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DESIGN AND IMPLEMENTATION OF MONITORING AND SAFETY SYSTEM FOR MINE WORKERS USING WIRELESS SENSOR NETWORK

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ABSTRACT

In this work, a safe Mines Monitoring system which replaces the traditional mines monitoring systems which tend to be wired network systems. This play an important role in mines safe production. With continuous enlarging of exploiting areas and extension of depth in mines, many laneways become monitoring blind areas, where are lots of hidden dangers. Moreover, it is inconvenient to lay cables which are expensive and consume time. In order to solve the problems, we designed a mines safety monitoring system based on wireless sensor network, which can improve the level of monitoring production safety and reduce accident in the mines. Zigbee technology provides a direction for scientists who commit to solve the safety monitoring problems of coal mine.

I. INTRODUCTION

Mining is the extraction of valuable minerals like solid, liquid and gas from the earth. Most of the materials recovered from the mines include gold, silver, zinc, diamond, metal, coal, etc.

Coal is extracted from underground mine method.Underground mine methods are supported or unsupported mines.

Underground mining involves high risk due to the problems of ventilation and potential for collapse. These major risks leads to more number of accidents which occur due to gas or dust explosions ,falling of rock structures, intoxications, fires due to rise in temperature, workers stumbling, falling /slipping. In order to overcome these accidents usage of personal protective equipment such as a helmet, shoes, etc. is under consideration. A worker falling unconscious in a dark underground mine because of suffocation or falling of rock structure in not noted by the supervisor and treatment is not provided in time. The most important requirement of mining industry is proper supervision and proper communication among the workers and the base station over the surface. Most of the miners die due to harmful gas explosions such as carbon monoxide, LPG, methane. Smart helmets provides the real time monitoring of harmful gases and temperature detection, person fall detection, etc. The wired communication network is

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not effective which gets damaged by a natural calamity and it is costlier to reinstall the entire system. Hence it is best suited to make use of the wireless communication system with zigbee technology.

II. LITERATURE SURVEY

To monitor the various characteristics in the mining environment by building a safety monitoring system.

Iot based mine safety system using wireless sensor network (Hongjie He, Yudong Lin, Fan Chen, Heng-Ming Tai, and Zhongke Yin/IEEE transactions 2017)

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 harmful gases like LPG, CO, CH4 exceed its limit, person fall detection and removal of helmet. 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 salve and improve the data transmission distance.

Mine Safety System Using Wireless Sensor Network(Valdo Henriques And Reza Malekian, (Member, IEEE)/Digital Object Identifier 10.1109/ACCESS.2016.2581844)

A complete mine safety system was constructed such that the system is compact and modular, using a combination of mechanical hardware, electronic hardware and specific software. This system can measure ambient characteristics inside the mine environment and communicate them between two nodes using the ZigBee communication protocol. The temperature, humidity, airflow and noise sensor measurements have an accuracy of 89.01%, 98.55%,90.5%,89.53%andaresolutionof0.105◦C,0.12%RH,0.05m/sand 0.23 dB SPL respectively.study of the security monitoring system in *coal* mine underground based on WSN (Li Rong /978-1-61284-486-2/11/$26.00 ©2011 IEEE)

The WSN creates many new and exciting application areas for remote sensing and monitoring. In the future, the wide range of application areas will make WSN an integral part of our lives. However, realization of WSN need to satisfy the constraints by its inherent factors such as fault tolerance, scalability, cost, hardware, topology change, environment and power consumption. Since these constraints are highly stringent and specific for WSN, new wireless ad hoc networking techniques are required. Many researchers are engaged in developing the technologies needed for different layers of the WSN protocol stack including communication protocols, hardware and software development. Along with the current research in WSN, we can foresee more developments in practice of WSN in the near future.

Design of Temperature Control Device Underground Coal Mine Based on AT89S52(Qingdong WANG,Jianfeng WEI/978-1-4244-4543-1/09/$25.00 ©2009 IEEE)

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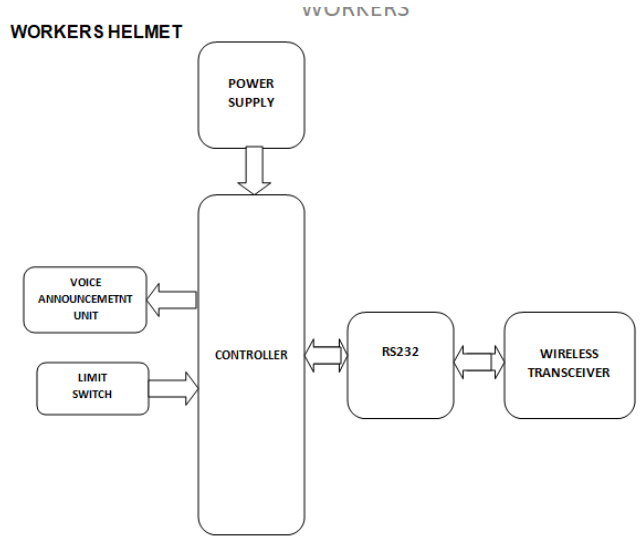
The performance of measurement-control device mainly depends on the performance of sensing element, the processing circuit and the transmission efficiency of collected data. Digital temperature sensor DSl8B20 and processing chip AT89S52 have characteristics of good technical indexes, and the field operations indicate that circuits system has many advantages, such as accurate data detection, good stability and easy adjustment. After industrial operation test, the system is excellent for worst mine environment, which provides powerful assurance for safe production in the coal industry, and brings good economic and social benefits.

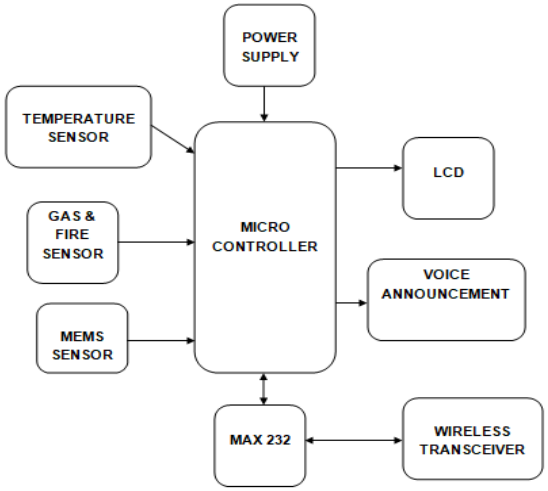
Methane and Carbon Monoxide Gas Detection system based on semiconductor sensor(Emil CORDOS, Ludovic FERENCZI, Sergiu CADAR, Simona COSTIUG/1-4244-0361-8/06/$20.00 ©2006 IEEE)

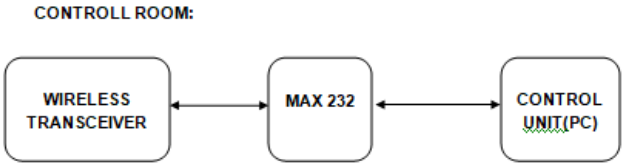
The SB-95 sensor has the optimal technical and functional characteristics for detecting methane and CO gases applications in rooms where these gases can appear accidentally. The presented application is an example.

III. BLOCK DIAGRAM:



Stationery unit:





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IV.COMPONENTS

PIC16F877A

The PIC microcontroller is a 40 pin package. It is made up of RISC architecture. It has five input output ports and thirty three input output lines PIC consist of three timers which are independent. It includes multi level of interrupts. It has 10 bit analog to digital convertor with 8 channel multiplexer. Inbuilt USART in PIC supports both synchronized and asynchronized channels.

SENSORS

Four main sensors are used-Temperature sensor(LM35) ,Gas sensor(MQ2) ,Smoke sensor(MQ4), MEMS. The explosion of toxic gases, immediate temperature change , person fall detection can be monitored and alerted both in workers area and base station.

LCD

It is a 2X16 alphanumeric display. It consist of two rows and sixteen columns in it. It consist of 8 pins of data and three pins of control(RS,RW,EN).The contrast of the LCD display is adjustable.

ZIGBEE WIRELESS TRANSCEIVER

The Zigbee trance receiver placed at miner helmet and base station. The real time data are sending through Zigbee. We use one master and one slave, so the data transmission distance is 9 to 10m. If we use number of slave and form a mesh networking distance of data transmission is increases.

SOFTWARE USED

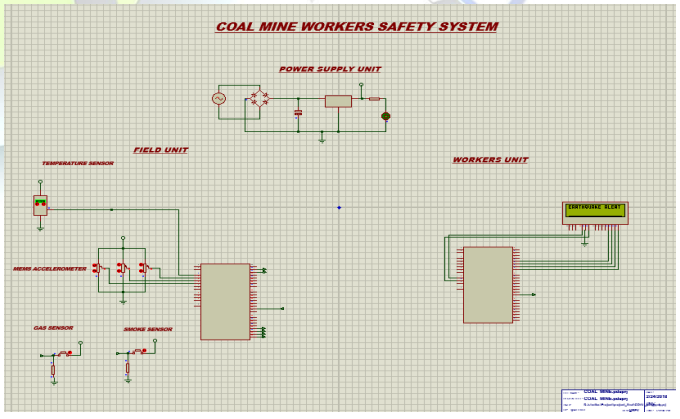
The coding is written in embedded C programming language. It is imparted into the controller through the PIC kit to software. Simulated using Proteus Design Suite 8.6.

V.WORKING

LM35 senses the temperature variations. Gas sensor detects the harmful gases like carbon monoxide, LPG, methane. Smoke sensor encounters the fire caused by equipment errors or manual errors. MEMS is used for recognition of person falling or slipping down .These sensors are equipped in the personal protective helmet and monitoring process is carried over. LCD and voice announcement are installed in helmet for alerting purpose.

Zigbee technology is used for effective communication between base station and mining area which helps in continuous passage of information about the current working environment.

VII. RESULT



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VI. APPLICATIONS

In mining industry underground mining involves higher risk due to problems of ventilation and potential for collapse. Workers safety is very important. The accident in mine occurs by explosion of toxic gases, immediate temperature change, rocks falls from walls and roofs, workers falling or slipping and Earth quake. It can be monitored and workers life has been saved.

VII. CONCLUSION

In this paper, we proposed the monitoring and safety system for mine workers using smart helmet. Here we using air quality sensor, thermal reading sensor and person fall detection sensor which sense and alert the workers during hazardous situation. Where wired communication is not so effective as it has chances of damage. Hence Zigbee wireless technology is used for communication between base station and mine workers. Zigbee technology mesh topology provide long distance wireless communication network.

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