

Smart Helmet for Coal Mining Workers

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Abstract – Mining is one of the most dangerous jobs in the world. There is possibility of getting many health hazards for underground coal mine workers. Rate of accidents under coal mines is increasing. This project describes the use of technology and wireless system to avoid accidents in coal mine. The main aim of designing this project is to detect harmful gases, high temperature and to monitor individual worker. This system uses Wi-Fi technology for wireless communication, GPS module for tracking and sensors for detection of gases and temperature. This system helps to monitor the mining area. Work as an emergency call system. This could also work as tracking and alerting system in the case of emergency and accident. Those tracking and alerting property surely help the rescue team.

Key Words: coal mining safety, smart helmet, sensors, Wi-Fi networking, wireless communication, mining monitoring.

1. INTRODUCTION

There is risk to the life of coal mine workers by leakage of hazardous gases and fire inside the mining areas. There are not many systems present which could help on the location detection as well as harmful situation. Most of solutions on this problem are costly. This is why there is need to introduce such system. To overcome this problem, we have used technical approach. This system is simply circuit on board which is mounted on helmet. System will collect the values of gas level and temperature with the help of sensors; then this data will be sent to the wireless network using Wi-Fi module.

This system can be further improved by building system on chip with more compact size; this will help in making system useful in practical manner. Any conventional energy source can be used for more compact and energy saving purpose instead of current power resource. Objective was to create wireless monitoring system. With help of this mobile system communication connectivity increases between mining workers and supervisor person or rescue team. This smart helmet ensures the safety of individual worker by detecting gas, high temperature and giving it's prewarning. This could be lifesaver for thousands of lives which we are losing due to lack of monitoring and technological approach to solve the problem.

2. SYSTEM OVERVIEW

2.1. BLOCK DIAGRAM

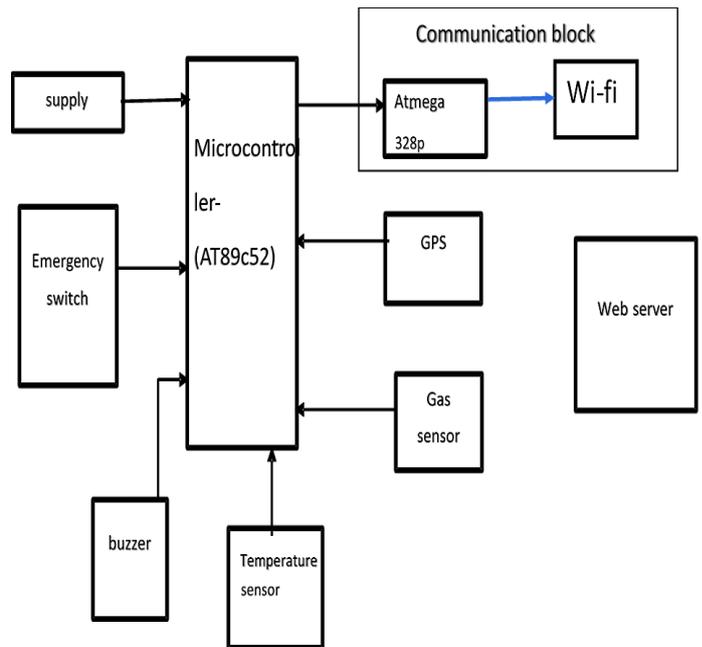


Fig _2.1. block diagram of smart helmet for coal mining workers

In this project we have presented a framework for designing smart helmet for coal mining workers. We have also built a website for the monitoring the system with wireless network. Because of website it is convenient to know the status of the system from anywhere in world. The actual aim was to detect the high temperature and leakage of gas. The detecting process will be conducted by sensors. The system consists of helmet which is mounted with the sensor circuit. The data will be sent to microcontroller by the sensor. Microcontroller will compare the data with pre-set threshold value. If it exceeds the value the information should be transformed to the web server. The system consists the helmet with a mounted circuit on it. The Wi-Fi module will send the information into the server and the location will be traced by the GPS.

2.2 FUNCTION ANALYSIS

Devices used in the system has their own functions. Each device has independent working. Together working of all component and module builds up system presented here. Coordination of working blocks in the system could be explained as follows,

1) Power supply block = Every block gets output of this block as a power input. It reduces the 12v power supply into 5v. Provides 5v supply to other component as their supply voltage.

Components in this block are 7805 voltage regulator, high temperature radiant capacitor (1000 μ f 25v), diode, ceramic capacitor and LED for indication, power jack (female plug barrier connector).

The power block gets the input from the 12v DC adapter through the power jack. Supply goes through the diode and enters the 7805-voltage regulator set up. At the voltage regulator this supply reduces to the 5v. The high temperature radiant capacitor and ceramic capacitors are available for the noise reduction.

2) GPS module = NEO_6MV2 GPS module is used. The module simply checks its location on earth and provides output data. The output is longitude and latitude of its position.

3) Temperature and Gas sensors = Temperature sensor DHT11 is used and gas sensor MQ6 is used. MQ6 can detect hazardous and flammable gases (LPG, methane, butane etc.). This sensor is used due to its properties of detections helps in detecting common gas leak under coal mines.

4) Communication block = This block will receive the status from the main processing unit which is microcontroller AT89c52 and convert it into the analog to digital data. This data will be forwarded into the network it connected by this communication block. It will continue to change the status of the information as per the program and new status it receives

This block consists of ATmega328p controller, Wi-Fi module (ESP8266-01), positive power supply connection from power supply block (5v) which is further reduced up to their required power supply range.

Transmitted signal will be transformed by AT89c52 through a serial communication wire to the Atmega328p controller. Further this Atmega328p controller will process the information and transfer it to the Wi-Fi module. The Wi-Fi module will forward it into the Wi-Fi network to which it has connected.

5) Networking = In this project networking plays main role in the mobility of the system. Being wireless there is need to provide an uninterrupted and reliable wireless communication. There are many ways to make a system communicate wirelessly for e.g., Bluetooth, Zigbee, etc.

But range of system also matters as it is being used in huge area of mining industry. System also needs to be compact with less supporting gadgets needed. Best solution is the Wi-Fi. WIFI with the help of ESP8266 Wi-Fi module. This Wi-Fi module is able to receive the data, manipulate data and forward that data package into the network.

3. WORKING

The system we have created will get the supply of 5v and turns ON. It works on detection of gas leakage and temperature detection with GPS location detection for miners. If gas or rise in temperature is detected then it will turn ON the alarm provided on system. an emergency switch is provided on the system. This will help to get instant attention in case of emergency.

The data and status of a sensor along with GPS location will be forwarded to a Wi-Fi module. This Wi-Fi module will forward data to the website through Wi-Fi network. The website will display all the data it receives. It changes the display if emergency switch is pressed or any other situation is detected by sensor. All this circuit is mounted on the safety helmet of worker. This system will save life of the workers in case of accident with its location detection and emergency switch facilities. Another use of it is; we will get alert and prevent accidents. Because we could monitor the environment around the person wearing helmet. In short this is mobile monitoring safety system for workers.



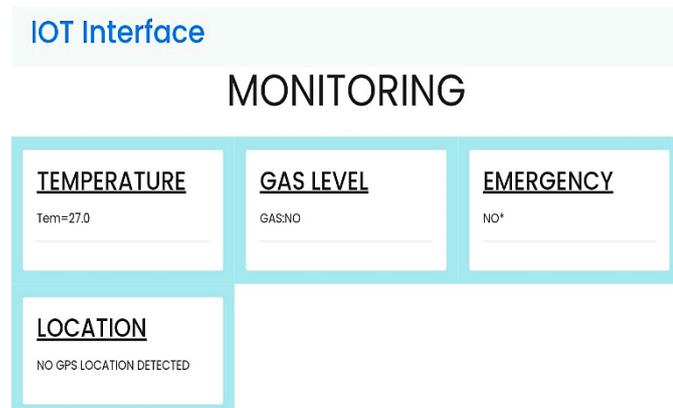
Fig_3. Implementation of system

3.1 software

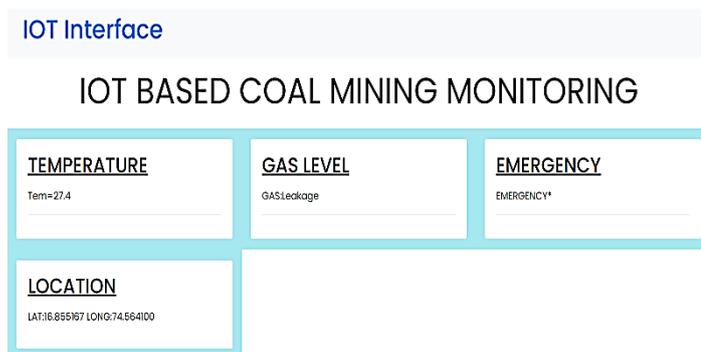
- 1) Keil micro vision for programming
- 2) Proteus for PCB design
- 3) Arduino IDE for programming

4. RESULTS

System collects the data with the help of implemented module and sensors. Network connectivity works without interruption. Status of gas, temperature, location and emergency on the website changes correspond to actual system changes.



Fig_4.1. website display before detection



Fig_4.2. website display after detection

5. CONCLUSION

System implemented in this project comes with detection and monitoring facilities. This system solves the problem of carrying large machine to mining area to check gas detection in it. Small size gas sensor used here which detects gas. Temperature sensor detects temperature in area. GPS module finds coordinates where system is present.

This compact system works for individual user as it's mounted on safety equipment (helmet). Created wireless system which provides safety and monitor mine workers. System is developed using sensor, controllers, and wi-fi network.

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