Design of Surveillance and Safety System for underground Coal Mines Based on Low Power WSN

Battu Vishwasi
P.G. Scholar (M. Tech),
Dept of ECE,
Siddhartha Institute of Technology & Sciences,
Ghatkesar, Hyderabad.

N.Uma Rani
Associate Professor,
Dept of ECE,
Siddhartha Institute of Technology & Sciences,
Ghatkesar, Hyderabad.

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. Which 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.

I. Introduction:

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, 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. variety of products for the current diversity of coal mine safety and underground coal mining process variability space, mine safety wireless network

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. an agent-based wireless local positioning system with ZigBee technology is proposed, mainly for factory level applications. A cost effective ZigBee-based wireless mine supervising system with early-warning intelligence on methane, temperature, humidity in mining area is proposed . ZigBee specification is incorporated by many manufacturers in their devices because of its low power consumption and decreasing development cost. In the work presented here, Digi make ZIGBEE product is used here for transmitting and receiving data wirelessly.

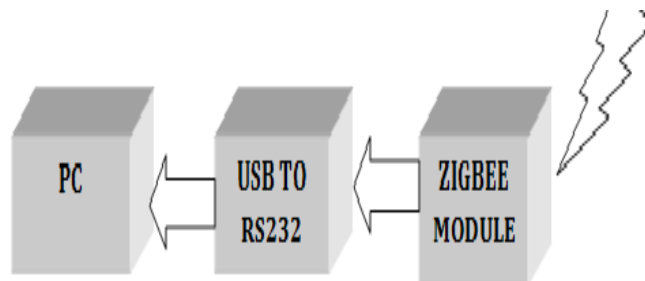## II.BLOCK DIAGRAM:

DESCRIPTION:

The proposed system is divided into two sections. First is a hardware circuit that will be attached with the body of the mine workers. This may be preferably fitted with the safety helmet of the workers also. The circuit has a sensor module consisting of some sensors that measures real-time underground parameters like temperature, humidity and gas concentration.

Gas concentration is meant for the harmful gases like methane and carbon-monoxide. A microcontroller is used with the sensors to receive the sensor outputs and to take the necessary decision. Once temperature is more than the safety level preprogrammed at microcontroller, microcontroller decodes beep alarms through the headset speaker connected with controller once the measured humidity value is more than the safety level preprogrammed at microcontroller; it decodes different type of beep alarms. Similarly when gas concentration crosses the safety level, microcontroller decodes siren alarms. Different sensors values are displayed in the LCD of mine workers section. A voice announcement is given when the sensor levels exceed the threshold levels. In all such cases, this will send an alarm through an urgent message and alarm sound to the ground control terminal through Zigbee. In control station the information is received by Zigbee transceiver and the status of the sensors is monitored in the PC.

UNDER GROUND MINER SECTION:
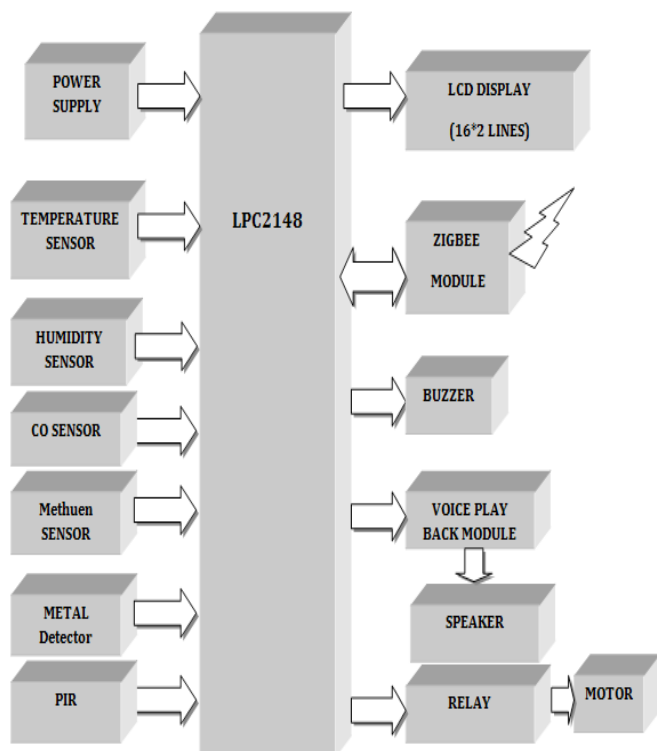
GROUND CONTROL CENTRE:

HARDWARE DESCRIPTION:

wireless sensor nodes mainly consist the sensor unit, signal conditioning circuitry, microcontroller (MCU), Zigbee module, timers, memory and power management module and other components shown in block diagram of proposed system.

Microcontroller :

In this work the micro-controller is playing a major role. Micro-controller is responsible for collecting environmental information (such as temperature,carbon monoxide, methane, etc.) and do some data conversion, responsible for controlling and managing the entire nodes. Micro-controllers were originally used as components in complicated process-control systems. However, because of their small size and low price, Micro-controllers are now also being used in regulators for individual control loops. The purpose of this work is to present control theory that is relevant to the analysis and design of Micro-controller system with an emphasis on basic concept and ideas. It is assumed that a Microcontroller with reasonable software is available for computations and simulations [3] so that many tedious details can be left to the Microcontroller. The control system design is also carried out up to the stage of implementation in the form of controller programs in assembly language OR in C-Language.

Max232:

The data which we are entering in to the hyper terminal editor is available at the COM1 port. Then the data enters in to the MAX232 voltage converter via the RS232 cable. [5]The MAX232 converts the voltage levels of the RS232 to the TTL level and then sends to the UART of the microcontroller. So the main duty of the max232 is for the voltage conversions.

LCD Display Section:

This section is basically meant to show up the status of the work. This work makes use of Liquid Crystal Display to display prompt for necessary information.

Zigbee Module:

ZigBee is an established set of specifications for wireless personal area networking (WPAN), i.e. digital radio connections between computers and related devices.WPAN Low Rate or ZigBee provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. Fig 2, ZigBee makes possible completely networked homes where all devices are able to communicate and be controlled by a single unit. Two Zigbee modules are used for the transmitter and the receiver. The experiment is done as per the IEEE 802.15.4a channel models i.e. for R (LOS and NLOS) and IO (LOS and NLOS). Prior to doing the experiment each Zigbee module is connected to each PC and the X-CTU software is installed in those PC's.

CO SENSOR:

Carbon monoxide detectors trigger an alarm based on an accumulation of carbon monoxide over time. Detectors may be based on a chemical reaction causing a color change, an electrochemical reaction that produces current to trigger an alarm, or a semiconductor sensor that changes its electrical resistance in the presence of CO. Fig 4,Most carbon monoxide detectors require a continuous power supply, so if the power cuts off then the alarm becomes ineffective.

Smoke sensor:

Sensitive material of MQ-2 gas sensor is SnO_2, 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.

III.FLOWCHART:
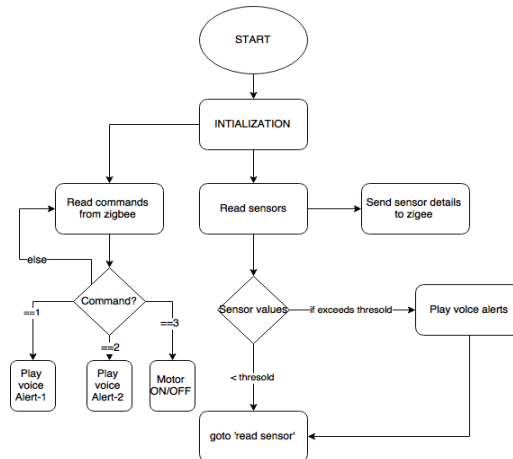
SCHEMATIC:
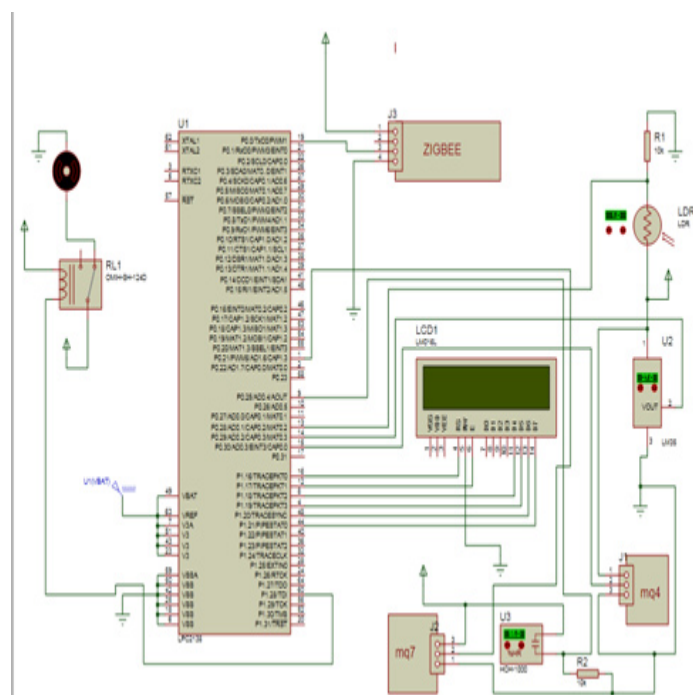
APPLICATIONS:

» Coal mine
» Industries

ADVANTAGES:

» Provide more safety for the mine workers.
» Automatic alert system in the nuclear industries

IV.RESULT AND CONCLUSION:

The proposed system was fully developed and tested to demonstrate its feasibility and effectiveness. The screen-shots of the smart home app developed has been presented in Figure bellow.
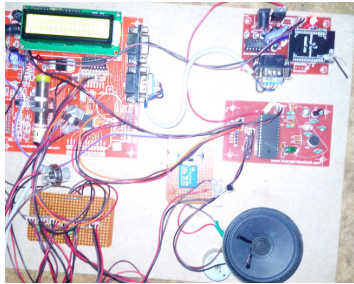
The Present work, coal mine safety monitoring system based on wireless sensor networks, and hardware and software design of wireless sensor network are described in detail, this system can detect concentration of the gas, temperature, humidity, wind speed and trace the location of miners in underground mine tunnels. Wireless sensor networks applied in monitoring coal mine security breaks through the traditional methods and ideas, which improvesthe practical ability and flexibility of monitoring system.

This system not only can monitor all kinds of parameters under the coal mine, but also can alarm automatically when environment parameters are abnormal to exceed the limitation, which help improve the level of monitoring safety production and reduce accident in the coal mine. Therefore, the coal mine Safety Monitoring system put forward in this article quite meets the need of coal mine safety monitoring.

Traditional mine security system can be effectively replaced by the surveillance and safety system proposed in the paper. The Example model messages to the registered mobile are shown in above figure. Along with Temperature and Humidity used get the alerts regarding moistures and hazardous gases if detected at the Site of the Sensor node. This System can extended for multiple tunnels by using sensor network.

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 Mukherjee "A Wireless Surveillance and Safety System for Mine Workers based on Zigbee".

[3] D. Egan, "The Emergence of ZigBee in building automation and industrial controls", J. IEE Computing & Control Engineering, vol.16(2), pp. 14-19, 2005.

[4] 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.

[5] Y.P. Zhang, G. X. Zheng, J. H. Sheng, "Radio Propagation at 900 MHz in Underground Coal Mines", IEEE transactions on antennas and propagation, vol.49(5), pp. 752-62, 2001.

[6] G.Pradeep Reddy, Gerardine Immaculate Mary "Optimal node placement in wireless sensor networks" IJEST, Vol. 3 No. 2 Feb 2011,pp.1124-1129.

[7] Rajkumar boddu, p.balanagu "zigbee based mine safety monitoring system with gsm" International Journal of Computer & Communication Technology, Volume-3, Issue-5, 2012.