
IOT-BASED REAL-TIME MONITORING AND SAFETY SYSTEM FOR UNDERGROUND MINING WORKERS

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ABSTRACT: The mining industry is one of the most dangerous in the world. It could be hard for underground miners to get social support and assurances of safety in some countries. They may have to deal with the matter on their own, without help, if they become hurt. Furthermore, there are negative social effects, like the need to relocate and the loss of jobs. When compared to other industries, the mining industry has the highest rate of safety-related fatalities. Falls, explosions, electrocution, methane poisoning, and fires are among the leading causes of death in the workplace. Underground mining has been the subject of a great deal of research. The underground mining industry has the greatest death rate in the world, according to recent studies done in China. An intelligent monitoring and alert system is essential, and these calamities necessitated the development of a more effective communication strategy. To facilitate communication amongst subterranean dwellers, RF technology was selected. The utmost importance must always be placed on safety. Prioritizing safety and security is crucial in the mining business. In order to decrease the occurrence of accidents, the mining sector strictly adheres to all necessary safety regulations.

KEYWORDS: Temperature Sensor, Gas Sensor, GSM, ZIGBEE, WIFI, Microcontroller, Buzzer, LCD Display.

1. INTRODUCTION

Refrain from putting your trust in other people. There are a lot of risks involved with coal mining. No matter what, your safety must always come first. Working in an underground mine puts an employee's health and safety at serious risk. These dangers are brought about by the various ways in which minerals are extracted. In particular, the mine's lower levels pose a threat. It is of the utmost importance to address these safety risks, especially in the coal business. When mining for coal or any other resource, the well-being of the personnel involved must constantly take first.

Cave-ins and ventilation issues make underground coal mining more dangerous than open-pit mining. However, because mining involves the use of heavy machinery and specialized methods, there are inherent safety issues.

Mining firms in the modern day not only comply with all health and safety rules that are applicable, but they also provide intensive training to their employees and

implement a wide variety of other safety controls. The standards governing safety in open-pit mining and underground mining are both greatly impacted by this information. For an extended period of time, coal has been the primary source of revenue. When it comes to the energy industry, coal is an essential component because it is utilized in the production of about 70 percent of the world's electricity. In the course of production, pollutants are generated, which have the potential to cause harm not only to the environment but also to the people who live in the neighborhood. The overarching objective of the project is to construct a detection system that is capable of providing an objective evaluation of the severity of the problem in real time. ZIGBEE, the energy resource of India, is one of the factors that has significantly contributed to the country's economic growth.

2. LITERATURE REVIEW

Ventilation systems are essential in underground mining because they supply sufficient oxygen, guarantee worker safety, and facilitate the mine's efficient operation. When working in dangerous conditions, a mine ventilation system can help keep workers safe. An early approach to monitoring mine air quality was using canaries and other animals as indicators to warn workers of harmful substances in the mining environment. Mine operators may make informed ventilation system adjustments using massive amounts of data collected by the ventilation monitoring system.

Unexpected changes to the ventilation system can be detected by the monitoring system, allowing for quick action. In order to keep people safe and healthy while working in underground mines, ventilation systems are crucial. These technological advancements guarantee an adequate supply of oxygen and get rid of any dangerous situations.

Potentially deadly events can be averted through the monitoring of subterranean mines. The first stage of mine air monitoring was using canaries and other animals to alert miners of impending bad weather. With the wealth of information provided by ventilation monitoring systems, mines may improve their ventilation systems and gain a better grasp of operational circumstances. If there are any sudden changes to the ventilation system, the monitoring system can react quickly. To improve mine monitoring and make data transmission to the surface easier, new and improved tracking and communication systems are offered.

Coal mine explosions persist despite technological improvements. Coal mine disasters often occur due to unpredictable labor conditions and unfavorable environmental factors.

Implementing a mine monitoring system is crucial for maintaining safety. The security of traditional coal mines relied heavily on wired networks in the past. With the growth and complexity of cities, laneways have become more difficult to navigate and even dangerous. Think about how much work and time went into installing those pricey wires. The only way to guarantee the security of the miners is to install a network of wireless sensors.

Nowadays, WSNs, or wireless sensor networks, are all the rage across the world. One kind of network that uses a large number of nodes spread out across a wide area to keep tabs on something is called a wireless sensor network (WSN).

Compared to traditional sensors, these tiny ones are more cost-effective and resource- and computational-efficient. It is possible for sensor nodes to evaluate, identify, and collect data about their immediate surroundings. The data can be sent to the control center by a regional statistical decision-making mechanism. Compared to traditional wired monitoring network systems, it varies mainly in three respects:

1. The ability to place the monitoring system in areas with limited sight without the need for cables means that the overall expense could be lowered. The inclusion of more nodes can eliminate blind spots. It makes it easier to communicate and divide up tasks.
2. The mining environment can be better monitored in real-time with dense nodes since more accurate data can be collected and disseminated.

The public's awareness of the risks associated with coal mining is growing.

3. SYSTEM OVERVIEW

The block diagram of the proposed system as follow:

1) Helmet unit

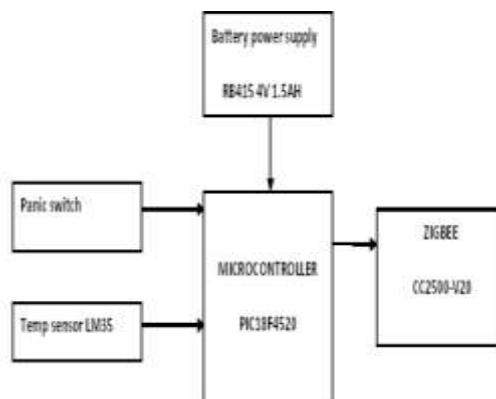


Fig- 1: Block diagram

2) Control unit

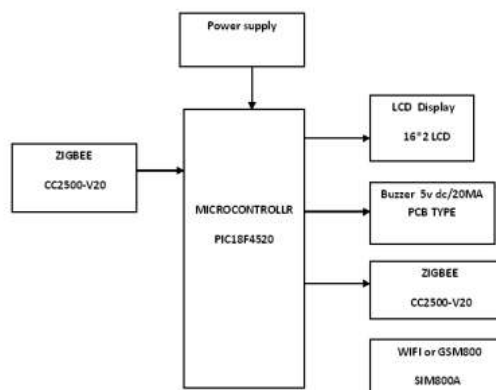


Fig- 2: Block diagram

Every business must prioritize safety above all else. The mining industry places a premium on safety and security. In order to reduce the likelihood of accidents, the

mining industry strictly enforces safety requirements. Problems with deep mines have persisted due to rising water levels, rising temperatures, and the emission of methane gas. Here is where we check if the employees are safe to work.

The establishment of a reliable communication system for individuals who are employed in mines and other permanent subterranean environments is of the utmost importance in order to accomplish the objective of enhancing the safety of underground mining. This choice was made taking into consideration a variety of factors. In the case that an employee feels threatened, they have the option of hitting the panic button, which will allow security agents to notify them of the situation while also allowing them to take appropriate action. There will never be any downtime experienced by the communication network since it is impossible for there to be any downtime occurring.

The adoption of wireless mine tracking systems that make use of ZIGBEE technology is strongly suggested due to the high-tech early warning capabilities that these systems provide at a price that is quite low.

A potential use of the Internet of Things (IoT) is the monitoring of the well-being and contentment of the employees working for your company.

4. PROPOSED ALGORITHM

Flowchart:

Ventilation systems that provide safe, non-combustible air with enough oxygen levels are necessary to ensure the correct execution of underground mining operations.

The amount of potentially harmful air pollution that is present in the mine can be reduced by the use of ventilation systems, which are an effective strategy. When the mining industry was just being started, canaries and other types of dogs were employed to alert miners to any conditions that had the potential to be hazardous. This was done in order to preserve the safety of the miners.

By making use of the large amounts of data that are provided by the monitoring system, the mine has the capacity to make modifications to the ventilation system that are informed and educated. This is achieved through the utilization of the monitoring system.

1). Flowchart of Helmet & Control Unit

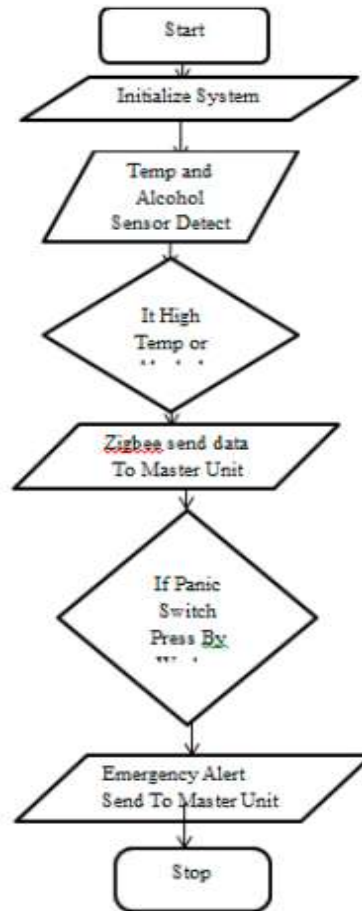


Fig- 3: Flowchart for Helmet Unit

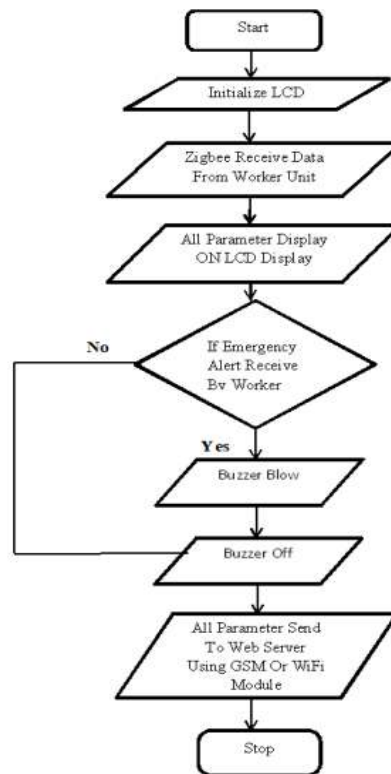


Fig- 4: Flowchart for Control Unit.

5. RESULT SECTION:



Fig-5: Hardware of IOT Mining Tracking & Worker

Safety Helmet

The outcomes of our initiative are being assessed in light of

1. Gas emissions and temperatures are identified.
2. Wireless data transmission

6. CONCLUSION

The utilization of a tracking system that functions in real time, it is possible to get a more comprehensive understanding of the underground mining system. The utilization of ZIGBEE technology not only makes it possible for miners to communicate with one another, but it also makes it possible for miners to communicate with one another by providing a more reliable form of communication. All of the miners who are working in the mine will benefit from this strategy since it will reduce the likelihood that accidents will occur while they are toiling away at their jobs.

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