Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 4, April : 2024

CONNECTED GUARDIAN:

COAL MINE DETECTION AND ALERTING SYSTEM USING IOT

Mrs. A Sruthi Patro[1], Tirumala Raju Karthik Varma[2], Alluri Govinda Varma[3], Botta Rohit Yadav[4] , Gonnabathula Hemanth Srinivas[5]

[1] **Assistant Professor, Department of Computer Science & Engineering, Raghu Engineering College, Vishakhapatnam, Andhra Pradesh**

[2,3,4,5] **Student of B-TECH, Raghu Engineering College, Vishakhapatnam, Andhra Pradesh**

Email: - sruthi.annepu@raghuenggcollege.in, karthikvarma9789@gmail.com, agovindavarma@gmail.com, rohitabhiabhi@gmail.com, hemanth20031104@gmail.com

ABSTRACT

The process of removing coal from the earth is called coal mining. Coal is used as fuel by the steel and cement industries to extract iron from iron ore and to make cement. The category that includes the underground mining business includes all parameters that need to be routinely monitored, including methane gas, high temperatures, fire accidents, and so on. The safe production level of coal mines is still low, and frequent tragedies there result in significant loss of life and property. It is crucial to keep an eye on the working conditions in coal mines since the variety of work done there and the complexity of the mine environment are the main causes of disasters. Nevon Projects has suggested using a wireless sensor network in a coal mining safety system as a solution to this issue.Conventional coal mine monitoring systems are dangerous, hard to install, and hard to maintain. In order to improve mineworker productivity and safety, it is essential to monitor and maintain the parameters in the background due to the intricacy of the mining environment and the variety of operations carried out in coal mines. Because of this, it is impossible to guarantee the safety of coal miners using conventional monitoring techniques. This study illustrates a smart helmet-based wireless monitoring system. Critical coal mine data, including methane gas, high temperatures, humidity, and fire, can be detected and transmitted by the wireless monitoring system that is being provided.This monitoring system sends out distress signals in an emergency. If emergency conditions are found, a buzzer will sound and the user interface machine will show the variables that are being monitored. In addition, the parameters are wirelessly sent to the control center so that individuals may ascertain the mine's safety condition. It is simple to reprogramme this model. The stability and dependability of the system have been shown through experiments.

KEYWORDS: IOT, ESP8266, NODE MCU, SENSORS, HAZARD DETECTION, GAS DETECTION, GSM MODULE

1. INTRODUCTION

All that is involved in the Internet of Things (IoT) is machines utilizing the network to exchange data with one another. IoT applications are diverse on a broad scale. Smart buildings, smart transportation, smart power, smart business, smart health, and smart environment are among the principal categories that are classified as essential IoT technologies by the European Research Cluster on the Internet of Things. All sensor data is stored in the cloud by IoT, a cutting-edge technology that makes it readily available over the internet. Additionally, this technology uses actuators and sensors for data delivery over the internet. In addition to storing data, cloud computing is also used for data analysis, capture, and visualization.

With the usage of this cutting-edge technology, several Internet of Things applications, including smart homes, agriculture, and health, can increase the effectiveness of their current systems. Resource pooling, elasticity, on-demand service delivery, and ubiquitous connectivity are some of the main characteristics of the cloud. India is home to 493 coal mines. The most significant commodity in the world is coal. These petroleum products are the natural resources found on Earth, helping to meet certain people's requirements and provide energy. Since coal is a non-sustainable resource that cannot be widely substituted by

humans, there have been several accidents in the mines, endangering the lives of the miners who work there. Sadly, on occasion, miners have even lost their lives in the mines.

This monitoring system sends out distress signals in an emergency. If emergency conditions are found, a buzzer will sound and the user interface machine will show the variables that are being monitored. In addition, the parameters are wirelessly sent to the control center so that individuals may ascertain the mine's safety condition. It is simple to reprogramme this model. The stability and dependability of the system have been shown through experiments.

2. LITERATURE SURVEY

2.1 Literature Survey :

Yongping Wu and Guo Feng: Implement coal mine monitoring using the Bluetooth wireless transmission system. Bluetooth technology is a standard for unified global short-range wireless communication, establishing a common low-power, low-cost wireless air interface and controlling software opening system. This paper describes the development background, technical features, and the structure of the protocol stack of Bluetooth technology and proposes solutions for the Bluetooth host controller interface (HCI) wireless communication complexity [1].

Zhenzhen Sun: Proposed DCS Coal Mine Monitoring System Based on RS485 Bus. The RS485 bus structure supports multi-point and two-way communication, allowing the system to be developed using common 8-bit microcontrollers. It offers simple circuit structure and low costs. However, due to the adoption of a master-slave structure network, it is difficult to guarantee the reliability of the network structure. Additionally, the data transmission distance is limited with poor real-time performance [2-3].

Jingjiang Song, Yingli Zhu: Proposed an automatic monitoring system for coal mine safety based on wireless sensor network. This system design for coal mine safety is constructed by MSP430F and nRF2401. The sensor groups of the system intensively monitor temperature, humidity, and other parameters in the underground mine, with parameters measured sent to a wireless communication module by the microcontroller. The collected information is then sent to a long-distance monitoring centre by cable [4]. However, a problem with this implementation is that hardware placed inside the coal mines is susceptible to damage during natural calamities or roof falls, leading to poor reliability and short system life. The harsh environment inside the mine also makes system installation and maintenance difficult. Additionally, the noisy working conditions inside the coal mine can interfere with proper message transmission if the distance between the miner and the system is too long.

Yogendra S Dohare and Tanmoy Maity: Designed a surveillance and safety system for underground coal mines based on Low Power WSN. This system uses a low-power, cost-effective, Zigbee protocol-based wireless sensor network to provide an intelligent surveillance and safety system for underground coal mines. It consists of wireless connection of several nodes, easily placed in underground mines to provide an effective surveillance and safety system for underground coal miners. Especially, it provides real-time data communication between miners and the surface control room through highly secure, reliable wireless sensor nodes [5]. However, a challenge with this system arises when miners are not within the range of the system. Additionally, this system only monitors the environmental conditions of the underground mine but does not monitor the health condition of the miner.

3. IMPLEMENTATION STUDY

We will use zig-bee software and three sensors such as temperature, humidity and gas sensor. Three sensors will detect the change in parameters of the environment and will give the information to the microcontroller. Then the microcontroller can check these values up to date, if any of the value exceeds the approved value, it will warn the person through the buzzer. This information is passed through the ZigBee module to the base station. Then the base station department must take safe measures to safeguard the people who work in coal mining.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 4, April : 2024

3.1 PROPOSED METHODOLOGY

The proposed system aims to enhance coal mine safety by integrating various sensors and IoT technology. The system includes components such as a GSM module, ESP8266, DHT11 for temperature and humidity sensing, a gas sensor, and a switch. These sensors are interconnected to continuously monitor environmental conditions within the coal mine. Data from the sensors is transmitted to the cloud for real-time analysis and further utilization. To ensure prompt response to potential hazards, thresholds are set for each sensor. If any sensor reading surpasses its predefined threshold, an alert is triggered, and the GSM module sends an SMS notification to designated recipients, providing details of the exceeded threshold. Additionally, the system allows for user interaction through a switch. When the switch is pressed, an SMS is sent to indicate the event. By implementing these functionalities, the system offers comprehensive monitoring and timely notifications, contributing to improved safety measures in coal mining operations.

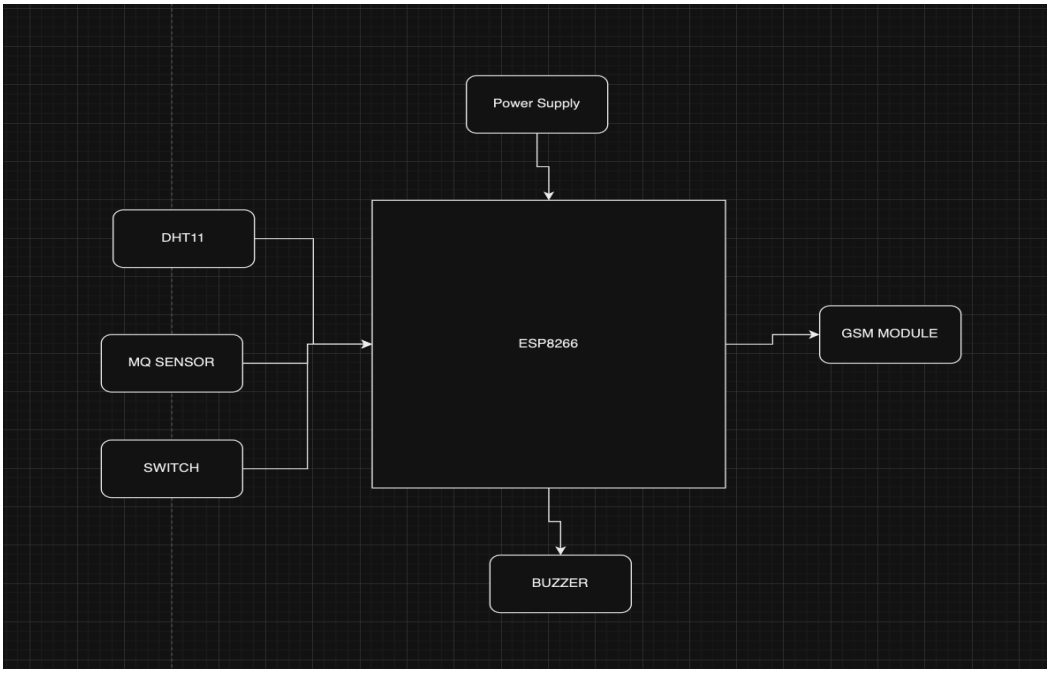

Fig 1:- Block Diagram

4. RESULTS AND DISCUSSION SCREEN SHOTS

Output Screenshots:

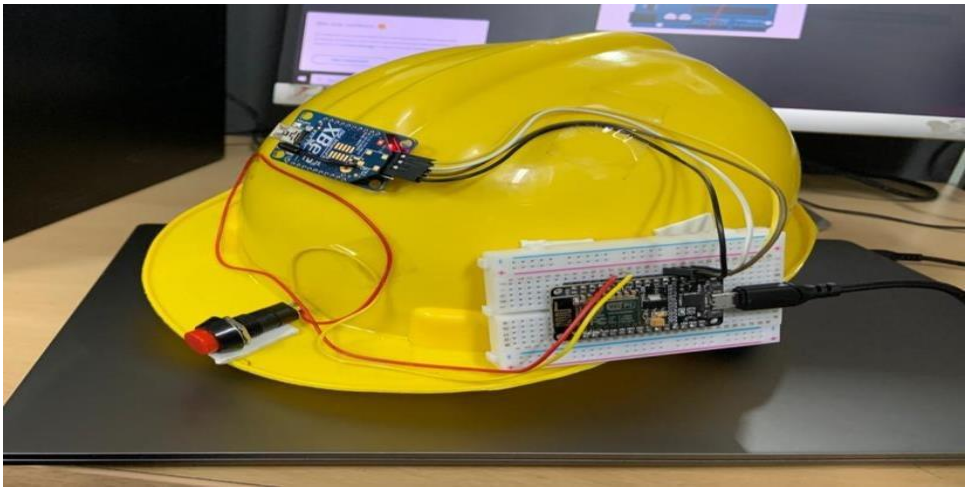

Fig 2:- prototype of product

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 4, April : 2024

Fig 3:- results displayed in dash board

5. CONCLUSION & FUTURE WORK

5.1CONCLUSION

The project's design, hardware components, and software implementation, as detailed in the report, demonstrate a systematic approach to addressing safety concerns in coal mines. The use of MQTT for communication, Adafruit IO platform for data visualization, and the integration of specific sensors for gas detection and environmental monitoring reflect a comprehensive strategy for ensuring worker safety in hazardous mining environments.

Future enhancements, such as adding moisture sensors for flood prevention and implementing a fail-safe operation with redundant systems, showcase a forward-thinking approach to improving the system's functionality and reliability. While the project offers several advantages, including cost-effectiveness and remote monitoring capabilities, challenges like internet connectivity failures and sensor lifespan limitations highlight areas for further optimization.

In conclusion, the "Coal-Mine Detection and Alerting System Using IoT" project presents a well-rounded solution for enhancing safety standards in coal mining operations. By combining IoT technology, sensor networks, and cloud-based data analysis, the project demonstrates the potential to mitigate risks, improve operational efficiency, and provide timely alerts for ensuring the well-being of workers in the mining industry.

5.2 FUTURE SCOPE

. We can use a moist sensor to detect the moisturizing content in the soil to prevent the sudden floods in the mines. We can use the wireless underground sensor network (WSN) to transmit and received the data through the soil in mines to improve the network facilities in the underground mines.We can use a moist sensor to detect the moisturizing content in the soil to prevent the sudden floods in the mines. We can use the wireless underground sensor network (WSN) to transmit and received the data through the soil in mines to improve the network facilities in the underground mines.

Future enhancements for an IoT-based Coal Mine Safety Monitoring and Alerting System could include:

Advanced Sensor Technologies: Integration of advanced sensor technologies such as AI-based gas sensors for more accurate and reliable gas detection.

Predictive Analytics: Implementing predictive analytics algorithms to forecast potential hazards based on historical data, enabling proactive measures to prevent accidents.

Machine Learning Algorithms: Utilizing machine learning algorithms for real-time data analysis to improve the system's ability to detect anomalies and issue timely alerts.

Integration with Wearable Devices: Integrating IoT devices into wearable safety gear for miners, providing real-time health and safety monitoring.

Autonomous Robots: Deployment of autonomous robots equipped with IoT sensors for remote monitoring and emergency response in hazardous areas of the mine.

Blockchain Technology: Implementing blockchain technology for secure and transparent data management, ensuring the integrity and authenticity of sensor data.

Energy Harvesting: Implementing energy harvesting techniques to power IoT devices, reducing reliance on external power sources and improving sustainability.

6. REFERENCES

[1] Yongping Wu and Guo Feng, “The study on coal mine monitoring using the Bluetooth wireless transmission system,” 2014 IEEE Workshop on Electronics, Computer and Applications, pp. 1016-1018, 2014.

[2] Xiaolong Feng, Jiansheng Qian, Zhenzhen Sun, Xing Wang, "Wireless Mobile Monitoring System for Tram Rail Transport in Underground Coal Mine Based on WMN," 2010 International Conference on Computational Aspects of Social Networks, pp.452-455, 2010.

[3] Yi-ming Tian, You-rui Huang, Yi-qing Huang, "Intelligent Information Processing of WSN Based on Vague Sets Theory and Applied in Control of Coal Mine Monitoring," 2008 ISECS International Colloquium on Computing, Communication, Control, and Management, vol. 2, pp.649-652, 2008.

[4] Jingjiang Song, Yingli Zhu, and Fuzhou DongK, “Automatic Monitoring System for Coal Mine Safety Based on Wireless Sensor Network,” IEEE Radio Science and Wireless Technology Conference, pp.933-936, 2011.

[5] Yogendra S Dohare and Tanmoy Maity, “Surveillance and Safety System for Underground Coal Mines Based on Low Power WSN,” IEEE, pp.116-119, 2014.

[6] Valdo Henriques and Reza Malekian, “Mine Safety System Using Wireless Sensor Network,” IEEE, pp. 1-12, 2016.

[7] Huping Xu, Feng Li, Yancheng Ma, "A ZigBee-based Miner Localization System," IEEE, 2012. Shuo Pang, Ricardo Trujillo, "Indoor Localization Using Ultrasonic Time Difference of Arrival," IEEE, 2013.

[8] Yongping Wu, Guo Feng, Zhang Meng, "The Study on Coal Mine Using the Bluetooth Wireless Transmission," IEEE

[9] Yuping Zhang, Yinghui Zhang, Chen Li, "Research of Short Distance Wireless Communication Technology in the Mine Underground," IEEE, 2014.

[10] Manash Jyoti Deka, Jetendra Joshi, Nishchay Sinha, Aman Tyagi, Apoorv Kushal Avijit Jain, "Indoor and Outdoor Position Identification Using RFID," IEEE, 2016.

[11] Mengda Wang, Bing Xue, Wei Wang, Junjie Yang, "The Design of Multi-User Indoor UWB Localization System," IEEE, 2017.

[12] Nisha Dube, Prof. K.S.Ingle, "Intelligent Mining: A Monitoring and Security System for Coal Mine Workers," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297:2007 Certified Organization) Vol. 5, Issue 1, January 2016.