

MODERN HELMET FOR SAFETY AND SECURITY OF COAL MINE WORKERS

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ABSTRACT

The main part of concern in any industry is the safety and security of workers working in that industry. If we do analysis on the coal mines, safety and security of workers is considered as one of the most important point. For this, we designed a helmet to give safety to life of workers against the accidents taking place in the coal mines. This helmet is mainly working on three parameters. It consists of two main sensors used to detect carbon monoxide and temperature. And the another one is the heartbeat sensor which is used to read the pulse of workers under any conditions. The HC12 transceiver section is used for wireless communication. The display screen is used to display all the readings of these parameters. The buzzer is used to give alert under harmful and critical condition.

Keyword: Buzzer, HC12 Module, wireless communication.

1. INTRODUCTION:

Safety of worker working in any industry is a very important factor of that industry. In coal mines, safety and security of workers is a part of concern. Many rules and precaution techniques are made mandatory to be followed by the workers to protect them. There are many conditions which can create harmful situation and can cause accidents in coal mines. For this many protective measures are adopted. One of the main problem in coal mine is lack of communication and the presence of harmful gases such as methane, carbon monoxide. The workers are not able to communicate under any dangerous condition. If the value of harmful gases increases beyond the limit, it can lead harmful condition for the workers.

To maintain the communication radio communication was used. But due to its drawbacks of transmission it cannot be used. Next to this, chain type wireless underground mine sensor network is recently proposed. Still there is a need to improve this communication system for the protection of workers. The gases present in the surrounding in the coal mines are methane, carbon monoxide, carbon dioxide, etc. These gasses are toxic gasses if they increase beyond a certain limit. If they increase beyond that limit, they can create the surrounding which can even cause fatal accidents of the coal mine workers. There is need to design a system which can give alert to the workers against the harmful condition.

2. LITERATURE SURVEY:

With the use of Bluetooth wireless transmission system, Yongping Wu and Guo Feng proposed the monitoring of coal mine. A common low-power, low-cost wireless air interface and controlling software opening system is provided by the Bluetooth technology. This paper mentions the development background technical features and the structure of the protocol stack consisting the use of Bluetooth technology. But, the Bluetooth is less distance wireless technology which is the major problem here and moreover, the use of cabling is also difficult. These cables may get damage during natural disturbances in the overall system.

The implementation of the safety helmet for coal mine workers is proposed by Pranjal Hazarika. In this helmet, methane and carbon monoxide sensors are introduced. Wireless transmission of data to the control room is enabled using Zigbee module. In case, the concentration of these gases increases above the specific limit, the alarm is basically triggered to keep the plant and the workers safe by preventing an upcoming accident. This system is unable to detect fall down of the worker and also whether worker is wearing the helmet or not.

Based on wireless sensor network, Jingjiang Song and Yingli Zhu implemented the proposal of automatic monitoring system for safety of coal mines. Its construction is done using MSP430 F & n RF2401. The system sensor groups are used to detect humidity, temperature and other parameters in the underground mines. Microcontroller send these measured parameters to the wireless communication module. As this hardware is placed inside the coal mines, the factors like natural calamities or roof fall occurrence cause damage to the system. Thus, because of harsh environment in the coal mines the maintenance and installation of the system is difficult enough.

3. SYSTEM ARCHITECTURE:

Block diagram is divided into two sections which is shown in figure 1.

1. Transmitter section
2. Receiver section

3.1 Transmitter section

The transmitter section ATMEGA328P microcontroller is used and three sensors i.e. temperature sensor, methane sensor, pulses sensor are connected to microcontroller. The sensor senses the value and it will be shown on the display which is placed on the helmet. If the value of the sensor exceeds beyond the pre-set value the buzzer gets activated. Here, HC12 transmitter and receiver network of wireless serial communication is used. The HC12 transmitter connected to the microcontroller will transmit the sensors data to the receiving unit. And the power supply is given to the various sensor and microcontroller.

3.2 Receiving section

Data from the transmitter is collected by receiver which is interfaced with the Arduino. And by using the Arduino software live data can be monitor on the PC.

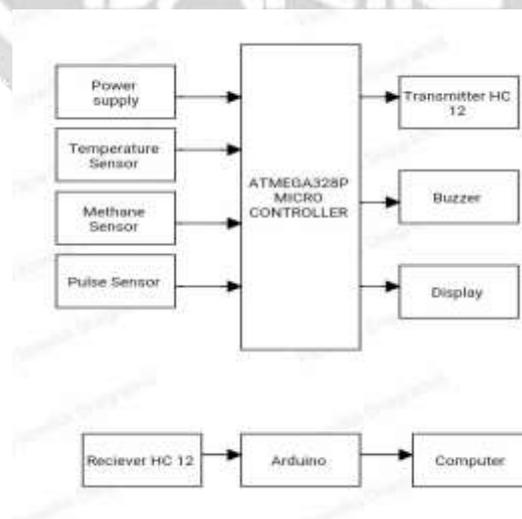


Figure 3.1 Block Diagram

3.3. ATMEGA328P:

In this project, we used ATMEGA328p which is a high performance, low-power controller from microchip. ATMEGA328p is an 8 bit microcontroller based on AVR RISC architecture. It combines 32 kb ISP flash memory, 1 kb EEPROM, 2kb SRAM, 23 general purpose I/O lines and 32 general purpose working registers. These devices operate between 1.8 to 5.5 volt.

3.4. MQ4 sensor:

MQ4 sensor is used to detect the concentration of methane gas in surrounding. It can detect the natural gas concentration anywhere from 200-10000 pm.

3.5. LM7805 voltage regulator IC:

A voltage regulator IC maintain the output voltage at a constant value. Its input voltage ranges from 7-35 volt having a current rating of 1 Amp and output voltage ranging from 4.8 volt to 5.2 v.

3.6. BUZZER:

Buzzer is a device which is used for audio indication. In this project, buzzer is used to alert monitoring section. When RF receiver receives alert information and send towards buzzer through microcontroller. It requires 5 volts for its proper operation.

3.7. HC12 Module:

HC12 is a half-duplex wireless communication module. This module is with 100 channels in the 433.4 to 473.0 MHz range which is capable of transmitting 1KM. The HC12 transceiver module has 100 supported channels spaced 400 KHz apart.

3.8. TEMPERATURE SENSOR:

It is stainless steel tube having 6mm diameter and 30 mm long. It is moisture proof sensor. It requires 3V to 5.5V input. It is rated for full -55°C to 125°C range. It has 0.5°C ensured accuracy from -10°C to 85°C .

4. RESULT:

For the protection of coal mine workers, development of modern device using helmet is one of the best methods. Here, our main focus is on gases detection, location, pulse rate and wireless communication. We have used MQ4 sensor for detection of methane. If any of the gas level goes beyond the critical level, the buzzer get activated. The pulse sensor sense and display the pulse rating of the worker. Variation in temperature is sense by temperature sensor. All these parameters will be shown on the display. HC trans-receiver is connected on control room PC and helmet of the worker

In this way, we have achieved the success in monitoring the location and health conditions of coal mine worker.

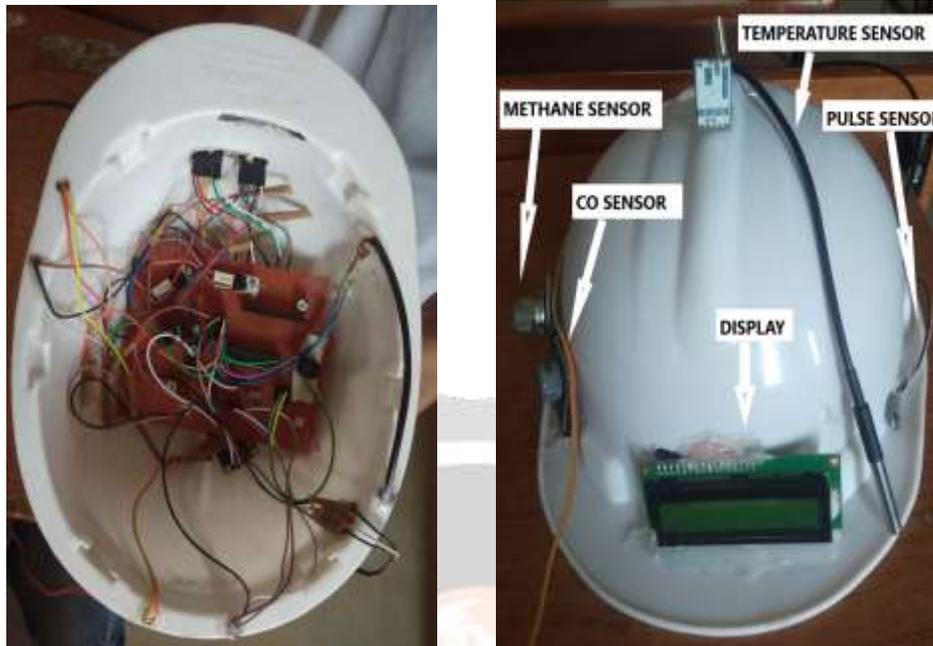


Figure 4.1 Internal Circuit and Helmet Design

5. CONCLUSION:

For detecting the dangerous level of gases, this is a prototype of modern helmet. The various types of gases present there are methane, carbon dioxide, etc. The important factor like to detect the gases level and the pulse rate is covered by this system. On occurrence of any dangerous situation, the buzzer gets activated. All the sensors are placed on the helmet of the worker properly. Display is also connected which shows the parameter present there. Same parameters are shown on the control room PC. HC trance receiver module are used to transmit and receive the data of sensors.

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