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An Intelligent Helmet for Coal Mine Workers– A Survey

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ABSTRACT: The safety of coal mine workers remains a critical concern due to the hazardous working environment, where risks of accidents, gas leaks, and physical injuries are prevalent. This paper Presents a survey and proposes a concept for the development of an Intelligent Helmet to enhance the safety features of coal mine workers by integrating real-time tracking and alerting systems. This Intelligent helmet is primarily designed to be helpful for the safety of the workers in coal mines, field of construction and in the industries. It helps to keep monitor the workers environment. A Microcontroller based proposed system can monitor the leakage of gases, falling objects and any flame or fire in the surrounding environment. Also, if any dangerous accident occurs it will be immediately notified to the supervisor to take immediate action and remedies for the safety of the workers.

KEYWORDS: IoT, leakage of gases, real time monitoring.

I. INTRODUCTION

Coal Mining is an inherently hazardous industry where the safety of workers is very important. Even though by taking all the safety measures, due to unpredictable nature of mining environment coupled with presence of potentially dangerous gases. Due to this many accidents happen. Traditional safety practices, though essential, often fail shorten preventing accidents due to their reactive nature. There are no concerns regarding suffocation, heat or humidity for the workers. The number of miners who get trapped is never known because the mine management does not keep track of these early adjournments. Mine managers may have challenges in identifying the victims of accidents. The environment around mining is complicated since it release harmful gases like methane and carbonmonoxide [1]. As a consequence, the importance of tracing the scenario that could possibly lead to an accident would be required to protect humans safety.

The development of this intelligent smart helmet consists of transmitter and receiver segment. By providing a smart helmet to workers with integrated safety monitoring and alerting system, it ensures the continuous real time tracking of environment al conditions and workers safety. This Smart Helmet would increase efficiency and safety in coal mining environment.

II. LITERATURE SURVEY

Some studies associated with development of an Intelligent Helmet for Coal Mine Workers is presented here.
B. Bomirani et al., [1] developed a device based on technology called LoRa. It is a system that ensures all the hazards in the environment are detected within the available time through multi-sensing integration. It reduces risks from mining accidents and helps save lives as it promotes safety in mining.

Mali et al., [2] With the use of a wireless detector network, this technology has created an underground mine real time environmental monitoring system. It can identify unusual environmental conditions and sound an alarm. Few advantages of this system is flexible networking, adaptability, inexpensive installation and maintenance.

Mangesh Rudrawar et al., [3] developed a device to monitor the real time conditions and estimate the underground features of coal mine to prevent disasters. This intelligent Helmet proves to be beneficial in unusual environmental conditions.

Mir Sajaad Hussain Talpur et al., [4] This paper presents the design of a helmet capable of identifying three categories of potentially hazardous situations: elevated toxic gas concentrations, unauthorized removal of the mining helmet and collision incidents using IoT.

Divyasudha, N et al., [5] The smart helmet system is developed with IoT technology and is used to prevent the accidents in motor bikes, identify the bike accidents on time and also used to inform the rider about the rear vehicles to avoid collisions. The device analyzed in this paper is used in mining industry to alert and safeguard the miners from hazardous gas emissions.

Sowmya, T et al., [6], The objective of the proposed project is to create an intelligent helmet designed for mining personnel. This helmet will incorporate various sensors, communication systems, and emergency functionalities to improve the safety of workers operating in dangerous environments.

Roja, P. et al., [7] An advanced helmet has been developed to identify the dangerous gases, carbon monoxide (CO) and carbon dioxide (CO_2), that accumulate in mining environments. With this helmet, miners can receive timely notifications regarding the presence of these hazardous gases. Additionally, the system is capable of alerting the miner if the helmet is removed during operations within the mining sector. This technology employs GPRS for the transmission of data from the mining site to the server. The Internet of Things (IoT) technology is extensively utilized for data transmission purposes.

Dhanalakshmi, A. et al., [8] The smart helmet is used in hazardous event detection. Monitor the environmental conditions surrounding the place and update the central console about information like GPS location and sensor data to allow easy tracking and provision of oxygen supplements to prevent inhalation of poisonous gases. The database can be made that continuously monitors the sensor modules.

Deokar, S. R. et al., [9] To overcome the problem of unawareness about the accident met by the coal miner and improper treatment, The proposed system alerts the supervisor in case of an emergency. Additionally, it offers an early warning that can assist all miners within the mine to safeguard their lives prior to any potential casualties. This system employs Zigbee technology and GSM for data transmission.

Alam, Md Mahbubul et al., [10] This system does not only ensure the safety of the mine worker but also tells any sudden change of atmospheric conditions in the mine in a very simple way. Also, the values of different sensors can be transmitted outside through Zigbee technology. The implementation of heartbeat detecting sensor adds a great dimension to the safety of the worker. After any major accident, the state of the worker can be known by this sensor

Pandit, Vaibhav, et al., [11] The accuracy of the system is more in real time. Thist can be applied in industrial monitoring. It has the advantages of high speed of execution and extreme low power consumption using sophisticated sensors.

G.Ahalya et al., [12] This safety system is developed for the Cole mine workers by applying wireless sensor networks. It covers larger area inside the hazardous mines such that the accidents are controlled effectively. In this paper a low-complexity parameter, is proposed to identify the best node placement in wireless sensor network environments.

Rajkumar Boddu et al., [13] This system possesses the capability to measure gas concentration, temperature, humidity, wind speed, and to track the positions of miners within underground mine tunnels. The implementation of wireless sensor networks for monitoring coal mine safety represents a significant advancement over conventional methods and concepts, thereby enhancing the operational effectiveness and adaptability of the monitoring system.

Kiran Kishore et al.,[14] A smart helmet equipped with Zigbee technology is designed to monitor hazardous gases, abnormal temperature conditions, and humidity levels in the air. This helmet incorporates sensors that track environmental conditions within coal mines. In the event of a hazardous situation, the helmet transmits information to the control station via a Zigbee transmitter. Subsequently, the control station alerts the coal miner through a Zigbee receiver, activating a buzzer located in the helmet. This feature provides miners with an opportunity to safeguard their lives from potential dangers encountered in coal mining operations

III. EXISTING WORK

The existing system as shown in Fig.1, is An IoT-enabled smart helmet designed to assist underground workers in various capacities is being introduced. This smart helmet is equipped with various sensors and microcontroller. The sensors will observe the environment continuously and if any unfavourable condition occurs then the safety measures will be taken. However, the current system lacks a real-time monitoring capability. To address this limitation, the proposed system incorporates a real-time monitoring feature[2].
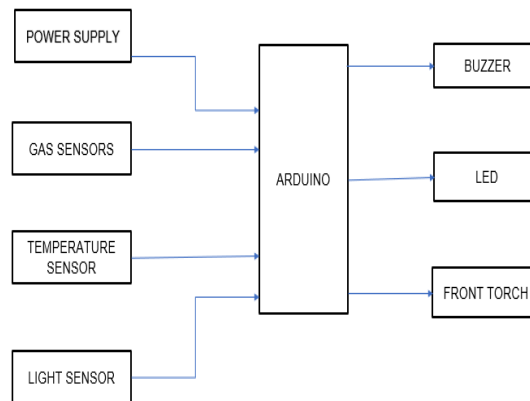

Fig. 1. Block Diagram representation of Existing Method

IV. PROPOSED WORK

The system outlined in Fig. 2.1 features a transmitter segment equipped with a microcontroller that gathers input from various sections such as accelerometer sensor, temperature sensor, heart rate sensor, gas sensor and camera. Web application is used for live streaming the collected data will get stored in cloud. The water sensor is used to detect water inrush in a coal seam floor. The information is sent from the radio frequency transmitter to the radio frequency receiver. In the receiver segment shown in fig 2.2, there is a controller with the RF receiver and LCD display. If the temperature rate, heart rate, toxic gas rate is higher than the threshold value, it will be displayed in the LCD display. Should any of the conditions become detrimental to the workers, the LED in the transmitter section will turn on, the heart rate, temperature and gas levels could be measured. Therefore the real time monitoring can be done.
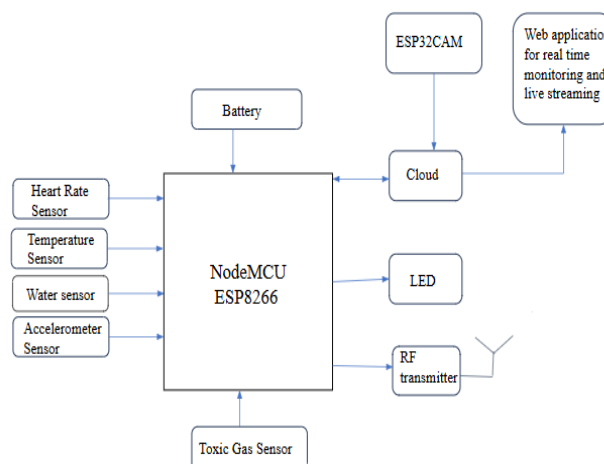

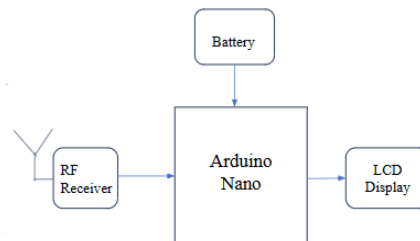Fig. 2.1 Representation of the transmitter side

Fig. 2.2. Representation of the receiver side

V. CONCLUSION

The Smart Helmet is a landmark development in safety of the workers in the field of construction and in the industries. It helps to keep monitoring the workers environment. This paper presented various literature reviews based on the concept of smart helmet. The proposed microcontroller based system can monitor the leakage of gases, falling objects and any flame or fire in the surrounding environment of coal mines, construction sites and industries. Also, if any dangerous accident occurs it will be immediately notified to the supervisor to take immediate action and remedies for the safety of the workers.

REFERENCES

[1] Bommirani, B., Kalaiselvi, P., Kowsalya, R., & Vindhiya, K. (2024). Lora based coal mine safety monitoring and security system using smart helmet, International Journal of Innovative Research in Advanced Engineering, Vol. 11, No. 04, pp. 310-314.

[2] Mali, Y., Sawant, N., Patil, S., Kumari, S. &Anose, M. (2023). Smart Helmet for Coal Mining. International Journal of Advanced Research in Science Communication and Technology ,Vol. 3, No.1, pp 17-23..

[3] Rudrawar, M., Sharma, S., Thakur, M., & Kadam, V. (2022). Coal mine safety monitoring and alerting system with smart helmet. In ITM Web of Conferences, EDP Sciences.Vol.44.

[4] Talpur, M. S. H., Chohan, A., Mahar, M. A., Talpur, F., Dahari, N. N., Kehar, A.,. & Khan, N. (2021). Smart helmet for coal mines safety monitoring with mobile app. International journal of computational Intelligence in Control, Vol.13, No. 2, pp. 241-250.

[5] Divyasudha, N., Arulmozhivarman, P., & Rajkumar, E. R. (2019), Analysis of Smart helmets and Designing an IoT based smart helmet: A cost effective solution for Riders. 1st IEEE International Conference on Innovations in Information and communication Technology (ICIICT)..

[6] T.Sowmya, G.SrinivasaRao ,Ch.Sruthi, I.Tanuja , I.Bhavya, M.Sindhu Priya, (2023),Smart Helmet for Mining Workers, Journal of Engineering Sciences, Vol 11, Issue 03,pp. 640-644.

[7]] Roja, P., and D. Srihari (2018), Iot based smart helmet for air quality used for the mining industry. International Journal of Scientific Research in Science, Engineering and Technology, Vol. 4, Issue.8, pp.514-521.

[8] Dhanalakshmi, A., P. Lathapriya, and K. Divya. (2017), A smart helmet for improving safety in mining industry. International Journal of Innovation Science and research Technology,Vol.2, Issue. 3, pp. 58-64.

[9] Deokar, S. R., and J. S. Wakode. (2017), Coal mine safety monitoring and alerting system.", International Research Journal of Engineering and Technology, Vol.4, No. 3, pp. 2146-2149

[10] Alam, Md Mahbubul, Partha Pratim Chakraborty, Shuva Biswas, and A. J. Islam. (2015),Design of an intelligent helmet for mine workers. In Proceedings of the International Conference on Mechanical Engineering and Renewable Energy, pp. 1-5.

[11] Pandit, Vaibhav, and U. Rane. (2013), Design of underground coal mine monitoring system. International Journal of Engineering Research and Technology, Vol.2, No. 5, pp.82-90.

[12] Ahalya, G., Babu, P. S., & Rao, P. P. (2013). Development of coal mine safety system using wireless sensor networks. International Journal of Engineering Science & Advanced Technology, Vol.3, No. 3, pp.74-78.

[13] Boddu, R., Balanagu, P., & Babu, N. S. (2012). Zigbee based mine safety monitoring system with GSM. International Journal of Computer & Communication Technology, Vol.3. No. 5, pp.63-67.

[14] Kishore, K., Narasimha, E., & Shruti, Y. (2013), Smart Helmet For Coal Miners Using Zigbee Technology. International Journal, for Research in Science & Advanced Technologies, Vo.2, Issue-2, pp.67-69.

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