

Voice Broadcasting Based Coal Mine Monitoring and Controlling System with Zigbee and GSM Technology

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ABSTRACT: This paper addresses a reasonable, flexible, uninterrupted monitoring system of underground mine workers on their protection and security. The atmosphere of mine exploitation is special and dangerous, how to real-time monitor and collect information on the different nodes, how to master the position of miner and atmosphere at any time, it is difficult problem for coal mine enterprise to urgently solve. In this research there are two different sections. The first section is tunnel section and another section is floor section. In tunnel section the sensors will sense the atmosphere conditions such as temperature, humidity, methane gas etc., and this information is send to the microcontroller. Microcontroller as well as displays this information in the Liquid crystal Display (LCD). The monitoring data is compared with the predefined threshold value, if the received value are exceeds the threshold value it sends the information to floor section by Zigbee. In floor section Zigbee receives the information and texts is send to the corresponding member and also making call through Global System for Mobile communication (GSM) modem. The predefined stored voice provided by voice processor. And this section gets the acknowledgements from the receiver.

KEYWORDS: Embedded control systems, GSM, Humidity Sensor, Temperature Sensor, Voice Processors, ZIGBEE.

I. INTRODUCTION

The safe production level of mine remains low, especially in recent year's disasters of mine occur frequently, that cause great loss of life, the protection issues of mine has step by step become to the main focus that the nation and society concern on. The disasters of mine happening are attributable to the quality of mine atmosphere and also the selection of work condition of coal mine, thus it is terribly necessary to monitor mine operating atmosphere. The varied environmental parameters of mine safety observance and controlling system, like temperature, gas and so on, are currently victimization the conventional cable transmission. Thus truly mine methane monoxide gas accumulation space mechanized mining face, like the dead gob cable security parameters cannot be monitored, in order that they cannot predict the alarm. form of merchandise for the present diversity of coal mine safety and underground coal mining method variability space, mine safety wireless network have to be compatible with existing mine safety system with information transmission functions, has sensible flexibility, measurability, self-set of network capabilities. Because the mine has its own special applications require a straightforward detector network protocols, easy network, self organization, self-healing ability. Come through the target location tunnel, environmental and alternative parameters of the remote assortment, will offer scientific basis for relief. Tunnel atmosphere, the quality of the ability consumption, interference immunity and then have additional stringent necessities. This method primarily projected to provide the warning message to mine emergency contact people by text and decision through GSM. There are two control section is projected for this technique. The tunnel section is observance the temperature, humidness and gas and that information sends to floor section and placed within the coal area. Since this method is exploitation in tunnel that is

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can't send data to end user. Therefore this method sends data to alternative unit by Zigbee. The floor section is causing information to for specific contact member by making the Call and Text via GSM Technology and voice process. Moreover the system gets the acknowledgement from receiver. By this manner the system can inform and provides warning messages to coal mine.

II. RELATED WORK

In previous system the monitoring value is compared with the predefined threshold value, if the received value are exceeds the threshold value it sends the data to floor section by wireless network. The information about monitoring value wont passed to the emergency section and there is no any voice process.

Our developed system is divided into two sections. Initial could be a hardware circuit which will be connected with the body of the mine employees. This could be ideally fitted with the security helmet of the employees conjointly. The circuit contains a sensing element module consisting of some MEMS based mostly sensors that measures real-time tunnel section parameters like temperature, wetness and gas concentration. Gas concentration is supposed for the harmful gases like methane series and carbon-monoxide.

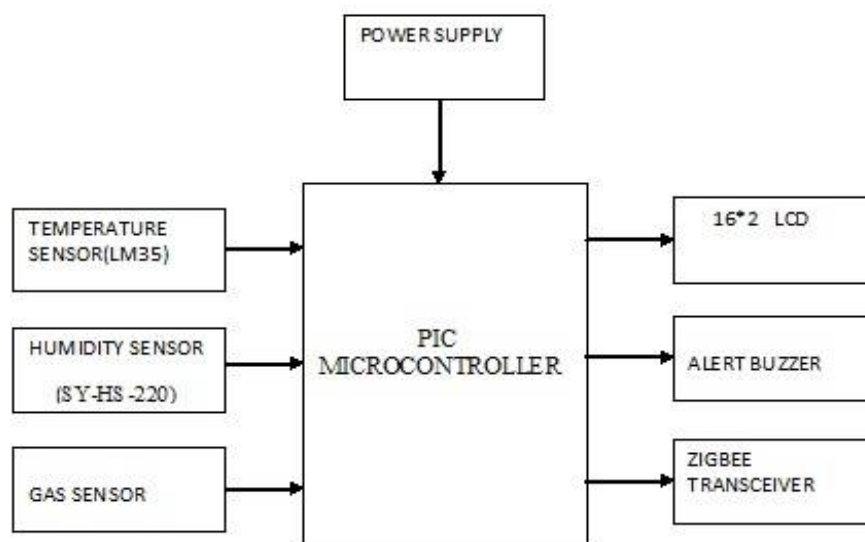


Fig. 1. Tunnel Section

A microcontroller is employed with the devices to receive the sensor outputs and to take the required decision. Microcontroller displays this data within the liquid crystal display. The monitoring information is compared with the predefined threshold values, if the received values are over the threshold values send the data to floor section by Zigbee. Since this method is victimization in tunnel section that is cannot send data to end user. So this method sends data to floor section by Zigbee. The floor section is sending data to for specific contact number by creating the call and Text via GSM Technology and voice process. Furthermore the system gets the acknowledgement from receiver. By this manner the system can inform and provides warning messages to mine. Fig. 1 & Fig. 2 Shows the Block diagrams of the Present work.

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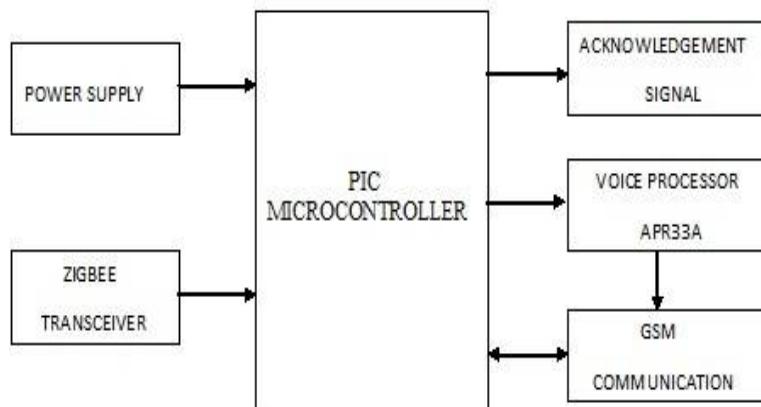


Fig. 2. Floor Section

The microcontroller used here is PIC16F877A with 20MHz in operation frequency. It is 5 I/O ports, eight A/D input channels and 368 bytes information memory. Zigbee is a new wireless technology guided by the IEEE 802.15.4 Personal Area Networks commonplace. It is primarily designed for the wide ranging automation applications. It presently operates within the 868MHz band at a information rate of 20Kbps in Europe, 914MHz band at 40Kbps within the USA, and the 2.4GHz Industrial Scientific and Medical (ISM) bands Worldwide at a most data-rate of 250Kbps. The Zigbee specification is a combination of Home RF low-cal and also the 802.15.4 specification. The transceiver has AN on-chip wire antenna and it operates at a frequency of two.4GHz .The data received from the microcontroller is organized supported the Zigbee protocol standards then modulated. The specification supports information transmission rates of up to 250 Kbps at a variety of up to thirty meters. Zigbee technology is slower than 802.11b (11 Mbps) and Bluetooth (1 Mbps) however it consumes considerably less power. Here a try of Zigbee modules is employed one to transmit the data from underground section and another to receive this data at ground or observation section. Fig. 3 show the pin diagrams of the Zigbee Transceiver module.

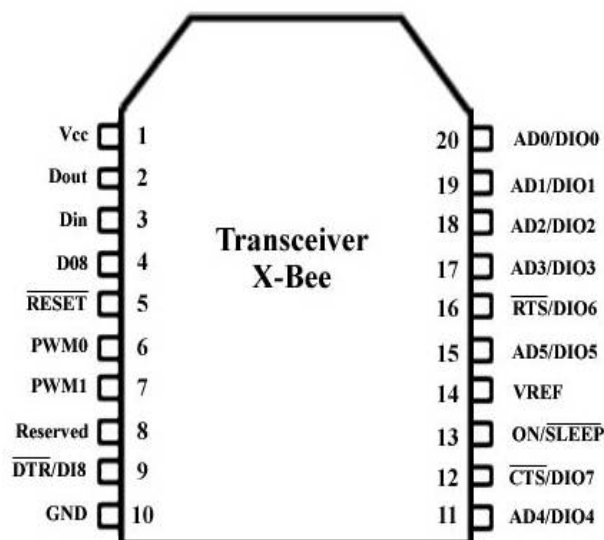


Fig. 3. Pin Diagram of Zigbee Transceiver

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III. HARDWARE DESIGN

The hardware components used to implement this system are summarized as follows,

Temperature Sensor

The LM35 sensing element is exactitude integrated circuit temperature sensing element whose output voltage is linearly proportional to the Celsius (centigrade) temperature. It can measure temperature additional accurately than a using a thermistor. The sensing element electronic equipment is sealed and not subject to oxidation, etc. The LM35 generates a higher output voltage than thermocouples and should not need that the output Voltage is amplified. The LM35 does not need any external calibration since it is internally calibrated. It output 10mV for each degree of centigrade temperature.

Gas Sensor

For detection of methane and carbon monoxide that are the major harmful gases in tunnel, MQ-7 gas sensor is in use. Sensor consists by micro AL₂O₃ ceramic tube, Tin Dioxide (SnO₂) sensitive layer, measure electrode and heater fixed into a crust created by plastic and stainless-steel net. The heater provides necessary work conditions for work of sensitive components. The enclosed MQ-7 has six pins, four of them are accustomed fetch signals, and other two are used for providing heating current. Fig. 4 Show the MQ-7 Gas sensor module.



Fig. 4. MQ-7 Gas Sensor

aPR33A

The aPR33A series are powerful audio processor on with high performance audio analog-to-digital converters and digital-to-analog converters. The aPR33A series are unit a completely integrated resolution providing high performance and unequalled integration with analog input, digital process and analog output practicality. Prime quality audio/voice systems with lower bill-of-material prices are often enforced with the aPR33A series attributable to its integrated analog data converters and full suite of quality-enhancing options like sample rate Converter. Fig. 5 show the aPR33A Module.

- ❖ Operating Voltage Range: 3V ~ 6.5V
- ❖ Single Chip, prime quality Audio/Voice Recording & Playback resolution
- ❖ 70/ 340/ 680 sec. Voice Recording Length in
- ❖ aPR33A1/aPR33A2/aPR33A3
- ❖ Non-volatile flash storage Technology
- ❖ No Battery Backup needed
- ❖ Powerful Power Management Unit
- ❖ Supports Power-Down Mode for Power Saving
- ❖ intrinsic Audio-Recording mike electronic equipment

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- ❖ No External OPAMP or BJT needed
- ❖ Averagely 1,2,4 or 8 voice messages record & playback



Fig. 5. aPR33A Module

Humidity

A wetness detector senses ratio. This means that it measures every air temperature and condition. Relative humidity, expressed as a percent, is that the quantitative relation of actual condition in the air to the best possible amount of condition air at that temperature can hold. The hotter the air is, the more moisture it will hold, thus quantitative relation changes with fluctuations in temperature. The foremost common form of humidity detector uses what is stated as "capacitive live." This system depends on electrical, or the flexibleness of two close to electrical conductors to create associate degree electrical field between them. The detector itself consists of two metal plates with a non-conductive matter film between them. The film collects moisture from the air, and so the condition causes minute changes in the voltage between the two plates. The changes in voltage are regenerate into digital readings showing the amount of moisture inside the air.

GSM

GSM (Global System for Mobile communication) is a digital mobile communication system that's wide utilized in several parts of the globe. The mobile communications has become one of the driving forces of the digital revolution. The complexity of the mobile phone is increasing as individuals begin sending text messages and digital photos to their friends and family. The mobile phone is slowly turning into a hand-held computer. All the options and advancements in mobile phone technology need a backbone to support it. The system needs to provide security and also the capability for growth to accommodate future enhancements. General System for Mobile Communications, GSM, is one in all the various solutions out there. GSM has been dubbed the "Wireless Revolution" and it doesn't take abundant to understand why GSM provides a secure and confidential technique of communication. GSM is a digital mobile communication system that's wide utilized in several elements of the world. GSM operates within the 900MHz, 1800MHz, or 1900 MHz frequency bands. GSM has been the backbone of the phenomenal success in mobile telecoms over the last decade. Now, at the dawn of the time of true broadband services, GSM continues to evolve to satisfy new demands. one in all GSM's great strengths is its international roaming capability; giving consumers a seamless service. GSM in conjunction with alternative technologies associate element} of an evolution of wireless mobile telecommunication that has High-Speed Circuit-Switched Data (HSCSD), General Packet Radio System (GPRS), Enhanced data GSM environment (EDGE), and Universal Mobile Telecommunications Service (UMTS). GSM security issues like thieving of service, privacy, and legal interception continue to raise important interest in the GSM community. The purpose of this portal is to boost awareness of those problems with GSM security.

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IV. SOFTWARE DESIGN

The design of software section consists of designing of the floor Section and tunnel Section. The flow charts for the tunnel and floor sections are shown in Fig.6 and Fig .7 respectively.

Tunnel Section:

In the tunnel section, first the parameter values from sensor are given to the microcontroller and these values are displayed on the LCD screen. Then check whether Zigbee is ready for transmission. If Zigbee is ready, then transmit the values otherwise wait until Zigbee is ready. If the values are beyond the limit, then Turn-on the Buzzer.

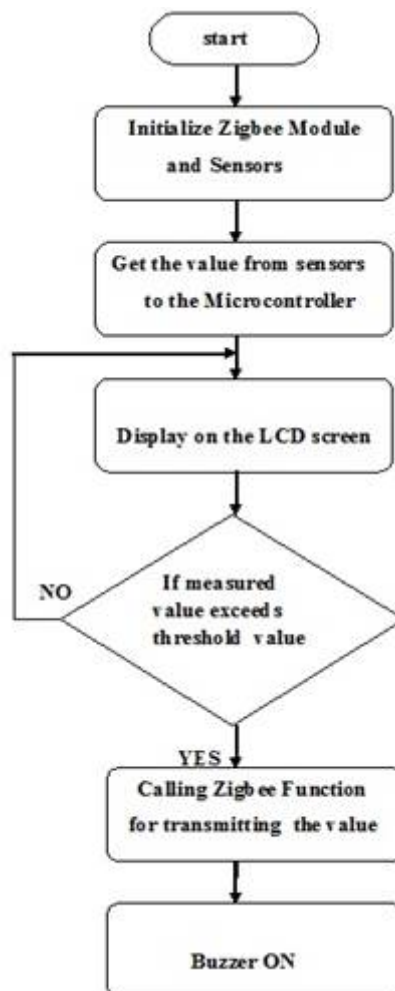


Fig. 6. Flow Chart of Tunnel Section

Floor Section:

In the floor Section, first the Zigbee should be ready to receive the data. If Zigbee is ready, then call the Zigbee receives function. After that, check whether the information is received or not. If information is not received, it waits until the information is received .After the information is received then it makes call and sends messages to the

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mobile phones through GSM. Software design mainly programmed with C language combining Lab view is responsible for the collected data display, analysis and storage etc.

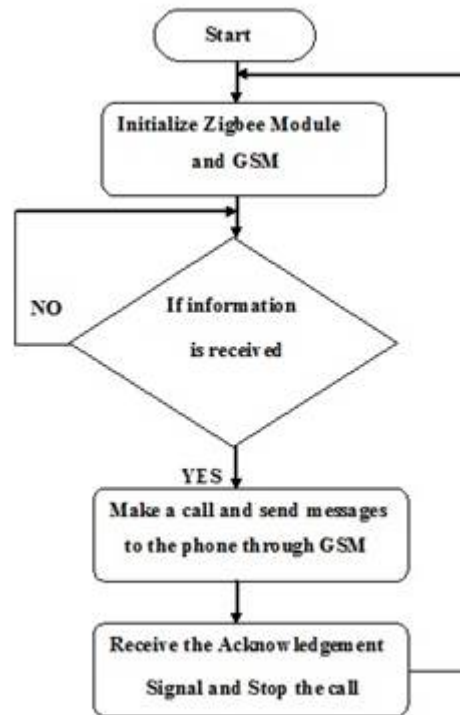


Fig. 7. Flow Chart of Floor Section

V. CONCLUSION

The present work, voice broadcasting based mine monitoring and controlling system with Zigbee and GSM technology are used. This system can detect concentration of the gas, temperature, humidity and trace the location of miners in underground mine tunnels. Additionally this method is sending information to specific contact number by creating the call and Text via GSM Technology and voice processing. Moreover the system gets the acknowledgement from receiver. By this way the system will inform and provides warning messages to coal mine. ZIGBEE and GSM technology applied in communication that improves the sensible ability and flexibility of communication system. This technique not solely will monitor all types of parameters under the mine, but also can alarm automatically once atmosphere parameters are abnormal to exceed the limitation, that facilitate improve the level of observance safety production and cut back accident in the coal mine.

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