IoT BASED MINES SAFETY MONITORING AND ALERTING SYSTEM USING ARDUINO

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Abstract **- The goal of the mine's monitoring system was to develop a system that could monitor the area as support in a variety of mines (coal, gold, copper, iron, zinc, limestone, etc.). The goal is to develop an affordable system that will increase worker safety in the mining environment by allowing the responsible party to remotely access an IoT platform and monitor key mine parameters from anywhere in the world. This will enable better management and higher production standards. The system's design wasmade in a way that makes it simple to use andhas features that are user- friendly for monitoring dangerous gases in mining environments.**

Keywords **– Arduino Uno, ESP8266 Wi-Fi Module, IoT Module, Sensors, Buzzer, LCD.**

I. INTRODUCTION

The mines are the most hazardous mining operation in the world, with thousands of miners losing their lives to enormous explosions every year. Recent research found that such mining accidents oftenresulted in the deaths of 12,000 persons. There are certain issues with the mining industry, and those who work in these mines put their lives in danger. Regrettably, some miners pass away as a result. The mishandling and leakage of hazardous gases inside the mines pose a major concern to archaeologists as well as to those engaged in subterranean activities. Such issues frequently emerge from outmoded technology and wireless equipment.

As a result, the model's primary goal is to develop a system for tracking the key variables in the mining environment and to use IoT to address the problems by validating each piece of data gathered by the sensors.

II. OBJECTIVES

The main objective of the proposed system is:

- ✓ To deploy a system which monitors and ensures the safety of the mine workers through IoT technology.
- ✓ To detect the importance of individual sources.
- ✓ To develop the warning systems for the prevention of undesired air pollution episodes.
- ✓ To determine the exposure and assess the effects of air pollution on health, vegetation and building materials.

III. RELATED WORK

To the best of our knowledge, no significant study has been documented to design a low-cost system that can categorize the type of accident the victim has experienced during mining explosions, despite the fact that there are numerous prior publications in the literature referencing accident detection in a mining context. If the EMS (Emergency Medical Services), police and family members are informed of the kind of accidents the mining workers have been in, the rescue and response operation will be more effective. Because of this, we suggest developing a safety monitoring and alerting system in

this study that can not only identify but also alert the concerned personnel about the accident.

IV. LITERATURE REVIEW

[1] "IoT based smart mine safety system using Arduino"

Authors: S. Sujitha, Dr. J. B. Shajilin Loret, Mrs. D. Merlin Geth – 2020

In this study, the author evaluated the safety system for coal mines and the employees that work there. The prototype, which combines software and hardware components, is discussed in this article. Through cellular networks, this project aims to automate the monitoring procedure.

[2] "IoT Based Smart Greenhouse Automation Using Arduino"

Authors: Prof. D. O. Shirsath, Punam Kamble, Rohini Mane, Ashwini Kolap, Prof. R. S. More – 2017

In this study, the author evaluated the safety system for coal mines and the employees that work there. The prototype, which combines software and hardware components, is discussed in this article. Through cellular networks, this project aims to automate the monitoring procedure... Here, the proposed system is implemented using the Arduino platform for greenhouse monitoring, controlling temperature and soil moisture with the help of a Web server using IoT.

[3] "A wireless surveillance and safety system for mine workers based on Zigbee"

Authors: Tanmoy Maity, Partha Sarathi – 2009

The author discusses a practical, affordable approach to the protection of underground mining employees. The author discusses the high precision, easy management, and dependability of using MEMS-based sensors for subsurface environment monitoring and automating the flow of measurement data using wireless digital communication.

[4] "Underground mines wireless propagation modelling"

Authors: M. Ndoh, G. Y. Delisle - 2004

This article describes the current condition of a wireless LAN network deployment in an actual gold mine underground. Here, the author discusses the use of mining topic without human involvement using sensors that screen the environment and a microcontroller that routinely turns on and off the buzzer in the event of an unstable circumstance.

V. BLOCK DIAGRAM

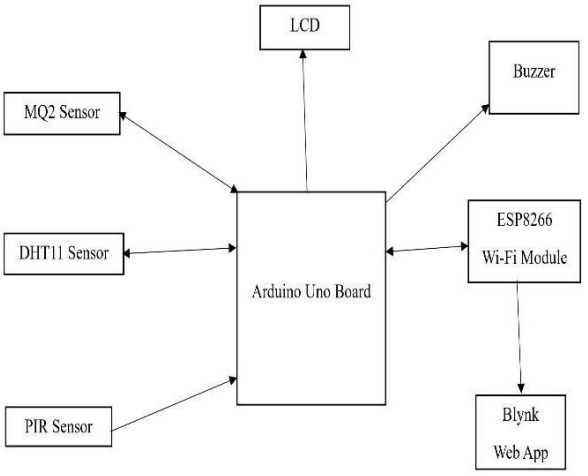

Figure 1: Block diagram of proposed model

This is a block diagram for an IoT based mines safety and monitoring system using Arduino. Mines are oftenbeen in an explosion. Initially, the model checks if ESP8266 is ready to transmit the data or not? If yes it willtransmit the sensor data to Blynk application. Then the Blynk application will compare the received data with the respective threshold values and if it exceeds the threshold value, Blynk application will be updated withnotification and the buzzer will turn on.

VI. TECHNICAL DESCRIPTION

A. Arduino UNO

The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input-output pins (of which 6 can be used as PWM outputs), 6 Analog inputs, a 16MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. The Uno can be programmed with Arduino Software (IDE).

Figure 2: Arduino Uno

B. ESP8266 Wi-Fi Module

ESP8266 is an impressive, low-cost Wi-Fi module suitable for adding Wi-Fi functionality to an existing microcontroller project via a UART serial connection. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement. The module can be reprogrammed to act as a standalone Wi-Fi connected device just to add power.

Figure 3: ESP8266 Wi-Fi Module

C. Blynk Application

Blynk is a toolset for all makers, badass inventors, designers, teachers, nerds and geeks who would love to use their smartphones to control electronics like Arduino, Raspberry Pi and similar ones. Blynk will work with all popular boards andshields. It is free and open source. Blynk is not an app that works only with a particular shield. Instead, it is been designed to support the boards and shields we are already using. And it also works on iOS and Android. Blynk is a popular IoT (Internet of Things) programmed application that let us to operate on tiny circuits hardware, gather data from sensors, create unique visual dashboards, and save data to the Blynk cloud automatically. Another feature of Blynk is the ability to send and push notifications or tweets when certain conditions are met.

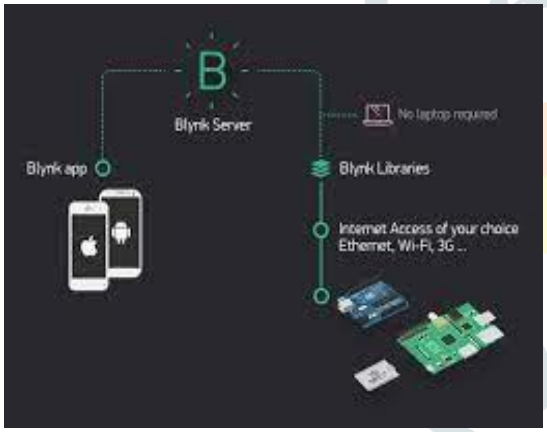

Figure 4: Blynk Application

VII. IMPLEMENTATION

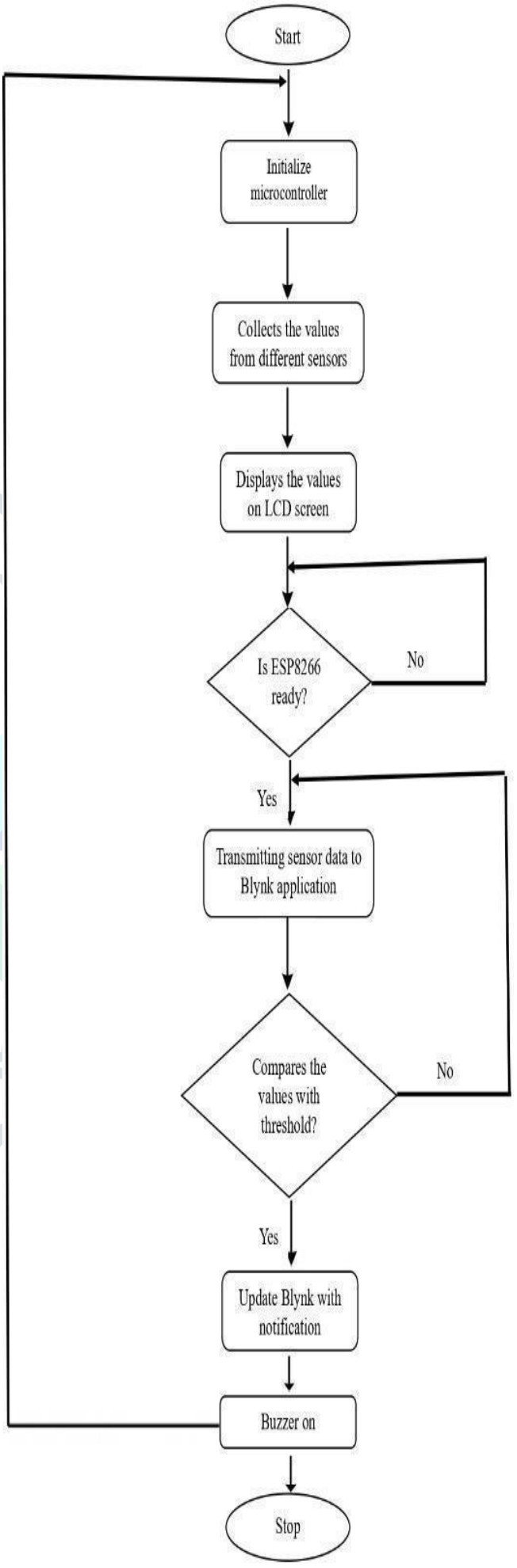

Figure 5: Flowchart

Table 1: Test condition for ESP8266 Wi-Fi Model and Data transmission

Sl. No	ESP8266 Wi-Fi Model	Data transmission
1	Line is busy	Checks the condition until the line is available
2	Line is idle	Transmits the sensor data to the Blynk application

Table 2: Test condition for Blynk application and Buzzer

Sl. No	Data Comparison	Blynk application and Buzzer
1	Data >Threshold value	Updates the Blynk application with notification and Buzzer turn on
2	Data< Threshold value	No updates and Buzzer turn off

VIII. RESULTS AND DISCUSSION

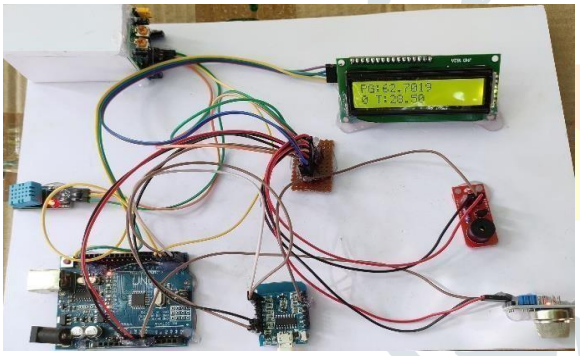

Figure 6: Proposed system model

The planned system consists of device modules that collect all the information around the mine setting and logs the information onto the cloud- controlled server page of the IoT module. The logged information is processed into the common values for every entry on an associate interval basis. The IoT module detects the alert signal and glows the intrinsic device and alerts the respected authorities through messages to take the precautionary steps.

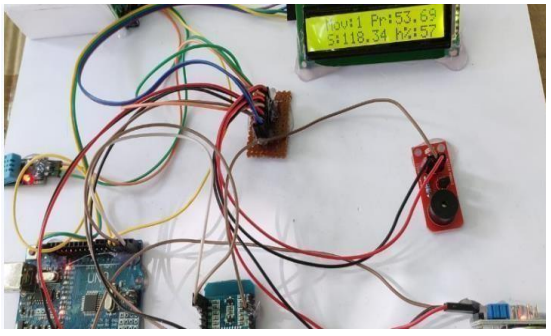

Figure 7: DHT11 output display on the LCD screen

The DHT11 sensor performs the operation of sensing the temperature and humidity, the threshold value is 40° C (Room Temperature).

So, the DHT11 detect the temperature and the value above threshold performs an operation of signaling a danger and updating the same to the Blynk application.

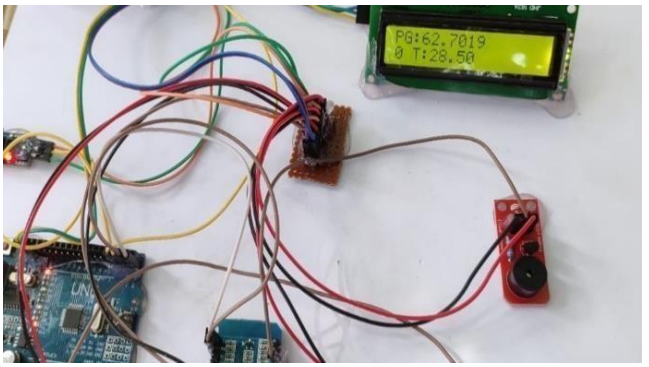

Figure 8: MQ2 sensor output display on the LCD screen

The MQ2 sensor performs the operation of sensing the gases, in our project there are many types of dangerous gases which could be exposed so, the MQ2 detect the gas and if it senses any dangerous gas, it sends an immediate signal to Blynk application and turns on the buzzer in the work area.

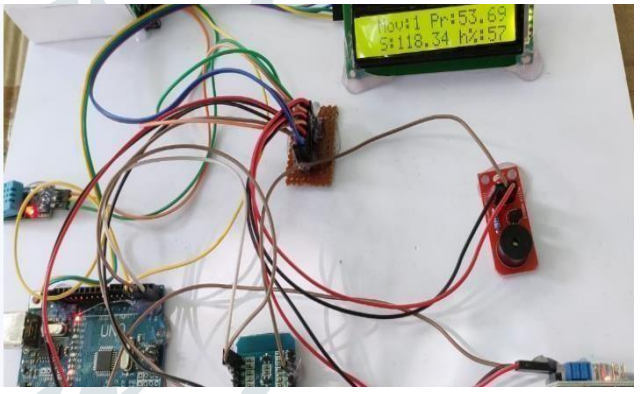

Figure 9: PIR sensor output with value 1 (detecting motion)

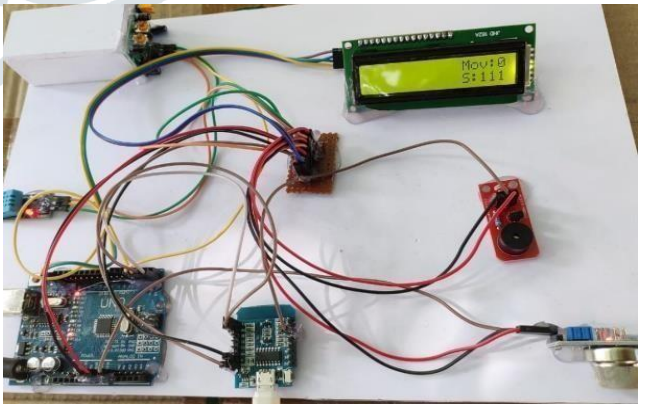

Figure 10: PIR sensor output with value 0 (detecting no motion)

PIR [Passive Infrared Radiation], it works on detecting any kind of motion in an enclosed area. So, we could utilize it in danger area to check if there is a motion of any stone, person etc. It provides an upper hand of precaution.

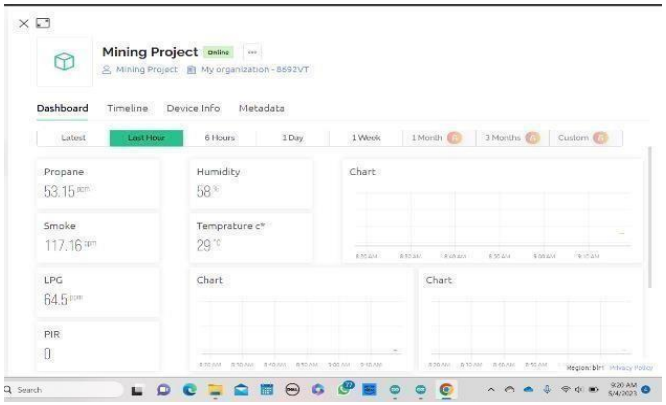

Figure 11: Output display of the proposed system on the Blynk Application

The figure shown above shows the output values of the various sensors implemented in the module on the LCD screen. Also, Figure 11. shows the output values on the Blynk application to the concerned person.

Sensor Name	Condition	Sensor Value
PIR Sensor	Motion detected	1
	No motion detected	0
DHT11	Inside the room	29.3 C 58.28% H
	Outside the room	36 C 42% H

Figure 12: Variations in temperature over time

Figure 13: Variations in humidity over time

Sensor name	Condition	Sensor Value
MQ2	Using deodorant	159.8 ppm
	Using sanitizers	117.1 ppm

Figure 14: Variations in smokes detected over time

Figure 15: Variations in LPG over time

IX. COMPARATIVE STUDY

Sl No.	Paper Title	Description	Difference
1	R. Rajalakshmi and J. Vidhya, "Toxic Environment Monitoring using Sensors based on Arduino", 2019.	The paper contributes to the field of environmental monitoring by presenting a system that can detect and monitor toxic substances.	The present paper contributes to the field of environmental monitoring by presenting a system that can detect and monitor hazardous gases along with the temperature, humidity and variations over time along with the application of Blynk Web App.
2	"Coal mines safety monitoring and modifying system"2020, Prof. Suresh Galve, Abhijeet Mali, Sagar Hande, Saurabh Madge, Gajanan Bagade.	The authors may propose a system or methods for modifying safety conditions based onthe monitored data. This could involve mechanisms for alerting personnel, initiating safety protocols, or implementing control measures to mitigate risks and ensure the well-being of workers.	The present paper contributes to the field of environmental monitoring by presenting a system that can detect and monitor hazardous gases along with the temperature, humidity and variations over time along with the application of Blynk Web App.
3	Prof. A. H. Ansari, Karishma Shaikh, Pooja Kadu and Nikam Rishikesh "IoT based Coal Mine safety monitoring and alerting system" 2021.	This paper focus to enhance the safety of the workers in underground mines. When workers are in danger, they can press panic switch which is using early-warning intelligence proposal system and the worker status can be monitor over IoT.	This paper focus only on underground mining and uses ZigBee based wireless system whereas the present paper considers various mining environment including underground miningand we consider Wi-Fi module.
4	Coal Mine Safety Monitoring and Alerting System with Smart Helmet Mangesh Rudrawar, Shivam Sharma, Madhuri Thakur and Vivek Kadam, Department of Instrumentation Engineering, Ramrao Adik Institute of Technology, Navi Mumbai, Maharashtra, India – 2022.	This paper states that it consists of a smart helmet worn by miners and a central monitoring system, where the monitoring is done only if the person wearing the helmet is present in the mine.	The difference in our mine monitoring system is that, first we check whether the working place is safe by placing the sensors mentioned above inthe head. After the safety of the place the workers are allowed to work and the place is further monitored.

X. ADVANTAGES

- ✓ Life-saving system in mining environment.
- ✓ Cost-effective solution.
- ✓ Easy to use and maintenance.
- ✓ Monitoring environment conditions in mines ispossible even under critical circumstances.

XI. APPLICATIONS

The following locations involve the employment of theMines safety monitoring and alerting system:

- ✓ Various kinds of mines.
- ✓ Oil industries.
- ✓ Petroleum industries.

XII. CONCLUSION

The proposed solution takes use of the Internet of Things (IoT) to identify the explosions and alert the concerned personnel by using Blynk application via IoT server. This project is developed for continuous monitoring and alerting about mine accidents. This would go a long way increasing the safety of the mine workers and help to predict the disasters in advance.

XIII. FUTURE SCOPE

In the future, the system can be modified to notify the user about the air quality when it reaches beyond a permissible level through SMS. And also, to make out the project more user friendly and more usable on other sectors and smart homes.

XIV. REFERENCES

[1] Valdo Henriques and Reza Malekian, “Mine safety system using wireless sensor network”, IEEE, pp. 1-12, 2016.

[2] Prof. D. O. Shirsath, Punam Kamble, Rohini mane, Ashwini Kolap, Prof. R. S. More “IoT based Smart Greenhouse Automation using Arduino” International Journal of Innovative Research in Computer Science & Technology (IJIRCST), 2017.

[3] Maheswaran U, Bhuvaneeswaran V, Hemanathan M, Jawahar K March-2019 “Controlling".

[4] R. Rajalakshmi and J. Vidhya, “Toxic EnvironmentMonitoring using Sensors based on Arduino”, 2019IEEE International Conference on System, Computation, Automation and Networking (ICSCAN), 2019.

[5] S. Sujitha, Dr J. B. Shajilin Loret, Mrs. D. Merlin Gethsy “IoT based smart mine safety system using Arduino” May-2020.

[6] “Coal mines safety monitoring and modifying system” 2020, Prof. Suresh Galve, Abhijeet Mali, Sagar Hande, Saurabh Madge, Gajanan Bagade.

[7] Prof. A. H. Ansari, Karishma Shaikh, Pooja Kuda and Nikam Rishikesh “IoT based Coal Mine safety monitoring and alerting system” 2021.

[8] Dr R. Bhuvaneswari’s “Design of Coal mining safety monitoring and warning system based on IoT” is due in 2021.

[9] Coal Mine Safety Monitoring and Alerting System with Smart Helmet Mangesh Rudrawar, Shivam Sharma, Madhuri Thakur and Vivek Kadam, Department of Instrumentation Engineering,Ramrao Adik Institute of Technology, Navi Mumbai, Maharashtra, India – 2022.