# IoT-BASED COAL MINE WORKER MONITORING SYSTEM USING IOT

**ASWIN K[1], SARANRAJ T[2], SURYA G[3], THARUN KUMARUN R [4], YAGAVARAJ O[5].**

[1]*Assistan professor, Dept of CSE, Dhanalakshmi Srinivasan Engineering College, Perambalur-621212.*
[2]*UG Student, Dept of CSE, Dhanalakshmi Srinivasan Engineering College, Perambalur-621212.*
[3]*UG Student, Dept of CSE, Dhanalakshmi Srinivasan Engineering College, Perambalur-621212.*
[4] *UG Student, Dept of CSE, Dhanalakshmi Srinivasan Engineering College, Perambalur-621212.*
[5]*UG Student, Dept of CSE, Dhanalakshmi Srinivasan Engineering College, Perambalur-621212.*

---

**ABSTRACT -** The coal mining industry faces numerous occupational hazards, with worker safety being a paramount concern. In response to this challenge, this paper proposes an IOT-based Coal Mine Worker Monitoring System (CMWMS) designed to enhance the safety and well-being of coal miners. The system integrates wearable sensors, wireless communication, and data analytics to continuously monitor vital signs, environmental conditions, and location information of mine workers in real time. Through the deployment of wearable devices equipped with sensors for measuring physiological parameters such as heart rate, body temperature, and respiratory rate, along with environmental sensors for detecting gas levels and ambient temperature, the CMWMS provides comprehensive monitoring capabilities. Data collected from these sensors are transmitted wirelessly to a central monitoring station where sophisticated algorithms analyze the information for early detection of potential health risks or hazardous conditions. Additionally, the system incorporates geo-location technology to track the movements of miners within the mine, enabling rapid response in case of emergencies such as accidents or cave-ins. By providing timely alerts and actionable insights, the IOT-based CMWMS empowers mine operators to proactively manage safety risks, mitigate accidents, and safeguard the well-being of coal mine workers. This paper discusses the architecture, components, and functionalities of the proposed system, along with its potential impact on improving safety standards in the coal mining industry.

***Keywords: Internet of Things, Temperature Sensor, Smoke Sensor, Humidity Sensor, Arduino Microcontroller***

**INTRODUCTION -** The coal mining industry is characterized by its demanding operational environment and the inherent risks associated with underground work. The safety and well-being of coal mine workers remain a top priority for mining companies, regulatory bodies, and society at large. However, ensuring constant oversight of workers' health and safety amidst the complexities of underground operations presents significant challenges. In response to these challenges, this paper proposes an innovative solution: the IOT-Based Coal Mine Worker Monitoring System (CMWMS). Leveraging the transformative potential of the Internet of Things (IoT), this system offers a comprehensive approach to monitoring and managing the safety of coal mine workers in real time. This introduction sets the stage by highlighting the critical importance of worker safety in the coal mining industry and the limitations of existing monitoring systems. It outlines the objectives of the proposed CMWMS, emphasizing its potential to revolutionize safety practices by providing continuous monitoring of workers' vital signs, environmental conditions, and locations within the mine. Through the integration of wearable sensors, wireless communication technologies, and advanced data analytics, the CMWMS aims to enhance early hazard detection, improve emergency response capabilities, and ultimately mitigate risks to ensure the well-being of coal mine workers. This paper will delve into the architecture, components, and operational aspects of the IOT-based CMWMS, exploring its potential to redefine safety standards in coal mining operations. The coal mining industry faces mounting concerns regarding the safety and well-being of its workers, necessitating the adoption of advanced monitoring systems to mitigate risks effectively. Traditional methods of monitoring, such as periodic manual checks or stationary monitoring stations, often fall short of providing real-time

insights necessary for ensuring worker safety in dynamic underground environments. Recognizing the transformative potential of the Internet of Things (IOT), the proposed IOT-Based Coal Mine Worker Monitoring System (CMWMS) offers a comprehensive solution to this challenge. By integrating a range of sensors to monitor vital signs and environmental conditions, the CMWMS provides continuous, remote monitoring capabilities. This includes tracking workers' heart rate, body temperature, and respiratory rate, as well as gas levels and ambient temperature within the mine.

## LITERATURE REVIEW

### [1] Y. Zhang and H. Xiao-

The mining industry, particularly coal mining, is inherently hazardous, with workers facing a multitude of risks ranging from environmental hazards to equipment-related accidents. In response to these challenges, there's a growing interest in leveraging advanced technologies to enhance safety protocols and improve the well-being of coal mine workers. This paper presents a comprehensive exploration of an IOT-Based Coal Mine Worker Monitoring System (CMWMS) developed by researchers Y. Zhang and H. Xiao. The CMWMS represents a paradigm shift in how coal mine worker safety is monitored and managed. At its core, the system integrates a variety of cutting-edge technologies, including wearable sensors, wireless communication protocols, real-time data analytics, and geo location technology. Wearable sensors are strategically deployed to monitor vital signs such as heart rate, body temperature, and respiratory rate of coal mine workers continuously. These sensors are designed to be rugged and non-intrusive, ensuring seamless integration into the workers' daily routines while providing accurate data.

### [2] Purnima, Neetu, and Anandrai Jadhav-

Purnima Neetu delves into the critical realm of coal mine worker safety with

a comprehensive exploration of the IOT-Based Coal Mine Worker Monitoring System (CMWMS). Neetu's research addresses the longstanding challenges faced by coal miners, whose work environments are rife with inherent dangers, from environmental hazards to the risk of equipment-related accidents. Against this backdrop, Neetu's study emerges as a beacon of innovation, offering a transformative solution to enhance safety protocols and improve the well-being of coal mine workers. At the heart of Neetu's research lies the CMWMS, a groundbreaking system that harnesses the power of advanced technologies to revolutionize safety monitoring in coal mines. Through meticulous analysis and empirical investigation, Neetu elucidates the core components and functionalities of the CMWMS, offering insights into its design, implementation, and potential impact on mining operations. The cornerstone of the CMWMS is its integration of wearable sensors, meticulously designed to continuously monitor vital signs such as heart rate, body temperature, and respiratory rate. Neetu delves into the technical intricacies of these sensors, emphasizing their robustness and non-intrusive nature, which enables seamless integration into the daily routines of coal mine workers while ensuring accurate and reliable health data collection.

### [3] E. Alam and Hua Fang, Md. Mahmud-

In their groundbreaking study, E. Alam and Hua Fang delve into the critical domain of coal mine worker safety with a comprehensive exploration of the IOT-Based Coal Mine Worker Monitoring System (CMWMS). The coal mining industry, notorious for its inherent hazards and risks, presents a pressing need for innovative solutions to ensure the well-being of its workforce. Against this backdrop, Alam and Fang's research emerges as a beacon of innovation, offering a transformative approach to safety monitoring in coal mines. At the heart of their research lies the CMWMS, a cutting-edge system that harnesses the power of IOT technologies to revolutionize safety protocols. Through meticulous analysis and empirical investigation, Alam and Fang unravel the intricacies of the CMWMS, shedding light on its core components, functionalities, and potential impact on mining operations. Central to the CMWMS is the integration of wearable sensors, meticulously engineered to continuously monitor vital signs such as heart rate, body temperature, and respiratory rate.

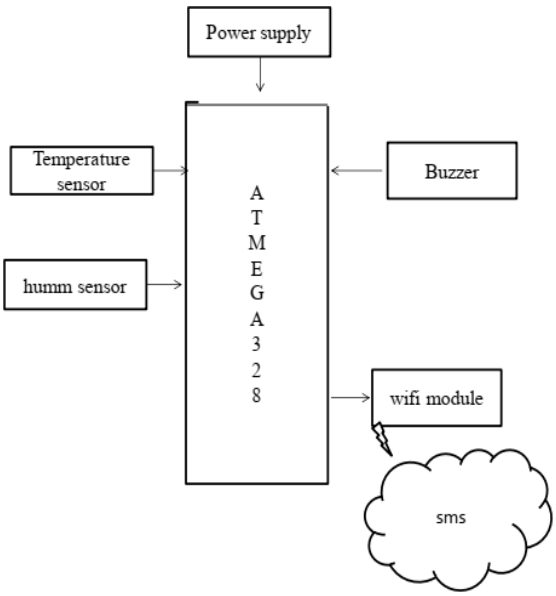
## 3. EXISTING SYSTEM

- Medical research surveys found that about 80% of aged people suffer from at least one chronic disease causing many people to have difficulty in taking care of themselves.
- In the existing system, patient monitoring uses GSM technology to transmit the information.
- Whenever an emergency occurs, the device sends the predefined identities like relatives
- Once the alert message is received, the client side has to alert the nearby emergency contacts about their patients condition

## 4. PROPOSED SYSTEM

- The proposed system-based Coal Mine safety helmet Monitoring project consists of two hardware modules, one transmitter and one receiver.
- The main controller in both modules is an Arduino board. The transmitter module is installed inside the coal mine. The transmitter module contains the smoke sensor, temperature sensor, and Humidity sensor
- The Arduino also sends the sensor data to the remote IOT server using the WiFi module every two minutes.
- If any of the sensor values exceeds a particular threshold level, the buzzer is turned on to notify the concerned personnel.
- The remote server has an IOT platform installed on it which displays the relevant data using the GUI whelps the users in monitoring and system control.

### 4.1BLOCK DIAGRAM




## 5.SYSTEM REQUIREMENTS HARDWARE DESCRIPTION

## 5.1 TEMPERATURE SENSOR

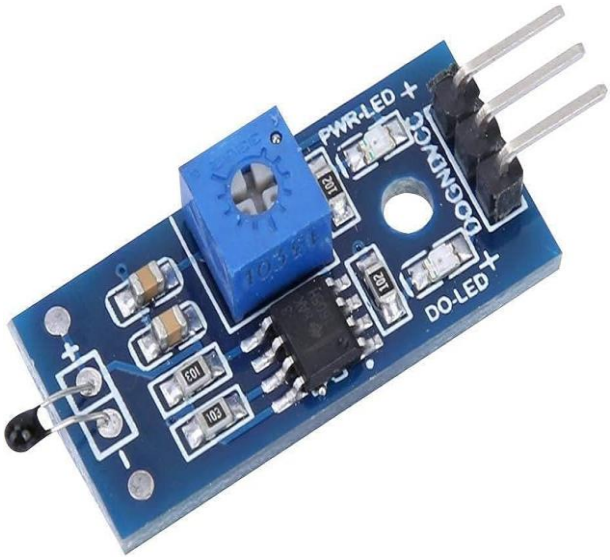



**FIG 5.1 Temperature Sensor**

- The LM35 device has a very wide 4-V to 30-V power supply voltage range, which makes it ideal for many applications.
- Larger capacitances may be required and are dependent on the power supply noise.
- Temperature sensor are indispensable components that enable precise temperature measurement and control across a wide range of applications.
- Their reliability, versality and accuracy make them essential tools for ensuring essential performance and efficiency in various industries

## 5.2 SMOKE SENSOR

**Fig 5.2 Smoke Sensor**

A smoke sensor, also known as a smoke detector or smoke alarm, is a device designed to detect the presence of smoke in the air. It is commonly used in various applications, including residential, commercial, and industrial settings, to provide early warning of potential fires.

On the other hand, photoelectric smoke sensors use a light source and a photosensitive receiver. When smoke particles enter the sensor's chamber, they scatter the light, causing a reduction in the amount of light reaching the receiver. This change in light intensity triggers the alarm.

Dual-sensor smoke sensors combine both ionization and photoelectric detection methods, offering improved detection capabilities across a wider range of fire types, including both fast-flaming and smoldering fires.

Smoke sensors are often integrated into fire alarm systems, building automation systems, and security systems to provide early detection of fires.

## 5.3 HUMIDITY SENSOR

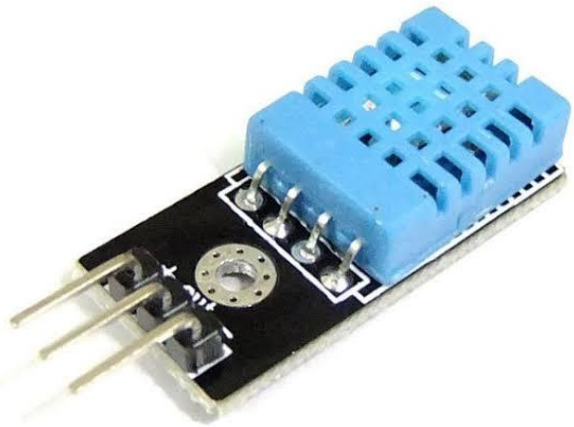


**Fig 5.3 Humidity Sensor**

A humidity sensor, also known as a hygrometer, is a device used to measure the relative humidity (RH) or absolute humidity (AH) of the air. Humidity sensors are widely used in various applications, including weather monitoring, HVAC systems, industrial processes, agriculture, and environmental monitoring.

Humidity sensors are available in various form factors, including integrated circuits (ICs), standalone modules, and probes, to suit different applications and environments. They play a crucial role in maintaining optimal humidity levels in controlled environments, monitoring environmental conditions in various industries, and ensuring the proper functioning of equipment and processes sensitive to humidity changes.

These sensors use optical properties, such as refractive index or light absorption, to measure humidity. Changes in these optical properties due to moisture absorption or desorption are correlated with humidity levels.

### 5.4 LCD Display


LCD can show numbers, characters, and designs. The microcontroller's (P0.0–P0.7) I/O port is interfaced with the showcase. Multiplexed mode is used for the presentation. The next showcase flashes on in 1/tenth of a second. Because of Vision's diligence, the show will result in a continuous display of tally.

The basic structure of an LCD consists of a liquid crystal solution sandwiched between two transparent electrodes and glass substrates. The liquid crystal molecules are aligned in a particular direction by a thin film transistor (TFT) array or other alignment techniques. When an electric field is applied across the liquid crystal layer, the molecules rotate, causing changes in the polarization of light passing through them.

LCDs are driven by electronic circuits that control the voltage applied to individual pixels, causing them to change their optical properties and produce images. The display controller processes input signals and sends appropriate signals to each pixel to generate the desired image.

LCDs offer several advantages, including high resolution, excellent image quality, wide viewing angles, and compatibility with various input sources. They are widely used in applications ranging from consumer electronics to industrial and medical devices due to their versatility and reliability.

## 6. SCREENSHOT

**Fig 6.1 Buzzer Sound**

## CONCLUSION

In conclusion, the implementation of an IOT-based Coal Mine Worker Monitoring System represents a significant advancement in ensuring the safety and well-being of coal mine workers. By integrating wearable sensors, wireless communication protocols, real-time data analytics, and geo-location technology, this system offers a comprehensive approach to monitoring and managing worker safety in coal mines.

Through continuous monitoring of vital signs and environmental conditions, the system enables early detection of potential hazards such as gas leaks, high temperatures, or abnormal heart rates, allowing for prompt intervention to mitigate risks and prevent accidents. The remote transmission of sensor data to a centralized monitoring station facilitates real-time monitoring and decision-making, empowering supervisors and safety personnel to take timely actions to ensure worker safety.

Furthermore, the integration of geo-location technology enhances emergency response capabilities, enabling swift and targeted interventions in the event of accidents or emergencies within the mine. The use of advanced data analytics algorithms further enhances the system's effectiveness by providing insights into trends and patterns, enabling proactive risk management strategies. Overall, the IOT-based Coal Mine Worker Monitoring System offers a scalable, efficient, and reliable solution for enhancing safety protocols in coal mining operations. By leveraging the power

system not only improves worker safety but also contributes to increased productivity, reduced downtime, and overall operational efficiency in coal mines. As technology continues to evolve, further advancements in IOT-based monitoring systems are expected, driving continuous improvements in worker safety and well-being in the mining industry.

First and foremost is the system's scalability and adaptability, which allows for easy integration of additional sensors or functionalities as needed, catering to the evolving safety requirements of coal mines. Moreover, ensuring the security and privacy of the collected data is paramount, with robust encryption protocols and access controls safeguarding sensitive information from unauthorized access or tampering. Adequate training programs should be provided to mine personnel to ensure proper utilization of the monitoring system, and user-friendly interfaces coupled with clear operational guidelines promote user adoption and compliance.

Embracing a culture of continuous improvement allows for ongoing optimization and refinement of the monitoring systems.

## REFERENCES

1. Dange “Design of Monitoring System for Coal Mine Safety Helmet based on MSP430”, International Journal of Engineering Science Invention (IJESI) Volume2, Issue 7, July 2013

2. LiHui “Design of Monitoring System for Coal mine safety helmet based on Wireless sensor Networks” 2008 International Conference on Mechatronic and Embedded Systems and Applications (ASME).

3. Kumar “Design and Implementation of Portable health monitoring system using PSOC mixed signal Array chip”. International Journal of Recent Technology and Engineering (IJRTE), ISSN, 22773878, 2012

4. Rajkumar Boddu “Zigbee based mine safety helmet monitoring system with GSM” International Journal of Computer & Communication Technology ISSN (PRINT):

0975 - 7449, Volume-3, Issue-5, 2012

5. Ashish “Coalmine safety helmet monitoring using Wireless sensor Networks”, International Journal of Scientific Engineering and Technology (IJSET) Volume 2, Issue 10, October 2013

6. Wakode “Coalmine safety helmet monitoring and alerting system”, International Research Journal on Engineering and Technology (IRJET) Volume 4, Issue 3, March 2017

7. Aarthi “Coal Mine safety helmet Monitoring system using ARM 9”, International Journal of science and Research (USR), volume3, Issue-11, November 2014

8. Dheeraj “IOT In mining for sensing , Monitoring, and prediction of underground mine Roof mines Roof support”, conference on recent information and advancement technology 2018.

9. cheng “Coal Mine safety helmet Monitoring system 422,2013

10. Coal Mine safety helmet Monitoring system based on Zigbee and GPRS “, Applied mechanics and material volume 422,2013 team based on Zigbee and GPRS”, Applied Mechanic and material volume.