

IoT BASED COAL MINE SAFETY MONITORING AND ALERTING SYSTEM

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Abstract— Now a day's coal miner's job is one of the risk full jobs in our world. Due to some critical issues such as methane gas, high temperature, fire accidents and natural disorders are making miners health and life is so vulnerable. To increase the miner's safety along with the production of ores, a novel approach is required. IoT based coal safety monitoring system can frequently send a report of that situation to the IOT data storage. Modernized embedded sensors are monitoring the level of harmful gases, temperature and mine condition etc. NODE MCU microcontroller is interfaced with the embedded sensors like temperature sensor, methane sensor and water sensor. All sensors monitor the real time values are send to the IOT receiver end via microcontroller transmitter. Using wireless fidelity all values is stored into the IOT data storage. It will alert and display the environmental condition to the LCD display or mobile display. The proposed system is evaluated the performance and analysis in an efficient manner.

Index Terms— IOT, Coal mine safety, Miner's monitoring, Safety alert and embedded sensors.

I. INTRODUCTION

Safety of miner's is major challenge in today issues, which is turned because of more and major miners have been killed and disabled. Mines are under the characteristics of very long in a Kilo Meter and minimum wider in a meter. Coal mines are act as a major resource role in many of the industries. It make major pivotal role in nation economical status. But in the miner safety is very low due to harmful gases, high temperature and natural disasters. In recent decades IoT plays an active role to reduce man power and man made mistakes. It will help easy to analyze and make a decision of the users. It saves the users time as well as the efficient decision making.

Using Bluetooth based wireless transmission system is a unified short range coal communication system. It has some of advantages like low power, low cost and open source controlling software. But it has one major disadvantage of its technical feature as Host Communication Interface complexity will be high. Another CAN bus based coal miner safety alert system is made the combination of both wired and wireless data communication system. It will also some major difficulties of like Bluetooth are short range, cabling for long distance, damage of cables and poor transmission rate. RS485 based coal mine monitoring system is an advanced

two-way communication system and it has salient feature is simple structural design and low cost. But it is low guarantee reliability in master-slave network structure. MSP430F and nRF2401 based coal mine safety system intensively interfaced with embedded sensors and it collects some parameters such as temperature, humidity and some other environmental criteria. It transmits the data to the monitoring center via long distance cables. Due to natural calamity and roof fall occurrence may be damage the cable and it causes the data lose about the particular time. It also has same failures under the conventional transmission system. In very long miner consists so noisy environment and it not get proper message. Zigbee based low power Wireless Sensor Networks (WSN) has an intelligent surveillance and safety system in underground coal monitoring system. It overcomes some disadvantages in traditional communication system and it has low power of utilization and cost efficient. It sends more reliable data about underground mines to surface control system. It only suitable for short range mines and it not covered in long range mines. This proposed system implement ESP8266 microcontroller and it's interfaced with IOT data storage, wifi module, RF receiver, and LCD display and burglar alarm. Based upon the sensor results, it reports a miner about their safety. The efficacy and cost effectiveness are revealed in the following sessions effectively.

II. THE PROPOSED SYSTEM

The key factors to control accidents and safety precautions in mines is discovered how the proposed system is to generate an alert. It monitors all the parameters accurately in a continuous manner with the help of embedded sensor networks. In fig.1 explains the proposed system reveals in both the transmitter and receiver side.

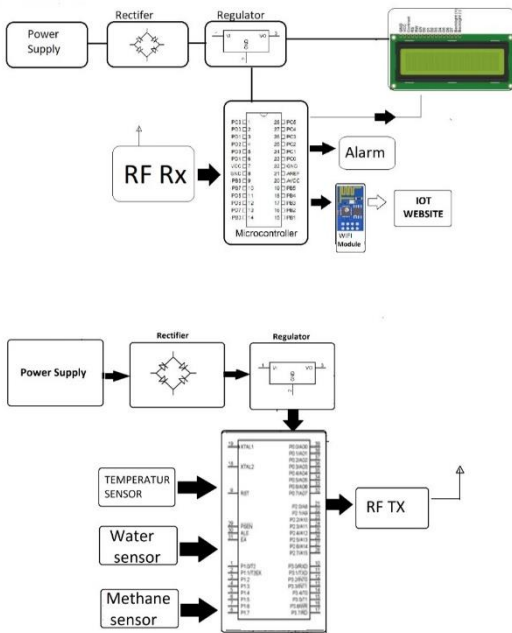


Fig.1 Block diagram of IOT based coal mine safety monitoring and alert system

A. Temperature Sensor

Sensor is a device while keep on monitoring the level of temperature in a specified region. It is a qualitative measure for classifying the temperature into a various levels. It is widely used to measure the level of temperature of the circuit. It is available in market as Resistance Temperature detectors (RTDs), Thermocouples, Infrared Sensor and semiconductor sensor. Temperature sensor can operate in nominal operating temperature rage is -550C to +1500C.

B. Methane Gas Sensor

Methane is a compound form of gas, it naturally occurring in underground earth and seafloor. It generated by both activities of biological and geochemical process. It was so harmful and easily flammable in nature. Gas sensor detects most efficiently if there is any presence of methane gas. It detects any harmfulness in air and immediately sends to the receiver. Gas sensor quantifies the amount of purity in air and the analysis delivers to the IOT storage.

C. Water Sensor

The device or sensor indicates the amount of water presence in the IOT based coal mine safety monitoring and alerting system in particular area.

D. NODE MCU MICROCONTROLLER

MCU is a micro-computer and it is made up of Metal oxide-Semiconductor (MOS) integrated circuit chip. It consists of microprocessor and input/output peripherals. It is widely used in embedded applications and other general purpose applications. In every automation and control system is implantable with the help of microcontrollers. It will easily modify and sized based on the circuit.

E. Internet of things

IoT is a system; it interrelates or collects the data and computing mechanical and digital machines with the help of Unique Identifiers (UID). It converge the real-time data, machine learning data and embedded results. It supports more than one ecosystem in user friendly. It helps to make the system into better way towards smartness.

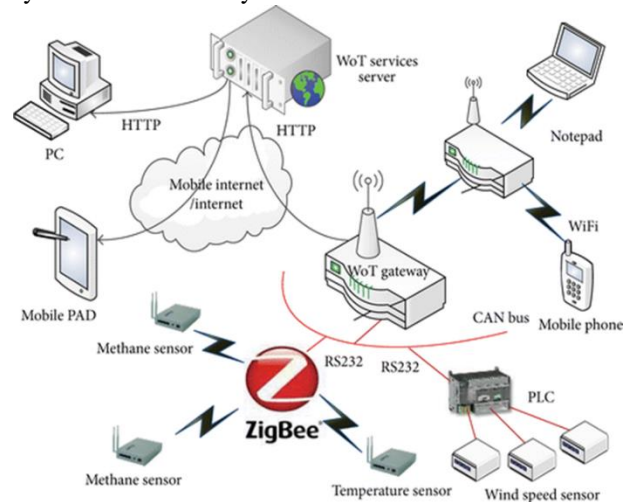


Fig-2 Architecture of IOT based Coal mine Safety and Alerting system

F. Wireless Transmission Device

Zigbee wireless system is chosen because it is low power, low cost, low maintenance monitoring and control system. This system or device is interfaced with software iotgecko and programming language “C”. It is used to transmit and receive the data and stored into the IoT remote centre. It will help to analyze any changes or abnormal activities.

G. LCD Monitor

A 16 x 2 LCD is demonstrating information regarding different parameters like temperature, air purity and water level.

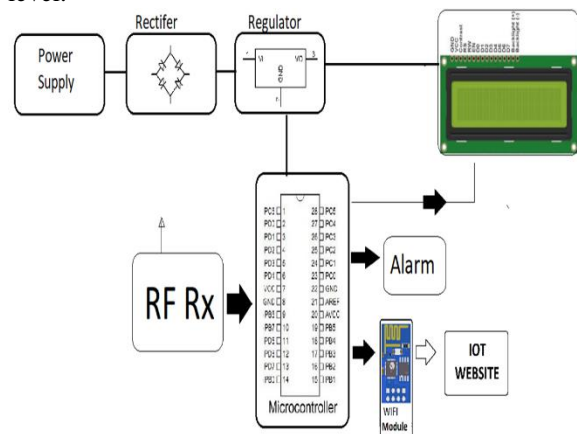


Fig.3. LCD Display with Sensor Information

III. WORKING PRINCIPLE

The proposed system combines both the CAN and WSN networks technology is easy to achieve timely monitoring and early warning of environmental parameters. Methane sensor, temperature Sensor and water sensor segregates all the real time data's and stored into the remote monitor center. The entire system makes the abilities of the various underground sensor values available at all applications layer on the access gateway side and operational system side. It encapsulates the open interfaces via the REST-framework and allows the application layer to access resources via HTTP.

IV. RESULTS AND DISCUSSIONS

In fig.4 reveals LCD display showed up all the mine parameters in every current situation. Temperature sensor is used to quantify the temperature level of miner present area. It will alert if case any change in temperature weather forecasting. Amount of humidity and water level was quantified by the use of water level sensor. Methane or gas detecting sensor measures the real time gas value of the miner present area. If there is any toxic or respiration problem gas is present and it alerts the miner immediately. All the real time values are set aside into the IOT data storing device. Data's are analyzed and it makes the decision based upon the programming codes. Every sensor outputs are displayed into the 16 x 2 LCD display. Any unwanted or difficult conditions are found in the mine area, the system immediately alert to the miner using alarm.

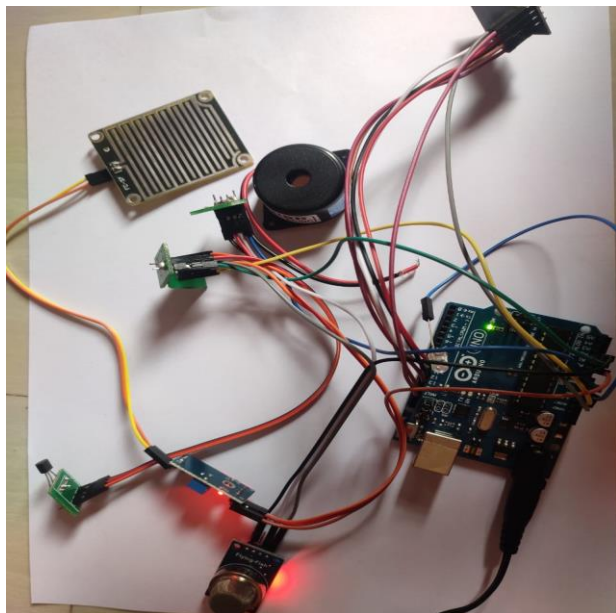


Fig.4. Coalmine safety Transmitter

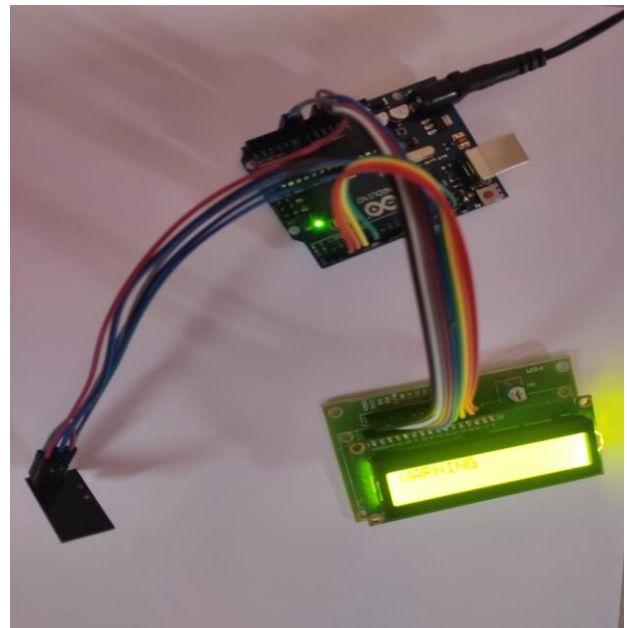


Fig.5.Coal mine safety Receiver

Table 1

Temperature	Status
Coal in 30 degree Celsius	Room temperature
Coal in 50 degree Celsius	Normal
Coal in 80 degree Celsius	Warning

V. CONCLUSION

Real time environmental status of underground mines is collected by the sensor networks continuously and it transmits data and it stored into the IOT data storage. This will ensure the safety of miners who is working underground in every minute of action. Using wireless sensor networks, it sends the safety level to the corresponding miner and safety controller room in a most efficient manner. If there is any difficult condition is identified and it alerts the miner with the help of burglar alarm. This system is made of low power wifi module and displays the outputs in a LCD display. It monitors the real time values in a well-organized performance. In feature enhancement is enlarge the system into fully wireless and automatic and the prototype is modified into all the tiny and superior mines. It increases the safety and precautions in minute actions.

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