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DESIGN OF SURVEILLANCE AND SAFETY SYSTEM FOR UNDERGROUND COAL MINES BASED ON LOW POWER WSN

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ABSTRACT

The aim of the project is to presents a low power, cost-effective of underground mine workers safety.The system consists of wireless connection of several sensor node mainly nRF24L01+ with Arduino controller system. Wireless Sensor nodejoin to other sensor node in specific multi-hop mesh network topology, that creates a nRF24L01+ based Wireless Sensor node. This network can be easily placed in underground mines and it provides an effectively surveillance and safety system for underground coal miners. Especially, it provides the real-time data communication between miners and surface control room through highly secure, reliable Wireless Sensor nodes. The proposed system improves the existing miner's safety and early warning surveillance in underground coal mines.

1. INTRODUCTION

Industrial safety is one of the main aspects of industry specially mining industry. In the mining industry safety is a very vital factor. To avoid any types of unwanted phenomena all mining industry follows some basic precaution and phenomena [1]. 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. 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. 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. It is very difficult to reinstall the wired communication system inside mines after a landslide or damage due to any reason

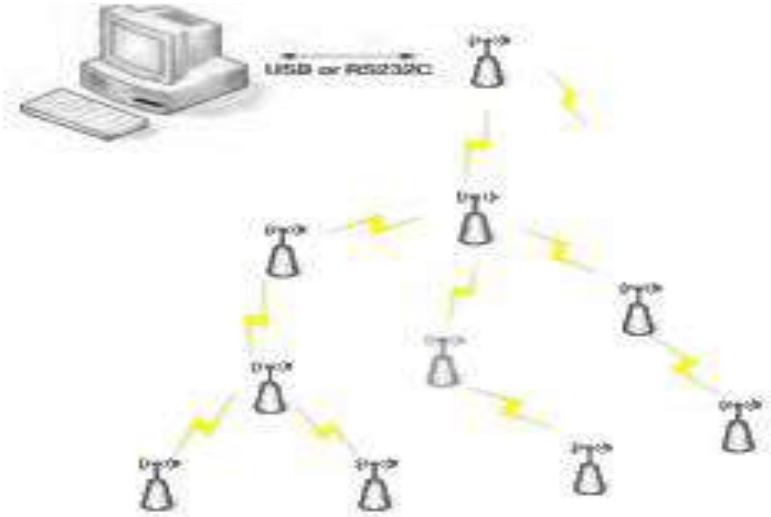

Fig 1: prototype of wireless sensor network

. Due to roof fall, if by any means some workers trapped inside mines, to maintain the continuity of the communication system is very much important to know the actual position and condition of the trapped workers. To monitor other parameters during this condition it is very much necessary to maintain the communication system as usual.

2. PROPOSED SCHEME

Advance wireless communication and embedded technology has developed a low power, cost-effective Wireless Sensor node for secured wireless data communications.

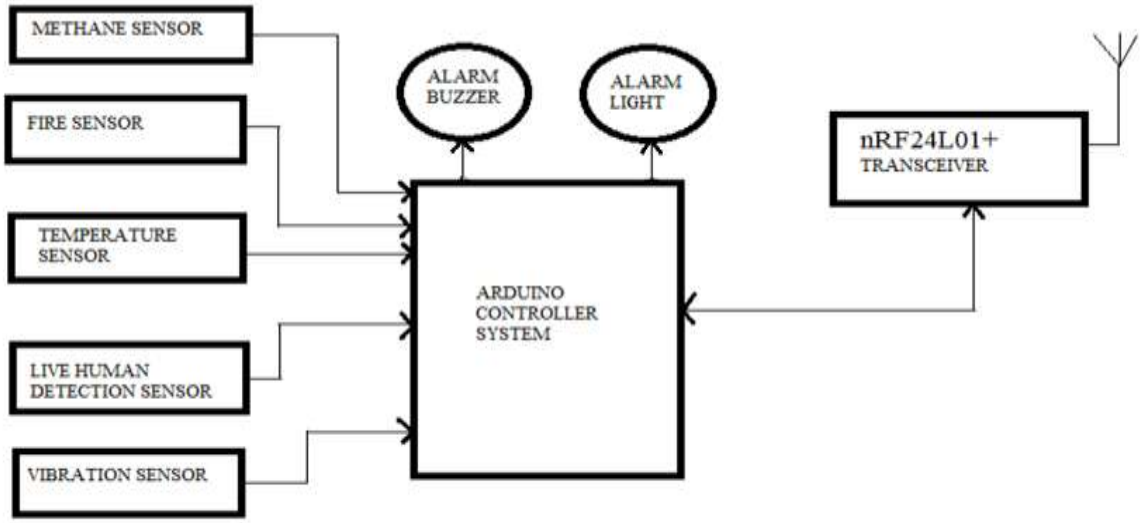

Fig 2.wireless sensor network transmitter side

After starting the node, first node behaves as a coordinator that is responsible for forming a wireless sensor network, which operates based on SPI standards protocol, 2.4GHz license free ISM frequency band. Transceiver al1iance are association of group of companies which is certified and designs a low power nRF24L01+ transceiver integrated with high performance

Arduino controller system [6]. Self- forming and self-healing multi-hop mesh network topology make it automated wireless sensor nodefor the use in surveillance and safety system in underground mines.

Gas concentration is meant for the toxic gases like methane and finding temperature, humidity using sensors. Also PIR sensor is used for detecting human live and vibration sensor for disaster like earthquake.

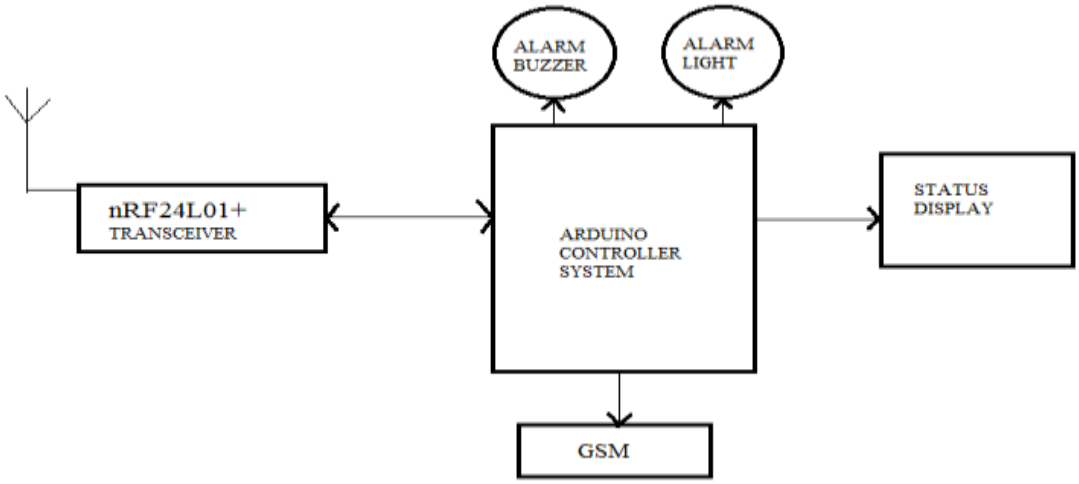

Fig. 3. Block diagram of receiver side

3. HARDWARE D1SCRIPTlON

This developed system has several types of sensor are used to detect various types of parameters such as Gassensor,fire sensorhumidity sensor ,temperature sensor, HC-SR501 PIR motion detector and vibration sensor. The Gas sensor MQ-4 gas sensor composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-4 have 6 pin ,4 of them are used to fetch signals, and other 2 are used for providing heating current. Resistance value of MQ-4 is difference to various kinds and various concentration gases. So,When using this components, sensitivity adjustment is very necessary.

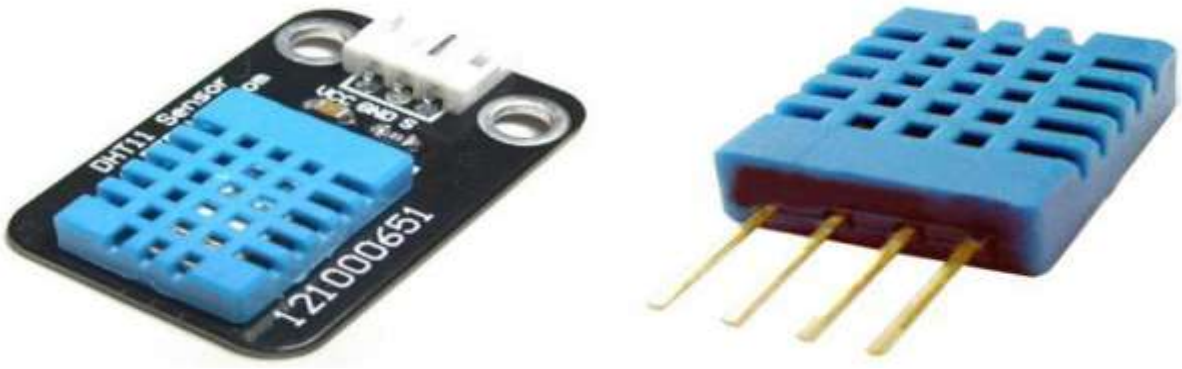

Fig 4: DTH11 sensor module

HC-SR501 PIR motion detectoris based on infrared technology, automatic control module, high sensitivity, high reliability, ultra-low-voltage operating mode, widely used in various auto- sensing electrical equipment, especially for battery-powered automatic controlled products. Atmega 328P is the Low-power CMOS 8-bit microcontrollerand throughputs approaching 1 MIPS per MHz, this Atmega 328Phas 32 general purpose working registers and Flash 32K BytesEEPROM has 1K Bytes and also RAM of 2K

Bytes. It has 23 Programmable I/O LinesOperatingand Voltage in the range of 1.8 - 5.5V.Power Consumption in Active Mode: 0.2 mA.nRF24L01+ Transceiver is a single chip 2.4GHz transceiver with an embedded baseband protocol engine, design for ultra low power wireless application.thenRF24L01+ is designed for operating in the Worldwide ISM frequency at 2.4-2.4835GHz. It has 126 RF channels and Common RX and TX interface. The Power management integrated the voltage regulator in the range of 1.9 to 3.6V supply**.**

4. EXPERIMENTAL RESULTS

Using of dynamic multi-hop mesh routing protocols in wireless sensor network, we transmitted data from one sensor node to other sensor nodes. A proteus software tool is used to monitor the wireless sensor network that is how the nodes are connected with each other. Network view of wireless sensor network indicates five sensor nodes identified with short addresses and connected to the router .Network view of the wireless sensor network are captured by wireless network proteus software tool. Each end-device nodes represents a 16- bit network address and router indicates a unique 64-bit PAN ID.In time view of messages it is observed the messages passing from node to node and/or node to router. Where M indicates the message. In left side, there indicates the short addresses of nodes and their corresponding message view at the right side. Similarly the PAN ID of the router is displayed at the bottom left and its corresponding message received at the bottom right.

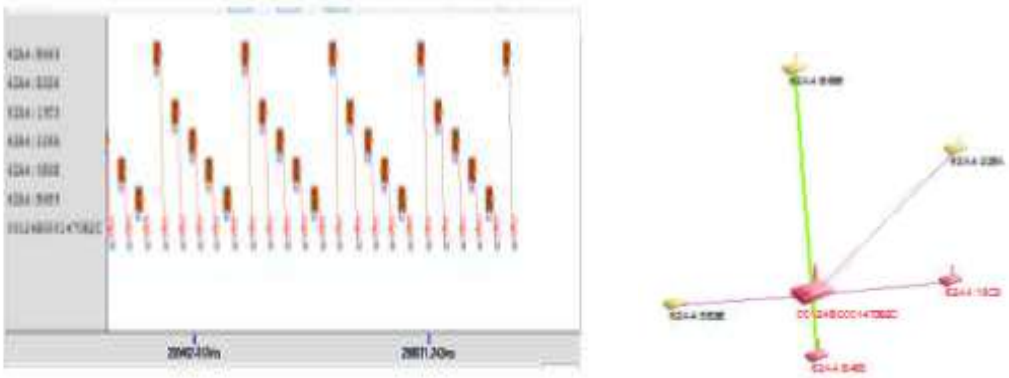

Fig 5:Time view of message and Network view of WSN

Through the use ofnRF24L01+ transceiver, wireless data packets can be captured from different sensor nodes which are used for analysis of data .Sample of raw data packets at a particular instant of time, where we received a number of information in packet frame such as packet number, data length, frame format of each layer etc.

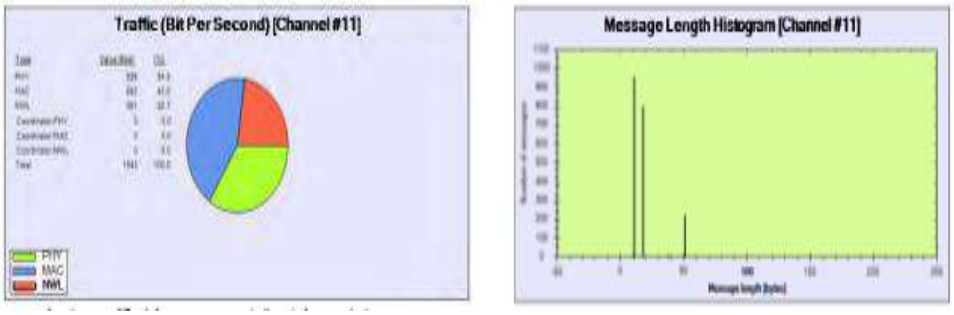

Fig 6: traffic bit per second in each layers and message length in bytes

Frame format of MAC layer is included with frame control field, sequence number, destination PAN ID, destination and source address and MAC payload. This same packet also contains frame format of NWK layer, APS layer, FCS and LQI. We have selected channel II in 2.4 GHz ISM/SRD frequency band. By using this channel, traffic bit per second (bps) in each layers, message length, message type statistics and channel activity statistics are measured and captured separately during data transmission from remote sensor.

5. CONCLUSION

Through joining of Wireless Sensor nodes, a wireless sensor network is developed. With the help of this network, data from the different sensors are transmitted from one node to other node and are effectively collected by a PC. It is observed that nRF24L01+ transceiver based wireless transmission is most suitable for underground coal mines for its low power, low cost intrinsic safe characteristics. Real time environmental data in underground mines are collected through sensor nodes and continuous data transmission to the surface control room is possible through wireless network. This will enhance the safety of the miners working underground with additional reliability and flexibility.

6. REFERENCES

[1] M. Bai, X. Zhao, Z. Hou, and M. Tan, "A Wireless Sensor Network Used in Coal Mines" Proceedings of the IEEE International Conference on Networking, Sensing and Control, London, UK, pp. 319-323,I S-17 April 2007.

[2] K. Holger, A.Willig," Protocols and Architecture for Wireless Sensor Networks",John Wiley and Sons, 2008.

[3] R. Conant, "Wireless sensor networks: Driving the New Industrial Revolution", Industrial Embedded Systems Magazine, Spring 2006.

[4] L. K. Bandyopadhyay, S. K. Chaulya, P. K. Mishra, "Wireless Communication in Underground Mines: RFID-based Sensor Networking", Springer Editions, 2009. [S] www. en. wikipedia.orglwiki/LeakyJeeder [5] www.ti.comlcc2S30. "NRF24L01+ transceiverSpeicification document" NRF24L01+ transceiver standard organization 2007.

[5] T. Maity, P. S. Das, M. Mukherjee, "Rescue and protection system for underground mine workers based on NRF24L01+ transceiver" International Journal of Advanced Computer Engineering and Architecture, Vol. I, pp. 101-06,2011.

[6] A. Chehri, H. T. Mouftah, P. Fortier , H. Aniss, "Experimental Testing of IEEE801.IS.4 INRF24L01+ transceiver Sensor Networks in Confined Area", IEEE Eighth Annual Conference on Communication Networks and Services Research, Montreal, Quebec, Canada, May,2 010.

[7] T. Mitsugu "Application of NRF24L01+ transceiver sensor network to data acquisition and monitoring". Measurement Science Review, Volume 9,No. 6, 2009.

[8] J. Heo, C. S Hong, S. B, Kang, S. S. Jeon, Wireless Home Network Control Mechanism for Standby Power Reduction. In: Proceedings of the International Conference on Wireless Information Networks and Systems, pp. 70-7S (July 2007).