IOT BASED COAL MINE SAFETY MONITORING AND ALERTING SYSTEM

Albin Johnson[1] , E. Samuel Vincent[2], K. Gnananjan[3], Roshan Shinde[4], Mr. Md. Raziuddin[5]

[1,2,3,4]B.tech Students, Department of Computer Science Engineering -Data Science, VJIT.
[5]Associate Professor, Department of Computer Science Engineering -Data Science, VJIT.

Abstract:: The firms that are responsible for coal mining are seeing a considerable number of accidents. As a result, it is of the utmost importance to ensure that the lives of coal mine workers are protected. It is possible that the complex structure of the environment and the wide variety of activities that take place within coal mines are to blame for the incidence of accidents that take place there. To this end, it is very necessary to keep a tight eye on the working conditions that are present in coal mines. It is possible that we may develop an application for the Internet of Things (IoT) that makes use of sensors to recognize potentially dangerous situations in order to solve this problem. These sensors will subsequently provide warning signals and alerts to workers as well as other persons who are present at the site, therefore reducing the likelihood of injuries and deaths occurring.

I INTRODUCTION

When it comes to energy resources, coal is always going to be an extremely important and considerable need. On the other hand, mining accidents have lead to the loss of a significant number of lives all over the globe. It was in their work named "Jing Change" that Cao and Yang (2001) created a thorough list of one hundred important mining incidents that took place between the years 2001 and 2010. The North East region of the country is comprised of coal mines that are in a state of underdevelopment, which is the primary cause of the high number of mining accidents that occur there. There is a significant amount of methane and carbon monoxide gas present in the mines, which is the major reason for these accidents. Humans are unable to identify these gasses since they are odorless, transparent, and cannot be recognized by their senses [2]. In order to properly handle such disasters, it is essential to predict outbursts by using sensors and microcontrollers, and it is also essential to trigger an alarm system prior to reaching critical air levels. Utilizing a sensor system that is both effective and accurate is required in order to carry out continuous monitoring. A number of different methods are used in order to identify the presence of these harmful gasses; however,

the utilization of semiconductor gas sensors has shown to be especially effective. Not only are these sensors able to be put in the neighborhood of the coal mine [3], but they also have the potential to sometimes create problems in the mining operation. Unintentional damage to the sensor device occurred often and frequently. This was a regular occurrence. Utilizing a robot is yet another approach that may be used [4]. The use of robots is inconceivable in a country like India, where industrialists do not place a high priority on the safety of their employees, despite the fact that these robots are effective. As an alternative, there is still another approach that may be taken to accomplish a solution that is both efficient and cost-effective for the implantation of sensors. Coal mine workers are required to wear the safety helmet at all times. It is fitted with a sensor array that can detect data and a wireless modem that can send it [5]. The smart safety helmet is equipped with both these.

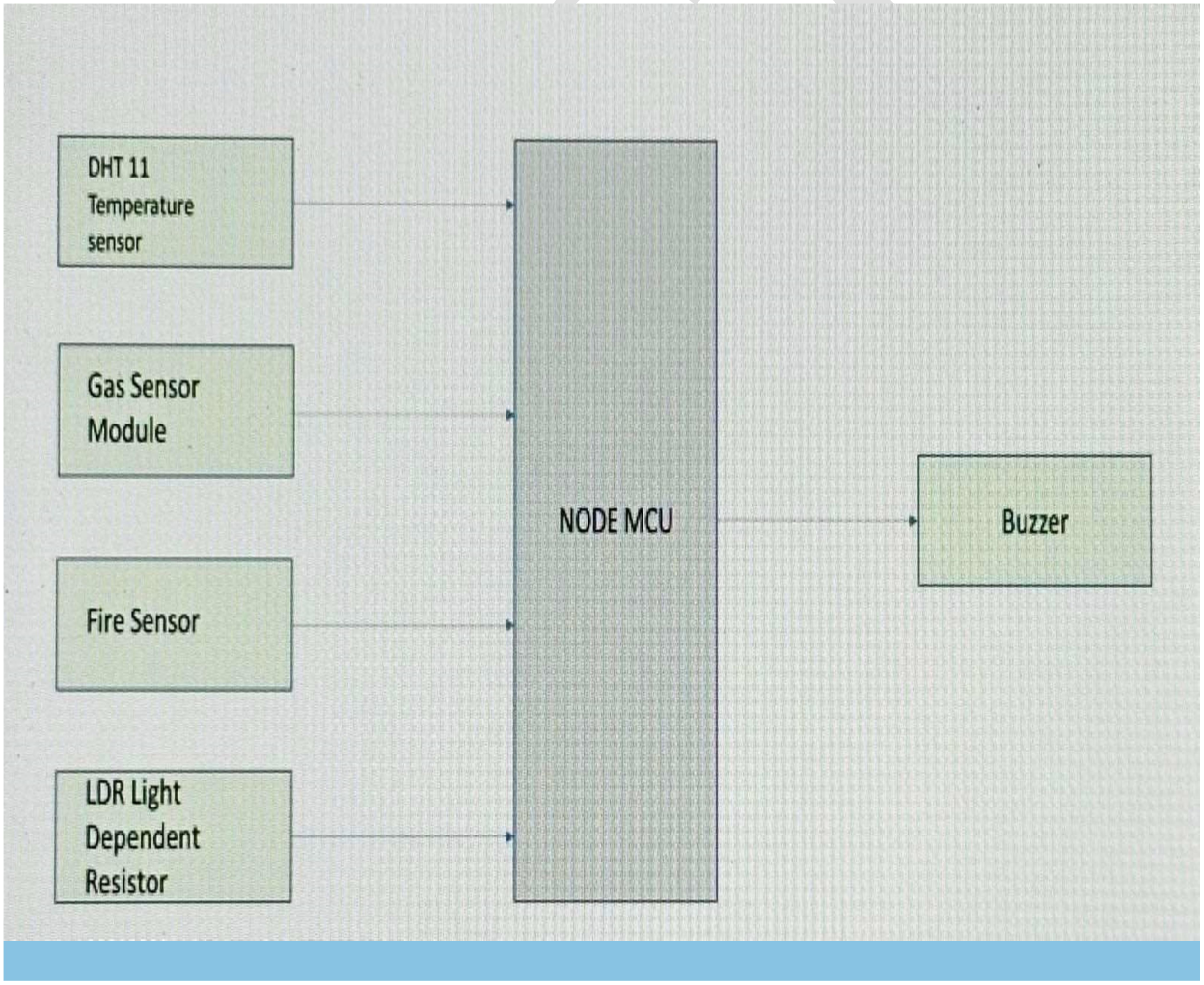
II. LITERATURE SURVEY

Yogendra S Dohare and Tanmoy Maity develop a monitoring and safety system for underground coal mines using Low Power Wireless Sensor Network (WSN) technology. This system is a wireless sensor network based on the Zigbee protocol, designed for underground coal mines. It is characterized by its low power consumption, cost-effectiveness, and ability to offer intelligent monitoring and safety measures. The system comprises a wireless network comprising several nodes. This network may be conveniently installed in underground mines and offers an efficient monitoring and safety system for underground coal miners. Specifically, it facilitates instantaneous data transmission between miners and the surface control center using extremely secure and dependable wireless sensor nodes. The placement of this system in the mine creates an issue when miners are out of range of the system. This system just monitors the environmental conditions inside the underground mine, but it does not monitor the health conditions of the miners. Yongping Wu and Guo Feng use the Bluetooth wireless transmission method to execute coal mine monitoring. Bluetooth technology serves as a universal standard for short-range wireless communication worldwide. Its purpose is to provide a shared, low-power, low-cost wireless interface and software system for controlling devices. This article provides an overview of the development history, technological characteristics, and structure of the protocol stack of Bluetooth technology. It also proposes solutions for the difficulty of developing the Bluetooth host controller interface (HCI) wireless communication.

Zhenzhen Sun introduced the DCS Coal Mine Monitoring System. The RS485 bus topology is designed to provide multipoint and bidirectional communication. This monitoring system may be created utilizing widely

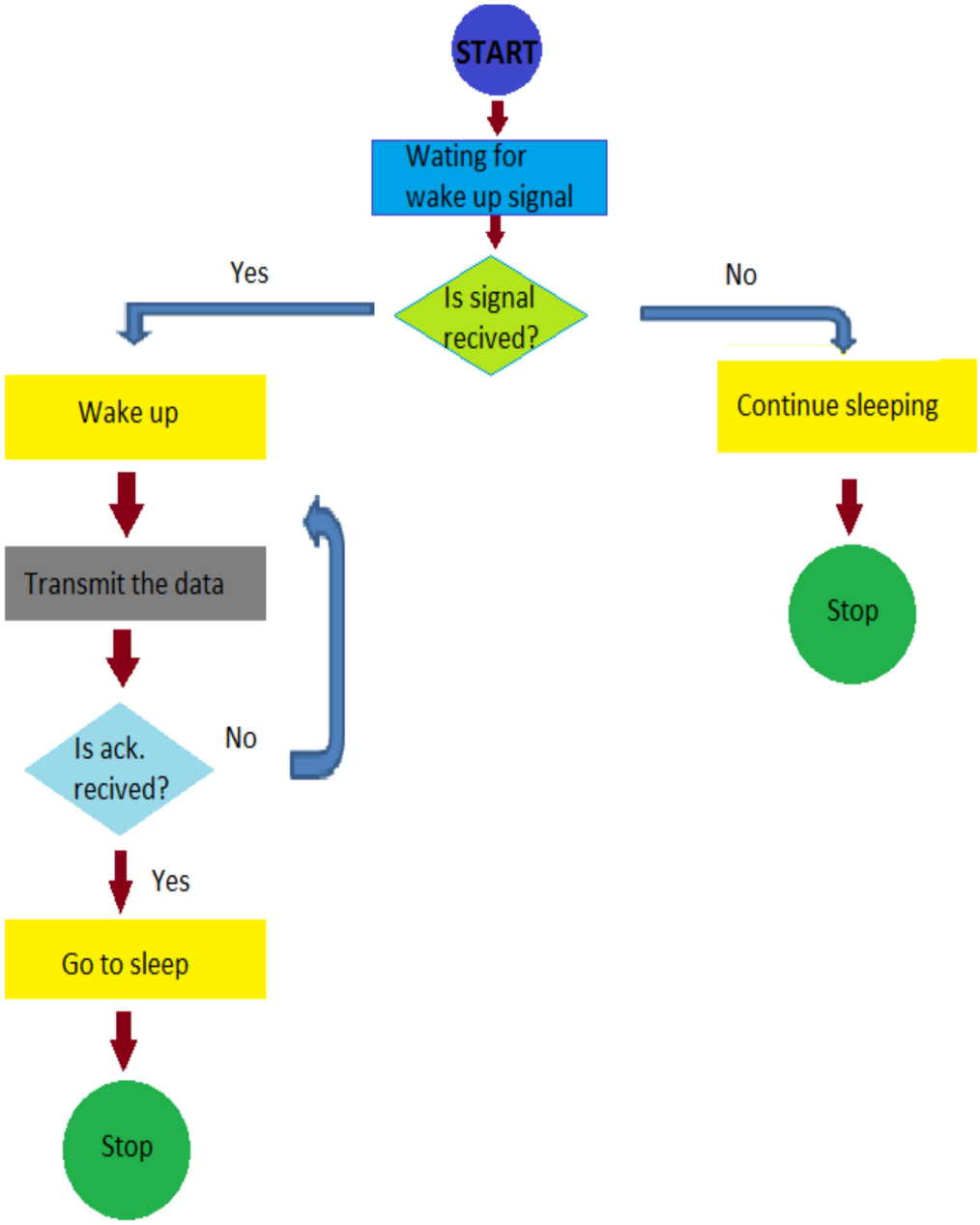
available 8-bit microcontrollers. It offers the benefits of a simple circuit design and affordable expenses. However, the presence of a master-slave structure in the network makes it challenging to ensure the durability of the network's structure. In addition, the data transfer distance is restricted and the realtime performance is subpar. Jingjiang Song and Yingli Zhu suggested an automated network. This system is designed to monitor the safety of coal mines and is created using the MSP430F and nRF2401. The system's sensor groups closely monitor temperature, humidity, and other conditions. The microcontroller transmits the measured parameters to the wireless communication module. The gathered data is sent via cable to a remote monitoring center. The issue with this approach is that the hardware is located within the coal mines. When a natural disaster or a roof collapse occurs, the system is damaged. The typical communication system has low dependability and a short lifespan. The challenging conditions inside the mine make it very difficult to install and maintain the system. Another issue is the high level of noise in coal mines, which might hinder effective communication between miners and the system, especially if they are far apart.

BLOCK DIAGRAM



NETWORK TOPOLOGY

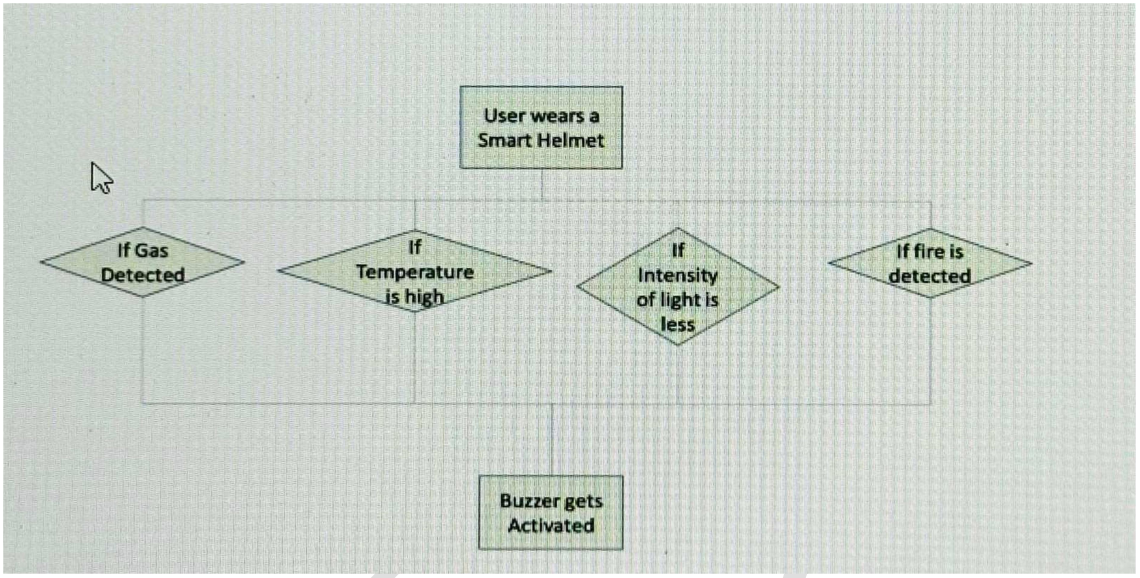
The system utilizes a Mesh network for communication, using the MAC protocol [6].The following diagram illustrates the flow chart of the transmitter system.



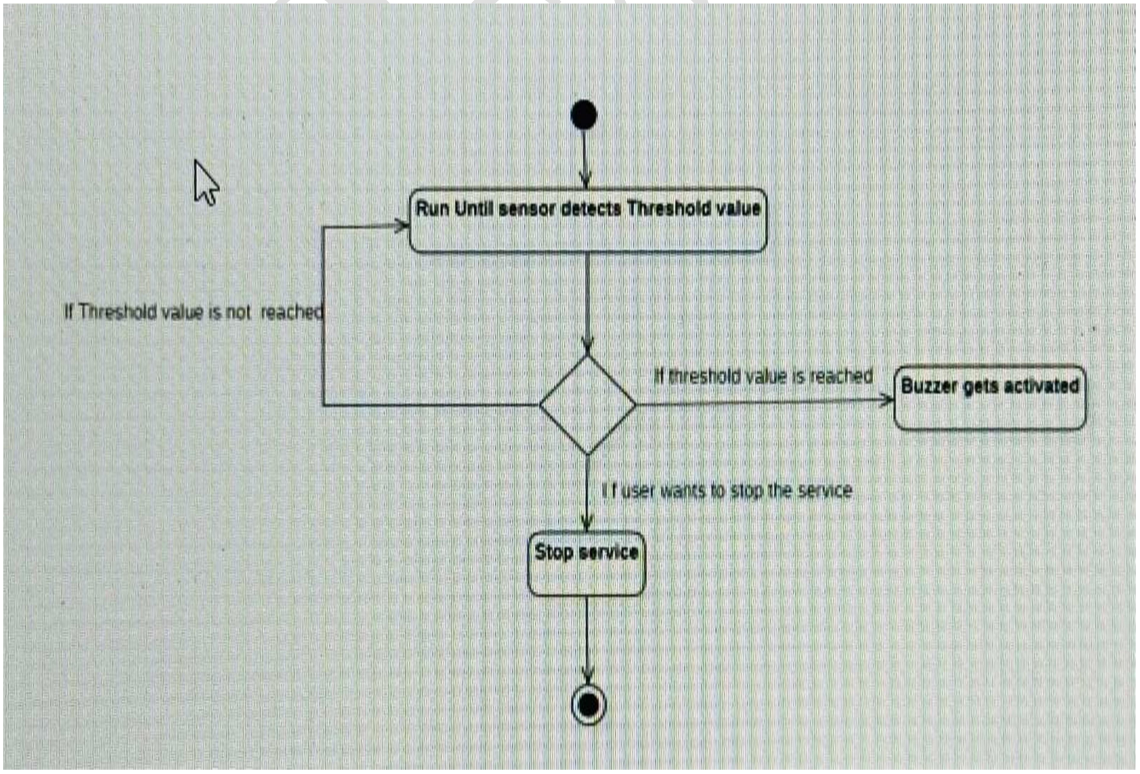
Flow Chart of Router X-Bee[1]

Whenever the router receives an awakening signal from the coordinator, the coordinator requests data from the router. This technique is referred to as the pull approach and is particularly advantageous when there is a higher quantity of routers present. This occurs because when several routers transmit simultaneously, the coordinator is unable to get the data and may have a crash. Token passing is another crucial mechanism used in this system. While transmitting data, the router sends a token along with the data to the coordinator to indicate that the data

is being transferred. Once the coordinator receives the token containing the data, it transmits an acknowledgment signal to the router and ceases to send any further awakening signals to that router. Subsequently, it transmits a wake-up signal to the subsequent router, and this process continues. Data may be continually monitored either by the use of a hardware setup, namely a microcontroller, or by using Lab-View software.



Data Flow Diagram



Activity Diagram

SOFTWARE REQUIREMENTS SPECIFICATION (SRS)

Adafruit.io:

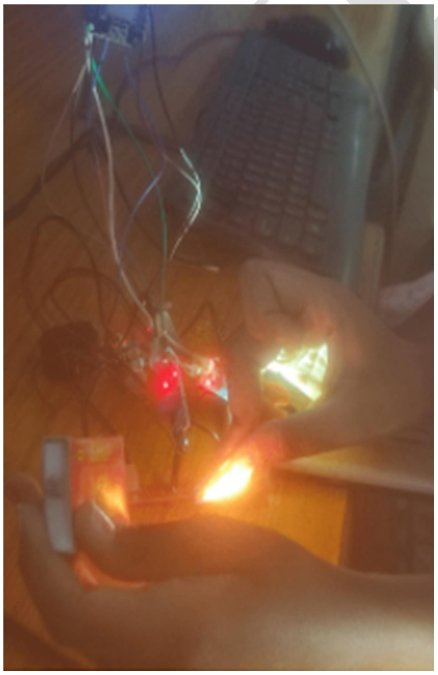
Adafruit.io is a cloud-based service. Users do not need to handle it. Users have the ability to establish a connection to it over the internet. Its primary purpose is to store and retrieve data, but it has other capabilities beyond that. Adafruit.io is a cloud service company that specializes on Internet of Things (IoT) deployments on the cloud. It has the capability to accommodate several hardware platforms such as Raspberry Pi, Arduino, and ESP2866.

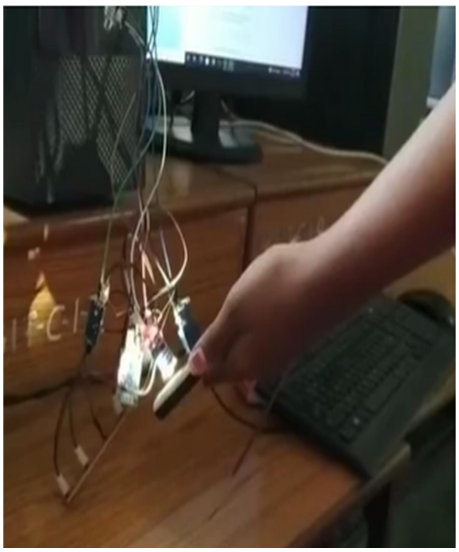
Adafruit io offers a robust API that includes libraries for many programming languages and built-in support for user interfaces. The dashboard provides a visual representation of the data via charts and graphs, facilitating informed decision-making. Data stored in the cloud is protected using more advanced encryption techniques. In addition, it has documentation and a community component.

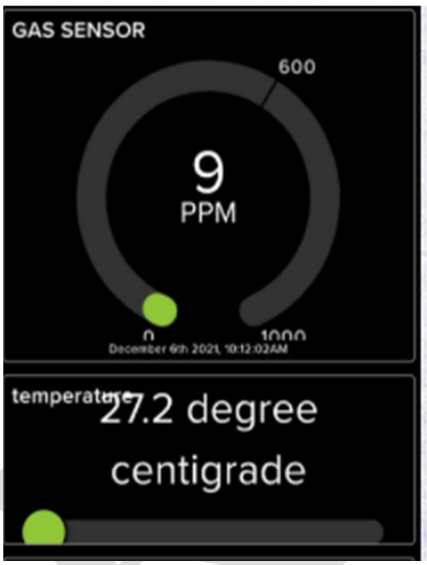
LUA scripting language:

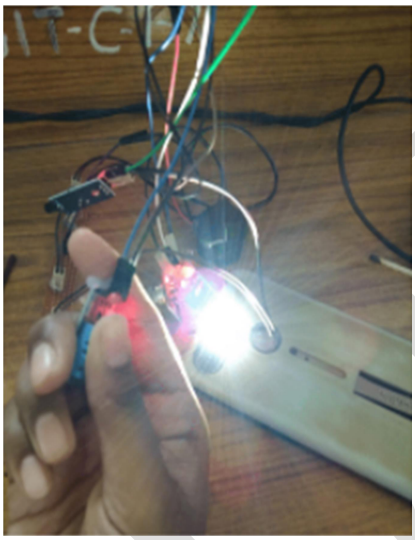
Lua is a compact and advanced scripting language that is mainly intended for use in embedded systems and game creation, while it is also used in several other domains. Lua is renowned for its compact size and high efficiency, which makes it well-suited for embedded systems that have limited resources. Developers may enhance the functionality of their C or C++ applications by using Lua scripts. The embedding method entails including the Lua interpreter into the C or C++ program and establishing channels for communication between the application and Lua scripts.

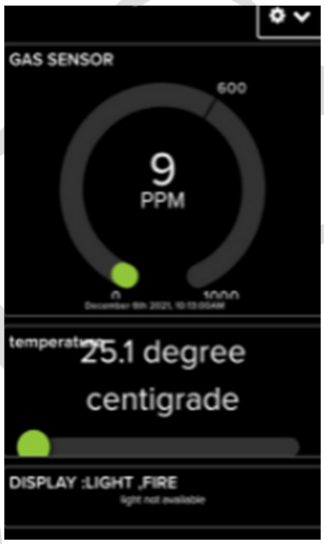
RESULTS

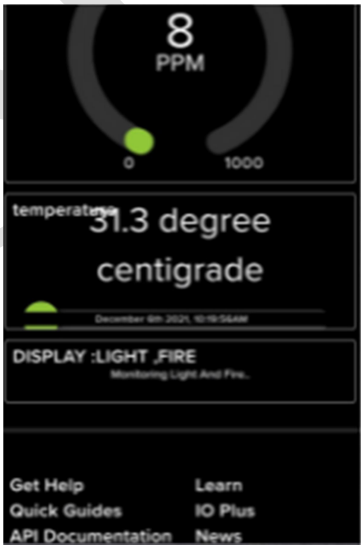


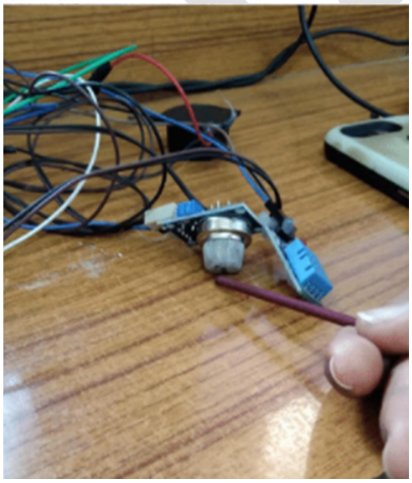


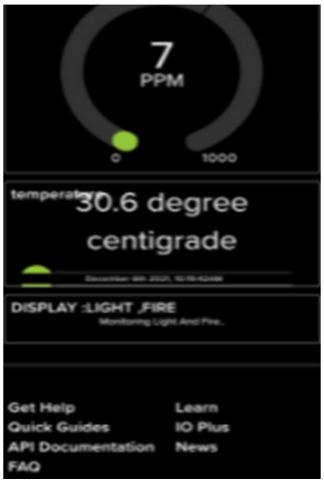

GAS SENSOR
600
9
PPM
0
1000
December 6th 2021, 10:12:02 AM
temperature
27.2 degree
centigrade




GAS SENSOR
600
9
PPM
0
1000
temperature
25.1 degree
centigrade
DISPLAY :LIGHT ,FIRE
light not available


8
PPM
0
1000
temperature
31.3 degree
centigrade
DISPLAY :LIGHT ,FIRE
Monitoring Light And Fire..
Get Help
Learn
Quick Guides
IO Plus
API Documentation
News




7
PPM
0
1000
temperature
30.6 degree
centigrade
DISPLAY :LIGHT ,FIRE
Monitoring Light And Fire..
Get Help
Learn
Quick Guides
IO Plus
API Documentation
News
FAQ


Dashboards > iot based coal mine monitoring and alerting system
GAS SENSOR
600
27
PPM
0
1000
temperature
27.6 degree
centigrade
DISPLAY :LIGHT ,FIRE
Monitoring Light And Fire..

CONCLUSION

Overall, the IoT-based Coal Mine Safety Monitoring and Alerting System is an innovative method for enhancing safety protocols in coal mines. This system seeks to use IoT technology to enhance safety in mining operations, minimize the occurrence of accidents, and promote the sustainable growth of the mining sector.

References

1. Xusheng Z and Yunlong Z. 2010. Accident cause analysis and counter measure of coal and gas outburst nearly two years of our country[J]. Mining Safety and Environmental Protection. 37(1): 84-87.
2. Dawud Y. 1999. "Smoke episodes and assessment of health impacts related to haze from forest fires:lndonesian experience". The Indonesian Association of Pulmonologist, Persahabatan Hospital Jakarta. pp. 3I3-322.
3. Gongbo Zhou, Zhencai Zhu, Guangzhu Chen, Ningning HU,2009, Energy-Efficient Chain-type Wireless Sensor Network for Gas Monitoring, Second International Conference on Information and Computing Science
4. Dani Martinez, Javier Moreno, Marcel Tresanchez, Merce Teixido, Davinia Font, Antonio Pardo,Santiago, Marco and Jordi Palacin 20IIExperimental application of an autonomous mobile robot for gas leak detection in indoor environments
5. Jinhao Sun, Jinhao Sun Yezi Li Xiaojin Ya, 201I The design of automatic detection processing deviceof gas leakage based on the MB95204K, IEEE-978-1-4244-8165-11l I
6. HE Si-yuan,2008, The Research of Energy Eficient MAC Protocols in Gas Monitoring System of Mine. International Symposium on Information Science and Engieering
7. Mohd Erwan Mohd Ussdek, Syed Abdul Mutalib AI Junid, Zulkitli Abd Majid, Fairul Nazmie Osman, Zulkitli Othman,2013, High Sensitivity Gas Detection and Monitoring System for High-Risk Welding Activity, Conference on Systems, Process & Control (TCSPC20I3), 13-IS December 20I3, Kuala Lumpur, Malaysia.
8. Y.P. Zhang, G. X. Zheng, J. H. Sheng, "Radio Propagation at 900 MHz in Underground Coal Mines", IEEE transactions on antennas and propagation, vol.49(5), pp. 752-62, 2001.
9. E. Stanek, "Mine Electrotechnology Research: The Past 17 Years", IEEE transactions on industry applications, vol. 24(5), pp 818-1988
10. X. Ma, Y. Miao, Z. Zhao, H. Zhang, J. Zhang, "A novel approach to Coal and Gas Outburst Prediction Based on Multi-sensor Information Fusion", Proc. IEEE international conference on automation and logistics, pp 1613-18, China 2008.
11. C. Qiang, S. J. Ping, Z. Zhe, Z. Fan, "ZigBee Based Intelligent Helmet for Coal Miners", Proc. IEEE World Congress on Computer Science and Information Engineering, pp. 433-35, 2009.