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SMART SAFETY SYSTEM FOR COAL MINERS BY USING AMALGAMATION OF WIRELESS COMMUNICATION TECHNIQUES

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ABSTRACT

The main objective of this paper is to develop an embedded system to monitor harmful emissions in the coal mines like CO2, LPG and it is also used to control the temperature and humidity. Coal mine emission parameter like CO2, LPG etc can be continuously monitored by using Gas sensor, temperature monitored by temperature sensor, and humidity is monitored by humidity sensor. The hardware is placed inside the coal mines. Whenever poison gases, fire are detected by the sensors connected to the micro controller, will give buzzer for alert & transmits the data through Zigbee. The transmitted data will be received by the Zigbee receiver and this information will be passed to the higher authorities and emergency services by using GSM module. And this information is having the details about the place, where the accident takes place by using GPS technologies.

Keywords: GPS, GSM, Zigbee, SMS, Micro controller, LPG sensor, fire sensor, humidity sensor.

I. 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. 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. 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. Accordingly, development of mine monitoring system to accurately detect temperature, pressure, flammable and poisonous gas and to track underground miners and vehicles on real-time has significant meaning to safety production and rescue of coal mine disaster. Generally, the coal miners are facing lot of problems in coal mines due to harmful emissions like CO2, LPG and methane gases, etc and fire accidents. Due to this, many of the people lost their lives and so much property (machinery) loss also arises. To overcome these problems, in olden days, sensor network was used for monitoring the harmful emissions as well as temperature. But this methodology having a drawback i.e., it just alerts the coal miners inside the coal mine.

In the next years, Zigbee miner's helmet is extensively deployed in large and medium-sized coal mines, for their flexibility of light weight and low power. In this methodology, it intimates the information to the responsible authorities by displaying the message in the LCD or by alarming the buzzer. But this methodology also having a drawback i.e., the Zigbee is a short distance wireless communication network. So, it is not possible to intimate to the responsible authorities who are at long distance. Meanwhile GSM based wireless sensor networks are recently investigated due to their remote environment monitoring capabilities. Such a network can easily collect sensor data and transmit them by radio. In some cases, due to profundity of the coal mines, the GSM network service is not efficient. So, the transmitted message can be reached to the destination with some delay.

To overcome all these drawbacks, we design a smart new safety system, which enable the system as a mobile node of Zigbee wireless sensor networks, gathering parameters from underground timely and quickly. Moreover miners can also exchange information's from control centre through wireless speech communication. It is convenient for centralized management to build real-time surveillance on environment parameters, so potential safety problems can be avoid by early-warning intelligence. Along with this, we can use the GPS network, to provide the information about the location, where the accident happens.

II. METHODS AND MATERIALS

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. The circuit has a sensor module consisting of some MEMS based 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.

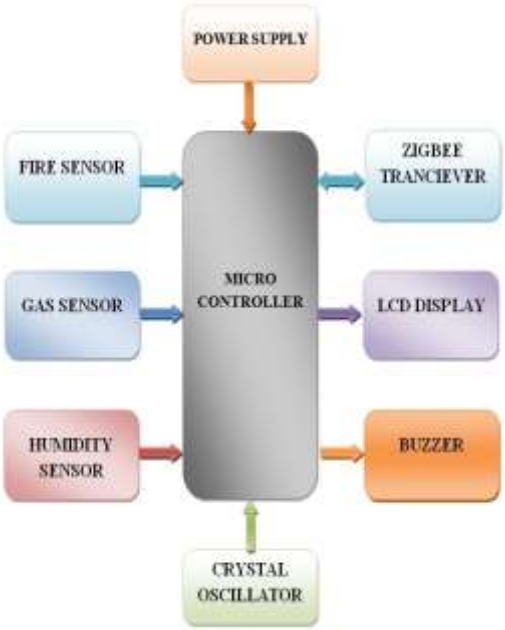

Fig: 1. Transmitter Block Diagram

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 buzzer connected with controller as shown in Fig. 1. Again, 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. In all such cases, this will send an alarm through an urgent message and alarm sound to the ground control terminal through Zigbee. The microcontroller data is transmitted through the ZigBee transmission module to the data collector or receiver module. The microcontroller used here is PIC 16F877A with 20MHz operating frequency. It has five I/O ports, eight A/D input channels and 368 bytes data memory.

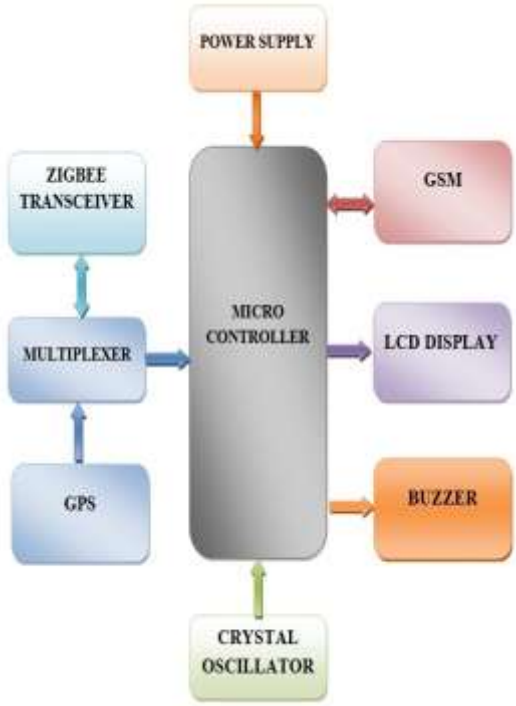

Fig: 2. Receiver Block Diagram

As shown in Fig. 2, the data receiving terminal of Zigbee XB_RX and data transmitting terminal XB_TX are cross connected to the microcontroller corresponding transmitter and receiver terminals TxD and RxD respectively. No extra component like MAX 232 and MAX233 is not required between these

connections. This is the advantage of PIC 16F877A. To know the position of the coal mine where the accident can be takes place we are using GPS (global position system). And at the receiver kit, the receiving information from transmitter and location details will be transmitted through the GSM network to the responsible authorities and emergency services. The GPS is connected to the microcontroller and the tracking values are given to the controller and this information will be given to the GSM module.

III. CONCLUSION

Traditional mine security system can be effectively replaced by the surveillance and safety system proposed in the paper. 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. And know the location of the coal mine also. The system also can be easily extended with ZigBee wireless image transmission facility in future.

IV. REFERENCES

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