

“Study based on Intelligent Brain Helmet for Coal Miners Safety”

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Abstract— In coal mining industry safety is a very important aspect. For this purpose we develop a smart helmet project to increases the safety feature of coal miners. This helmet has been able to detect three most dangerous events such as air pollution, helmet removal by miners and collision on the head in mining area and used wireless technology such as RF communication module is used to give the alert information to the user. All these three dangerous events are detected continuously by gas sensor, infrared (IR) sensor, and pressure (collision) sensor and if they cross the pre-defined limit, then the user gets alert information on LCD screen and buzzer will turn on automatically. The values of different sensor are continuously transmitted by using RF transmitter to the monitoring unit which are received by RF receiver module.

Index Terms— Sensors, RF transmitter, RF receiver.

1) INTRODUCTION

Safety is very important factor in any type of industry. In mining industry miner's safety and security is more important factor in all. To reduce dangerous event in the working area of mining industry and increase safety features for miners. For this purpose we develop a microcontroller base intelligent brain helmet which is able to detect dangerous event in the mining industry. In the development of helmet we consider three main types of event such as air quality, removal of helmet by the miners and collision (crash of an object on head).

The first event is concentration level of the dangerous gases such as CO, SO₂, NO₂, and particulate matter. This dangerous gas is detected by the gas sensor. The second event is helmet

removal by the miners. This dangerous event is detected by infrared (IR) sensor. And the third dangerous event is the collision on the miner's head which is detected by the pressure sensor. The outputs of all the sensor is transmitted by the RF transmitter towards through micro controller towards monitoring unit which are received by the RF receiver module.

2) LITERATURE SURVEY

Chenge Quing and et al [2] have introduced an intelligent helmet for coal mines based on zigBee wireless communication, the main concept for this project is that identify the humidity level, methane concentration and the temperature in the working area. All these sense data which is transfer towards another ground station wirelessly by using ZigBee.

In another station the person who is monitoring station alert the miner by using voice communication.

The problem in this project is that miner gets alert by voice communication since miner will be working in a noisy area then he does not gets alert.

D. Kock, et al. formulated automation for the coal mining industry in South Africa considering that of productivity, health and safety [3]. They conjointly investigated the coal interface detection (CID); to do this they used two well-known techniques such as vibration analysis and natural gamma radiation. Communication channels- they also considered infrared, power line carrier, radio and optical fibre communication channels for transmission of data in the coal mines. Here it

needs to be more thoroughly explored to accomplish the prosperous implementation of computerized systems in underground mines. People commit to take ownership of the operation. Otherwise, the system, despite how fine it operates, is doomed to decline in the long spurt.

3) PROPOSED SYSTEM

To explain the whole system, the system is divided in two sections. First section is the transmitter section and another is the receiver or monitoring section as show in figure 1 and figure 2.

Transmitter section consists of helmet removal sensor, air quality sensor and collision sensor, microcontroller and RF module. All the sensors are connected to the microcontroller. The helmet removal sensor is used to detect whether the safety helmet is remove or not by the miner. Air quality sensor is used to detect air pollution in miners working area. In mining industry air is polluted because of mining operation such as drilling, blasting etc. And the collision sensor is used to detect whether any object is fall on the miner head. All these sensors data is process by the microcontroller, if any dangerous event is occurred

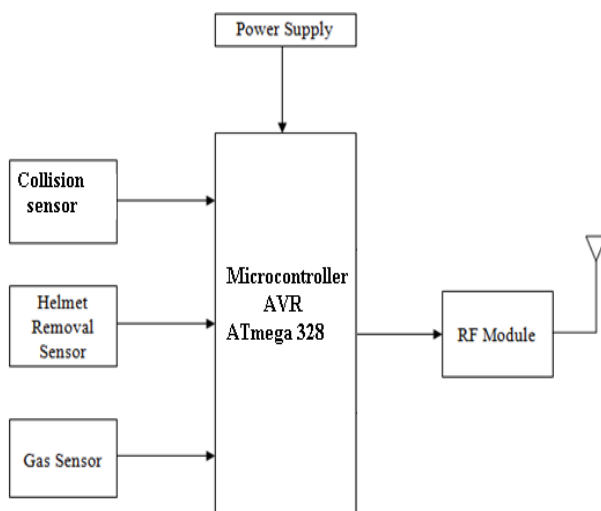


Fig.1 block diagram for transmitter section

then microcontroller send alert information towards receiver or monitoring section through RF transmitter.

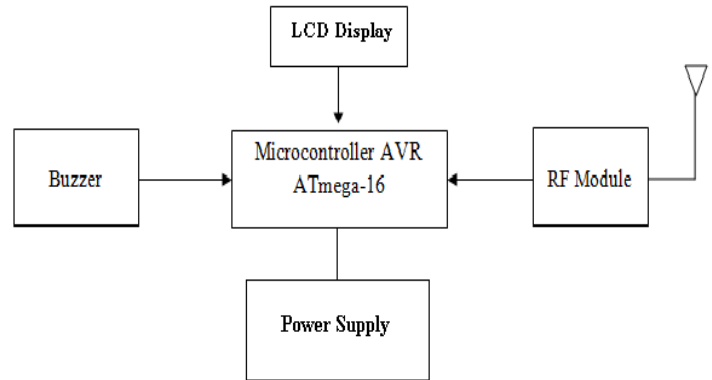


Fig. 2 block diagram for receiver section

In receiver section, when RF receiver receives alert signal then this signal is gives to the microcontroller. Microcontroller processes receive signal and gives towards LCD display and buzzer.

4) HARDWARE

A] Sensor network

1. Collision (Pressure) sensor:-

In order to detect collision on the miners head, a pressure sensor is used. In this project piezoelectric sensor is used as a pressure sensor. A piezoelectric sensor is a device which used piezoelectric effect to measure change in pressure and convert them into electrical signal.

2. Air Quality Sensor:-

In coal mines, air is polluted due to emission of particulate matters and toxic gases such as methane (CH₄), sulphur dioxide (SO₂), nitrogen oxides (NO₂) and carbon monoxide (CO).

In this project we used MQ5 gas sensor to detect the presence of toxic gases in air. MQ5 gas sensor is a device which is highly sensitivity to detect LPG. The MQ5 gas sensor device is used to detect various types of gases such as hydrogen, carbon monoxide and methane. The cast of MQ5 is low and it is suitable for different application.

3. Helmet removal Sensor:-

To detect whether the miner has removed or not its safety Helmet a technique is used which is known as helmet removal sensor technique. In this technique Infrared (IR) sensor is used to detect whether the miner is remove or not its safety helmet.

B] Microcontroller AVR ATmega328

Microcontroller AVR ATmega328 is used in the transmitter section. AVR ATmega328 is a low power CMOS 8-bit microcontroller. It used RISC architecture. It executing powerful instructions in a single clock cycle.

C] Microcontroller AVR ATmega-16

In this project, we will learn How to convert an analog signal to digital signal using the Analog to Digital Converter of AVR ATmega16 microcontroller. The AVR ATmega16 has an inbuilt 8 channel, 10 bit analog to digital converter. Here, we will first convert a 5V signal and then a 0V signal with a reference voltage of 5V of ADC. After each conversion, the analog to digital converter of ATmega16 will give a 10-bit value for each signal (5V and 0V). These outputs of the analog to digital converter are displayed in a LCD display. When a 5V signal is converted, the output of analog to digital converter is 0x3ff (1023) and when 0V signal is converted, the output is 0x00 (0).

D] RF Module

In this project CC2500 RF module is used for transmit or received radio signal between transmitter and receiver section. CC2500 transceiver is low cost 2.5 GHz transceiver and it is

design for low power wireless application. It required 5volt power supply and its range is 100 meter.

E] Buzzer & Driver

The Buffer provides unit gain amplification to inputted signal and fed it to Driver for driving relay. The Driver is power amplifier, which provides high current and voltage to relay coil for proper switching action.

5) CONCLUSIONS

Aim of this project is to increase the safety feature for coal miners. This system can monitor most important dangerous events. Monitoring the dangerous event and performing rescue operation for miners safety made easy with this project. In this project we used low power RF module. All the sensors can be easily place on helmet that helps in continuous monitoring.

6) REFERENCES

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