing the analysis using the Thingy system. Controlling can be done automatically or manually.

II. LITERATURE SURVEY

In underground mining, ventilation systems play vital role to supply sufficient oxygen, maintaining non-explosive and non-toxic atmospheres and operating a systematic mine. Mine ventilation system can help to get rid of high risky atmosphere. Primitive techniques to monitor the mining atmosphere can be outlined back to the use of canaries and other animals to awake miners, when the atmosphere becomes toxic. Integrating ventilation monitoring system enables mine to intelligently make ventilation changes based on the vast data, the monitoring system supply.

Unanticipated substitute in the ventilation system is noticed by the monitoring arrangement, letting prompt action to be considered. In underground mine, ventilation systems are condemnatory to supply adequate oxygen, keeping up nondangerous and non-lethal environments and an efficacious working mine.

To scan an underground mine, can aid killing high hazard environments. Primitive strategy of monitoring a mine's air can be ensue back to the utilization of

canaries and distinct creatures to ready diggers when the climate gets to be fatal.

- 1) "Toxic Environment Monitoring Using Sensors Based on Arduino," by R. Rajalakshmi and J. Vidhya (2019): This paper proposes a system to monitor toxic gases in unsafe environments for safety purposes, using Wi-Fi. The system uses sensors to detect harmful gases such as Carbon Monoxide, Methane, Hydrogen, and Flammable gases. If the level of these gases goes beyond a certain limit, the system will send an alert message to the user using GSM technology.
- 2) "Design of coal mining safety monitoring and alerting system based on IOT" by Dr. R. Bhuvaneswari, Richard Roy, Leo Deepak J, Sanjay Kumar. S (2021): A system is being built using a platform called Thing Speak to display data collected from sensors connected to a NodeMcu. The NodeMcu is programmed using the Arduino IDE and Embedded C language to monitor gas, humidity, temperature, fire, and light. If there are any problems detected, the system will send alerts to the user, admin, and workers using Thing Speak, MQTT, and buzzers.
- 3) "Iot based Underground Coalmine Safety System" by Mr. B. Vinodh kumar, Ms. B. Jayasree and MS. D. Kiruthika (2020): This project stores data collected by sensors to detect hazards and analyse the health of mine workers. They have shown real-time plots of each sensor on a PC or mobile using the Thing Speak application installed on the monitor unit. This application was user friendly and requires only the channel ID to display the plots with date and time information.

III. PROPOSED SYSTEM

In any type of industry safety plays a significant role. In the coalmines the fundamental aspect is safety and security, and these play a vital role. To avoid accidents that occur in coalmines they follow some basic precautions. Even though accidents occur in mining

places due to the change in temperature, humidity and due to leakage of some harmful gases. Here we provide safety to worker.

When a worker is in danger by the leakage of gases then automatically the alarm gives the alert sound to the workers over there and through webpage higher authorities can receive information to secure their lives and save them from any fire accidents by which speculative gases are diffused into the environment underground and changes in temperature and humidity takes place.

Block diagram

The block diagram consists of many components. They are Arduino Uno, power supply, Wi-Fi module, DHT11(Digital Humidity and Temperature) sensor, MQ2 gas sensor, LCD (Liquid Crystal Display) and alarm. Both DHT11 and MQ2 gas sensors are acts as input and sends information to Arduino Uno. ESP8266 Wi-Fi module sends data to webpage. Alarm and LCD are output devices. Alarm gives alert sound whereas, on LCD we can observe the output.

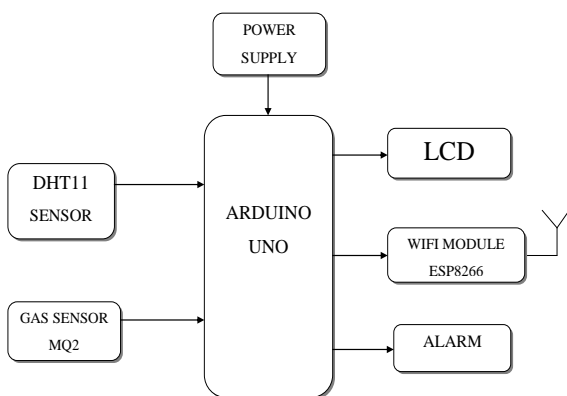


Fig.1.Block diagram of Coalmine safety using IOT

Arduino Uno consists of ATmega328P microcontroller which is used to execute commands and decisions based on the code. Power supply is used to give power to all devices. DHT11 and MQ2 gas sensors will sense the changes in the environment and acts like an input device to Arduino Uno and sends information to it. Then micro controller and Wi-Fi module interface with each other and sends information to alarm,

webpage, and LCD. After receiving information from Arduino, the alarm alert workers from a threatening situation such as gas leakage by making sound. The change in temperature, humidity and gas cleared/ detected will be displayed on LCD.

A. GAS DETECTION

Usage of MQ2 Sensor takes place for coal mine safety system which is highly sensitive to the harmful gases like Propane, LPG and Hydrogen, also could be used to detect Methane and other combustibile steam. This sensor has compact design and easily mountable and has features like long life and low cost. It is very useful to maintain the environmental standards and also air quality.

This sensor is connected to an Arduino board which is programmed to analyse the information provided by the sensors. This is done through a code that is written to interpret and manipulate the data obtained from the sensors, in order to generate useful outputs or perform specific actions.

B. HUMIDITY AND TEMPERATURE DETECTION

We use DHT11 which is Digital Humidity and Temperature Sensor. This device uses advanced technology to collect digital signals and measure humidity and temperature. It is very reliable and stable. The DHT11 is a small device that doesn't use a lot of energy and can send information over long distances. This makes it perfect for use in tough environments.

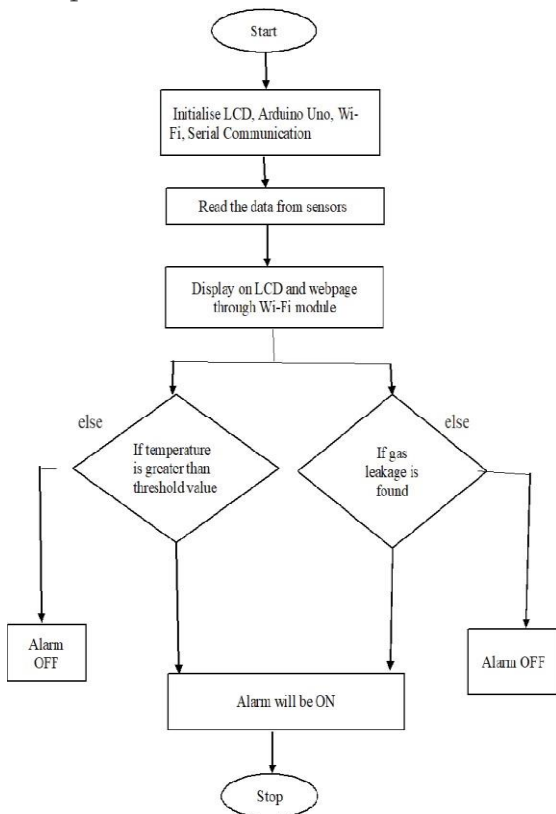
This sensor is attached to a microcontroller called an Arduino board. The Arduino is programmed with a special code that can read the information from the sensor and use it to do something useful, like making a sound. After collecting data, the Arduino board compares it to pre-set values to see if the temperature or humidity has increased too much. If the values are too high, the Arduino will say that the environment is not good to the higher authorities via LCD and webpage.

C. ALERTING SYSTEM

After the gas or temperature and humidity levels crosses their threshold level then the alarm which is connected to Arduino Uno is turned on and blows sound and also displayed on webpage via Wi-fi module by these they can save the lives of people working hard in underground.

IV. IMPLEMENTATION

Start the code by initializing LCD, Arduino Uno, Wi-Fi module, Serial Communication. Then read the data from sensors. Now display on LCD and webpage through Wi-Fi module. If the temperature value is greater than the threshold value and if gas is leaked, then the alarm will be ON else the alarm will be in OFF position.



The workflow of the proposed system is explained in this section.

Step1: Start

Step2: The entire system starts up when the power is turned on.

Step3: Coalmine safety kit retrieves information from two sensors. They are MQ2 gas sensor and DHT11 (Digital Humidity and Temperature sensor) which are used to determine whether harmful gases were in coalmine and to measure temperature and humidity levels respectively.

Step4: The data is being constantly sent without any pauses to the LCD and webpage through wifi module

Step5: In this level two conditions are being checked one is with respect to gas detection and other with respect to temperature and humidity levels. If the conditions satisfied one operation performed else other operation is done.

Step6: If the temperature goes above a certain limit or if there is a gas leakage, then alarm will sound else it will be in off position. **Step7:** Stop

Overall, the proposed methodology consists of combination of sensor technology and Wi-Fi module to ensure quick responses and actions to be taken at hazardous situations in coalmine to save their lives. The flow chart detailing the various steps involved in the methodology is shown in Figure.

V. SOFTWARE DETAILS

Arduino IDE development platform is used for coal mine safety system which ensures the communication between the Arduino Uno which is a hardware component it is paired with software with the help of USB connection and then the whole programs are uploaded and the changes reflected with respect to the sensors is updated regularly.

VI. HARDWARE DETAILS

To carry out the coal mine safety device several hardware components were used and they are Arduino Uno, DHT11 sensor, MQ2 gas sensor, Wi-fi module, LCD and an alarm where Arduino Uno is heart to the system without which there is no communication with the Arduino IDE and also used for processing the sensor data and blows alarm and displays it on a LCD

when gas is detected or raise in temperature and humidity levels than their threshold values.

The sensors are used to sense the surrounding environment like harmful gases and temperature and humidity changes and collects it and sends to Arduino Uno. The Wi-fi module also collects the data and presents it on a webpage which can be accessed by higher authorities for observation of the weather conditions and to take up a quick action to protect them.

VII. RESULTS

The result of the project includes:

1. Sensing the emission of harmful gases.
2. Monitoring conditions like temperature and humidity.
3. Transmission of data using ESP 8266 WiFi module.

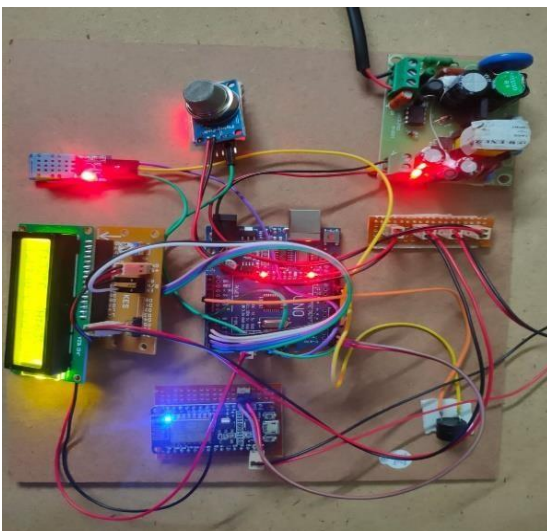
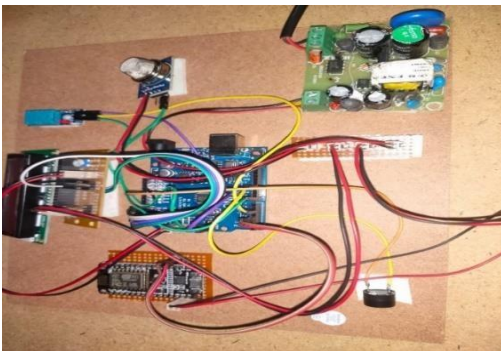


Fig.3. Hardware of IOT Coal Mine Safety

If there are any changes in temperature and humidity levels, directly the data will be displayed in the LCD shows the values of both temperature and humidity.



Fig.4. Output on LCD when gas is detected

Simultaneously, the buzzer alarm will blow automatically when the gas is detected and alerts the workers in coal mine system.



Fig.5. Output on LCD when gas is cleared

If there is any change in temperature, humidity and if gas detected then automatically there will be change in webpage by these higher authorities will get updated and knows the situation inside the coal mine and can take immediate action to save the lives of people working underground for extracting coal which is very toughest work to do.



Fig.6.Output displayed on Webpage

VIII. CONCLUSION

To provide safety to the workers in coal mines, a real time monitoring system is developed and to provide a reputable communication using ESP 8266 Wi-Fi Module to the coal miners.

This system consists of various sensors to monitor the safety while operating in coal mines. This system consists of devices that monitor the conditions such as temperature, humidity, light, fire, and gas inside the coalmine and alerts the user. It also has applications to view the readings remotely. This system is wireless hence it has the advantages that wireless systems have such as being economically feasible and having low maintenance. The development of coal mining protection for employees using Arduino, Gas Sensor, Temperature and Humidity Sensor (DHT11) continues to track the safety of mining and update information to the IoT site. By using this tool, we guarantee the safety of workers.

IX. FUTURE ASPECTS:

The IoT based Coal mine safety system is a encouraging solution to ensure workers safety in the

mining field. The future scope of the system is replacement of Wi-Fi Module with Global System for Mobile Communication (GSM) for longer distances. GSM was developed using digital technology. It has an ability to carry 64 kbps to 120 Mbps of data rates. Presently GSM supports more than one billion mobile subscribers in more than 210 countries throughout the world. GSM provides basic to advanced voice and data services including roaming service. This can also be enhanced by replacing with ZigBee (Zonal Intercommunication Global-standard) which collects the data from multiple nodes. It uses much less energy than Wi-Fi. The battery life of your devices will therefore be much longer on Zigbee than on Wi-Fi. Overall, with the replacement of modules, this system can boost up the workers working in the coal mines.

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Cite this article as :

Jyothisna Bhagirathi, Vemisetty Harshitha, Thoudoju Akshayasree, "Coal Mine Safety using IOT", International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Online ISSN : 2394-4099, Print ISSN : 2395-1990, Volume 10 Issue 2, pp. 696-702, March-April 2023.
Journal URL : <https://ijsrset.com/IJSRSET23102111>