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Zigbee Based Safety Monitoring System

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Abstract:

The main objective of this project is protecting mine workers from harmful gases. In this project a warning message will be sent to concerned manger, if any harmful gases are detected. Here, gas sensor is used to detect the gas. Zigbee is used to transfer the data from the analog sensor to care taker. The voice system with both microphone and speaker transforms into digital signal and effectively communicate wirelessly with the ground control centre computer.

Key words: Zigbee, MEMS (Microelectromechanical systems), Mines, Micro sensors, hybrid tunnels, waveguide propagation, Data Management

1.Introduction

Safety is the most vital part of any type of industry. Negligence in the safety part may cause damaging of high quality equipment hampering of production or may cause loss of human life also in extreme cases. In the mining industry safety and security is a fundamental aspect of all. To avoid any types of unwanted phenomena all mining industry follows some basic precaution and phenomena. Communication is the most vital key factor today, to monitor different parameters continuously and to take necessary actions accordingly to avoid any types of hazards related to production, security, managing of human resources. To avoid loss of material and damaging to human health, security and safety system as well as reliable continuous faithful communication system is essential in the interior of the underground mines. To enhance security, safety and productivity in underground mines, a reliable communication system must be established between workers, moving in the mine, and a fixed base station. The communication network must not be interrupted at any moment and at any condition. Inside underground mines, the wired communication network system is not so effective. The reliability and long life of conventional communications systems in harsh mining environments has always been a problem. Inside the 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 mines after a landslide or damage due to any reason. If due to some reason any wire of the communication network damages, it may cause temporary interruption of the continuous process or may cause a long term breakdown of the system.

2.Proposed Block Diagram

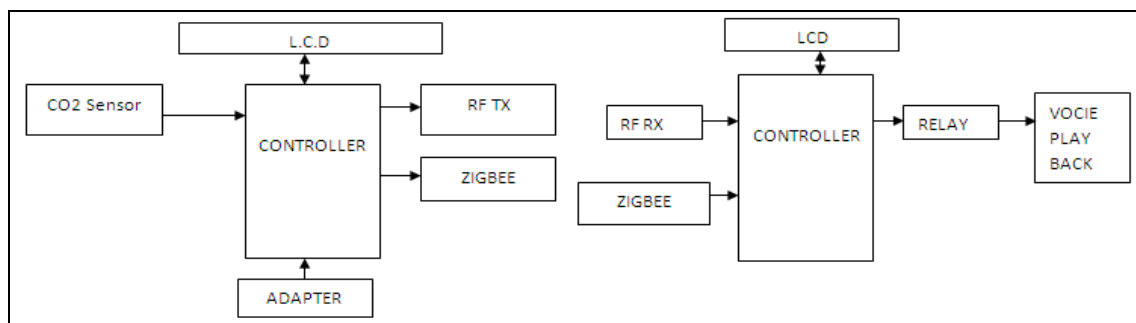


Figure 1

The above figure shows the transmitter and receiver blocks of the proposed concept. Here, zigbee is use to transfer the gas status. Another RF wireless communication protocol also proposed to activate the voice playback system.

3.Description Of The Scheme

The developed system can be 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 which should be mandatory in the premises of any underground mines. An additional stand by system can be fitted with the wrist of the underground mine workers if required. The circuit has a sensor module consisting of some MEMS based sensors that measures real-time underground parameters like temperature, humidity concentration of different gases, vibration inside mines etc. Gas concentration is meant for the harmful gases like methane and carbon-monoxide etc. Some of the gases are toxic and some are inflammable. A microcontroller is used with the sensors to receive the sensor outputs and to take the necessary decision.

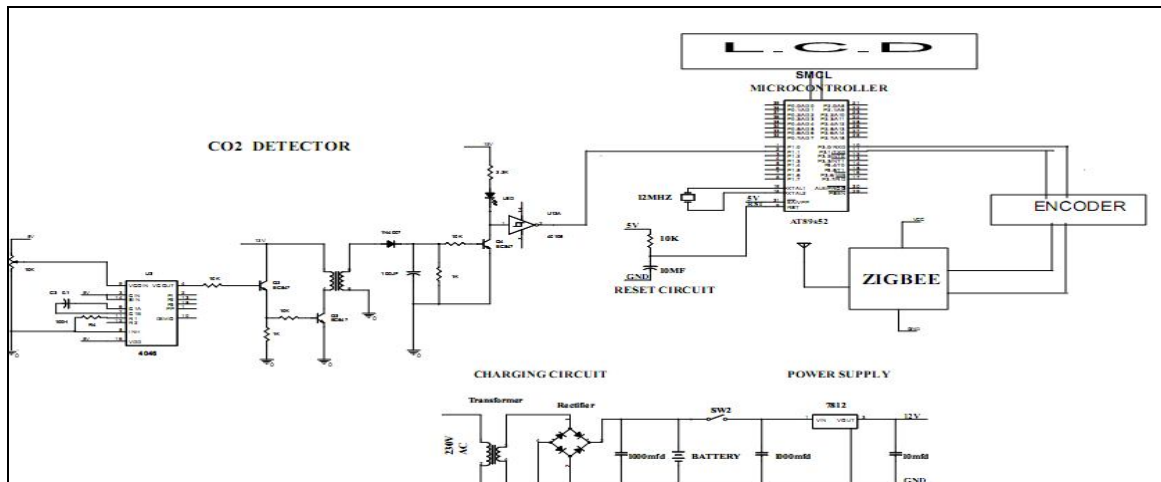


Figure 2: Transmitter Section

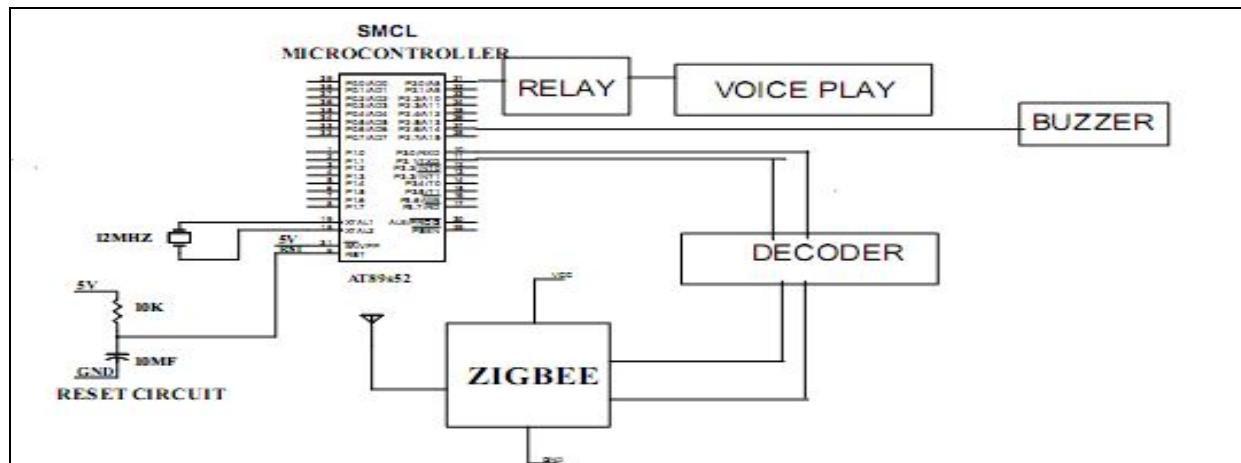


Figure 3: Receiver Section

The microcontroller can store data as required by the user for maintaining of records. Once temperature is more than the safety level preprogrammed at microcontroller; microcontroller decodes beep alarms through the headset speaker connected with controller as shown. When gas concentration crosses the safety level, microcontroller decodes siren alarms. In all such cases, this will send an alarm through an urgent message and alarm sound to the ground control terminal through zigbee. Data Transmission through Zigbee The main characteristics of ZigBee network are simple implementation, low power consumption, low cost interface, redundancy of devices, high node density per physical layer (PHY) and medium access controllayer (MAC). Besides, they allow the network to work with a great number of active devices. ZigBee is based on IEEE 802.15.4 standard in terms of the PHY and MAC layers [12]. IEEE 802.15.4 defines two kinds of devices: the Full Function Device (FFD) and the Reduced Function Device (RFD). The FFD has the function to coordinate the network and consequently has access to all other devices. The RFD is limited to a star topology configuration, not being able to work as a network coordinator, so it does not have all the protocol services. The FFD and RFD devices can operate in three different ways at the ZigBee standard as the ZigBee coordinator (ZC), ZigBee Router (ZR), or ZigBee End Device (ZED). The network layer supports three topologies: star, cluster tree and mesh as shown in Figure. A star topology

consists of a coordinating node and of one or more FFD or RFD which communicates with the ZC. At the cluster tree, the final devices can be associated to the network by the ZC and the ZR helping the increasing of number of nodes and the network scope. At the mesh topology, the FFD can distribute messages directly to other FFD. To enter the network, each device receives an address given by ZC or a ZR. Figure. Different topologies of ZigBee network X-CTU is a windows-based application provided program designed to interact with the firmware files and to provide a simple-to-use graphical user interface. Each of the four tabs there has a different function. PC Settings tab allows selecting the desired COM port and configuring that port to fit the zigbee settings. As shown in Fig. 5 baud rate, type of flow control and no of bits are required to set before the operation. The Test / Query button is used to test the selected COM port and PC settings. A response is received if the communication between them is correct. The range test tab is used to verify the range of the radio link by sending a user-specified data packet and verifying the response packet is the same, within the time specified. Terminal tab accesses to the computers COM port with a terminal emulation program. This tab also allows to send and receive predefined assemble packet data or data in Hex and ASCII formats using suitable commands. A complete list of commands is available in the product manual [13]. Terminal tab of the X-CTU software is also used to change the RF module's DL (Destination Address Low) parameter and save the new address to non-volatile memory. Modem Configuration tab is used to program the device firmware settings via a graphical user interface.

4.Result



Figure 4

5.Advantages

Security is very high due to cryptography insertion. Very easy to access and more reliable. Here is no complexity involved in implementing this project.

6.Applications

It plays vital role in Bio medical, military, electronics industries with low cost and low complexity. Plenty of applications are merged and fabrications also joined together to get high performance with more efficiency.

7.Conclusion

Traditional mine security system can be effectively replaced by the safety monitoring system proposed in the project. This project gives a system related to safety and security of underground mines. The system is reliable, faithful, uninterrupted, economical and user friendly. A larger area and more depth inside hazardous underground mines are now can be covered and potential accidents can be controlled effectively. The system combined the low power, low cost Zigbee based high frequency wireless data transmission technology with modern age MEMES based small size sensors. The sensor and zigbee module can be preferably installed over the helmet of mine worker. Proper monitoring and conversation is possible between the workers and the ground staff which can help to take appropriate actions more rapidly and smartly. The system also can be easily extended with ZigBee wireless image transmission facility in future; it will improve scalability of underground environment and extend accurate position of miners

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