

Intelligent Helmet for Coal Miners Using IOT

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Abstract

Our proposed system provides safety to the miners by detecting and informing about the environmental changes. System provides wireless sensor network for monitoring real time situation through microcontroller and GSM module, providing cellular network underground by the companies such as star solution making it easier to monitor the coal miner from remote areas i.e detecting harmful gases and rise in temperature by using gas or heat sensors. It warns the miners about the critical environmental changes and helps to take immediate safety measures. To provide the security in coal areas using IOT, a monitoring and protection device for underground employee is to be implemented.

Keywords: Real time monitoring; IOT; Coal mine safety

INTRODUCTION

India is a country, which is renowned for its extensive and distinct mineral reserves and big mining businesses. India produces about eighty eight minerals, out of which it has four minerals related to fuel, ten minerals that is of kind metals, fifty minerals that is of non-metallic in nature and remaining twenty four includes minor minerals . As

of 2014 Apr India has over three hundred Billion Tonnes coal holds. Generation of coal in the year 2012 and 2014 remained at five hundred and forty Million Tonnes and five hundred and fifty seven Million Tonnes respectively. Coal not only used in electricity generation it can be also used in steel production, cement manufacturing and as a liquid fuel. Along with these

contributions the coal mining process are very dangerous. The coal mining processes are of

- Underground mining
- Open cast mining

The proper supervision for worker wear the protective equipment is very important factor for consideration. Underground mines are very dark so any miners are fall unconscious because of suffocation or falling of structure, supervisor don't known about her health condition and proper treatment is not provided her in time.

The main reason for miner death is harmful gases explosions. In coal mines carbon monoxide, methane, LPG gases are existing and they are very harmful for human body. The proper supervision and proper communication is very important requirement of mining industry. The smart helmet provides a real time monitoring of harmful gases, temperature and humidity.

LITRETURE SURVEY ON INTELLIGENT HELMET

This is not an original idea for the implementation of intelligent helmet for coal miners. The idea existed from many

years using different technology. After IoT field finding its grip in our lives this is however an original plan for designing intelligent helmet with different sensors and GSM module.

Kannan hemachandran in his paper of 2017 explains to design a wireless helmet for coal miners using Zigbee wireless technology

Geetha in her paper of 2015 introduces about Intelligent Helmet for Coal Miners with Voice over Zigbee and Environmental Monitoring

Junyi Yu and Yongfeng Huang in their paper of 2015 explains about a Layered Two-Step Hidden Markow Model Positioning Method for Mine Environments Based on Wi-Fi Signals

Lincan Yan in his paper of 2015 explains about antenna arrangement investigation Through-the-Earth (TTE) communication in coal mines

PROBLEM SYSTEM

The safe production level of coal mine is still low, especially in recent years, disasters of coal mine occur frequently, which lead to great loss of possession and life, the safety problems of coal

mine has gradually become to the focus that the nation and society concern on. The disasters of coal mine happening are due to the complexity of mine environment and the variety of work condition of coal mine, so it is very necessary to monitor mine working environment.

DESIGN

This project, a continuous monitoring system, which monitors the environmental parameters such as presence of poisonous gases and it also, measures the temperature and humidity. The different sensors such as temperature sensor, gas sensor, carbon dioxide sensor, humidity sensor are placed in the helmet of the miners. It will sense and gives the values to the microcontroller. The controller compares the input values with the threshold values. This system uses GSM

technology for wireless transmission. It is received by the receiver and displayed in the PC.

Block Diagram

IOT is trending, cost effective, more reliable. One prototype is placed in coal mines and another one in Alert room. The coal mines side GSM is used to transmit the signal coming from sensor like temperature, gas and humidity sensor.

System Architecture

The architecture includes the complete system comprising the helmet, server that serves for the purpose of IoT and a web application for monitoring purpose at the control room. The helmet comprises of a Renesas microcontroller, a GSM module, temperature sensor, gas sensor, humidity sensor.

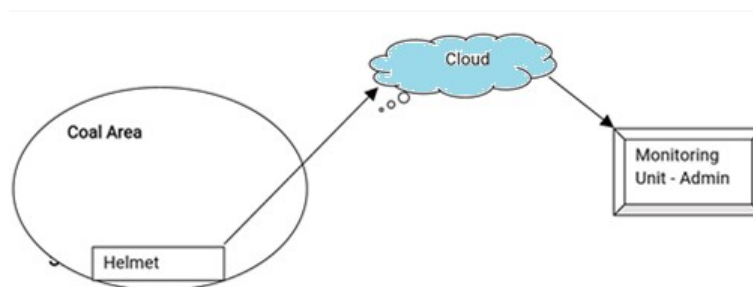


Fig 1: Monitoring system

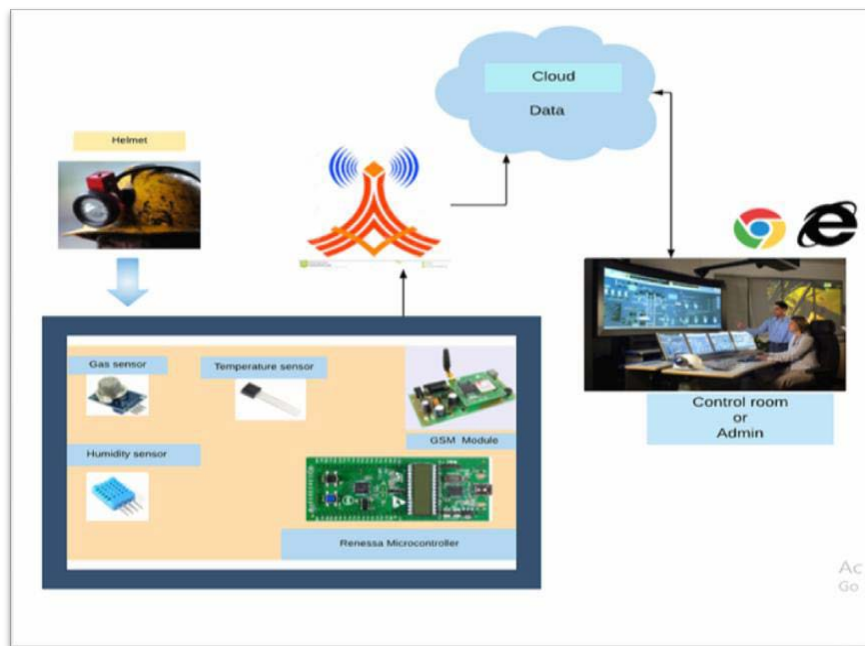


Fig 2: System Architecture

Hardware Components:

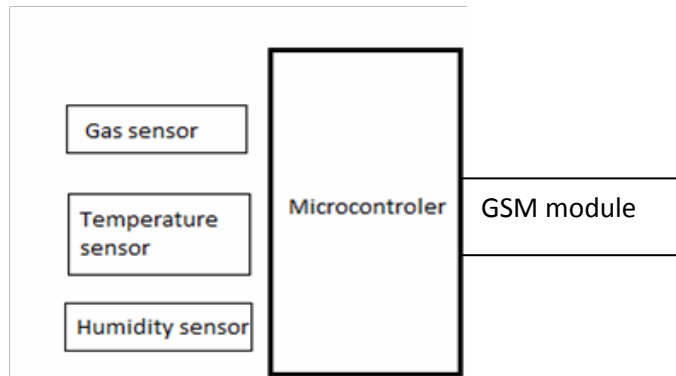


Fig 3: Components of helmet

Temperature Sensor [LM35]:

Temperature sensor is a device that measures the hotness or coolness of the system or environment. LM35 is the temperature sensor we have used in our project. It is a semiconductor sensor. It is low in cost and easily available. It can also

be directly connected to the microcontroller. It measures temperature in degree Celsius .Operates at very low voltage level that is 4 to 30 volts. Current drain is less than 60 mA. LM35 operates at very low voltages that is for per one degree rise in temperature the output of the

sensor will rise to 10mv and if the temperature is 23 degree Celsius the output will be 230mv i.e., 0.32V this is the main advantage of LM35 temperature sensor.

In our project we have deployed temperature sensor inside the helmet. As the coal miner works under the ground, he may suffer through high temperature because the temperature under the ground may be different from above temperature. Threshold temperature that a coal miner can withstand under the ground is set and if the temperature exceeds above the mentioned, LM35 detects and warns the admin.

Gas Sensor [LNG]:

A gas sensor is a device that detects the harmful gases in areas specially the safety systems. It detects the gases like methane, biogas, LPG and hydrogen etc. It is low in cost and very sensitive towards the gases like methane, propane or any other combustible gases Gas sensor is embedded onto the helmet. Due to the presence of coal and other environmental parameters under the ground, there may lead to gas leakages that are fatal. And hence if any harmful gas is detected by the sensor it is notified to the admin and necessary actions are taken.

Resistive Humidity Sensor:

Humidity is the amount of water content in air. Humidity allows micro organisms (parasites) to grow on human's body causing health problem. Humid environment increases temperature. Humidity sensor we have used is of type resistive. A humidity sensor senses the amount of water content in air. The main advantage of resistive humidity sensor is that it is low in cost and smaller in size ,it allows to operate from remote areas that is the sensor and the controller circuit can be at any place. Humidity sensor in helmet detects the relative humidity underground and then if humidity is more it detects and notifies the admin.

GSM (Global System for Mobile communication) MODULE:

GSM is widely used communication technology used for transmitting data. GSM architecture has three components Mobile station: Is module that has processor, transceiver and a SIM card that is main source of network. Base station: Is the interface between the mobile station and the network system. It decides the protocols for communication. Network system: Provides the network to the mobile station. The GSM module in our project collects the data from all the

sensors and passes it to the microcontroller.

Renesas (RL78_R5F 102AAA)

Microcontroller:

Renesas microcontroller operates faster and is low in cost. This board has reset button, this microcontroller is simple as in it allows the user to program the device and run the code with its simple platform. It has 8 bit general purpose register, 2KB or 16KB ROM, 2KB RAM. Needs an adaptor to be connected as a power supply source

Software Components

MongoDB:

MongoDB is a database a document oriented one also called as NoSQL. This database is written in C, C++ and Java programming language. MongoDB stores unstructured data. It is freely available. Data can be stored horizontally, schemas can be dynamic, it is more secure than SQL database.

Angular JS:

Angular JS is a JavaScript framework that helps us build web applications. Benefits of Angular JS is a two way data binding, dependency injection and testing. Angular JS it is very easy to develop applications and a clean model view controller way.

Bootstrap:

Bootstrap is developed by Twitter and is freely available. It is HTML, CSS and a JavaScript framework for creating web applications it includes HTML and CSS based design templates for common user interface components like buttons, drop downs, tables, navigations etc. One of the greatest advantages of using bootstrap is that it helps us create responsive web applications faster and easier. Responsive web applications are adjustable that is according to screen.

IMPLEMENTATION

Hardware Implementation (Helmet)

The helmet is implemented using Renesas microcontroller, a GSM module and three different sensors. The sensors used in our project are humidity sensor, temperature sensor and gas sensor

The sensors main function is to sense the accurate environment parameters and with the use of GSM will send these parameters to the cloud.

Server Implementation (cloud)

The cloud is implemented to collect these parameters and stored using MongoDB. The cloud also allows the controller or admin to access the information of these parameters received from coal areas. He

can also make changes which will be reflected on the cloud.

Software Implementation (Web Application)

In software implementation we have developed a web application for the controller in the control room. This web application comprises of admin module. In this admin module the admin can monitor the different coal areas, and the environment in which he is working. He can also add or remove coal miners and coal areas which will be updated.

ADVANTAGES

The system functions as a Safety monitoring system of the environment. It also provides improved service in coal mining.

It also Provides wireless connection security. The system provides awareness of high temperature, humidity and harmful the gases. Quick searching is possible and is able to give the warning.

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CONCLUSION

A real time monitoring system is developed to provide clearer and more point to point perspective of the underground mine. This system is displaying the parameters on the base station PC and alerting miner if any abnormal condition occurs. It will be helpful to all miners present inside the mine to save their life before any casualty occurs. In future using additional sensors all possible safety issues could be monitored such as dust, vibration, water leakage etc. Also we can use number of slave and improve the data transmission distance.

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