Smart Device for Security of Coal Mine Workers

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***Abstract*- The main point of concern in any industry is the safety of workers working in that industry. If we do study on the coal mines, safety of workers is considered as main part of management .For this, we have designed a device to give safety to the workers against the accidents in the coal mines. We have designed a helmet which is working on three parameters. It consists of two main sensors which are used to detect carbon monoxide and temperature inside the coal mine. The next is the GPS module which is used to locate the position of the worker in the coal mines.for wireless communication HC12 transmitter and receiver section is used. The display screen is used to read these parameters. The buzzer is used to give alert indication under harmful and dangerous condition.**

Index Terms- Buzzer, GPS module, HC12,Sensors, wireless communication.

I. INTRODUCTION

Safety of worker in any industry is considered as the most important part of that industry. And if we talk about coal mines, safety of workers is a part of concern. Many rules & regulations and precaution techniques are made compulsory to be followed by the workers. There are many factors and considerations which can create harmful situation and can cause accidents in coal mines. For this many protective measures are followed by the workers .One of the main problem in coal mine is difficulty in communication and the presence of harmful gases such a methane, carbon monoxide, carbon dioxide in the surrounding of the coal mines. The workers are unable to communicate under any dangerous and harmful condition. If the value of harmful gases increases beyond a certain limit, it can create harmful condition for the workers the in coal mine.

To create a wed of communication radio communication was used. But due to its drawbacks of transmission it cannot be used. Later, the chain type wireless underground mine sensor network is currently proposed. Still there is a need to enhance this communication system to the protect the workers. The gases present in the environment of the coal mines are methane, carbon monoxide, etc. This gases are toxic i.e. they prove harmful for human heath. If they increases beyond a certain limit, they can create the condition which can even cause death accidents of the coal mine workers. Hence, there is need to develop a system which can give alert indication to the workers against the dangerous condition.

II.LITERATURE SURVEY

Yongping Wu and Guo Feng proposed the monitoring of coal mines with the help of Bluetooth wireless technology. From Bluetooth technology, we are able to get provided with a common low-power, low-cost wireless air interface and controlling software opening system. Description of the development background technical features and the structure of the protocol stack of Bluetooth technology is obtained through this paper. Since, the Bluetooth is less distance wireless technology and hence it is the major problem here and also, the use of cabling is difficult. In the overall system, these cables are subjected to damaged conditions when there is occurrence of natural disturbances.

For coal mine workers, implementation of the safety helmet is implemented by PranjalHazarika. The helmet is able to detect the methane and carbon monoxide as it is provided with various sensors. The module named Zigbee module is used for the wireless transmission of data to the control room. When the level of concentration of these gases increases beyond the specific limit then there is triggering of alarm in order to keep the plant and the workers safe through prevention of an upcoming accident. Detection of fall down of the worker and

also whether worker is wearing the helmet or not is not possible through this system.

Jingjiang Song and Yingli Zhu have implemented the proposal of automatic monitoring system for safety of coal mine workers using the wireless sensor network.MSP430 F & n RF2401 are used for its construction. The sensors are used to detect various parameters in the underground mines along with humidity and temperature. These measured parameters are provided to the wireless communication module using microcontroller. This hardware is placed inside the coal mines and due to this, the factors like natural calamities or roof fall occurrence causes damage to the whole system. In this way, because of harsh environment in the coal mines, the maintenance and installation of the system is hard enough.

III. SYSTEM ARCHITECTURE

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

1. Transmitter section
2. Receiver section

1. Transmitter section

The power supply is given to the various sensor and microcontroller. The transmitter section ATMEGA328P microcontroller is the main part of the transmitter section. To this microcontroller three sensors i.e. temperature sensor, carbon monoxide sensor, pulses sensor are connected. The sensor senses the value and it will be displayed on the display which is placed on the helmet body. If the value of the sensor exceeds more than the preset value the buzzer gets activated and gives the alert indication. Here for communication, HC12 transceiver network of wireless serial communication is used. The HC12 transmitter is connected to the microcontroller which will transmit the sensor's data to the receiving unit of HC12. And the power supply is given to the various sensor and microcontroller.

2. Receiving section

Data from the transmitter section is collected by receiver section. This received section is interfaced with the arduino The arduino software monitor the live data on the PC

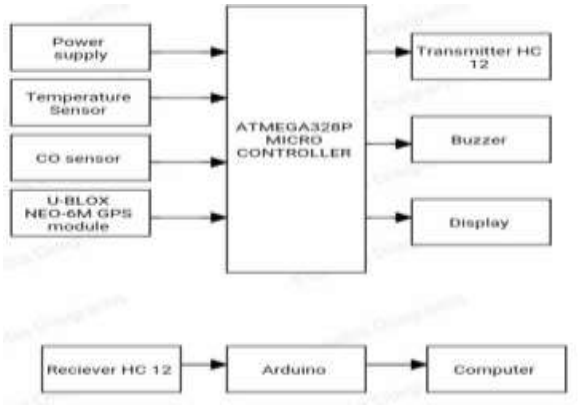

Figure: Block Diagram

A. 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.

B. U-BLOX NEO -6M GPS module

A complete GPS module is with an active antenna integrated and build in EEPROM to save configuration parameter data. It requires power supply of 3-5 volt .It has default baud rate of 9600 bps.

C. MQ7 Sensor:

MQ7 sensor is a carbon monoxide sensor which can sense and detect the concentration of carbon monoxide which is ranging from 20 to 2000 ppm. The operating voltage is 3.3 to 5V.

D.LM7805 voltage regulator IC:

A voltage regulatorIC maintain the output voltage at a constant value. It's input voltage range from 7-35 volt having a current rating of 1 Amp and output voltage ranging from 4.8 volt to 5.2 v.

E. BUZZER:

Buzzer is a device which is used to give the alarm. In this project, buzzer is used to alert monitoring section. When RF receiver receives alert information and send towards buzzer through microcontroller. The operating voltage is 5 volts.

F. HC12 Module:

HC12 is a half duplex wireless communication module .these 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 channel spaced 400 KHz apart.

G. TEMPERATURE SENSOR:

The temperature sensor is having stainless steel tube with 6mm diameter and 30 mm long. The sensor is moisture proof. The operating voltage is 3V to 5.5V. It is Rated for Full −55°C to 125°C range. It has 0.5°C ensured accuracy from -10 °C to 85 °C.

RESULT

One of the best methods for the protection purpose of coal mine workers is the design of modern device i.e.helmet. Also, the main focus is on gases detection, location, and wireless communication. MQ4 and MQ7 sensors are used here for the detection of methane and carbon monoxide. The buzzer gets activated if the gas concentration increases above critical level and also, the location will be observed with the help of GPS module. The worker's pulse rate is sensed using the pulse sensor. Display shows the values of all the parameters and their concentration. HC transceiver is provided on the helmet and also in the control room.

Successful monitoring of location and health conditions of coal mine workers is achieved in this manner.

Figure:Internal Circuit and Helmet Design

CONCLUSION

This is a prototype of modern safety helmet for detecting the dangerous gases concentration. Methane, carbon monoxide, carbon dioxide, etc are some of the harmful gases present in the surrounding of coal mines. The important factors like detection of the gases level, the pulse rate and also the location of the worker is covered by this system. On occurrence of any dangerous situation, there is activation of the buzzer. There is a proper placing of sensors on the helmet. Display is also connected which is used to show the parameters present there. The control room PC shows the same parameters. HC transceiver module is used for transmission and receiving of the data of sensors.

REFERENCES

[1] Ali M. Eltamatly, A. I. Alolah, R. Hamouda, M. Y. Abdulghany, " A Novel Control of AC Voltage Controller Under Induction Motor Load" , IEEE Trans and Conv of engineering, June 2012.

[2] International Journal of Advanced Research in Computer and Communication Engineering ISO 3297:2007 Certified Vol. 6, Issue 7, July 2017 Copyright to IJARCCE DOI10.17148/IJARCCE.2017.6702 9 Smart Helmet for Coal Mines Safety Monitoring and Alerting S. R. Deokar1, V. M. Kulkarni2, J. S. Wakode3.

[3] Study based on Intelligent Brain Helmet for Coal Miners Safety First author- Sunil E. Waghmare, Second author-Prof. Ashish Manusmare, Third author – Prof.Vijay Roy M.Tech Student, Department of Electronic & Communication, Ballarpur Institute of Technology, Bamni , Ballarpur, Chandrapur, Gondwana University .

[4] David Walters, Emma Wadsworth, "A study of role of workers representatives in health and safety arrangements in coal mines in Queensland", Jan 2014.

[5] D. Kock and J. W. Oberholzer, "The development and application of electronic technology to increase health, safety, and productivity in the South African coal mining industry," IEEE Trans. on Industry Applications, vol. 33, no. 1, pp. 100-105, Jan/Feb. 1997.

[6] S. R. Deokar1, J. S. Wakode, "Coal Mine Safety Monitoring and Alerting System", IRJET, Vol.4,March 2017.

[7] Gautam Gowrishankankaran and Charles He, "Productivity, safety and regulation in underground coal mining: Evidence from diasters and fatalities," Arizon education, March 2017.