Improved Cost Effective IoT Based Coal Mining Safety System

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Abstract. In recent years there are lot of life risk occurs to skilled labors in coal mines which requires an advancement in coal mining safety system. In order to improve this current scenario, An IOT based coal mining safety system is proposed. Proposed system is implemented using IOT module to monitor and control various parameters in the coal mines such as leakage of gas, earthquake, water level and Fire ignition detection in the coal mine. All these sensors are intergrated with microcontroller and placed in different parts of coal mines. In case of any uncertainties then buzzer will alert, then the notification is sent to the serial monitor and to the authorized person. This system enhances the safety and improved working conditions of labours in coal mining system.

Keywords: safety, sensor, microcontroller, IOT module

1. Introduction
Coal is considered to be most important commodities and raw materials for a number of industries. The extraction of coal from the coal mine are a tedious and dangerous process. Many accidents takes place in the coal mines world over which causes fatalities and economic losses. The dangers and hazards can be reduced significantly by making use of the latest smart technologiesMining industry is considered to be world's most harmful industry and has a safety issues of miners have slowly turned into a major concern for the society. There are many accidents in mining due to gas explosions, shifting rocks, chemical leakage, water leakage and fires. So, the hazardous parameters should be taken under consideration. To improve health and safety of work and reduce the rate of accidents we proposed the system based on Internet of Things. At present, the IOT has been commonly used in different fields like smart health, smart industry, traffic monitoring agriculture maintenance management. In this proposed system, ATMEGA8 Microcontroller is used. Here different sensors like gas sensor, fire sensor, earthquake sensor and water sensor are used as input of this microcontroller. The automated monitoring system ensures the safety and working conditions of the labourer. The signals from the sensors are fed to the adc of the microcontroller where the analog to digital conversion takes place. In case of any increased gas level or if any fire occurs then microcontroller will switch a relay system that runs alert to control room through IOT

2. Literature survey
[1] proposed a system which uses Zigbee technology and GSM for transmission of data to monitor the concentration level of harmful gases, semiconductor gas using sensors.
[2] implemented a system using machine learning which focuses on checking the possible
working condition in the mine. The information collected from algorithms is transferred wirelessly. [3] proposed a system based on ATMEGA328P Microcontroller interfacing with Zig-Bee transceiver module which monitor the working atmosphere using temperature sensor and heartbeat sensor and for monitoring mine industry by using carbon monoxide and methane sensor for tracking workers by using GPS sensor.

[4] proposed a project which provides safety monitoring system of coal mine based on spatial data mining and GIS technology. [5-6] proposed a system based on RS485 communication for data exchange which improves the performance of methane monitoring substation by providing reliable, stable operation of the coal mine environment in a timely and effective manner.

Pavithra et al designed a smart safety helmet for the coal miner using LI-FI technology for data transmission via IOT equipped with the network of sensors such as heartbeat, humidity, gas and temperature sensors Figure 1.

3. Proposed System

![Figure 1. Block diagram](image)

A. FIRE SENSOR

A fire sensor is a device that senses smoke of fire. The fire sensor circuit is very sensitive and can recognize a rising in temperature of 10 degree or more in its locale. Fire sensor comprises of four pins, where A0 is analog pin that is connected to analog pin of microcontroller, GND is connected to GND, VCC supply is given as 3.3v. B0 takes digital as an input figure 2.

![Figure 2. Fire Sensor](image)

B. GAS SENSOR

A gas detector is a device that detects the presence of gases in a particular area. Here mq2 gas
sensor has an advantage of high sensitivity and a fast response rate. Gas sensor mainly comprises of four Figure 3. pins, A0 is an analog pin that is connected to analog pin of microcontroller, GND is connected to GND, VCC supply is 3.3v. It designed with a long service life and reliable stability.

**Figure 3. Gas Sensor**

**D. EARTHQUAKE SENSOR**

A Earthquake sensor detects the acceleration caused by an earthquake using a small built-in accelerometer. One of its most important feature is signalling. The SDA, SCL, SET, INT1 and INT2 pins of the D7S are available on the six pin strip connector, while LEDs Figure 4.

**Figure 4. Earthquake Sensor**

**D. WATER SENSOR**

Water sensors detect the presence of water and, when placed in areas, where water should not be present a leak. It comprises of 3 pins such as S (signal), VCC, GND. It is highly sensitive and compatible Figure 5.

**Figure 5. Water Sensor**

**E. ATMEGA8 MICROCONTROLLER**

The ATmega8 is an 8-bit AVR microcontroller that is based on reduced instruction set computer (RISC) architecture. It comes in 3 packages known as PDIP, MLF and TQFP. It consists of 28 pins and 3 ports such as port B, port C, port D. The two exterior interrupt are located at port Figure 6.

**Figure 6. Atmega8 Microcontroller**

**F. RELAY**

A relay acts as an electrically operated switch. Relays are used to provide time delay functions. Relays are used to control high voltage circuits with the low voltage signals. Similarly these are usedto control high current circuits with the help of low current signals Figure 7.
G. ESP8266

The ESP8266 is a low cost Wi-Fi microchip integrated with TCP/IP protocol stack that generates inbuilt wifi to get accessed by any microcontroller. It is user friendly and capable to provide internet connectivity. It is an extremely cost effective board with huge and ever growing community Figure 8.

4. Methodology

Proposed system comprises of two units(sensor unit and monitoring unit). The integration of both the units is done by ATMEGA8 microcontroller. The sensor unit consist of fire, gas, water, earthquakesensors are dumped inside the coal mine. All the sensor data are displayed on the LCD screen by the ATMEGA8 microcontroller. The monitoring unit comprises of LCD,WIFI Module. The ATMEGA8 sends the captured data from coal mines to the remote IOT server using the WiFi module every two minutes. If any of the sensor values exceeds a particular threshold level, the buzzer is turned on to notify. An IOT platform installed on it displays the relevant data using the GUI which enhances the safety monitoring coal mines Figure 9.
5. Simulation Outcome

The above fig representing the simulation result, values of various sensor used in this project and their status are displayed on serial monitor and the output is passed to the user through control room via IOT Figure 10, 11 and 12.

6. Conclusion

In this paper we proposed an effective method for monitoring controlling, alerting the coal mine using Fire sensor, Gas sensor, vibration sensor, Water sensor to increase the safety of the workers in the coal mine and to prevent them from danger. This system helps in constant checking of the coal mine and alerting the worker is done by using IOT. It is cost-effective and highly efficient.

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