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Research Article

# AN INTERNET OF THINGS BASED ADVANCEDCOAL MINE SAFETY SYSTEMUSING WIRELESS SENSOR NETWORK

Kannan K[1], Sai Rahul Kartheek G[2], N Sai Manoj M V[3], Poorna Sai O[4], Vamsi Krishna U[5]

## ABSTRACT

This paper introduces a checking framework based on remote sensor organisation that can monitor the gas focus, temperature, and mugginess boundaries, and warn when the boundaries exceed the fixed value, taking into account the issues of danger, consumption, and mishaps in underground coal mineshaft construction. Today, the safety of diggers is put to the test. Digger's health and life are powerless in the face of a few basic concerns, including the work environment, as well as its long-term consequences. A creative technique is necessary to increase the productivity and lower the cost of mining while also considering the safety of workers. Coal mineshaft health monitoring system based on remote sensor organisation can accurately and conveniently represent the dynamic situation of employees in subterranean regions to the ground PC system and mobile unit. Semiconductor gas sensors are used to monitor the concentration of harmful gases. We are using a vibration sensor in this framework to detect any load that has fallen on the excavator's top. The approach also provides an early warning, which will be beneficial to those loaders working within the underground in order to save their lives before a setback occurs. For data transfer, the system makes use of Zigbee technology and GSM. For emergency purposes, there is a ready switch on the collection and transmitter sides.

***Keywords**: Internet of Things, Global System for Mobile communication, Wireless Sensor Networks, Coal Mine*

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Department of Electronics and Communication Engineering *R.M.K.* College of Engineering and Technology, Chennai.

**Email:** kannan@rmkcet.ac.in, sai17ec@rmkcet.ac.in, udat17ec@rmkcet.ac.in

## I. INTRODUCTION

Coal mineshaft security has progressively been a major source of concern for the general public and the government. More than 100,000 workers have been killed in coal mineshafts in the United States since 1900 (Alford, 1980), and many more have been injured or disabled [1]. Underground mining loaders face a variety of hazards, including gas explosions, moving stone, falls, and hardware and portable equipment failures [2]. Coal, being a major source of energy in contemporary creation, plays an important role in the global market. In this approach, the excavator's safety is an important consideration. By and large, diggers only have a hat for the purpose of securing their heads. The objective of this paper is to develop a smart head protection that can monitor the concentration level of harmful gases and dangerous events in coal tunnels and send the data to a ground station through Zigbee.

The semiconductor gas sensor is used to monitor the concentration of harmful gases found in coal mineshafts, such as SO2, NO2, CO, and others. We're also looking at the problem of those who use a fall detection sensor. The removal of the digger's weight placed is also an important issue to consider. The absolute limit switch is used to determine whether or not the excavator is wearing a hat. Zigbee is used to transmit all data from the line marked

to the base station. GSM is used to transmit information from the beneficiary's side to the web.[3]. Attempting to convince loaders in a mine may be a difficult cycle to remember, especially given the pit's typical operating circumstances. Tunnels are extremely dark, thus excavators employ security caps with mining lights that may be connected. Subterranean mining equipment produces a lot of noise and vibrations, which is exacerbated by the restricted circumstances in the underground passageways.

The trouble with the commotion is that using a speaker, alert, vibration unit, and LED framework to warn an excavator when an individual digger is meeting a dangerous event would most likely be futile because the excavation will not understand the warning [4]. As a result, it was decided to implement a framework that would warn the digger by flashing the mining light a couple of times. This admonish approach also has the benefit of using the mining head protection light of the digger who is confronted with the hazardous situationThe light is always blazing to show who is having trouble as well as the digger's location. The crisis message is also delivered by earphones and speakers [5].

Currently, a coal mineshaft safety monitoring system and a labour force location system are required for coal mineshaft security creation frameworks [6]. Wired organisation is sent to the traditional coal mineshaft wellbeing checking framework. It is tough to build a link at any time due to the progress of mining. The majority of gas explosion accidents, according to investigation and measures, are caused by mine lights and subterranean linkages [7]. Furthermore, because the wired observing framework cannot be modified by the functioning elements due to the set organisation structure, there should be susceptible edges inside the recognition. Similarly, if the wired organisation is affected, the maintenance cycle would be lengthy and support costs will be expensive. Sensor networks have been successfully utilised in many sectors recently, thanks to the improvement of remote correspondence innovation and MEMS innovation.

## 2.LITERATURE SURVEY

Coal mining tunnel security has continually evolved into a major source of worry for the general public and the government. Over 100,000 professionals have been killed in coal mines in the United States since 1900 (Alford, 1980), with many more injured or disabled [1]. Gas hits, moving stone, falls, and equipment and compact material accidents are among the hazards faced by underground coal earthmovers [1]. Coal, being a large source of energy in current creation, plays an important role in the public economy. In this regard, the backhoe's success is an important element to consider. In this task, a cunning head defender must screen the concentration level of harmful gases and dangerous events in mining operations tunnels and transmit the information to the ground station through Zigbee.

The semiconductor gas sensor is used to monitor the centre degree of dangerous gases found in coal mines, such as SO2, NO2, CO, and others. Using a fall finding accelerometer, we are also evaluating the illness of individuals. In the same way, removing the digger defence cap is a crucial practical issue. The circuit breaker is used to determine whether or not the earthmover is wearing a hat. All data is sent by Zigbee from the protective cap to the base station. GSM is used to send data to the recipient via the internet. In a mine, advised tractors might be an inconvenient cycle that recalls the normal working circumstances that are familiar with a mining industry. Because mining operations are extremely dark, earthmovers employ security coverings with connectable mining lights [8]. The materials used in underground mines may cause a great deal of upheaval and vibrations, which are exacerbated by the controlled conditions found beneath.

The problem with the disturbance is that advising a tractor with a speaker, alert, vibration unit, and LED system when an individual digger is experiencing a potentially dangerous event would most likely be ignored since the earthmover would not hear the warning. It was decided to build a structure that would warn the excavator by shimmering the excavation twice or more times. The added benefit of using the mining head defender light of the digger who is experiencing the hazardous event when employing this reprimand approach is that it uses the mining head protector lighting of its excavator which are encountering that affects the environment. In the meanwhile, bursts of light reveal who is suffering the problem while also displaying the digger's space. Moreover, the alarm warning is communicated via headphones and speakers[9].

For coal mine security creation systems, a coal mining tunnel prosperity noticing system and a work power arranging structure are now required. A wired association is used to send the standard coal mine prosperity

checking system. With the advancement of miners, it is difficult to establish a link at any moment. Most disasters are caused by mine lights and underground connections, according to assessments and estimates of gas impact incidents. Furthermore, because the wired noticing system can't be altered by the functioning components due to the established association structure, there should be flaws inside the Identification. Sensor networks have recently been widely used in a variety of sectors, thanks to advancements in long-distance communication and MEMS technology.

## 3.METHODOLOGY

### 3.1 Existing system:

They used the existing infrastructure to create a remote reconnaissance and safety system for Zigbee-enabled diggers. This system is designed to provide a cost-effective and flexible solution for subsurface mineworker safety. For subsurface climate observation, a module of MEMS-based sensors is used, and a mechanised movement of estimate information is proposed using an innovative wireless communications method with high precision, smooth control, and dependability. A microcontroller is used to acquire data and make decisions, and the mineworker is educated via alarm and speech system. The speech framework, which includes both a receiver and a speaker, switches to advanced flag and successfully communicates with the ground control focus PC through a remote connection. For this short-distance communication here between excavator's hardware and the ground control focus, ZigBee is used in accordance with the IEEE 802.15.4 standard [9]. Because Zigbee is a short-range remote communication system, expecting to communicate with trustworthy professionals who are far away is absurd.

### 3.2 Proposed system:

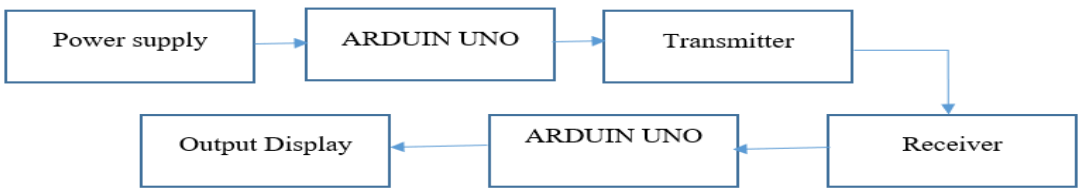
The method for managing coal cave system accidents is to use detectors and microcontrollers to predict disturbance and to set up a warning system before the fundamental environmental level. Continuous verification is essential, which necessitates the use of a feasible and precise detection system. There are a few techniques for detecting the presence of these toxic gases, one of which is the use of a semiconductor type gas sensor. These sensors can be installed in the coal mineshaft region, however they can also cause problems in mining. The sensor device was frequently damaged unintentionally. The use of a robot is another technique. These robots are fascinating, but they are expensive. However, there is another technique of obtaining a powerful and low-cost sensor installation configuration; that's on the protection cap of coal cave system workers.

A smart well-being protective headgear with a sensor cluster that detects data and a remote modem that transmits it. The protection cap is the only piece of safety equipment that excavators will generally wear, and it is to this cap that the additional safety hardware was attached. This module handles everything and also regulates the remote communication between separated protective caps. Because the framework runs on battery power, the entire framework was deconstructed during the planning stage to reduce force usage. To maintain the force level as low as possible, several sensors were examined for each distinct component.

There are four sensors in this framework: a humidity sensor, a pressure sensor, a motion detector, and an LDR. The light force is distinguished using LDR, and if the light power is low, the lights on the cap will naturally turn on. If any of the sensors detects an abnormality, the ZigBee transmitter will send the information to the ZigBee receiver. A message will be sent to the approved persons from that pack, and on-site checking will be done using the WIFI module.

### 3.3 Block Diagram:

The construction of the coal mine safety system utilising a wireless sensor network using the Arduno processor and ZigBee transmitter and receiver is shown in the block diagram below.



In the transmitter we are utilizing ARDUINO UNO its chance on power supply is 5 volts. The force supply will change over AC current into DC current. The temperature sensor will detect the temperature in the mine ceaselessly once the temperature surpasses the specific sum fixed by the coal mineshaft it will detect it and will turn on the signal[10]. Estimating carbon dioxide is significant in checking indoor air quality so we are utilizing CO2 sensors to detect the measure of co2 in the room. It utilizes the Infrared rule to quantify the measure of CO2.A vibrator sensor is a sensor that delivers an electrical sign that is relative to the speed increase of the vibrating segment to which the accelerometer is joined (Light Detecting Sensor) used to check the power of light eg: when the force of light declines it will show. The LCD will show the upsides of Temperature, Gas, LDR and Vibrator. The Zigbee transmitter will send the information to the Zigbee collector[11].

In the collector part we will gather information from Zigbee transmitters by Zigbee beneficiary. The GSM (Global System for Mobile Communication) is utilized for media transmission purposes. The Wi-Fi module is utilized for network availability and the LCD is utilized to show the upsides of Temperature, Gas, LDR and Vibrator.

## 4. HARDWARE IMPLEMENTATION

The ATmega328 is used in the Arduino Uno board, which is a microcontroller. It has a 16 MHz earthenware resonator, an ICSP header, a USB connection, 6 simple data sources, a force jack, and a reset button, as well as 14 computerised input/yield pins, six of which can be used as PWM yields. It also has a 16 MHz earthenware resonator, an ICSP header, a USB connection, and a reset button. This provides all of the essential assistance for using a microcontroller. To begin, they must be connected to a computer through a USB port, an AC-to-DC converter, or a battery. The Arduino Uno Board differs from the rest of the sheets in that it does not have the FTDI USB-to-chronic driver chip. The Atmega16U2 (Atmega8U2 up to form R2) has been modified as a USB-to-chronic converter and includes it.

**Figure 1 Arduino Setup**

The Arduino Development Environment (IDE) includes a word processor for writing code, a message area, a book console, a toolbar with buttons for common functions, and a series of menus. As illustrated in Figure 1, it communicates with Arduino and Genuine equipment to transfer programmes and communicate with them.

## 5. RESULT

The result of our work as shown in Figure 2 is discussed with different fields are

**FIELD-1:** It is a LDR graph. In every 5 sec the value is changed and it displays in the system.

**FIELD-2:** It is a Gas graph. In every 5 sec the value is changed and it displays in the system.

**FIELD-3:** It is temperature graph. In every 5 sec the Value is changed and it displays in the system

**FIELD-4:** It is a vibrator graph. It changes the value 1 to 0 when stones fall in the coal mine.


**Figure 2 Output screenshots**

## 6. CONCLUSION

To give a sharper and more point-to-point picture of the underground mine, a real-time monitoring system is being created. This system displays the parameters on the monitoring device, which will aid all miners within the mine in saving their lives before any casualties occur. When sensor values exceed a certain threshold, an alarm is triggered. This method also saves all of the data to a computer for further review. This sector has undergone a tracking system for the underground structure of a mining town predicated on a sensor network that can supervise real time data and transfer it to the tracking outermost computer, as well as realise communication interplay among mine terminals and mines and alarms for anomalous environmental conditions. The system's real-time and stability can fulfil mine's monitoring needs. This platform offers the benefits of easy networking, high flexibility

and expansibility, and inexpensive operation and maintenance costs, all of which are important for mine safety and intelligence.

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