MINI PROJECT REPORT

On

Mine Surroundings Analyzer: Mines Environment Analysis & Gas leakage alert using Z-Score Analysis

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Submitted in partial fulfillment of the requirements

for

Degree of Bachelor of Engineering

Guided By: -

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DEPARTMENT OF INFORMATION TECHNOLOGY

S.B. JAIN INSTITUTE OF TECHNOLOGY, MANAGEMENT & RESEARCH, NAGPUR.

2020-2021

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DEPARTMENT OF INFORMATION TECHNOLOGY

SESSION 2020-2021

CERTIFICATE

This is to certify that the Mini project titled **"Mine Surroundings Analyzer: Mines Environment Analysis & Gas leakage alert using Z-Score Analysis"** is a bonafide work of **Ms. Shweta Lanjewar, Ms. Namrata Thakre, Mr.Himanshu Saha, Ms. Vijayalaxmi Yelchalwar** carried out for the partial fulfillment of the requirement of Mini Project in third year of Bachelor of Engineering in **Information Technology, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur.**

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DECLARATION

We hereby declare that the Mini Project titled **"Mine Surroundings Analyzer: Mines Environment Analysis & Gas leakage alert using Z-Score Analysis"** submitted herein has been carried out by us in the Department of Information Technology of S. B. Jain Institute of Technology Management and Research, Nagpur under the guidance of **Prof. Mayuri Kawalkar**. The work is original and has not been submitted earlier as a whole or in part for the award of any degree / diploma at this or any other Institution / University.

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ABSTRACT

Today safety of miners is a major challenge. Mining industry has been always ranked among those that have the foremost dangerous working environments. Mining activities release harmful and toxic gases successively exposing the associated workers into the danger of survival. Miner's health is at risk mainly due to the toxic gases which are fairly often released in underground mines. Mine Surroundings Analyzer system takes environmental parameters like temperature, humidity and toxic gases. All this is done using Z-Score analysis. This technique also provides an early warning, which can be helpful to all authorities or miners present inside the mine to save lots of their life before any casualty occurs.

Key Words— Internet of Thing, Mine Surroundings Analyzer, Z-Score

INDEX

LIST OF FIGURES

CHAPTER NO 1

INTRODUCTION

CHAPTER 1
INTRODUCTION

1.1 PROJECT BACKGROUND

Underground mining operations proves to be an adventure as far because the safety and health of workers is concerned. These risks are because different techniques used for extracting different minerals. Underground mining industry comes to the category, were each and every parameter such as methane gas, high temperature, fire accidents and so on has to be monitored regularly.

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. Presence, of various toxic gases such as carbon monoxide (CO) carbon dioxide (CO2) methane (CH4), nitrogen (N20) nitrogen oxides (NOx), and hydrogen sulfide (H2S) can lead to disaster in mine leading to deaths.
Mine Analyzer is an IOT based system in which various environmental condition in mines can be detected. In which various parameters of environment such as temperature, humidity, pressure is taken in concern. Implementing this project using Z- Score analysis to get instantaneous results and with high accuracy. Depending upon the certain conditions it will provide an alert to the authorities and miners to take further precaution

1.2 PROBLEM STATEMENT

Toxic gases in Mines leads to various accident resulting in financial & human loss. It needs to be detected at an early stage so that we can offer assistance in saving lives.

1.3 PURPOSE OF STUDY

The Internet of things (IoT) describes the network of physical objects— "things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet. Mining is a job known to have high risk of injury and disease. Miners are exposed to various harmful gases and atmospheric conditions leading to number of diseases as time passes. Miners are exposed to various potentially toxic or harmful materials or agents like fuels, reagents, solvents, detergents, chemicals, coal dust, silica dust, asbestos, noise, welding fumes, metal dust etc. As a result, number of disorders develop through the passage of time.

Mine Surrounding Analyzer will help mine workers by generating previous alerts for the upcoming hazardous situations. This analyzer will detect the air conditions and other essential factors related to safety of workers. By generating alerts, it will help the authorities to take quick actions and save the life of many mine workers working in difficult atmospheric conditions.

Similar project has been made before also but as we are using Z-score analysis technique so this will give accurate readings and will generate proper alerts.

Objectives

- To provide real time monitoring & Alert System in coal mines.
- To reduce the casualties, cause due to accident in coal mines.
- To provide the Safety towards the workers.

1.4 TECHNOLOGICAL BASE

This Project can be implemented by using various technologies like-

Python

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. It was created by Guido van Rossum in 1991 and further developed by the Python Software Foundation. It was designed with an emphasis on code readability, and its syntax allows programmers to express their concepts in fewer lines of code. It is a dynamic, high level, free open source and interpreted programming language. It supports object-oriented programming as well as procedural oriented programming.

Features:

- Easy-to-learn − Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.
- Expressive-Language − Python can perform complex tasks using a few lines of code.
- Easy-to-maintain − Python's source code is fairly easy-to-maintain.
- Portable − Python can run on a wide variety of hardware platforms and has the same interface on all platforms.

MICROSOFT AZURE

Microsoft Azure, commonly referred to as Azure is a cloud computing service created by Microsoft for building, testing, deploying, and managing applications and services through Microsoft-managed data centers. It provides software as a service (SaaS), platform as a service (PaaS) and infrastructure as a service (IaaS) and supports many different programming languages, tools, and frameworks, including both Microsoft-specific and third-party software and systems.

Features:

- It supports various programming languages, tools and frameworks and lets you build, deploy and manage applications any way you like.
- The data storage, backup and recovery become easier with Azure. Also, it becomes easy to build applications that span both cloud and on-premises.
- It brings the best of Linux and Windows ecosystems and enables you to build robust Sharepoint applications and services that works well with every device.
- It is quite scalable and matches every demand so you can pay for what you use.

JAVA

Java is a high-level, class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible. It is a general-purpose programming language intended to let application developers write once, run anywhere, meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of the underlying computer architecture.

Features:

- In Java, everything is an Object. Java can be easily extended since it is based on the Object model.
- It is not compiled into platform specific machine, rather into platform-independent byte code.

- It is designed to be easy to learn.
- Java makes an effort to eliminate error-prone situations by emphasizing mainly on compile time error checking and runtime checking.

FIREBASE

Firebase is a platform developed by Google for creating mobile and web applications. It was originally an independent company founded in 2011. In 2014, Google acquired the platform and it is now their flagship offering for app development.

Features:

- It is free and can report 500 event types, each with 25 attributes.
- With Firebase, we can focus our time and attention on developing the best possible applications for our business.
- Dynamic Links are smart URLs which dynamically change behavior for providing the best experience across different platforms.
- It has a lot of built-in features, which ensures that it is exactly what we do.

CHAPTER NO 2

LITERATURE SURVEY

CHAPTER 2

LITERATURE SURVEY

2.1 RELATED WORK

- **India records 377 mine deaths in three years/ The Hindu**

Methane/CO Poisoning, Water Drowning & Temperature/Pressure Change are the majority of the reasons for accidents in coal mines. At a time when multiple agencies are involved in the rescue of 15 miners trapped in a rathole mine in Meghalaya, data tabled in the Lok Sabha earlier this week revealed that 377 workers involved in the mining of coal, minerals and oil were killed in accidents between 2015 and 2017. Of the 377 deaths, 129 occurred in 2017 alone. As many as 145 died in 2016, while the figure was 103 in 2015. Coal mines have accounted for the highest number of casualties due to accidents in mines. Of the 377, more than half, 210, were killed in coal mines. These figures were provided by the Labor and Employment Ministry on December 31, 2018, in response to a question raised by Laxman Giluwa, BJP MP from Jharkhand.

- **Respiratory Protection Selection Made Easy/ EHS Today**

An estimated 5 million workers are required to wear respirators in 1.3 million workplaces throughout the United States, according to OSHA[1]. Knowing what the agency requires for respirator use in the workplace, as well as having a thorough understanding of both the application and contaminants present are critical to the respiratory protection selection process. Before an EHS professional starts down the path of purchasing respirators, an understanding of OSHA's hierarchy of hazard control measures is in order. From the agency's perspective, personal protective equipment (PPE) is the last option for an employer seeking to prevent employee exposure to a contaminant. When it comes to respiratory hazards, elimination/substitution means phasing out the contaminant or substituting a non- hazardous material for the contaminant causing the concern. Examples of engineering controls include the isolation or dilution of the contaminant through the use of a fume hood or ventilation. For respirator applications in which the worker could be exposed to unknown contaminants or unknown concentrations of contaminants, APRs are not an option.

APRs also are not an option in applications where the worker could encounter oxygen deficiency. OSHA defines this as oxygen levels of less than 19.5 percent[3]. For these, employers must use either a self-contained breathing apparatus (SCBA) or a pressure-demand SAR with an emergency egress (escape) supply of auxiliary breathing air. When it comes to choosing respiratory protection, there's not a one-size-fits-all solution & custom made are too costly to provide to daily Wage Labors hence safety gets neglected.[2]

- **R.Craig Schroll "Fire Detection and Alarm Systems: A Brief Guide"/Occupational health & safety|December2007**

To be useful, detectors must be coupled with alarms. Alarm systems provide notice to at least the building occupants and usually transmit a signal to a staffed monitoring station either on or off-site. In some cases, alarms may go directly to the fire department, although in most locations this is no longer the typical approach. These systems have numerous advantages as discussed above. The one major limitation is that they do nothing to contain or control the fire. Suppression systems such as automatic sprinklers act to control the fire. They also provide notification that they are operating, so they can fill the role of a heat detection-based system if connected to notification appliances throughout the building. They will not, however, operate as quickly as a smoke detection system. [3]

- **Deokar Wa et al. (2017)**

Proposed the key to controlling coal mine accidents the prediction of outburst by implementing sensors and microcontrollers and generating an alarm system before critical atmospheric levels. Continuous monitoring is necessary which again requires some effective and accurate sensing system. Several techniques are adapted to sense the presence of these poisonous gas, among them use of a semiconductor type gas sensor is very much effective. These sensors can be mounted in the coal mine area but sometimes these create some problems in mining too. Accidental damage to the sensor device often took place. Another technique is the use of the robot. These robots are effective but the cost of the robot is very high. However, there is another way of getting an effective and low-cost solution of sensor implantation; it is on the safety helmet of the coal mine workers.[1]

- **Pravin et al. (2018)**

  The proposed system consists of the sensor modules that sense all the data around the coal mine environment and logs the data onto the cloud-controlled server page using the IoT module. The sever page is maintained using the Java Server Page. The logged data is processed into the average values for each entry on an interval basis. These values are automatically processed using predefined values maintained by the server page. Then there is any arbitrary change in the values of the sensed data an alert is sent to the IoT MODULE and the concerned authorities. The IoT module detects the alert signal and glows the inbuilt alarm system and alert message to the authorities may take precaution steps. The main advantage of this project is that IOT detects the uncertainty in the environment beforehand using data analysis reports the situation to the concerned authority and the miners. The system also considers the emergency situations in hand to alert the miners quickly as possible. This project serves the aspect of "Prevention is better than Cure".[2]

- **Cheng Bo et al. (2012)**

  Proposed a restful web services mashup improved coal mine safety monitoring and control automation using WSN network. This system can collect the values of methane, temperature, humidity and personal position information inside the mine. The complex environment of coal mines requires continuous monitoring of the underground environment, equipment and miners to ensure safe coal mining. However, the existing coal mines cannot meet these requirements because of blind spots when using wired networks. We have developed a lightweight web-based remote monitoring and control platform that uses a REST-style wireless sensor network (WSN) to collect data on temperature, humidity, and methane content in coal mines using sensor nodes. It also collects information about the location of people in the mine. They implemented a RESTful application programming interface (API) that allows access to underground sensors and instruments via the Internet, making it easy to connect physical equipment in underground coal mines to remote monitoring and control applications. Various solutions for easy remote Web monitoring and security control, as well as measurement and analysis of system performance.

CHAPTER NO 3

METHODOLOGY / PROPOSED SOLUTION

CHAPTER 3

METHODOLOGY / PROPOSED SOLUTION

3.1 PROPOSED SOLUTION

The intent of our project is that the authorities/miners should be safe. Our system will provide an alert by checking the environmental surroundings of mines.

Modules:

- Module 1- Study of Z-Score Analysis for sensor values and implementing it provisionally using Arduino.

- Module 2- Integrating the “Module 1” with Bolt IOT.

- Module 3- Integrating “Module 2” with an User Interface.

3.2 SYSTEM ARCHITECTURE

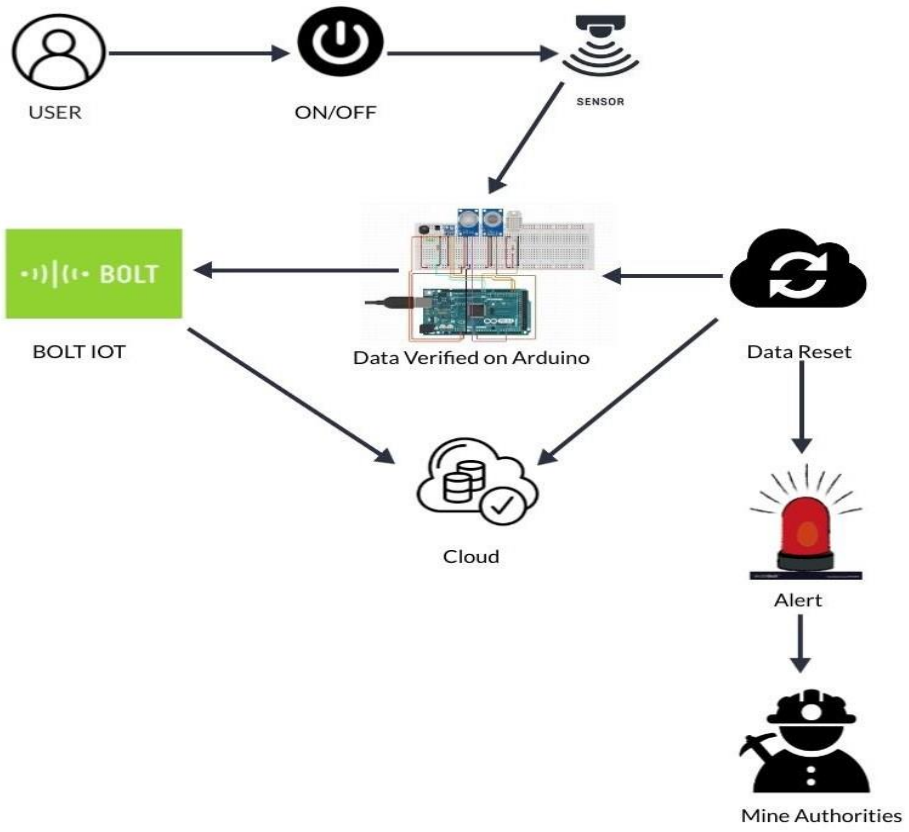

Fig 3.2 System Architecture

The primary focus of the system is to provide authorities/miners the detail of the environment in mines with the environmental parameters which can safeguard there life if any hazardous condition occurs.

The above architecture describes the complete view of the system and its usage in the perfect manner.

3.3 FLOW CHART

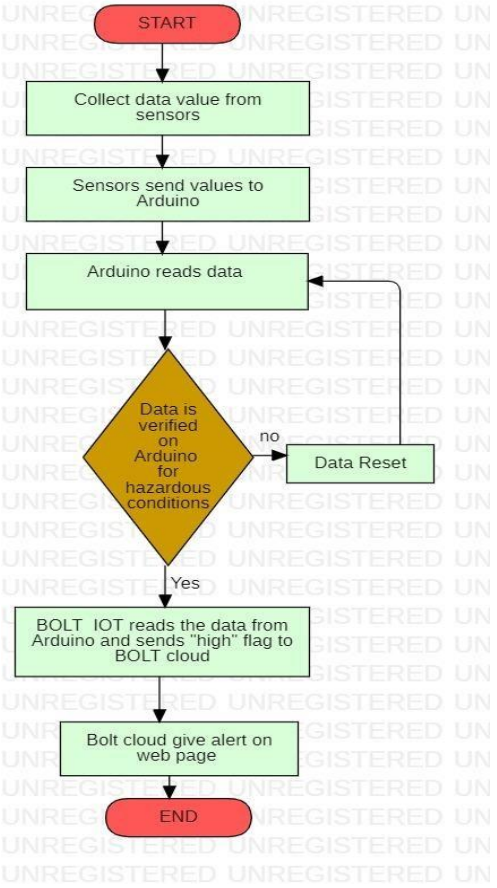

Fig 3.3 Flow Chart

Above we have shown the flow of our project. In this first all the data will be collected from sensor and then send to Arduino. Arduino reads the data and get the data verified for any hazardous condition. Then Bolt IOT reads the data from Arduino and sends high flag to cloud then it provides alert on the webpage.

CHAPTER NO 4

TOOLS / PLATFORM

CHAPTER 4

TOOLS / PLATFORM

4.1 SOFTWARE REQUIREMENT

1. **Operating System**: Windows 7 or Higher
2. **Web Framework**: Bolt IOT Cloud
3. **Server-Side Technology**: JavaScript
4. **Client-Side Technology**: HTML
5. **Training Environment**: Google Colab, Bolt IOT training
6. **Designing Tool**: Draw.io, Easy EDA online PCB designing
7. **Libraries Used**: DHT Sensor Library, BMP-180, Wire.h library
8. **Testing Tool**: MS Excel, Arduino Serial Monitor, Visual Inspection

4.2 HARDWARE REQUIREMENT

Hardware: MQ-9, MQ-135, BMP180, DHT-11, Bolt IOT Wi-Fi Module & Arduino Mega.

1. OPERATING SYSTEM:

Any Operating System (preferably windows 7 or higher) which is having architecture of 32-bit or higher is supported. We have used Windows 10 64-bit.

2. WEB FRAMEWORK:

- **Bolt IOT:**

Bolt is an Internet of Things Platform made for Machine Learning. Bolt IoT platform gives you the capability to control your devices and collect data from IoT devices safely and securely no matter where you are. Get actionable insights by deploying machine learning algorithms with just a few clicks to detect anomalies as well as predict sensor values.

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3. SERVER-SIDE TECHNOLOGY:

- **JavaScript:**

JavaScript is a dynamic computer programming language. It is lightweight and most commonly used as a part of web pages, whose implementations allow client-side script to interact with the user and make dynamic pages. It is an interpreted programming language with object-oriented capabilities.
JavaScript was first known as LiveScript, but Netscape changed its name to JavaScript, possibly because of the excitement being generated by Java. JavaScript made its first appearance in Netscape 2.0 in 1995 with the name LiveScript. The general-purpose core of the language has been embedded in Netscape, Internet Explorer, and other web browsers.

Features:

- All popular web browsers support JavaScript as they provide built-in execution environments.
- JavaScript follows the syntax and structure of the C programming language. Thus, it is a structured programming language.
- JavaScript is a weakly typed language, where certain types are implicitly cast (depending on the operation).
- It is light-weighted and interpreted language

4. CLIENT-SIDE TECHNOLOGY:

- **HTML:**

HTML stands for Hyper Text Markup Language. It is used to design web pages using markup language. HTML is the combination of Hypertext and Markup language. Hypertext defines the link between the web pages. Markup language is used to define the text document within tag which defines the structure of web pages.

Features:

- It is easy to learn and easy to use.
- It is platform independent.
- Images, video and audio can be added to a web page.
- Hypertext can be added to text.

5. TRAINING ENVIRONMENT:

- **GOOGLE COLAB:**

Colaboratory (also known as Colab) is a free Jupyter notebook environment that runs in the cloud and stores its notebooks on Google Drive. Colab was originally an internal Google project; an attempt was made to open source all the code and work more directly upstream, leading to the development of the "Open in Colab" Google Chrome extension, but this eventually ended, and Colab development continued internally.

Features:

- Write and execute code in Python.
- Document your code that supports mathematical equations.
- Create/Upload/Share notebooks.
- Import/Save notebooks from/to Google Drive.
- Import/Publish notebooks from GitHub.
- Import external datasets e.g. from Kaggle.
- Integrate PyTorch, TensorFlow, Keras, OpenCV.
- Free Cloud service with free GPU.

Advantages:

1. Sharing: You can share your Google Colab notebooks very easily. Thanks to Google Colab everyone with a Google account can just copy the notebook on his

own Google Drive account.

2. Code snippet: Google Colab has a great collection of snippets you can just plug in on your code. E.g., if you want to write data to a Google Sheet automatically, there's a snippet for it in the Google Library.

- **BOLT IOT TRAINING:**

The Bolt IoT Platform consists of three major components: Bolt WIFI module, Bolt Cloud Bolt Mobile App. Bolt is an Internet of Things Platform made for Machine Learning. Bolt IoT platform gives you the capability to control your devices and collect data from IoT devices safely and securely no matter where you are. Get actionable insights by deploying machine learning algorithms with just a few clicks to detect anomalies as well as predict sensor values. Bolt IoT platform gives you the capability to control your devices and collect data from IoT devices safely and securely no matter where you are. Get actionable insights by deploying machine learning algorithms with just a few clicks to detect anomalies as well as predict sensor values.

Advantages:

- Bolt provides all services at one place where in Arduino you cannot store data on cloud and bolt data can be obtained later and it is less prone to losses.
- Bolt is IOT platform and Arduino is a general platform.
- Bolt requires less libraries and Arduino requires many libraries and the codes are also lengthy for Arduino when compared bolt.

6. DESIGNING TOOL

- **Star UML**

StarUML is an open-source software modeling tool that supports the UML (Unified Modeling Language) framework for system and software modeling. It is based on UML version 1.4, provides eleven different types of diagrams and it accepts UML 2.0 notation. It actively supports the MDA (Model Driven Architecture) approach by supporting the UML profile concept and allowing to generate code for multiple languages.

Features:

- Multiple platform support
- Model-driven development
- Drag & Drop Interface
- Third Party Integration

- **EasyEDA online PCB designing**

EasyEDA is a free and easy to use circuit design, circuit simulator and pcb design that runs in your web browser.

7. LIBRARIES

- **DHT-11 SENSOR**

The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed).

- **BMP-180**

The BMP180 Breakout is a barometric pressure sensor with an I2C ("Wire") interface. Barometric pressure sensors measure the absolute pressure of the air around them. This pressure varies with both the weather and altitude. Depending on how you interpret the data, you can monitor changes in the weather, measure altitude, or any other tasks that require an accurate pressure reading.

- **Wire.h**

This library allows you to communicate with I2C / TWI devices. On the Arduino boards with the R3 layout (1.0 pinout), the SDA (data line) and SCL (clock line) are on the pin headers close to the AREF pin. The Arduino Due has two I2C / TWI interfaces SDA1 and SCL1 are near to the AREF pin and the additional one is on pins 20 and 21.

8. TESTING TOOL

For testing purpose, we used MS Excel and Arduino serial monitor to observe the results of application.

HARDWARE

1.) MQ-9: MQ-9 Carbon Monoxide, Methane, and LPG Gas Sensor Module can be used to sense Carbon Monoxide and Methane Gas. Sensitive material of the MQ9 gas sensor is SnO2, which with lower conductivity in clean air.

It makes detection by the method of cycle high and low temperature, and detect CO when the low temperature (heated by 1.5V). The sensor's conductivity is higher along with the gas concentration rising.

When a high temperature (heated by 5.0V), it detects Methane, Propane, etc. combustible gas and cleans the other gases adsorbed under low temperature.

2.) MQ-135: Air quality sensor for detecting a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2. Ideal for use in office or factory. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benze steam, also sensitive to smoke and other harmful gases.

3.) BMP-180: BMP180 is also distinguished by its very stable behaviour (performance) with regard to the independency of the supply voltage. Through its high relative accuracy of ±0.12 hPa (±1m) the BMP180 has become the most reliable sensor for precise applications, like indoor-navigation.

4.) DHT-11: The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data.

5.) BOLT IOT WIFI MODULE: Bolt is a fully integrated IoT platform for developers that

helps them build IoT projects and products quickly and easily. The Bolt WIFI module and their accompanying environment makes getting started with IoT easy and fast.

6.) ARDUINO MEGA: Arduino Mega 2560 is an open-source development board based on Atmega2560 AVR microcontroller. This microcontroller is an 8- bit Microcontroller. It uses ATmega16U2 Microchip Technology. This board can be programmed using programmed using wiring/ processing language. It includes: -

- 54 digital input/ output pins out of which 14 pins can be used as PWM outputs
- 16 analog pins
- 4 UARTs (hardware serial ports)
- A 16 MHz crystal oscillator
- A USB connection
- A power Jack
- An ICSP Header
- A reset buttons

CHAPTER NO 5

DESIGN & IMPLEMENTATION

CHAPTER 5

DESIGN & IMPLEMENTATION

5.1 SYSTEM DESIGN

5.1.1 USE-CASE DIAGRAM

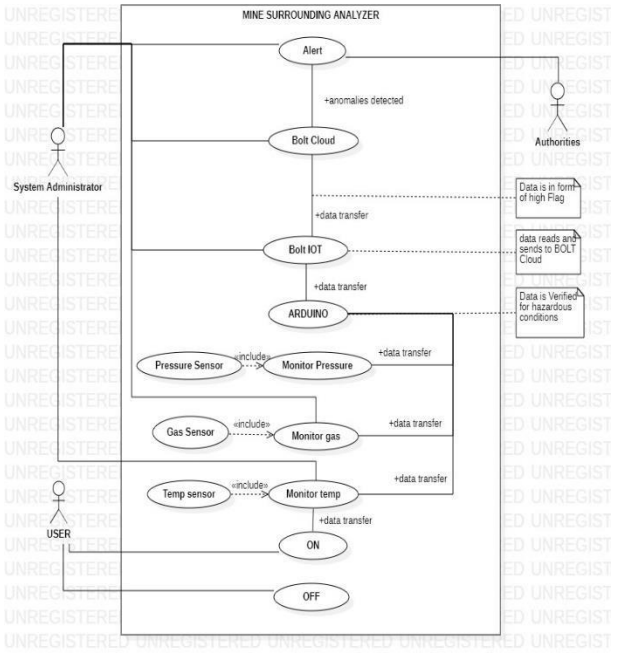

Fig. - 5.1.1: Use-Case Diagram

The above use case diagram simply depicts the task which administrator and user performs.

These tasks are as follows:

• User can switch on/off the circuit.

• Administrator can handle the whole system.

5.1.2. CLASS DIAGRAM

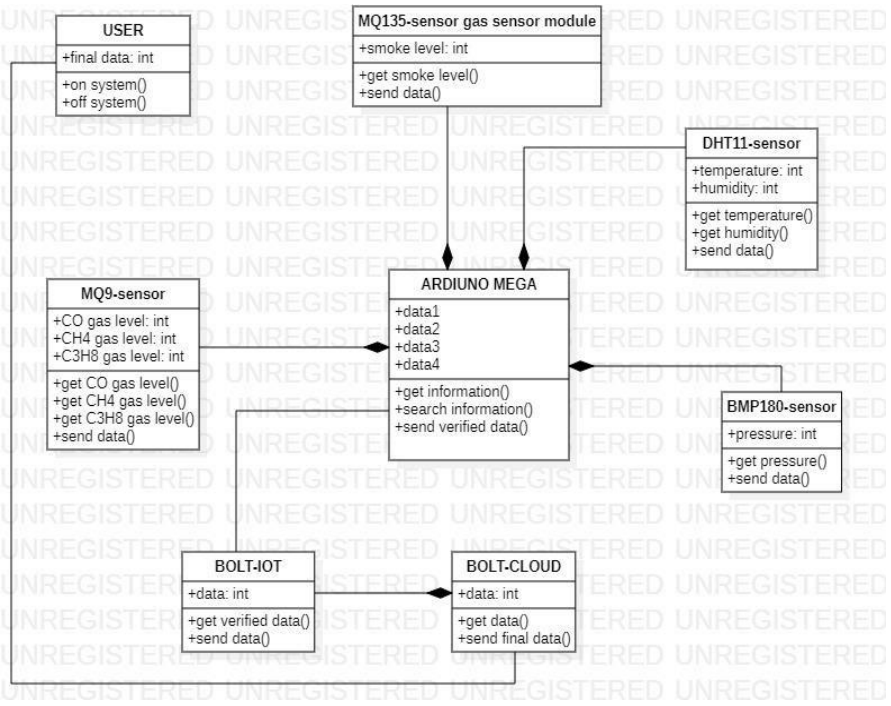

Fig. - 5.1.2: Class Diagram

In the above class diagram, the whole system is represented with methods and its attributes. The user class is responsible for on/off the circuit. Other are the sensor along with their attributes and methods.

5.1.3 SEQUENCE DIAGRAM

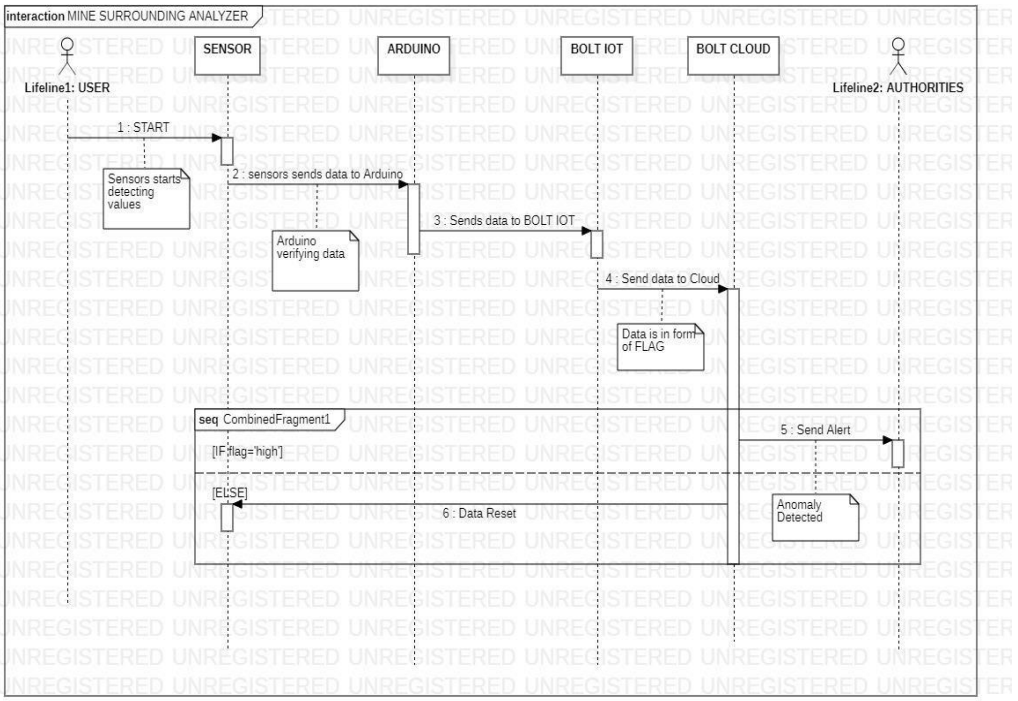

Fig. - 5.1.3: Sequence Diagram

The above represent the sequence diagram which shows the interaction between different Objects how and in what order they are working.

5.2 IMPLEMENTED MODULES

- **MODULE 1:** Study of Z-Score Analysis for sensor values and implementing it provisionally using Arduino

  The value of the z-score tells you how many standard deviations you are away from the mean. If a z-score is equal to 0, it is on the mean.

  A positive z-score indicates the raw score is higher than the mean average. For example, if a z-score is equal to +1, it is 1 standard deviation above the mean.

  A negative z-score reveals the raw score is below the mean average. For example, if a z-score is equal to -2, it is 2 standard deviations below the mean.

- **MODULE 2:** Integrating the “Module 1” with Bolt IOT

- **MODULE 3:** Integrating “Module 2” with a User Interface

5.3 SAMPLE CODE

```
int cycle = -10;
#include "DHT.h"                          //DHT11
#define DHTPIN 7                         //DHT11
#define DHTTYPE DHT11                    //DHT11
dht(DHTPIN, DHTTYPE);                    //DHT11
float temper,t2,t3,t4,t5,t6,t7,t8,t9,t10;
boolean fl_temp=LOW;
boolean fl_air=LOW;
 boolean fl_inf=LOW;
boolean fl_pres=LOW;
boolean fl_humd=LOW;
int fl_alert=0;
int sensorValue; //mq135
int digitalValue; //mq135
#include <SFE_BMP180.h>     //BMP180
#include <Wire.h>                //BMP180
SFE_BMP180 pressure;          //BMP180
#define ALTITUDE 1655.0     //BMP180
float sumis;
float pres;
double T,P,p0,a;                          //BMP-180
void setup() {
// put your setup code here, to run once:
Serial.begin(9600);
Serial.println(F("Test Begin or Restart.....................!!!!!!"));
//Test Begin dht.begin();
//DHT11
pinMode(50,OUTPUT);
pressure.begin();
}
void loop()
{
```

```
// put your main code here, to run repeatedly:
delay(2000);
float h = dht.readHumidity();        //DHT11
float f = dht.readTemperature(true);      //DHT11
float hif = dht.computeHeatIndex(f, h);
sensorValue = analogRead(0);   //mq135      // read analog input pin 0
digitalValue = digitalRead(22);            //mq135
float sensor_volt;                    //mq9
float RS_air;                         //mq9   // Rs in clean air
float R0;                                   //mq9    // R0 in 1000 ppm LPG
float sensorValue_mq;           //mq9
float ratio;                          //mq9     //Average MQ-9          //mq9
sensorValue_mq = analogRead(A7);                          //mq9
sensor_volt = ((float)sensorValue_mq/1024)*5.0;      //mq9
RS_air = (5.0-sensor_volt)/sensor_volt;                   //mq9 // Depend on RL on your module
R0 = 0.23;                                          //mq9 // According to MQ9 Calculated test Value
ratio = RS_air/R0;        //mq9 //
ratio = RS/R0
//Average_end MQ-9    //mq9
Serial.print("\n\nNew Cycle : ");  //check
Serial.println(cycle);
pressure.startPressure(3);          //BMP-180
pressure.startTemperature();
pressure.getTemperature(T);
pressure.getPressure(P,T);         //BMP-180
float temp = dht.readTemperature();    //DHT11
temp = temp * 1.8 + 32;          // convert Celsius to Farenheit
//delay(2000);
Serial.println("\n");
Serial.println("DHT-11");
Serial.print("Temperature: ");     //DHT11
Serial.print(temp);                 //DHT11
Serial.print(hif);                          //DHT11
```

```
Serial.println(F("°F"));          //DHT11
Serial.println("DHT-11 END \n\n");
Serial.println("MQ-135");
Serial.print("Air Quality : ");
Serial.println(sensorValue, DEC);    //mq135
// prints the value read Serial.println("MQ-135 END \n\n");
Serial.println("MQ-9");
Serial.print("sensor_volt = ");             //mq9
Serial.print(sensor_volt);                  //mq9
Serial.println("V");                        //mq9
Serial.print("RS_air/R0 Ratio = ");      //mq9
Serial.println(ratio);     //mq9
Serial.println("MQ-9 END \n\n");

Serial.println("BMP-180");
Serial.print(P*0.0295333727,2);
Serial.println(" inHg");
Serial.println("BMP-180 END\n\n");
// delay(5000);  //Delay
//t2=temper;
//Serial.println(t2);       Used while testing... t10=t9;
//Serial.println(t10); t9=t8; t8=t7; t7=t6;
//Serial.println(t7); t6=t5; t5=t4;
//Serial.println(t6); t4=t3; t3=t2;
temper = dht.readTemperature();
temper = temper * 1.8 + 32;
Serial.print("Temper");
Serial.println(temper);
t2=temper;
sumis=temper+t2+t3+t4+t5+t6+t7+t8+t9+t10;
float humd = dht.readHumidity();
float air = sensorValue;
float sum = sumis;
float pres = P*0.0295333727;
```

```
float mean;
// Count of values for calculating mean is 10
float bug;
float zscore;
zscore = bug/7;        //StandardDeviation to be 7
////////////////////////////Values and flag check - Part 1
float ub=0.10;    //Upper Bound
for Z-Score
if(cycle>=0)
{
if(ub<zscore)
{
if(ub<zscore)
{
fl_temp=HIGH;
}
}
if(air>700)
{
fl_air=HIGH;
}
if(ratio<5)
{
fl_inf=HIGH;
}
if(humd<50)
{
fl_humd=HIGH;
}

if(pres>40)

{
```

```
fl_pres=HIGH;
}
fl_alert=fl_temp+fl_air+fl_inf+fl_humd+fl_pres;

if(fl_alert>0)
{
digitalWrite(50,HIGH);
}
////////////////////////////////End of Values check - part 1
Serial.print("Z-Score ");
Serial.println(zscore);
Serial.print("Mean ");
Serial.println(mean);
Serial.print("Flag Temp ");
Serial.println(fl_temp);
Serial.print("Flag Air ");
Serial.println(fl_air);
Serial.print("Flag Inf ");
Serial.println(fl_inf);
Serial.print("Flag Pres ");
Serial.println(fl_pres);
Serial.print("Flag Humd ");
Serial.println(fl_humd);
Serial.print("Flag Alert ");
Serial.println(fl_alert);
cycle= cycle+1;//Cycle Increment
//delay(5000);   //Delay
}
```

CHAPTER NO 6

TESTING, RESULTS & DISCUSSION

CHAPTER 6

RESULTS & DISCUSSION

6.1 TESTING

6.1.1 TYPES OF TESTING

Manual Testing

Manual testing includes testing a software manually, i.e., without using any automated tool or any script. In this type, the tester takes over the role often end-user and tests the software to identify any unexpected behavior or bug. There are different stages for manual testing such as unit testing, integration testing, system testing, and user acceptance testing.

Testers use test plans, test cases, or test scenarios to test a software to ensure the completeness of testing. Manual testing also includes exploratory testing, as testers explore the software to identify errors in it.

Following are the testing techniques that are performed manually during the test life cycle:

- Acceptance Testing
- White Box Testing
- Black Box Testing
- Unit Testing
- System Testing
- Integration Testing

Automation Testing

Automation testing, which is also known as Test Automation, is when the tester writes scripts and uses software to test the product. This process involves automation of a manual process. Automation Testing is used to re-runthe test scenarios that were performed manually, quickly, and repeatedly.

Apart from regression testing, automation testing is also used to test theapplication from load, performance, and stress point of view.

Test Automation should be used by considering the following aspectsof a software:

- Large and critical projects
- Projects that require testing the same areas frequently
- Requirements not changing frequently
- Accessing the application for load and performance with many virtual users
- Stable software with respect to manual testing
- Availability of time

6.1.2 LEVELS OF TESTING

There are four levels of testing: Unit, Integration, System and Acceptance.

1. **Unit Testing:** A level of the software testing process where individual units/components of a software/system are tested. The purpose is to validate that each unit of the software performs as designed.

2. **Integration Testing**: A level of the software testing process where individual units are combined and tested as a group. The purpose of this level of testing is to expose faults in the interaction between integrated units.

3. **System Testing:** A level of the software testing process where a complete, integrated system/software is tested. The purpose of this test is to evaluate the system's compliance with the specified requirements.

4. **Acceptance Testing**: A level of the software testing process where a system is tested for acceptability. The purpose of this test is to evaluate the system's compliancewith the business requirements and assess whether it is acceptable for delivery.

6.1.3 TESTING REPORT

PROJECT:	Mine Surroundings Analyzer: Mines Environment Analysis & Gas leakage alert using Z-Score Analysis.					
MODULE:	Sensors					
PREPARED BY:						
	Namrata Thakre					
	Shweta Lanjewar					
	Himanshu Saha					
	Vijayalaxmi Yelchalwar					
SR.NO.	**TEST CASE ID**	**TEST OBJECTIVE**	**STEPS**	**EXPECTED**	**ACTUAL RESULT**	**STATUS**
1	TC_DHT-11_MODULE_02	Check whether sensor working properly.	1.Switch on the circuit. 2.Read the data on serial monitor.	DHT-11 should be give temperature range 91°F	DHT-11 should be give temperature range 91.04°F	Pass
2	TC_MQ-135_MODULE_02	Check whether sensor working properly.	1.Switch on the circuit. 2.Read the data on serial monitor.	1.Air Quality < 300ppm (Good) 2.Air Quality =300-700 ppm (Moderate) 3.Air Quality =700 & above (hazardous)	Air Quality is 152 ppm.	Pass
3	TC_MQ-9_MODULE_02	Check whether sensor working properly.	1.Switch on the circuit. 2.Read the data on serial monitor.	MQ-9 sensor should give the ratio in range of 9 to 11.	Ratio= 10.64	Pass
4	TC_BMP-180_MODULE_02	Check whether sensor working properly.	1.Switch on the circuit. 2.Read the data on serial monitor.	BMP-180 should give pressure as 32 inHg or its equivalent.	BMP-180 giving result as 32.95 inHg.	Pass
5	TC_BOLT_INTERFACE_MODULE_03	Check interfacing with BOLT Cloud	1. Switch on & connect BOLT IOT with Arduino. 2.Go to BOLT IOT page to see & download the data.	All the data from the sensors and flag alert as 0.	All the data from the sensors and flag alert as 0.	Pass

6.2 RESULTS AND DISCUSSIONS

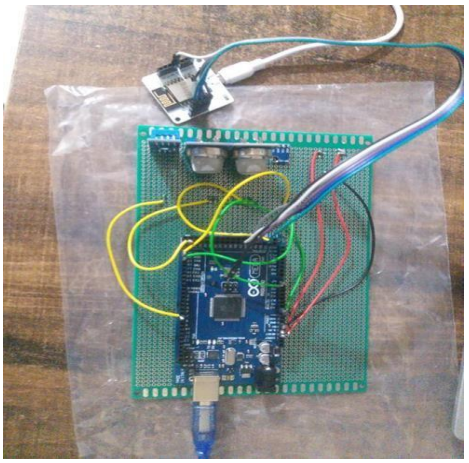

Fig 6.1 Circuit

This is our Circuit for the system.

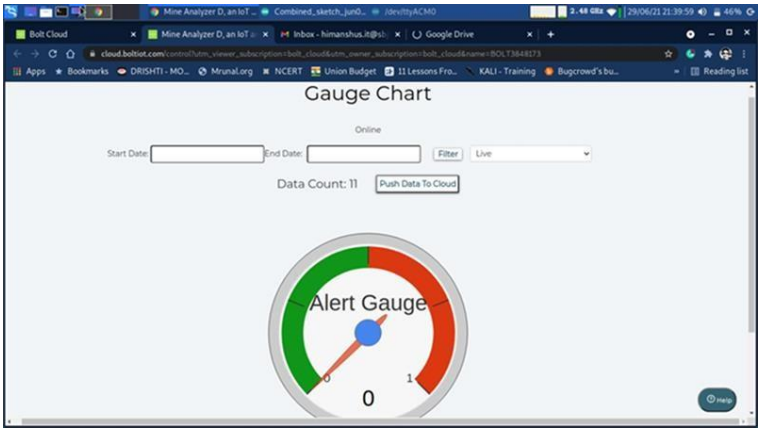

Fig 6.2 Gauge Chart

This is the chart showing whether the flag is high (1) or low (0) depending on the Surrounding.

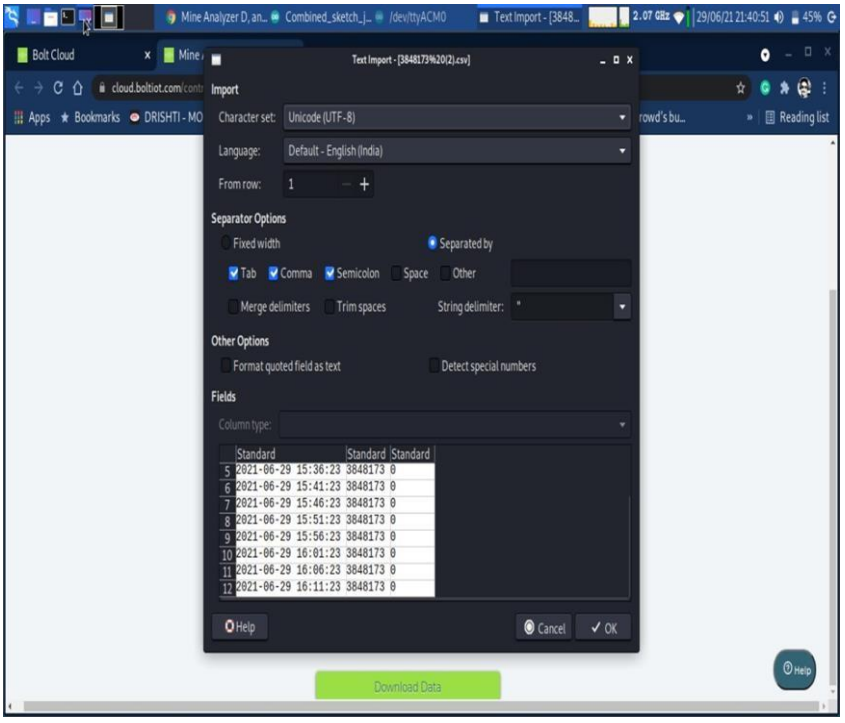

Fig 6.3 Result

This is the final result which is passed to cloud from Arduino.

CHAPTER NO 7

ADVANTAGES AND APPLICATIONS

CHAPTER 7

ADVANTAGES AND APPLICATIONS

7.1 ADVANTAGES

1. It is possible to get instantaneous results and with high accuracy with Z-Score analysis.
2. Automated detection of flammable/Poisonous gases Change in Atmospheric Pressure & Temperature.
3. Supervisors and managers can use the remote platform(s) to monitor key parameters in mines anywhere in the world, thereby improving management and production standards.

7.2 APPLICATIONS

- This system can be used in mines providing safety to miners and authorities.
- It can be also used in various chemical industries.
- It also provides application in oil and gas industries where lots of toxic gases is release which is harmful for the workers.

CHAPTER NO 8

CONCLUSION & FUTURE SCOPE

CHAPTER 8

CONCLUSION & FUTURE SCOPE

8.1 CONCLUSION

We have **designed** and developed a IOT based alert system by applying **engineering knowledge** so that we can offer assistance in saving lives. Toxic gases in Mines leads to various accidents resulting in financial & human loss so it need to be detected in early stages. We have identified and **analyzed** problems in coal mines due to which many workers are been killed by various accidents in mines. This alert system is providing an alert to the authorities so that they can take precautions. In this project hardware used are MQ- 9, MQ- 135, BMP180, DHT-11, Bolt IOT Wi-Fi Module & Arduino Mega. During the development of the project, we understood the importance of **individual and teamwork** while **project development and management**. While showcasing our project through various seminars we enhanced our **communication skills** a displayed **professional ethics** which results in **lifelong learning.**

8.2 FUTURE SCOPE

- This project can be used in various chemical industries & factories.
- By using other advanced sensors all possible safety issues could be monitored such as gases, dust, vibrations, fire etc. Threats. Also, all the underground operations can be Monitored out from the ground Stations.
- In future, the work can further be extended for other minerals extracted for commercial purpose in India and safety levels at sites can be improved.
- With the growing innovations future work of this experimentation may include, more development of the system.
- Important data can be communicated through this system making it feasible where wired communication is a hindrance.

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APPENDIX I

SmallSEOTools

PLAGIARISM SCAN REPORT

Words	109	Date	July 29, 2021
Characters	774	Excluded URL	

0%	100%	0	6
Plagiarism	Unique	Plagiarized Sentences	Unique Sentences

Content Checked For Plagiarism

Today safety of miners is a major challenge. Mining industry has been always ranked among those that have the foremost dangerous working environments. Mining activities release harmful and toxic gases successively exposing the associated workers into the danger of survival. Miner's health is at risk mainly due to the toxic gases which are fairly often released in underground mines. Mine Surroundings Analyzer system takes environmental parameters like temperature, humidity and toxic gases. All this is done using Z-Score analysis. This technique also provides an early warning, which can be helpful to all authorities or miners present inside the mine to save lots of their life before any casualty occurs.

APPENDIX II

Instruction Manual

On

"Mine Surroundings Analyzer: Mines Environment Analysis & Gas leakage alert using Z-Score Analysis"

Submitted By

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Ms. Namrata Thakre

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2020-2021

1. Abstract

Today safety of miners is a major challenge. Mining industry has been always ranked among those that have the foremost dangerous working environments. Mining activities release harmful and toxic gases successively exposing the associated workers into the danger of survival. Miner's health is at risk mainly due to the toxic gases which are fairly often released in underground mines. Mine Analyzer system takes environmental parameters like temperature, humidity and toxic gases. All this is done using Z-Score analysis. This technique also provides an early warning, which can be helpful to all authorities or miners present inside the mine to save lots of their life before any casualty occurs.

Key Words — Internet of Thing, Mine Analyzer, Z-Score

2. Modules Implemented

2.1 Module

We have completed the three modules. In first module we have done with study of Z-Score and its analysis, in second integrated the module1 with Bolt IOT and in last module we have done the user interface.

3. Software and Hardware Requirement

3.1 Software Requirement

1. **Operating System**: Windows 7 or Higher
2. **Web Framework**: Bolt IOT Cloud
3. **Server-Side Technology**: JavaScript
4. **Client-Side Technology**: HTML
5. **Training Environment**: Google Colab, Bolt IOT training
6. **Designing Tool**: Draw.io, Easy EDA online PCB designing
7. **Libraries Used**: DHT Sensor Library, BMP-180, Wire.h library
8. **Testing Tool**: MS Excel, Arduino Serial Monitor, Visual Inspection

1. OPERATING SYSTEM:

Any Operating System (preferably windows 7 or higher) which is having architecture of 32-bit or higher is supported. We have used Windows 10 64-bit.

2. WEB FRAMEWORK:

- **Bolt IOT:**

Bolt is an Internet of Things Platform made for Machine Learning. Bolt IoT platform gives you the capability to control your devices and collect data from IoT devices safely and securely no matter where you are. Get actionable insights by deploying machine learning algorithms with just a few clicks to detect anomalies as well as predict sensor values.

Bolt IoT platform gives you the capability to control your devices and collect data from IoT devices safely and securely no matter where you are. Get actionable insights by deploying machine learning algorithms with just a few clicks to detect anomalies as well as predict sensor values.

3. SERVER-SIDE TECHNOLOGY:

- **JavaScript:**

JavaScript is a dynamic computer programming language. It is lightweight and most commonly used as a part of web pages, whose implementations allow client-side script to interact with the user and make dynamic pages. It is an interpreted programming language with object-oriented capabilities.

JavaScript was first known as LiveScript, but Netscape changed its name to JavaScript, possibly because of the excitement being generated by Java. JavaScript made its first appearance in Netscape 2.0 in 1995 with the name LiveScript. The general-purpose core of the language has been embedded in Netscape, Internet Explorer, and other web browsers.

Features:

- All popular web browsers support JavaScript as they provide built-in execution environments.
- JavaScript follows the syntax and structure of the C programming language. Thus, it is a structured programming language.
- JavaScript is a weakly typed language, where certain types are implicitly cast (depending on the operation).
- It is light-weighted and interpreted language

4.CLIENT-SIDE TECHNOLOGY:

- **HTML:**

HTML stands for Hyper Text Markup Language. It is used to design web pages using markup language. HTML is the combination of Hypertext and Markup language. Hypertext defines the link between the web pages. Markup language is used to define the text document within tag which defines the structure of web pages.

Features:

- It is easy to learn and easy to use.
- It is platform independent.
- Images, video and audio can be added to a web page.
- Hypertext can be added to text.

5.TRAINING ENVIRONMENT:

- **GOOGLE COLAB:**

Colaboratory (also known as Colab) is a free Jupyter notebook environment that runs in the cloud and stores its notebooks on Google Drive. Colab was originally an internal Google project; an attempt was made to open source all the code and work more directly upstream, leading to the development of the "Open in Colab" Google Chrome extension, but this eventually ended, and Colab development continued internally.

Features:

- Write and execute code in Python.
- Document your code that supports mathematical equations.
- Create/Upload/Share notebooks.
- Import/Save notebooks from/to Google Drive.
- Import/Publish notebooks from GitHub.
- Import external datasets e.g. from Kaggle.
- Integrate PyTorch, TensorFlow, Keras, OpenCV.
- Free Cloud service with free GPU.

Advantages:

1. Sharing: You can share your Google Colab notebooks very easily. Thanks to Google Colab everyone with a Google account can just copy the notebook on his own Google Drive account.
2. Code snippet: Google Colab has a great collection of snippets you can just plug in on your code. E.g., if you want to write data to a Google Sheet automatically, there's a snippet for it in the Google Library.

- **BOLT IOT TRAINING**:

The Bolt IoT Platform consists of three major components: Bolt WIFI module, Bolt Cloud Bolt Mobile App. Bolt is an Internet of Things Platform made for Machine Learning. Bolt IoT platform gives you the capability to control your devices and collect data from IoT devices safely and securely no matter where you are. Get actionable insights by deploying machine learning algorithms with just a few clicks to detect anomalies as well as predict sensor values. Bolt IoT platform gives you the capability to control your devices and collect data from IoT devices safely and securely no matter where you are. Get actionable insights by deploying machine learning algorithms with just a few clicks to detect anomalies as well as predict sensor values.

Advantages:

- Bolt provides all services at one place where in Arduino you cannot store data on cloud and bolt data can be obtained later and it is less prone to losses.
- Bolt is IOT platform and Arduino is a general platform.
- Bolt requires less libraries and Arduino requires many libraries and the codes are also lengthy for Arduino when compared bolt.

6. DESIGNING TOOL

- **Star UML**

StarUML is an open-source software modeling tool that supports the UML (Unified Modeling Language) framework for system and software modeling. It is based on UML version 1.4, provides eleven different types of diagrams and it accepts UML 2.0 notation. It actively supports the MDA (Model Driven Architecture) approach by supporting the UML profile concept and allowing to generate code for multiple languages.

Features:

- Multiple platform support
- Model-driven development
- Drag & Drop Interface
- Third Party Integration

- **EasyEDA online PCB designing**

EasyEDA is a free and easy to use circuit design, circuit simulator and pcb design that runs in your web browser.

7. LIBRARY

• DHT-11 SENSOR

The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed).

• BMP-180

The BMP180 Breakout is a barometric pressure sensor with an I2C ("Wire") interface. Barometric pressure sensors measure the absolute pressure of the air around them. This pressure varies with both the weather and altitude. Depending on how you interpret the data, you can monitor changes in the weather, measure altitude, or any other tasks that require an

accurate pressure reading.

• Wire.h

This library allows you to communicate with I2C / TWI devices. On the Arduino boards with the R3 layout (1.0 pinout), the SDA (data line) and SCL (clock line) are on the pin headers close to the AREF pin. The Arduino Due has two I2C / TWI interfaces SDA1 and SCL1 are near to the AREF pin and the additional one is on pins 20 and 21.

8. TESTING

For testing purpose, we used MS Excel and Arduino serial monitor to observe the results of application.

3.2 Hardware Requirement

Hardware: MQ-9, MQ-135, BMP180, DHT-11, Bolt IOT Wi-Fi Module & Arduino Mega

Sr. No	Name of Component	Cost (Approximate)
1	MQ-9	119
2	MQ-135	112
3	BMP-180	58
4	Arduino Mega	745
5	DHT-11	73
6	BOLT IOT Wi-Fi Module	2750

3.3 Flowchart

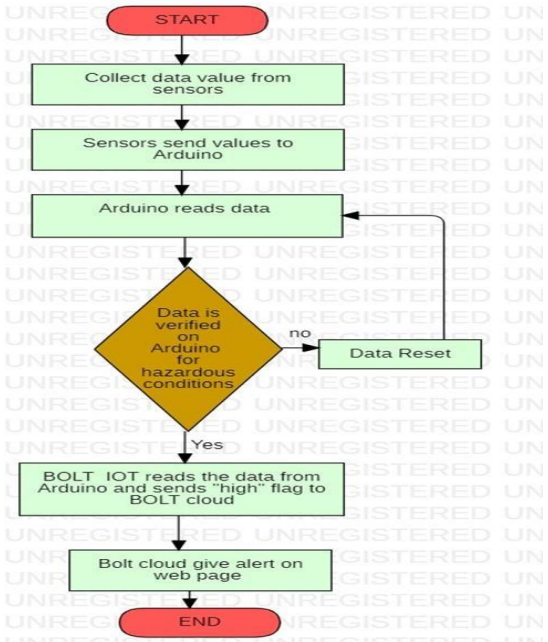

Fig Flowchart

4. Steps to Run the Project

1.) Connect all wires to the circuit properly.

2.) Check if all the sensors connected properly with Arduino.

3.) Switch on the circuit.

4.) Compile and verify the Arduino sketch.

5.) Upload the code on Arduino.

6.) We get the dataset on the console after uploading the code.

7.) Connection with Bolt IOT

8.) Deploy the configuration and check the final result.

5. Future Scope

1. This project can be used in various chemical industries & factories.

2. By using other advanced sensors all possible safety issues could be monitored such as gases, dust, vibrations, fire etc. Threats. Also, all the underground operations can be Monitored out from the ground Stations.

3. In future, the work can further be extended for other minerals extracted for commercial purpose in India and safety levels at sites can be improved.

4. With the growing innovations future work of this experimentation may include, more development of the system.

5. Important data can be communicated through this system making it feasible where wired communication is a hindrance.

6. New developing communication technologies can be used for highspeed data transfer in integration with smart sensors for sensing the mine conditions. Also, more Advanced IOT enabled systems can be developed for more advanced functionality.

6.Limitations

1.) Lack of Internet Connection.

2.) Lack of Electricity.