Individual Health and Safety Monitoring of Workers in Deep Underground Mines Using IOT

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Abstract. Lethal mishaps related with underground coal mineshafts require the usage of elevated level gas observing and excavators limitation ways to deal with advance underground safety and wellbeing. As per the International Labour Organization (ILO), digging represents 1% of worldwide work, however, is liable for 8% of deadly mishaps. This paper presents a strategy for investigating and guaranteeing wellbeing of the labourers in mines. It is actualized by utilizing IOT (Internet Of Things) to set up remote sensor organize. Sensors are utilized for estimating air quality boundaries, for example, temperature, CH4 (Methane), CO2 (Carbon di-oxide) and CO (carbonmonoxide). This paper is principally founded on the advancement of an open source, adaptable and financially savvy stage for successfully advancing underground coal mineshaft wellbeing. This is additionally useful for tackling the issues of openness, usefulness, interoperability and adaptability related with wellbeing in coal mineshafts.

1. Introduction

Coal has consistently been the essential asset of vitality in India, which has altogether added to the quick mechanical improvement of the nation. About 70% of the force age is subject to it in this way, the significance of coal in vitality area is basic. Underground coal mining incorporates a higher peril than open pit mining on account of the issues of aeration and potential for breakdown. In any case, the use of overwhelming hardware in addition to the strategies achieved during unearthing keen on dangers in all sort of excavation. In subsersive excavation, aeration structures are fundamental to deftly palatable oxygen, keeping up non-dangerous and non-destructive conditions and a ground-breaking working mine. Monitoring a subsersive mine will lend a hand in executing high hazard circumstances. Simple strategies of seeing a mine's space disputably followrear to the adventure of canaries and diverse creatures to arranged diggers whenever the environment finds the opportunity to be fatal. Combining ventilation watching systems empowers a mine to adroitly turn out ventilation upgrades considering the wide information given by the checking structures. Unexpected changes in the ventilation structure are perceived by the checking system, permitting smart shift to be ended. Novel and influencing connection with the following systems know how to be used to monitor mines even more skilful and move the info to the facade.

Far off sensor frameworks (WSNs) have earned a significant by and large thought in current circumstance. A WSN is a remarkable off the cuff, multi-hop and self-sifting through framework that contains a huge number of centres sorted out in a wide domain in order to screen the marvels of interest. It might be truly significant for clinical, common, intelligent and military applications. Far off sensor sorts out generally include sensor centre points or pieces responsible for distinguishing a wonder and base centre points, which are at risk for managing the framework and get-together data from removed centres. It has three significant points of interest over wired checking system frameworks:
• There is no need of links to lay and simple establishment in dazzle territories, lessening cost of the observing framework. The quantity of hubs can be expanded to take out visually impaired territories. Additionally, it offers an overall correspondence and assignment of the objective.
• The thick hubs guarantee the information obtaining with high precision and ideal information transmission, and further acknowledgment of constant checking framework for mine condition.
• A touch of processing capacity, stockpiling limit with information combination of sensor hubs make them reasonable for the distant checking framework.

The objectives are listed below:
✓ Discovery of various poisonous gases inside mining condition
✓ Correspondence foundation among sensors and IOT
✓ Establishment of Wireless Sensor Network
✓ Plan of a continuous observing framework

2. Monitoring Devices
2.1. Arduino
The Arduino board is an exceptionally organized trackpanel for programming and prototype with Atmel microcontrollers. The microchip on the panel is modified utilizing the Arduino encoding Language (in view of electric wiring and the Arduino advancement condition (in light of dispensation). It is generally modest and socket directly to PCs Universalhaven or force it with an AC-to-DC connector or array to get underway. This software is easy to use for the beginners and it is more flexible for advanced applications. It runs on Mac, Windows, Linux. Arduino UNO probably speaks with a PC or other Arduino or different microchips. It imparts through sequential correspondence (UART TTL). This sequential correspondence run as a practicalterminalhaven to programming on the processor.

Fig. 1 Structure of Arduino UNO Panel

2.2. GSM Pro S2B
The GSM Pro S2B unit is a remote sensor arrangement works inside the IOT convention & backing the special want of minimal effort and squat force. This cosponent requires least power and give solid conveyance of information flanked by gadgets. It works at 2.4GHz recurrence mob. This GSM data processor can acknowledge any GSM network administrator SIM card & perform simply like a cell phone with its own interesting telephone number. Preferred position of utilizing this modem will be that you can develop its RS232 port to impart and create installed applications. Applications like SMS Control, information move, controller and categorization can be grown without any hitch.
2.3. IOT USB Interfacing Panel
IOT (GSM) USB interfacing panel is utilized to edge GSM remote panel amid PC frameworks. This panel is utilized to associate IOT panels to formulate correspondence between processor to processor, PC to automatic assemblage or android, processor to install microchip based path. Since IOT conveys all the way through successive Communication so contrary finish of USB which is associated with a processor, treated as COM port for Serialised Communication. It is furnished in the midst of sign LEDs for simplicity. It underpins in cooperation with AT and API type. Its baud rate ranges from 2400 bps to 115200 bps. On this interfacing panel, CP2102 IC is used for changing over TTL rationale to USB rationale.

2.4. Heart beat sensor
Heart Beat can be estimated dependent on optical force diversity as beam is dispersed or consumed during its line of attack all the way through the blood as the pulse changes. The heartbeat feeler is based on the rule of plethysmography snap is shown in the figure 4. It measures the alteration in volume of blood during any organ of the body which causes a modification in the light force through that organ (a peripheral locale). On the off chance that there ought to be an event of employments where heart beat rate to be checked, the situation of the thumps is huger. The movement of blood volume is picked by the pace of heart thumps and since light is devoured by blood, the sign pulses are relative to the heart beat pulsates.

2.5. Carbon Monoxide Sensor (MQ-7)
Different sorts of detectors are accessible in the souk in which semiconductor detectors are well thought-out to have quick reaction. MQ7 semiconductor detector is chiefly utilized intended for recognizing carbon monoxide (CO) is shown in the figure 5. MQ-7 gas detector made out of miniaturized scale Al2O3 fired cylinder and Tin Dioxide (SnO2). The radiator gives obligatory effort conditions to crafted by touchy segments. The conductivity of sensor is higher alongside the gas fixation rising. At the point when the sensor, warmed by 5V it comes to very elevated temperature, it
showered different hazes under squattroridity. This detector has totally six pins among them four pins are used to get signals and remaining two signals are utilized meant for giving warming current. This detector consists of 2 sections. One is warming path and the other one is the sign yield path, in which warming circuit is utilized for time control and sign yield circuit will precisely react in changes of surface obstruction of the sensor.

![Fig. 5 MQ-7 sensor, MQ7 Module](image)

### 2.6. Methane Gas Sensor (MQ-4)

MQ-4 gas sensor made out of fired cylinder and Tin Dioxide is shown in the figure 6. Anode and radiator are fixed into a layer. The warmer gives required work conditions to crafted by touchy components. When the objective flammable gas present, the conductivity of sensor is higher alongside the gas focus rising.

![Fig. 6 MQ-4 sensor](image)

### 2.7. Carbon Dioxide Sensor (MG811)

This CO₂ sensor is planned by DF Robot engineer. The MG-811 sensor is exceptionally delicate to CO₂ and less touchy to liquor and carbon monoxide. The MG-811 sensors have stumpy dampness and warmth reliance. Its configuration is equivalent to carbon monoxide sensor yet remaining are extraordinary. This detector is created by strong substance stratrum, radiator, Cathodes, Ceramic Tube, 100m twofold stainless steel and cusalverhalo.

![Fig. 7 MG811 Sensor](image)

### 2.8 DHT-11 Sensor

This DHT11 Sensor gauges the temperature and stickiness is shown in the figure 8. The sensor has more prominent unwavering quality and excellent steadiness. A resistive-type moistness estimating segment with negative temperature coefficient is utilized. It associates with a microcontroller and shows fantastic quality, hostile to impedance and quick reaction capacity.
3. Block Diagram

A) SAFETY NODE

B) HEALTH NODE
4. Hardware Implementation
To test planned continuous checking framework utilizing remote sensor arrange, a counterfeit mining condition is mimicked inside the research centre. As a first usage, we planned the total framework on a breadboard which is introduced in Figure 10. The framework comprises of subsequent segments such as ArduinoPanel, GSM Pro S2B, LCD (Liquid precious stone showcase), Carbon monoxide Detector, Methane Detector and Signals.

5. Conclusion
The investigation on incessant monitoring of poisonous gases and dissimilar boundaries in subversive excavation has examined utilizing remote sensor. A continuing examination outline is shaped to offer an additional obvious and more highlight standpoint of the subversive excavation. This sketch is screening the boundaries on the LCD at the subversive area where sensor element is brought just as on the observing element; it is useful to all operators present inside the mine to standby their existence before any hinder happens. Caution triggers when sensor crosses the edge echelon. Outline stores all the info in the PC for outlook investigation. Also Sensor nodes can rearrange tenuously over a wireless system & most of the dispensation will be ready in the processor side. The errorless equations of gas sensors have exaggerated the precision of the ppm outcome. This is a squat charge and enduring structure. The price on the whole of system is roughly around 320-380 $ by means of 2 sensor nodes and 250$ extra for each supplementary sensor node.
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