Wireless: Mine Safety System

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Abstract— In this work, a system is proposed for safe Coal Mine Monitoring, which plays an important role in coal mine safe production. With continuous enlarging of exploiting areas and extension of depth in coal mine, many laneways become monitoring blind areas, where are lots of hidden dangers. It is very difficult to lay cables which are not reliable and not effective. For to overcome this, a new system is proposed with the help of Zigbee technology. This can improve the level of monitoring production safety and reduce accident in the coal mine. And this system proposes a low complexity parameter to determine the optimal placement of sensor nodes. The system realized real-time surveillance with early-warning intelligence on LPG, FIRE, Humidity, Metal, PANIC in mining area, and used voice alerts to reduce potential safety problems in coal production.

Key words: Zigbee Device, Mining, Tracking & Monitoring, Wireless Sensor Network

I. INTRODUCTION

Safety is one of the main aspects related to industries specially the mining industry. In the underground coal mines, human safety is most important thing which need to look. To avoid any types of unwanted phenomena all mining industry follows some basic precaution and rules. Communication is the main key factor for any industry today to monitor different parameters and take necessary actions accordingly to avoid any types of hazards. In recent years, disasters in coal mine occur frequently, which lead to great loss of possession and life. The accidents happening in coal mine are due to the complexity of mine environment and the variety of work condition of coal mine, so it is necessary to monitor mine working environment. To avoid loss of material and damaging of human health, protection system as well as faithful communication system is necessary inside the underground mines. To increase both safety and productivity in mines, a reliable communication must be established between workers, moving in the mine, and a fixed base station or control room. Inside mines, the wired communication system is not so effective. The reliability and long life of conventional communications systems in harsh mining environments has always been a problem. Inside mines due to uncomfortable situation the installation cost as well as maintenance cost is high for wired communication networks.

II. LITERATURE REVIEW

1) N.chaamwe, H. Jiang designed a network called chain type wireless underground mine sensor network which consists of three kinds of sensor nodes: sensing nodes, cluster head nodes and a base station deployed on both sides of the tunnel at regular intervals to monitor the underground environment and locate the miners [1].

2) A wireless surveillance and safety system for mine workers based on zigbee designed by Tanmoy Maity and Partha Sarth Das .The design proposed a cost effective, flexible solution of underground mine workers safety. A module of MEMS based sensors are used for underground environment monitoring and automatic progression of measurement data through digital wireless communication technique is proposed with high accuracy, smooth control and reliability [3].

3) Mr. Kumarsagar, R.T.Patil design a monitoring system for coal mine safety based on MSP430. This system utilizes low power, cost effective microcontroller MSP430, a temperature sensor, humidity sensor, smoke detector, gas sensor for sensing the mine climate parameter and a wireless zigbee trans receiver for remote sending of data at central unit. The microcontroller used in this system MSP430 is ultra-low power controller which is reduces power consumption [4].

4) T. Asesh Kumar and K. Sambasiv Rao design a integrated mine safety monitoring and alerting system using zigbee and CAN bus. In this, they use CAN bus along with zigbee technology to reduce the cost and increase the speed of communication between base station and synchronize node [5].

III. BACKGROUND

The mining industry is known worldwide for its highly risky and hazardous working environment. Technological advancement in ore extraction techniques for proliferation of production levels has caused further concern for safety in this industry. Research so far in the area of safety has revealed that the majority of incidents in hazardous industry take place because of human error, the control of which would enhance safety levels in working sites to a considerable extent.

IV. OBJECTIVE

Mining environment often has hidden dangers within such as toxic gases, which may present severe health exposures to the people working within mining. These gases need to be detected at times and informed the dangerous situation in right time for the safety of miners. Wired network monitoring systems have assisted the mine safety significantly, but it is not idea for all types of mining environment.

Real-time monitoring systems may assist in monitoring and control over the mining environment. Zigbee technology offers its most of the advantages ideal for the real-time monitoring system. Thus, the primary objective of this project is decided to design an efficient real-time monitoring system so that various leaked mine gases could be identified at times and preventive measures could be devised accordingly.

V. SYSTEM DESIGN

This monitoring system contains several components like boards (Arduino board, Xbee module and Zigbee USB interfacing board), LCD (Liquid crystal display), different sensors and other small electronic components.

The system consists of following components:
1) Arduino Board – Model Arduino UNO
2) Xbee – Model Xbee Pro S2B
3) LCD (Liquid crystal display) – 16*2 LCD
4) Carbon monoxide Sensor – Model MQ-7 IV.
5) Buzzer
6) Methane sensor-Model MQ-4
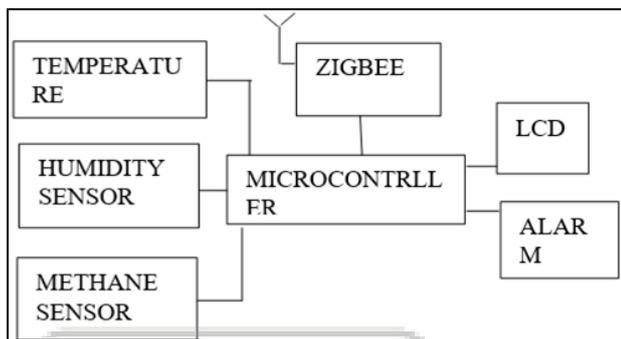
VI. BLOCK DIAGRAM OF SYSTEM
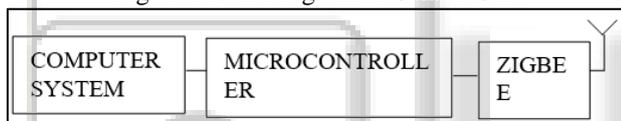

Fig. 1: Block Diagram of Sensor Unit

Fig. 2: Block Diagram of Monitor Unit

VII. RESULT

The real time monitoring of toxic gases and other parameters present in underground mine has analyzed using wireless sensor network. 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 LCD at the underground section where sensor unit is installed as well as on the monitoring unit. This system also stores all the data in the computer for future inspection.

VIII. FUTURE SCOPE

1) Using additional sensors all possible safety issues could be monitored such as gases, dust, vibrations, fire etc.
2) Zigbee can also be used for the surveillance of mining operations such as subsidence, water leakage etc.
3) The other important data can be communicated through this system making it feasible where wired communication is a hindrance.
4) The control can be governed from the surface itself as the system provides easy access.

IX. ADVANTAGES

1) Provide more safety for the mine workers.
2) Automatic alert system in the nuclear industries.

X. CONCLUSION

The Present work, coal mine safety monitoring system based on wireless sensor networks, and hardware and software design of wireless sensor network are described in detail, this system can detect concentration of the gas, temperature, humidity, wind speed and trace the location of miners in underground mine tunnels. Wireless sensor networks applied in monitoring coal mine security breaks through the traditional methods and ideas, which improves the practical ability and flexibility of monitoring system.

The hardware and software for the real time monitoring system of mine gases has been implemented in an artificially created mine environment. The different mine gases were observed through this system

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