

Safety System for Mine and Underground Industries

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Abstract— In the mining industry safety is a very vital factor. Safety is one the main aspects of the industry mainly mining industry. Inside mines wired communication is not so effective. Wireless safety system is more effective inside to avoid loss material, health of workers and communication between workers and base station. To increase both safety and productivity in mines, a reliable communication must be established between workers, moving in mines and a fixed base station. It is very difficult to lay cables which are not reliable and not effective. For to overcomes this, a new system is proposed with the help of Zigbee technology. This can be improve the level of monitoring production safety and reduce accident in the coal mine.

Key words: Industry Safety, Safety System for Mine and Underground Industries

I. INTRODUCTION

A Wireless Surveillance and Safety System for Mine Workers based on Zigbee Abstract Industrial safety is one of the main aspects of industry specially mining industry.

The safe production level of coal mine is still low, especially in recent years, disasters of coal mine occur frequently, which lead to great loss of possession and life, the safety problems of coal mine has gradually become to the focus that the nation and society concern on. The disasters of coal mine happening are due to the complexity of mine environment and the variety of work condition of coal mine, so it is very necessary to monitor mine working environment. The various environmental parameters of mine safety monitoring and controlling system, such as methane, carbon monoxide, temperature, oxygen and so on, are currently using the traditional cable transmission. Thus truly mine methane, carbon monoxide gas accumulation area mechanized mining face, such as the dead gob cable security parameters cannot be monitored, so they cannot predict the alarm. A variety of products for the current diversity of coal mine safety and underground coal mining process variability space, mine safety wireless network should be compatible with existing mine safety system with data transmission functions, has good flexibility, scalability, self- set of network capabilities. As the mine has its own special applications require a simple sensor network protocols, network easy, self-organization, self-healing ability. Zigbee is a wireless communications technology, with a short distance, safe and reliable, you can use Zigbee technology to collect the various parameters of the terminal transmitted to the sensor on the tunnel gateway, and then use a wired data transmission to the gateway on the ground central control computer, by computer analysis and comparison of the data in order to assess the security situation in the Mine. To achieve the target location underground, environmental and other parameters of the remote collection, can provide scientific basis for relief. Underground mine environment, the complexity of the power consumption,

interference immunity and so have more stringent requirements.

II. BACKGROUND AND CURRENT RESEARCH

- A safe Coal Mine Monitoring system which replaces the traditional coal mine monitoring systems which tend to be wired network systems. This play 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. Moreover, it is inconvenient to lay cables which are expensive and consume time. In order to solve the problems, we designed a coal mine safety monitoring system based on wireless sensor network, which can improve the level of monitoring production safety and reduce accident in the coal mine. Zigbee technology provides a direction for scientists who commit to solve the safety monitoring problems of coal mine. The purpose of this study is to propose a solution suitable to mine wireless communication, safety monitoring, give a proof to the further study.
- Continuous monitoring underground coal mines parameter such as carbon monoxide, temperature, water level and use wireless Zigbee technology for communication. A microcontroller based system is used for collecting and storing data using respective sensors and making decision accordingly, based on which the mine worker is informed through different alarm tone as well as LED display system. The communication system is reliable based on zigbee, IEEE 802.15.4 standard. This is used for transmission between the hardware circuit fitted in the local site (mines) and the remote monitoring site (computer) through routers. This system is highly beneficial for rescue and protection of miners.

III. WIRELESS INFORMATION & SAFETY SYSTEM FOR MINES

Core system component, zigbee-compliant active RFID device, can be programmed to act as tag, router or coordinator that enables them to form an IEEE 802.15.4 based mesh network. It uses a unified wireless mesh networking infrastructure to locate, trace and manage mobile assets and people as well as monitor different environmental conditions using sensors.

IV. PARAMETER MEASUREMENT

A. Zigbee Wireless Technology

The ZigBee protocol is the only international IEEE 802.15.4 Standard wireless sensor network protocol in existence, catering to the specific needs of low-power, low-cost, low maintenance monitoring and control systems with talks of using it in sensor networks. The good characteristics of the ZigBee are extremely low energy consumption and support for several different topologies, which makes it a good

candidate for several sensor network applications. However, it is reported that ZigBee cannot meet all the requirements for at least some industrial applications. For example, it cannot serve the high number of nodes within the specified cycle time.

B. Humidity Sensor (HSM-20G)

Humidity is the amount of water vapor in the air. The humidity sensor HSM-20G is of resistive type. It is an analog humidity and temperature sensor that outputs analog voltage respects to relative humidity and temperature. The HSM-20G is an analog humidity and temperature sensor that outputs analog voltage respects to relative humidity and temperature. However from this sensor relative humidity is found along with temperature. Relative humidity is the percentage of moistures of airs for a particular temperature.

C. Fire Sensor

The sensor is used to detect any trace of fire and it will give interrupt signal as soon as it detects Fire in underground regions. The sensor works on the principle of IR rays or Heat radiation detection. The Fire sensor is used to detect fire flames. The module makes use of Fire sensor and comparator to detect fire up to a range of 1 meters. The fire sensor circuit is too sensitive and can detect a rise in temperature of 10 degree or more in its vicinity.

D. Temperature Sensor (LM35)

In the proposed system we use LM35 which is a precision IC temperature sensor with an output voltage linearly proportional to Centigrade temperature. LM35 is a precision IC temperature sensor with its output proportional to the temperature (in °C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possess low self-heating and does not cause more than 0.1°C temperature rise in still air.

E. Light Dependent Resistor (LDR)

In this system LDR is use to sense the darkness in underground mining section. If the working area is dark then LDR triggered circuit will turn ON the LED lights present on workers Helmet. This arrangement provides the system to have good battery backup and also gives convince to miner. A Light Sensor generates an output signal indicating the intensity of light by measuring the radiant energy that exists in a very narrow range of frequencies basically called "light", and which ranges in frequency from "Infra-red" to "Visible" up to "Ultraviolet" light spectrum.

F. MQ-4 Semiconductor Sensor for Natural Gas

For detection of Methane, also to Propane and Butane which are the major toxic gases in underground coal mines, MQ-4gas sensor is used. MQ-4 has 6 pins; 4 of them are used to fetch signals and other 2 are used for supplying heating current.

G. Vibration Measurement

This is one of the critical measurements in a underground coal mines. Tremor can be felt because of landslide or because of minor earthquake so it is very much important to know the suitable value for allowable vibration inside underground mines .There are various sensor available which effectively

measure the vibration. Sensors like Tilt sensor, Accelerometer sensor can be very useful in underground coal mines.

H. Smoke Sensor

Sensitive material of MQ-2 gas sensor is SnO₂, which with lower conductivity in clean air. When the target combustible gas exist, the sensor's conductivity is higher along with the gas concentration rising. Fig 5, MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application.

V. PROPOSED WORK

In this system, the basic parameters like temperature, humidity, fire and hazardous methane gas are going to be monitored and if any abnormality happen in any of the parameters means it will be intimated in the form of voice within the mine and transmitted to the monitoring section via Zigbee communication module. Here sensors are used for sensing these parameters and transmitted value to the base station or monitoring section. For that we will use Microcontroller, in that the sensors are interface with it.

REFERENCES

- [1] C. Qiang, S. J. Ping, Z. Zhe, Z. Fan, "ZigBee Based Intelligent Helmet for Coal Miners", Proc. IEEE World Congress on Computer Science and Information Engineering, pp. 433-35, 2009.
- [2] Tanmoy Maity, Partha Sarathi Das, Mithu Mukher-jee "A Wireless Surveillance and Safety System for Mine Workers based on Zigbee".
- [3] S. Wei, L. Li-li, "Multi-parameter Monitoring System for Coal Mine based on Wireless Sensor Network Technology", Proc. International IEEE Conference on Industrial Mechatronics and Automation, pp 225-27, 2009.
- [4] Rajkumar boddu, p.balanagu "zigbee based mine safety monitoring system with gsm" International Journal of Computer & Communication Technology, Volume-3, Issue-5, 2012.
- [5] S. Jin-ling, G. Heng-wei, S. Yu-jun, "Research on Transceiver System of WSN Based on V-MIMO Underground Coal Mines", Proc. International Conference on Communications and Mobile Computing, pp 374-378, 2010.
- [6] N. Chaamwe, W. Liu, H. Jiang, "Seismic Monitoring in Underground Mines: A case of Mufulira Mine in Zambia Using wireless Sensor Networks for Seismic Monitoring", Proc. IEEE international Conference on Electronics and Information Engineering, vol. 1(V1), pp 310-14, 2010.
- [7] <http://www.citeseerx.ist.psu.edu/viewdoc/download>, accessed August 2010.
- [8] <http://www.MaxStream.net>, accessed June, 2011.
- [9] Tanmoy Maity, Partha Sarathi Das, Mithu Mukherjee, "A Wireless Surveillance and Safety System for Mine Workers based on Zigbee", First International Conference on Recent Advances in Information Technology, RAIT, 2012.
- [10] G.Ahalya, P.Suresh Babu, P.Prabhakar Rao, "Development Of Coal Mine Safety System Using

- Wireless Sensor Network", IJESAT, Jun-Jul 2013, Volume-3, Issue-3, pp 74-78.
- [11] H. K. Chan, "Agent-Based Factory Level Wireless Local Positioning System with Zigbee Technology", IEEE Systems Journal, vol. 4(2), pp. 179-85, 2010.
- [12] T. Asesh Kumar and K. Sambasiva Rao, "Integrated Mine Safety Monitoring and Alerting System Using Zigbee and CAN bus", IOSR Journal of Electrical and Electronics Engineering, Volume 8, Issue 3 (Nov.-Dec. 2013), pp 82-87.
- [13] Mr. Kumarsagar, Prof. R. T. Patil, "Design of Monitoring System for Coal Mine Safety Based on MSP430", International Journal of Engineering Science Invention ISSN, Volume 2, Issue 7, July 2013.
- [14] Dange, K. M., Patil, R. T. (2013), "Design of Monitoring System for Coal Mine Safety Based on MSP430".
- [15] Liu, T., Wei, Y., Song, G., Li, Y. (2013), "Advances of optical fiber sensors for coal mine safety monitoring applications".
- [16] Osunmakinde, I. O. (2013), "Towards Safety from Toxic Gases in Underground Mines Using Wireless Sensor Networks and Ambient Intelligence".
- [17] Naticchia, B., Vaccarani, M., Carbonari, A. (2012), "A monitoring system for real-time interference control on large construction sites".
- [18] Xiaodong, Z., Yuegang, T., Yan, H. (2014), "Research and Application of Embedded Technology in Remote Network Monitoring System of Coal Mine".

