COAL MINE SAFETY MONITERING

AND ALERTING SYSTEM

FINAL REPORT

TEAM MEMBERS:

22BCE20122- G.Tejaswi 22BCE8252- Dinesh 22BCE8613- Harsha Relangi 22BCE8992- P.Abhiram Reddy 22BCE9181- K. Manikanta 22BCE9266- Y. Samyuktha

FACULTY GUIDE: PROF.YADA NANDUKUMAR

DEPARTMENT: DEPARTMENT OF MATHEMATICS

PROBLEM STATEMENT: Safety is a paramount concern in coal mining operations due to the inherent risks associated with working in underground and open-pit environments.

IDENTIFICATION OF PROBLEM:

Safety is a paramount concern in coal mining operations due to the inherent risks associated with working in underground and open-pit environments. Traditional coal mine monitoring systems tend to be wired network systems, which play an important role in coal mine safe production. Inhalation of harmful gases at high temperatures may lead to worse breathing problems and more.

This system ensures the safety of mine workers by providing real-time data and wireless notifications to both miners and mine management, enabling swift response to potential dangers and improving overall safety measures.

EXISTING SYSTEMS:

Manual Methane Monitoring:

Existing System: Methane levels in mines are often monitored manually by trained personnel who take periodic readings using handheld devices.

Drawbacks:

Delayed Response: Manual monitoring is not continuous and can lead to delayed detection of dangerous methane levels.

Risk to Personnel: Manual monitoring exposes workers to potentially hazardous conditions

Temperature and Humidity Measurement:

Existing System: Some mines use traditional instruments to measure temperature and humidity at certain intervals.

Drawbacks:

Limited Coverage: These measurements provide only periodic and localized data, potentially missing critical changes in environmental conditions.

Lack of Real-time Monitoring: The existing system does not offer real-time monitoring and alerts for sudden temperature or humidity variations.

Water Presence Detection:

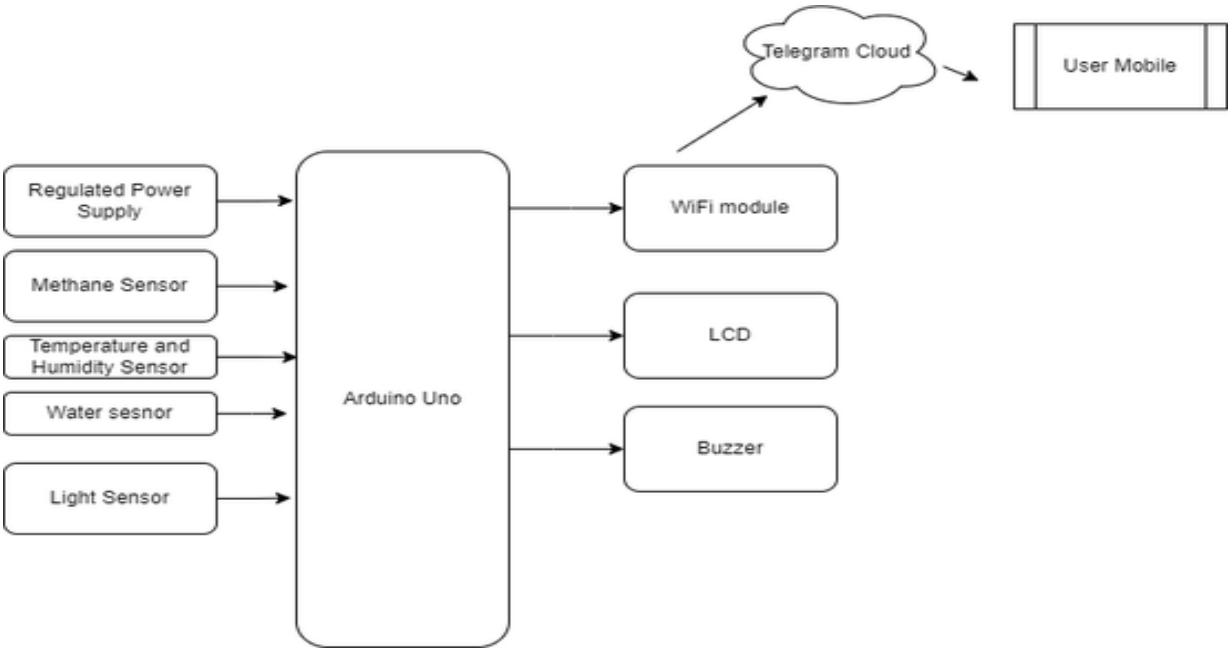
Existing System: Detection of water presence is often reliant on visual inspection and manual reporting by miners.

Drawbacks:

Delayed Identification: Water presence may not be detected until it becomes a significant issue, leading to delays in response.

Inadequate Coverage: Visual inspections may not cover all areas of the mine, leaving some locations vulnerable to flooding.

PROPOSED SYSTEM BLOCK DIAGRAM:



KEY FEATURES OF PROPOSED SYSTEM:

Methane Gas Monitoring: Continuous monitoring of methane gas levels in the mine atmosphere to prevent explosions and ensure miner safety.

Temperature and Humidity Sensors: Real-time monitoring of temperature and humidity levels within the mine for improved working conditions and safety.

Water Presence Detection: Detection of water presence in critical areas to prevent flooding and equipment damage.

Wireless Connectivity: Utilization of IoT technology to transmit sensor data wirelessly to a central monitoring station or cloud-based platform.

Real-time Data Monitoring: Continuous monitoring of sensor data to enable immediate response to changing conditions.

Alert and Notification System: Automatic triggering of alerts and notifications via SMS, email, or mobile apps when predefined safety thresholds are exceeded.

HARDWARE TOOLS:

1.Arduino Uno2. Methane Sensor3. Temperature And humidity sensor

4.Water sensor5. Light Sensor6. vibration sensor

7.Regulated Power Supply8.LED OR LCD9. Buzzer

10. Wi–fi module11.PCB12. Connecting wires

SOFTWARE TOOLS:

Arduino IDE hardware tools:

Arduino IDE (coding website) Arduino–C programming language

Firebase Cloud (used for building a new mobile app)

Mobile App

TIME LINE:

Work	**Time**
Identify and buying components	1 week
Circuit Interfacing	2 weeks
Programming	2 weeks
Testing	1.5 week

*Total its takes 60–65 days to complete the Project

BUDGET ESTIMATION:

1) Arduino Uno	**650**
2) Methane Sensor	**200**
3) DHT11	**120**
4) LDR	**50**
5) Water Sensor	**50**
6)Regulated Power Supply.	**250**
7)Wi-Fi module	**320**
8) Buzzer	**30**
9) PCB	**100**
10)Connecting wires	**100**
Total: 1780	

CONCLUSION:

The IoT-Based Coal Mine Safety Monitoring System is a comprehensive and proactive solution that significantly improves safety measures in coal mines and other industrial settings. It demonstrates a commitment to safety compliance, worker welfare, and the well-being of individuals working in potentially hazardous environments. This system represents a critical step toward safer and more of secure coal mining operations while embracing the benefits of cutting-edge IoT technology.

REFERENCES:

www.wikipedia.com

S.Sujitha; Dr. J. B. Shajilin Loret; Mrs. D. Merlin Gethsy "IOT based smart mine safety system using Arduino" –May-2020.

Prof. A. H. Ansari, Karishma Shaikh, Pooja Kadu, and Nikam Rishikesh, "IOT Based Coal Mine Safety Monitoring and Alerting System"-2021

Abstract:

This project proposes a design and development of a IoT system with the help of Arduino microcontroller board which is able to monitor the temperature,humidity,methene, CO and smoke in an underground mine. This system utilizes low power, cost effective Arduino Uno, DHT11 sensor, smoke detector, gas sensor for sensing the mine climate parameters and Wi-Fi for remote logging of data at central location. Traditional coal mine monitoring systems tend to be wired network systems, which play an important role in coal mine safe production. With continuous enlarging of exploiting areas and extension of depth in coal mine, many laneways become blind areas, where in there are lots of hidden dangers. Moreover, it is inconvenient to lay cables which are expensive and consume time. In order to solve the problems, we will design a coal mine safety monitoring system based on IOT, which can improve the level of monitoring production safety and reduce accident in the coal mines Wireless sensor network is composed of a large number of micro-sensor nodes which have small volume and low cost.

Motivation and contribution:

A Coal mine safety monitoring system is developed to provide clearer and more point-to-point perspective of the underground mine. This system is displaying the parameters on the LCD at the underground section where sensor unit is installed as well as on the monitoring unit; it will be helpful to all miners present inside the mine to save their life before any casualty occurs. Alarm triggers when sensor values cross the threshold level. Implementation of Coal mine safety system is implemented using Gas sensors and temperature, humidity to increase the safety of the workers in the coal mine and to prevent them from danger, by using this system constant checking of the coalmine and alerting the worker is done. The system is cost-effective and efficient.

Features Of Coal Mine Safety and monitoring system:

Methane Gas Monitoring: Continuous monitoring of methane gas levels in the mine atmosphere to prevent explosions and ensure miner safety.

Temperature and Humidity Sensors: Real-time monitoring of temperature and humidity levels within the mine for improved working conditions and safety.

Water Presence Detection: Detection of water presence in critical areas to prevent flooding and equipment damage.

Wireless Connectivity: Utilization of IoT technology to transmit sensor data wirelessly to a central monitoring station or cloud-based platform.

Real-time Data Monitoring: Continuous monitoring of sensor data to enable immediate response to changing conditions.

Alert and Notification System: Automatic triggering of alerts and notifications via SMS, email, or mobile apps when predefined safety thresholds are exceeded.

Description of the Components Used:

HARDWARE TOOLS:

1. **Arduino Uno:** the Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer

with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

1.

1. **Methane Sensor:**

Features of MQ-2 Gas Sensor:

Operating Voltage is +5V

Can be used to Measure or detect LPG, Alcohol, Propane, Hydrogen, CO and even methane Analog output voltage: 0V to 5V

Digital Output Voltage: 0V or 5V (TTL Logic) Preheat duration 20 seconds

Can be used as a Digital or analog sensor

The Sensitivity of Digital pin can be varied using the potentiometer

1.

1. Gas Sensor for Air Quality**:** MQ-135 Sensor Features

Wide detecting scope

Fast response and High sensitivity Stable and long life

Operating Voltage is +5V

Detect/Measure NH3, NOx, alcohol, Benzene, smoke, CO2, etc. Analog output voltage: 0V to 5V

Digital output voltage: 0V or 5V (TTL Logic) Preheat duration 20 seconds

Can be used as a Digital or analog sensor

The Sensitivity of Digital pin can be varied using the potentiometer.

1. **Gas Sensors:**

MQ7 is a Carbon Monoxide (CO) sensor, suitable for sensing Carbon Monoxide

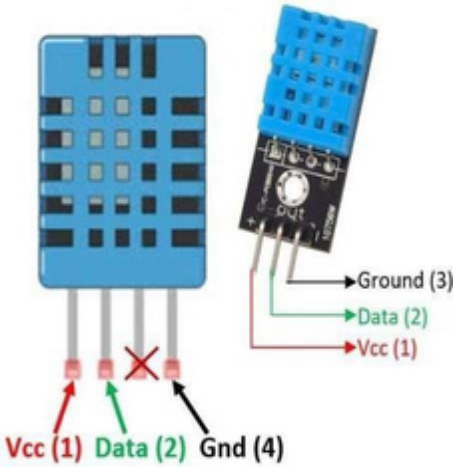
concentrations(PPM) in the air. MQ7 Gas sensor can measure CO concentrations ranging from 20 to 2000 ppm. This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance.This sensor comes in a package similar to MQ3 alcohol sensor. MQ7 gas sensor has high sensitivity to Carbon Monoxide. The sensor could be used to detect different gases

contains CO, it is with low cost and suitable for different application. They are used in gas detecting equipment for carbon monoxide(CO) in family and industry or car.

High sensitivity to carbon monoxide Stable, long life and low cost

Good sensitivity to Combustible gas in wide range High sensitivity to Natural gas 5.**DHT11–**

Temperature and Humidity Sensor



Specifications:

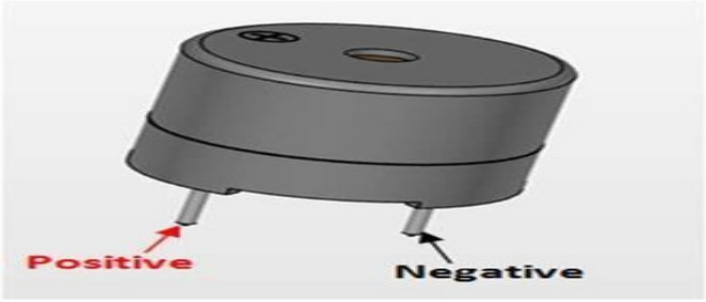
Operating Voltage: 3.5V to 5.5V

Operating current: 0.3mA (measuring) 60uA (standby) Output: Serial data

Temperature Range: 0°C to 50°C Humidity Range: 20% to 90%

Resolution: Temperature and Humidity both are 16-bit Accuracy: ±1°C and ±1%

6.Buzzer Pin



Buzzer Features and Specifications

Rated Voltage: 6V DC

Operating Voltage: 4–8V DC Rated current: <30mA

Sound Type: Continuous Beep

Resonant Frequency: ~2300 Hz Small and neat sealed package

Breadboard and Perf board friendly

SOFTWARE TOOLS:

Arduino IDE hardware tools:

Arduino IDE (coding website)

Arduino–C programming language

Firebase Cloud (used for building a new mobile app) Mobile App

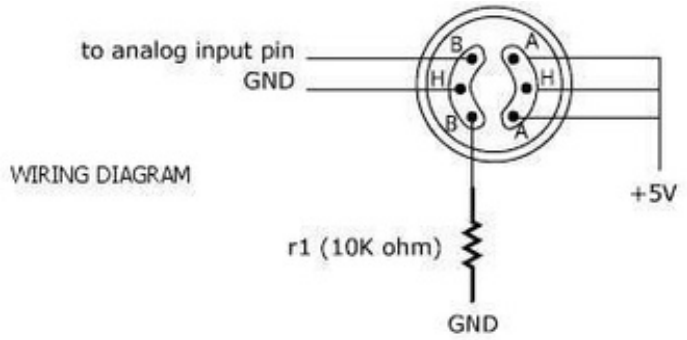
5. Methodology

How to use MQ–2 Sensors to detect gas:

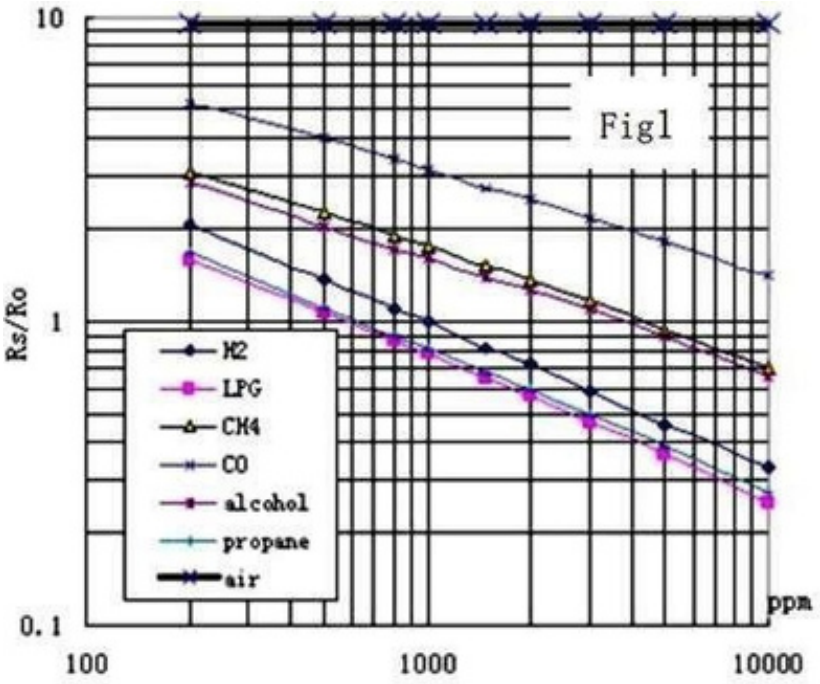
Using an MQ sensor it detects a gas is very easy. You can either use the digital pin or the analog pin to accomplish this. Simply power the module with 5V and you should notice the power LED on the module to glow and when no gas it detected the output LED will remain turned off meaning the digital output pin will be 0V. Remember that these sensors have to be kept on for pre–heating time (mentioned in features above) before you can actually work with it. Now, introduce the sensor to the gas you want to detect and you should see the output LED to go high along with the digital pin, if not use the potentiometer until the output gets high. Now every time your sensor gets introduced to this gas at this particular concentration the digital pin will go high (5V) else will remain low (0V). You can also use the analog pin to achieve the same thing. Read the analog values (0–5V) using a microcontroller, this value will be directly proportional to the concentration of the gas to which the sensor detects. You can experiment with this values and check how the sensor reacts to different concentration of gas and develop your program accordingly.

How to use the MQ–2 sensor to measure PPM:

If you are looking for some accuracy with your readings then measuring the PPM would be the best way to go with it. It can also help you to distinguish one gas from another. So to measure PPM you can directly use a module. A basic wiring for the sensor from datasheet is shown below.



The procedure to measure PPM using MQ sensor is the same but few constant values will vary based on the type of MQ sensor used. Basically, we need to look into the (Rs/Ro) VS PPM graph given in the datasheet (also shown below).



The value of Ro is the value of resistance in fresh air and the value of Rs is the value of resistance in Gas concentration. First, you should calibrate the sensor by finding the values of Ro in fresh air and then use that value to find Rs using the formulae

Resistance of sensor(Rs): Rs=(Vc/VRL-1)×RL

Once we calculate Rs and Ro we can find the ratio and then use the graph shown above we can calculate the equivalent value of PPM for that particular gas.

Selecting between sensor and module

When it comes to measuring or detecting a particular Gas the MQ series Gas sensors are the most inexpensive and commonly used ones. **MQ135** is available as a module or as just the sensor alone. If you are trying to only detect (not measuring PPM) the presence of a gas then you can buy it as a module since it comes with an op-amp comparator and a digital output pin. But if you planning to measure the PPM of a gas it is recommend buying the sensor alone without module.

Where to use MQ-135 Gas sensor

The MQ-135 Gas sensors are used in air quality control equipments and are suitable for detecting or measuring of NH3, NOx, Alcohol, Benzene, Smoke, CO2. The MQ-135 sensor module comes with a Digital Pin which makes this sensor to operate even without a microcontroller and that comes in handy when you are only trying to detect one particular gas. If you need to measure the gases in PPM the analog pin need to be used. The analog pin is TTL driven and works on 5V and so can be used with most common microcontrollers.

If you are looking for a sensor to detect or measure common air quality gases such as CO2, Smoke, NH3, NOx, Alcohol, Benzene then this sensor might be the right choice for you.

How to use MQ-135 Sensors to detect gases

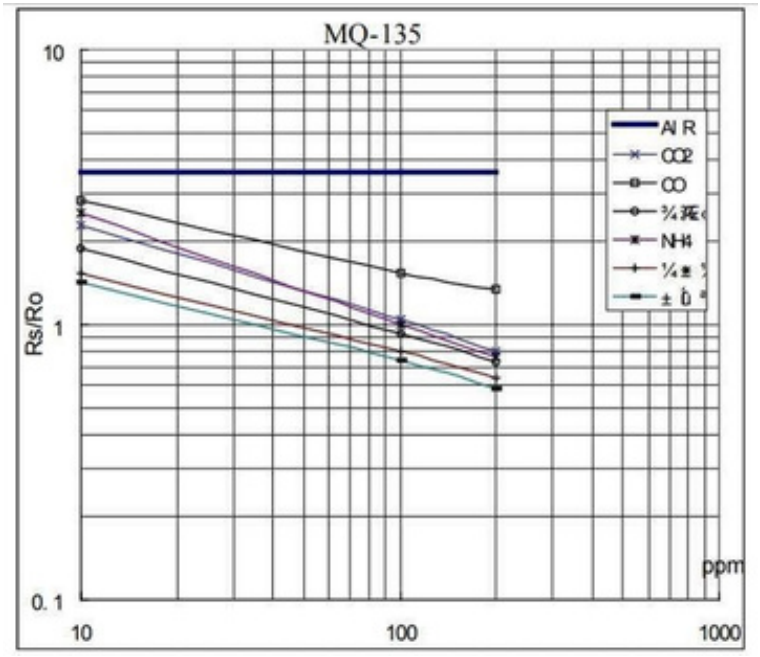
You can either use the digital pin or the analog pin to do this. Simply power the module with 5V and you should notice the power LED on the module to glow and when no gas it detected the output LED will remain turned off meaning the digital output pin will be 0V. Remember that these sensors have to be kept on for pre-heating time (mentioned in features above) before you can actually work with it. Now, introduce the sensor to the gas you want to detect and you should see the output LED to go high along with the digital pin, if not use the potentiometer until the output gets high. Now every time your sensor gets introduced to this gas at this particular concentration the digital pin will go high (5V) else will remain low (0V).

You can also use the analog pin to achieve the same thing. Read the analog values (0-5V) using a microcontroller, this value will be directly proportional to the concentration of the gas to which the sensor detects. You can experiment with this values and check how the sensor reacts to different concentration of gas and develop your program accordingly.

How to use MQ-135 sensor to measure PPM

MQ-135 gas sensor applies SnO2 which has a higher resistance in the clear air as a gas-sensing material. When there is an increase in polluting gases, the resistance of the gas sensor decreases

along with that. To measure PPM using MQ-135 sensor we need to look into the (Rs/Ro) v/s PPM graph taken from the MQ135 datasheet.



The above figure shows shows the typical sensitivity characteristics of the MQ-135 for several gases. in their: Temp: 20, Humidity: 65%, 02 concentration 21%, RL=20kΩ, Ro: sensor resistance at 100ppm of NH3 in the clean air.

Rs:sensor resistance at various concentrations of gases.

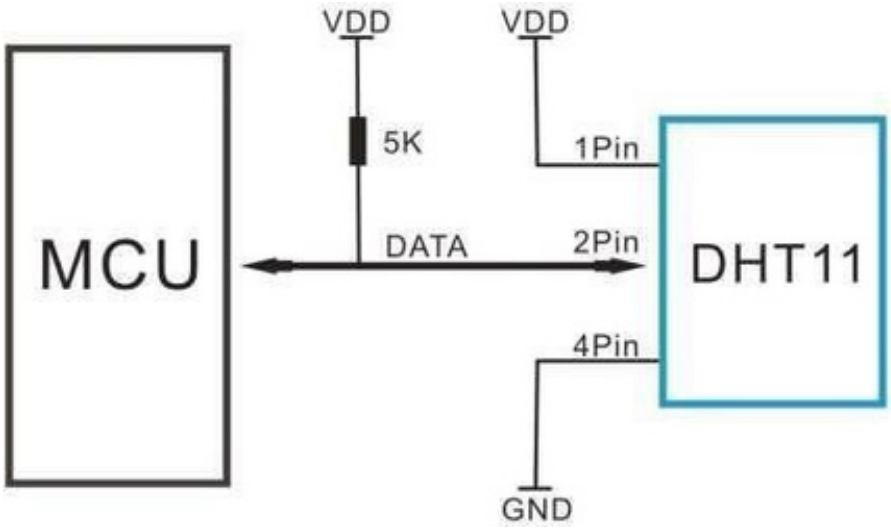
The value of Ro is the value of resistance in fresh air (or the air with we are comparing) and the value of Rs is the value of resistance in Gas concentration. First you should calibrate the sensor by finding the values of Ro in fresh air and then use that value to find Rs using the below formula:

Resistance of sensor(Rs): Rs=(Vc/VRL-1)×RL

Once we calculate Rs and Ro we can find the ratio and then using the graph shown above we can calculate the equivalent value of PPM for that particular gas.

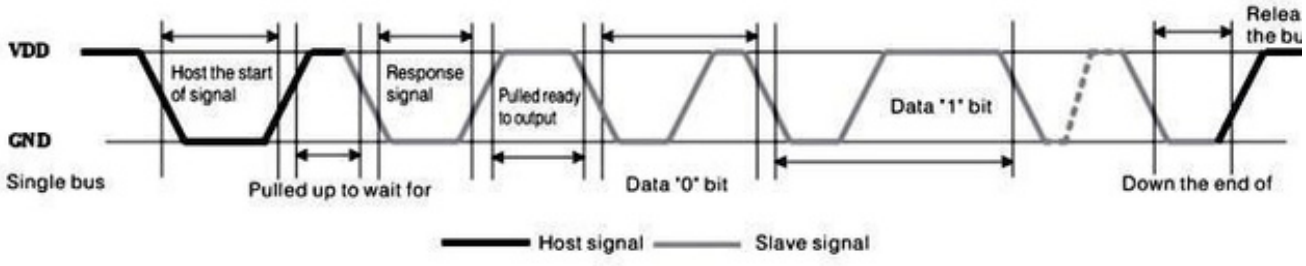
How to use DHT11 Sensor:

The DHT11 Sensor is factory calibrated and outputs serial data and hence it is highly easy to set it up. The connection diagram for this sensor is shown below.



As you can see the data pin is connected to an I/O pin of the MCU and a 5K pull-up resistor is used. This data pin outputs the value of both temperature and humidity as serial data. If you are trying to interface DHT11 with Arduino then there are ready-made libraries for it which will give you a quick start.

If you are trying to interface it with some other MCU then the datasheet given below will come in handy. The output given out by the data pin will be in the order of 8bit humidity integer data + 8bit the Humidity decimal data +8 bit temperature integer data + 8bit fractional temperature data +8 bit parity bit. To request the DHT11 module to send these data the I/O pin has to be momentarily made low and then held high as shown in the timing diagram below



The duration of each host signal is explained in the DHT11 datasheet, with neat steps and illustrative timing diagrams.

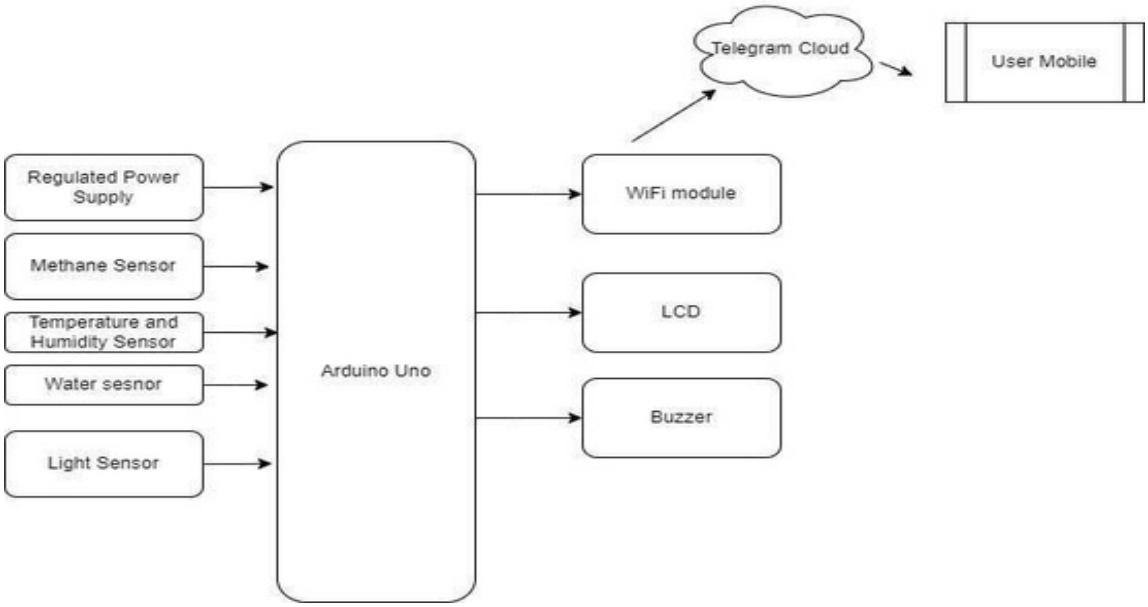
PROPOSED SYSTEM BLOCK DIAGRAM:

In this proposed system the coal mine safety systems are fixed with gas sensor modules, temperature sensor and humidity sensor. We integrate all the sensors to the Arduino MCU.First we need to create an account in the Things speak platform. In this system we mainly have

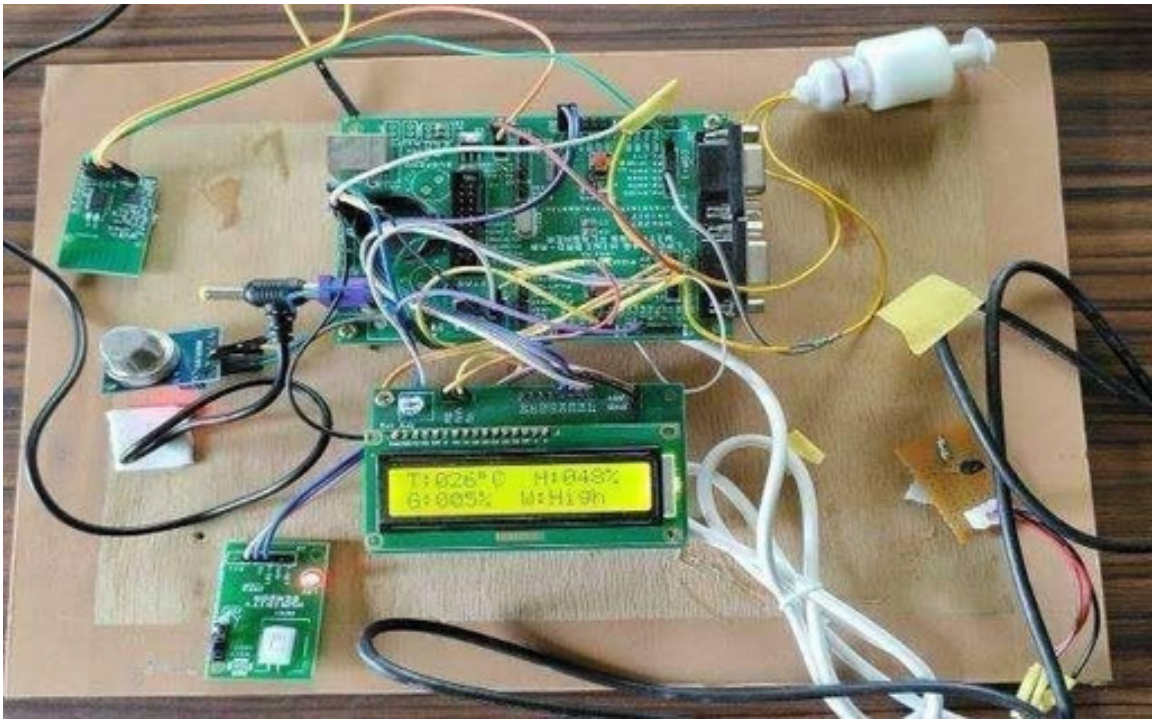
monitoring and controlling systems. In monitoring system, we monitor all the data from different

sensors. Gas sensor detects the gas in the coal mine environment. If the gas level exceeds the normal level, then the buzzer gets high so that the mine workers get notified.

These sensor values are continuously uploaded to the cloud (Thinger.io) for analysis and also for further use. The temperature and humidity values are also monitored inside the coalmine. If in case any fire accidents occur, then immediately fire alert messages are sent to the authorized persons. The proposed system block diagram



PROTOTYPE:



REFERENCES:

www.wikipedia.com

S.Sujitha; Dr. J. B. Shajilin Loret; Mrs. D. Merlin Gethsy "IOT based smart mine safety system using Arduino" –May-2020.

Prof. A. H. Ansari, Karishma Shaikh, Pooja Kadu, and Nikam Rishikesh, "IOT Based Coal Mine Safety Monitoring and Alerting System"-2021

Maheswaran U, Bhuvaneeshwaran V, Hemanathan M, Jawahar K Mar-2019 – "controlling"

Dr. R. Bhuvaneswari's "Design of coal mining safety monitoring and warning system based on IoT" is due in 2021.

J

ABSTRACT

Coal mining is the process of extracting coal from the ground. Steel and cement industries use coal as a fuel for extraction of iron from iron ore and for cement production. Underground mining industry comes to the category, where each and every parameter such as methane gas, high temperature, fire accidents and so on has to be monitored regularly. Safe production level of coal mine is still low, disasters in coal mine occur frequently, which lead to great loss of possession and life.

The disasters happening in coal mine are due to the complexity of mine environment and the variety of work carried out in coal mine, so it is very necessary to monitor the working environment of coal mine. Safety in coal mines is of paramount importance due to the potentially hazardous environment characterized by methane gas, varying temperatures, humidity levels, and the presence of water.

The IoT-Based Coal Mine Safety Monitoring System addresses these concerns by utilizing a network of sensors to continuously monitor methane levels, temperature, humidity, and water presence within the mine. This system ensures the safety of mine workers by providing real-time data and wireless notifications to both miners and mine management, enabling swift response to potential dangers and improving overall safety measures.

INTRODUCTION

IoT is nothing but the devices communicating with each other by using the internet. IoT applications vary on a large scale. European Research Cluster on the Internet of Things classifies major IoT applications as smart buildings, smart transportation, Smart energy, smart industry, smart health and the smart city as major areas. IoT is a trend-setting innovation in which all the data from sensors is stored in the cloud where it can be easily accessed from the cloud. Sensors and actuators for gathering the data and sending across the internet are also included in this advancement. We use cloud not only to store data but also for data analysis, gathering, visualization. In India, we have 493 coalmines present. Coal is the most vital asset in the world. These petroleum products are natural assets of the earth which help create power and for some, purposes. Coal is a non-sustainable source which can't be supplanted commonly by humans, there are numerous coalmine mischance happening in the mines, and the diggers are putting their lives in hazard by working in the coal mines, even once in a while they wind up losing their lives in the coal mines which is an unfortunate part. Mainly these mishaps are happening as a direct result of the old hardware and the wired systems, resulting in the terminate mischance's, spillage of the noxious gases in the coal mines are presenting immense dangers to the excavators inside the coalmines. They can't leave the mine if there is no legitimate lighting which coming about them to harm the mineworker's vision because of working under low lighting area. So, to stay away from this issue we have structured the coalmine security framework. In our work, we have tackled the issues by checking every one of the types of information gathered by the sensors which we have utilized and the observing is finished utilizing the Things platform. The microcontroller here in the work we have utilized is Arduino Uno.

BACKGROUND

Safety measures in port operations are primarily concerned with the protection of working machinery, with sensors and switches used to ensure worker safety. Port worker observation and control are not possible with current technologies due to their high mobility and risk. A manhole cover online monitoring system is suggested. This scheme offers active, in-the-moment analysis of labour on the field in the event of a threat. This paper investigated the smart data observing device's network topology, the data processing machine, along with the remote administration and surveillance facility. For underground coal miners, a smart sensor system tracks extremely risky conditions like humidity, temperature, and airborne gas constituents like sulfur dioxide and methane in real time. Drowning, gas poisoning, flooding, mine collapses, or explosives will occur if these parameters surpass a certain threshold. This technique enables buzzers to measure these variables and sends a warning about the condition to ground control and the crew.

PROBLEM DEFINITION

Safety is a paramount concern in coal mining operations due to the inherent risks associated with working in underground and open-pit environments. The major goal of this project is to include IoT in a coal mine safety monitoring and warning system based on hazards.

Underground mining issues such as methane gas, high temperatures, fires, and other conditions must be monitored on a regular basis. Coal Mine Safety is still a problem, with deaths as a result. It is very dangerous for rescuers to enter a coal mineshaft without first paying attention to the surroundings, due to the threats that will almost certainly surface at any moment. We might employ Wi-Fi Modules in Coal Mines to enhance a variety of safety processes.

PROPOSED SYSTEM BLOCK DIAGRAM

ObJECTIVES

- Methane Gas Monitoring
- Temperature and Humidity Sensors
- Water Presence Detection
- Wireless Connectivity
- Real-time Data Monitoring
- Alert and Notification System

METHODOLOGY

1. **Hardware Components**
    1. Arduino Uno
    2. Methane Sensor
    3. Temperature And humidity sensor
    4. Water sensor
    5. Light Sensor 6.Regulated Power Supply 7.LCD
1. Buzzer
2. Wi-Fi module

1. PCB
2. Connecting wires

1. **Software Components**
    1. Arduino IDE
    2. Arduino-C programming language
    3. Firebase Cloud
    4. Mobile App
2. **ARDUINO UNO**

Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno

differs from all preceding boards in that it does not use the FTDI USB to serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

1. **GAS SENSOR**

The **MQ-2 Gas sensor** can detect or measure gasses like LPG, Alcohol, Propane, Hydrogen, CO and even methane. The module version of this sensor comes with a Digital Pin which makes this sensor to operate even without a microcontroller and that comes in handy when you are only trying to detect one particular gas. When it comes to measuring the gas in ppm the analog pin has to be used, the analog pin also TTL driven and works on 5V and hence can be used with most common microcontrollers.

So if you are looking for a sensor to detect or measure gasses like LPG, Alcohol, Propane, Hydrogen, CO and even methane with or without a microcontroller then this sensor might be the right choice for you.

The MQ-135 Gas sensors are used in air quality control equipment's and are suitable for detecting or measuring of NH3, NOx, Alcohol, Benzene, Smoke, CO2.

1. **TEMPERATURE AND HUMIDITY SENSOR**

The **DHT11** is a commonly used **Temperature and humidity sensor.** The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers.

The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of

±1°C and ±1%. So if you are looking to measure in this range then this sensor might be the right choice for you.

RESULT AND DISCUSSION

We used an APP named 'Things view' which is based on IOT Security. It gives us the resulting graphs of Coal mine Temperature , Humidity,LDR,GAS,Watervalues in detail. This is the APP Interface which we

had used for our project. And we had created a channel in that PP called "VIT_coalmine with channel no: "248930"

Link: https://thingspeak.com/channels/2489

So, in this APP we can able to see the updated values of the Temperature, Humidity, LDR GAS, Water values with graphs w.r.t to date and it also displays the details of the MAX, LAST values of sensor. It also gives the details of Last update Time for our convenience. From Fig 7.1 We can observe the App Interface that's showing all the Graphs according to the date in greater Detail.

FIG:7.1

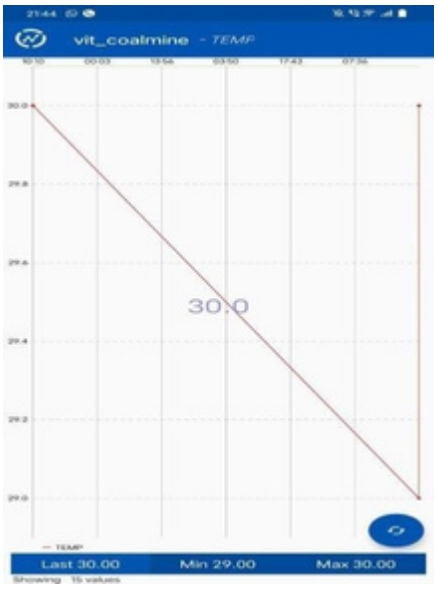


FIG 7.2 TEMPERATURE

FIG 7.3 HUMIDITY

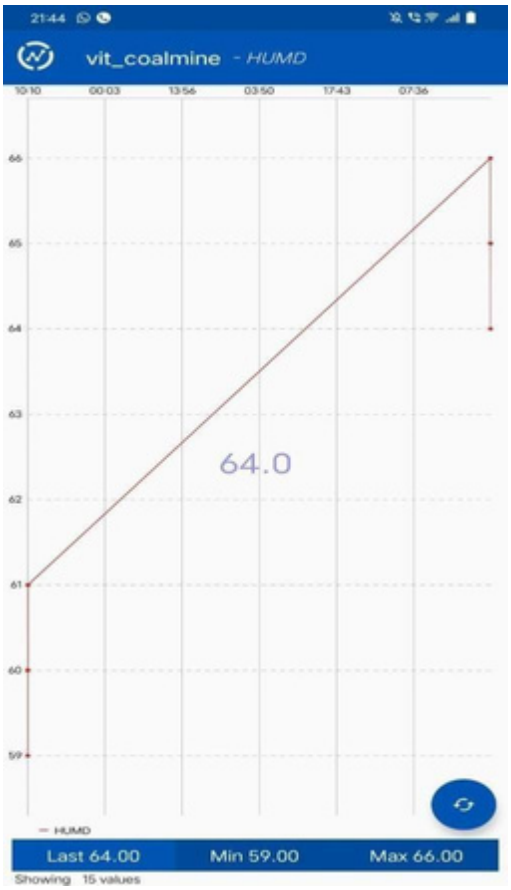


FIG 7.4 LDR

FIG 7.5 GAS

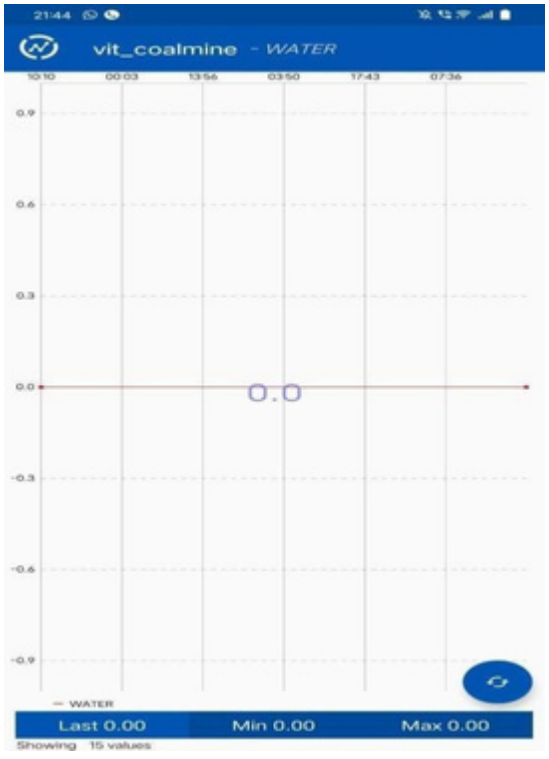
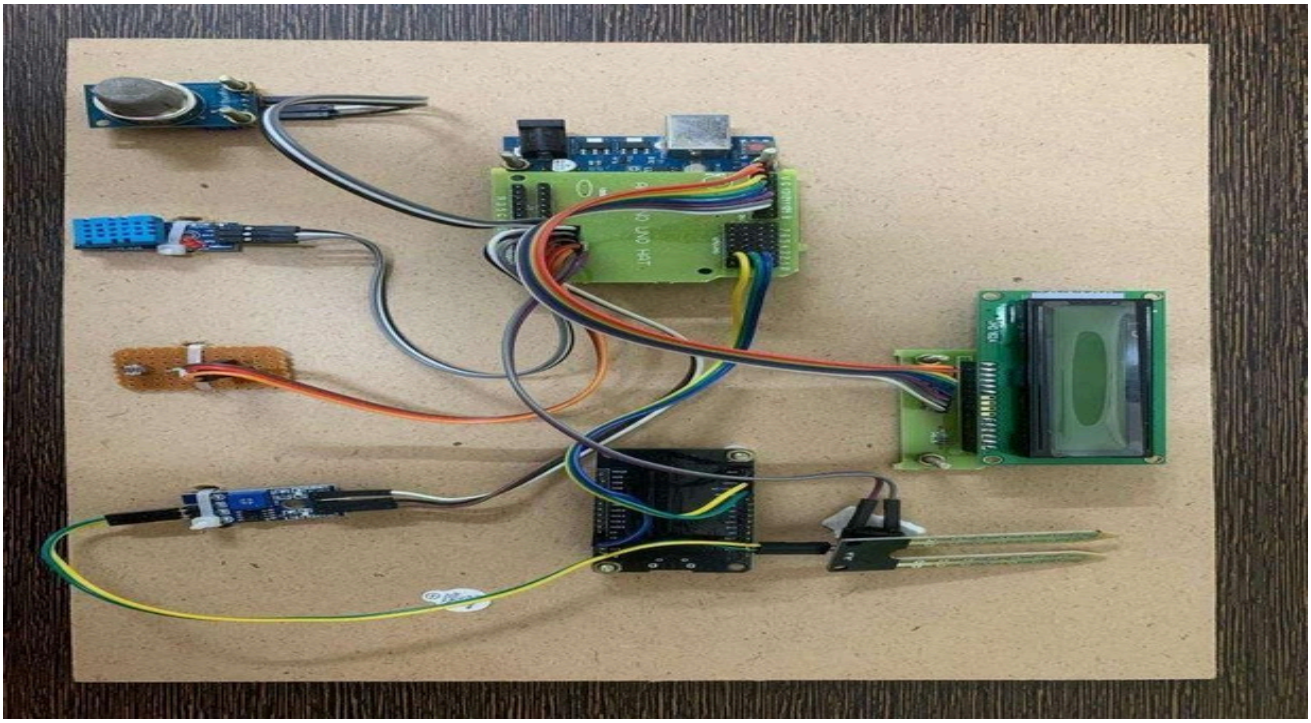


FIG 7.6 WATER

From, 7.1,7.2.7.3 we can observe all the values of Temperature,humidity,ldr,water values. We can see details of particular sensor in greater Detail by clicking on the graph of required Data. Then it gives us the details about individual sensor with Date wise Graph of MIN, MAX and Last updated values.



CONCLUSION

IoT-Based Coal Mine Safety Monitoring System is a comprehensive and proactive solution that significantly improves safety measures in coal mines and other industrial settings. It demonstrates a commitment to safety compliance, worker welfare, and the well-being of individuals working in

potentially hazardous environments. This system represents a critical step toward safer and more secure coal mining operations while embracing the benefits of cutting-edge IoT technology.

FUTURE SCOPE

Coal mining safety monitoring and control using IoT Additional safety hazards, including as dust, landslides, fire, and vibration, can be addressed with automation. Additional sensors can be used to address these safety concerns. Water leaks, subsidence, and other mining operations can all be monitored. By making the system functional, all critical data may be delivered to the authorities, whereas cable connection may become an impediment. Because the method allows for easy access, the administrated can be controlled from the outside. When other mechanized vehicles are utilized for the other topographic zones, this framework can be applied at a high level.

REFERENCES

- [1] S.Sujitha; Dr. J. B. Shajilin Loret; Mrs. D. Merlin Gethsy "IOT based smart mine safety system using Arduino" –May-2020.
- [2] Prof. A. H. Ansari, Karishma Shaikh, Pooja Kadu, and Nikam Rishikesh, "IOT Based Coal Mine Safety Monitoring and Alerting System"-2021.
- [3] Maheswaran U, Bhuvaneeshwaran V, Hemanathan M, Jawahar K Mar-2019 – "controlling"
- [4] Dr. R. Bhuvaneswari's "Design of coal mining safety monitoring and warning system based on IoT" is due in 2021.
- [5] "coal mines safety monitoring and modifying system" – 2020, Prof. Suresh Galve1, Abhijeet Mali 2, Sagar Hande3, Saurabh Madge4, Gajanan Badade5.
- [6]"2023 International Conference on Advances in Computing, Communication and Applied Informatics (ACCAI)"
- [7]" Dange "Design of Monitoring system for Coal mine safety based on MSP430", International Journal of Engineering Science Invention (IJESI) Volume2, Issue 7, July 2013
- [8] LiHui "Design of Monitoring system for Coal mine safety based on Wireless sensor Networks"

2008 International Conference on Mechatronic and Embedded systems and Applications (ASME).

- [8] Kumar "Design and Implementation of Portable health monitoring system using PSOC mixed signal Array chip". International Journal of Recent Technology and Engineering (IJRTE), ISSN, 22773878, 2012
- [9] Rajkumar Boddu "Zigbee based mine safety monitoring system with GSM", International Journal of Computer & Communication Technology ISSN (PRINT): 0975 – 7449, Volume-3, Issue-5, 201
- [10] Ashish "Coalmine safety monitoring using Wireless sensor Networks", International Journal of Scientific Engineering and Technology (IJSET) Volume 2, Issue 10, October 2013 .

1. APPENDIX

Code:

```
#include <LiquidCrystal.h> #include <DFRobot_DHT11.h> DFRobot_DHT11 DHT;

#define DHT11_PIN A1

int rs = 8, en = 9, d4 = 10, d5 = 11, d6 = 12, d7 = 13;

LiquidCrystal lcd(rs, en, d4, d5, d6, d7); int buz=A4;

int ldr=A3; int ws=A2; int  gs=A0; int cnt=0; void setup() {

// put your setup code here, to run once: Serial.begin(9600);

delay(200); pinMode(buz,OUTPUT); lcd.begin(16, 2); lcd.print(" WELCOME"); delay(200);

}

void loop() {
```

```
// put your main code here, to run repeatedly// int lval=analogRead(ldr)/10.23;

int gval=analogRead(gs)/10.23;

int wval=100-analogRead(ws)/10.23; DHT.read(DHT11_PIN);

int tval=DHT.temperature; int hval=DHT.humidity; lcd.clear();

lcd.print("T:"+String(tval) + " H:"+String(hval) + " L:"+String(lval)); lcd.setCursor(0,1);



lcd.print("G:"+String(gval)+ " W:"+ String(wval)); cnt=cnt+1;

if(cnt>15)

{

cnt=0;

Serial.print("248930,64B5G8TKFAYZMNRZ,0,0,Desktop123,1234567890,"+ String(tval) + ","+String(hval)+
","+String(lval)+ ","+String(gval)+ ","+String(wval) +",0\n");

}




if(tval>40 || hval>80 || gval>30 || wval>30)

{

digitalWrite(buz,1); delay(300); digitalWrite(buz,0);

}

delay(1000);

}
```