IOT BASED SMART SYSTEM FOR MINE WORKERS SAFETY

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ABSTRACT

In every business, but particularly in the underground coal mining industry, worker safety is of utmost importance. To monitor underground environmental and health parameters and to take the appropriate actions to prevent any types of dangers, underground communication is required. Based on IOT, the programme creates a warning system for coalmine safety. The working environment and workers' health are determined by the underground system. This device monitors both environmental and physiological factors, including heart rate, temperature, and moisture levels. The processor receives the collected data and stores it for later retrieval by remote users. The data can be downloaded as well as shown in a graphical representation.

I. INTRODUCTION

Mining is a broad sector of the economy that involves intricate operations carried out in tunnels. This comprises a number of risk variables that have an impact on miners' health. It's possible that miners are unaware of environmental factors like temperature changes. Sometimes, mining equipment or hard rock, may collide with miners and their lives could be in danger. The miners' exposure to dangerous gases puts them in danger and has an impact on them as well. Miners are unable to contact with the outside world in this circumstance. In this situation, the smart system becomes a crucial and practical tool to safeguard the miners from potential mishaps. In order to prevent the inhalation of harmful gases, this project seeks to develop a smart system for hazardous event detection, monitoring the local environmental conditions, updating information like IOT and sensor data to the central console for easy tracking, and giving oxygen supplements. This safeguards the miners' lives in the mining sector. Several pieces of information are received through the survey. Mining is the most dangerous employment in India, where one person dies every third day.

In whatever type of construction, worker safety should always come first. Operations that include underground mining pose a considerable danger to the safety and health of the workers. These risks are caused by the varied methods used to extract different minerals. The risk increases with mine depth. In the coal industry, these concerns regarding safety are especially acute. The unsupported mining method does not have access to artificial supports. Using underground coal poses a greater danger than due to ventilation issues and the possibility of collapse, surface mining. Most accidents happen in subterranean mines. So, whether mining for coal or other minerals, worker safety should be a top focus. To solve the issues in mining, we have now developed a gadget based on a coal mine safety monitoring system.

II. RELATED WORK

The protection of working machinery is the main goal of the implementation of safety measures in port operations, where sensors and switches are used to provide safety for personnel. With current technology, it is impossible to control and observe the port personnel due to their high levels of mobility and risk. In this article, a warning system utilising Radio Frequency Identification (RFID), the Internet of Things, and a smart alarm system is used to ensure safety [1]. In the event of a threat, this system offers a real-time, active study of the workers on the field. This paper examined the system architectures of the data processing device, the remote monitoring and control station, and the wearable data observing device. A smart helmet system for underground coal miners is keeping an eye on the extremely dangerous conditions in the mines in real time, including humidity, temperature, and airborne gas components like sulphur dioxide and methane [2]. There will be explosions, flooding, gas poisoning, mine collapses, and choking if certain factors rise over a particular

threshold. These characteristics are measured by this system, which uses buzzers to notify employees and ground control about the situation. To assure functionality, small sensors and radio frequency modules are employed. High levels of psychological and physical stress cause poor performance and unsafe procedures that can end in a person's death [3]. Worker health criteria have been applied in this article based on the worker's personal health characteristics, including body mass index (BMI), sleeping habits, age, chronic illness, and family responsibilities, as well as workplace elements, including the nature of the task and the perception of the maximum injury shift. The findings demonstrate that injuries are sustained by employees varies depending on the task. Workers above the age of forty are more likely to get injuries. Workers who get less sleep suffer greater injuries, particularly those that are abrasive and piercing in nature. Villagers and casual labourers work in sites where they are exposed to dust and run the danger of contracting deadly diseases, including mines, pharmacies, and textile factories. Untrained individuals are moving to other locations mostly in order to provide for their families financially. [4]. The MGNREGA programmes' principal objective is to enhance security for every rural home whose adult members volunteer to perform menial labour chores. A real-time tracking system for the workers' health issues at work is implemented due to a lack of knowledge about the threats. The tracking system also offers details on the workers who received sick pay, disability payments, and information on illnesses that need reporting. The monitoring and warning device detects harmful gases including H2S, CO, and methane and immediately displays them on an LCD as a result of drainage and abandoned wells. [5]. If the levels of these gases go above a specific threshold, the alarm goes off right away, and a GSM alert note is sent to the person who needs to know. The primary function of this system is to quickly respond to and accurately identify emergency situations. It also diffuses gas by turning harmful gas into clean air. To lessen air pollution in the area, a garbage alerting system is used. With the help of smartphone applications and a Wi-Fi module, the properties of gas sensors are carefully monitored. This technology is very useful for creating smart cities, which reduces the number of fatalities among people.

III. PROPOSED SYSTEM

A. Block Diagram

The advanced way, which is an IoT-based model, is suggested in order to get over the short-range constraints of the traditional method, which employs Zigbee or Bluetooth technology. The suggested device can gauge a worker's temperature, air quality, gas level, and pulse rate. Sensors are used to monitor gas and humidity in the air. Gas is identified by the carbon monoxide demarcation level and a humidity sensor that measures the dampness of the surrounding air. IoT is used in this suggested system for both data transmission from below ground to the management system and data reception.

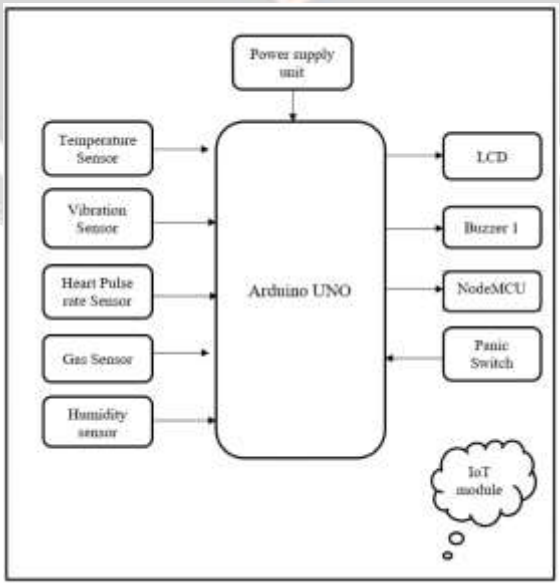

Figure 1. Block Diagram

This IoT-based solution for underground coalmine safety is presented. The intended systems are dispersed throughout the mine. The sensors pick up on environmental and physiological factors like temperature, heart rate, vibration, gas, etc., and transfer that data to the microcontroller so that it may be shown on the LCD. When sensors surpass the threshold level, the controller communicates the information to the control system through

IOT, and the control system alerts the mining work area. This system focuses on keeping an eye on the factors that might help someone live, and it sends this information to the IOT server for first assistance.

B. Hardware Requirements

- Arduino ATMega 328P
- NodeMCU ESP8266
- Temperature Sensor
- Vibration Sensor
- Heart pulse rate Sensor
- Gas Sensor
- Humidity Sensor
- Buzzers
- Panic Switch
- LCD display

C. Software Requirements

- Arduino Software (IDE)

D. Working

The intended systems are spread throughout the mine in various locations. The sensors will pick up on environmental factors like temperature, vibration, gas, and so on. This data is sent to the microcontroller and shown on the LCD. When sensors surpass the threshold level, the controller transmits the information to the Node MCU and the modem sends the information to the server. All of the primary data processing is done in the control block diagram unit. Five sensors are used by us: a temperature sensor, a gas sensor, a heartbeat sensor, humidity sensor and a vibration sensor. This system uses a (LM35) temperature sensor, which continually monitors the ambient temperature. The server displays a graphical representation of this data together with the date and time. When the safety value is exceeded, the hazardous gases present in the coal mine environment may have negative effects on a worker's health. The MQ2 sensor, which is employed in this case, measures the amount of CO and methane in the air. The heart's activity is continually calculated using the heart rate sensor. According on the detected data, a graph is drawn. The processed data from the sensor is subsequently transmitted to the web server through the Wi-Fi connection module. The think speak programme is installed on the PC or mobile device at the monitor unit, where we may view the real-time plots of each sensor.

IV. RESULTS AND DISCUSSION

A gas sensor and a heartbeat sensor, respectively, are used in the proposed system to monitor the smoke in the mine area and the health conditions of mine employees, such as heart rate. Various sensors, including the vibration sensor, gas sensor, temperature sensor, heartbeat sensor, moisture sensor, and so on, enable worker safety. The sensor receives the threshold value or limit value. The micro-controller's output is what determines whether to turn the buzzer ON or OFF. The IoT portal regularly updates with the received outputs that are obtained from the mine worker and the mining environment. The buzzer will turn on if the readings are higher than the threshold. IoT is the system controller that gathers and interprets all sensor data before sending it to a website. The Internet of Things (IoT), which takes more decisive action after receiving data, automatically modifies the sensors and alerts the coal mine personnel. Additionally, it protects their mine from any unintended losses and saves them significant time.

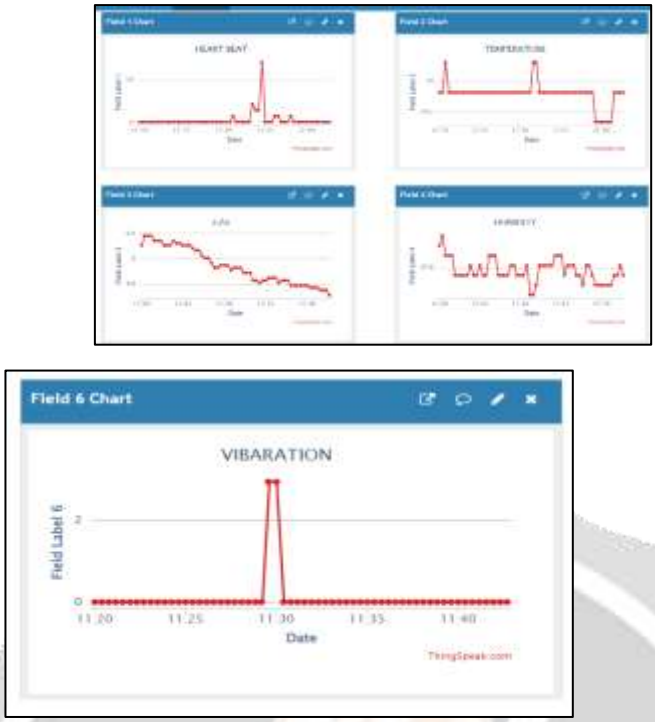

Figure 2 View of the proposed IOT page

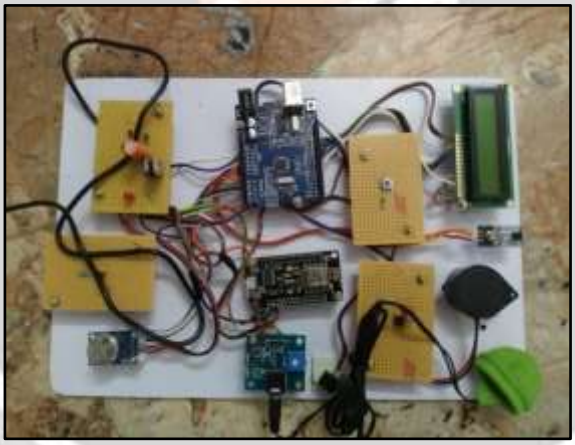

Figure 3 Prototype

V. CONCLUSION

The saved data in our project may be utilised to identify dangers and assess the health of the mine employees since we are storing the values of the parameters in the processor. It would be helpful for the staff to preserve their lives and stay away from the environmental accident zone as we are informing them of the precautions to take in case of a danger. The think speak programme is installed on the PC or mobile device at the monitor unit, where we may view the real-time plots of each sensor. You only need to input the channel ID to access the think-speak programme, and then you can see your plots with date and time information.

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