Coal Mine Robot for Detection of Hazardous Gas

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ABSTRACT- Safety of human life is an important factor .So improve life safety, many system have been developed. While working environment such coal mine safety is an important factor because coal mine is an underground tunnel. In previous work environment in coal mine different accident take place due to gas explosion, fire, and low percentage oxygen gas (O_2) content layer, excess amount of carbon monoxide gas (CO), carbon dioxide gas (CO_2), methane gas (CH_4) so that , in that accident many worker's injured and died. This system helps people who were working in coal mine by using coal mine robot. A control system uses microcontroller and a Zigbee communication system to transfer the coal mine environment data acquired through the MQ 135 and temperature sensor. Robot enters and move in coal mine and detect hazardous gas and provide safety against fire explosion, poisoned gases like CO,CO_2 , CH_4 and alert people in tunnel. So using coal mine robot probability of accident reduced.

KEYWORDS: safety,co2 sensor, coal mine

I. INTRODUCTION

In past years, in underground coal mine explosion accidents 55 people died and injuries from 1984 and 1993.from 1993 to 1999 from coal mine fires and explosions caused 37 deaths. [1]

When the concentration of methane in air is exorbitance, it can kill people caused by suffocation .In the underground of coal mine, when the environmental temperature reaches certain condition, the coal will be spontaneous combustion, as the Oxygen supply of those places is insufficient, it will cause combustion inadequate and forms a large amount of CO, have a strong attractive to haemoglobin. When CO entered respiratory system it will cause anoxemia, and lead to histanoxia, and the inhibition of tissue respiration can killed people caused by suffocation. According to their features of the mash gas and CO they are both possess explosive, and dangerous for human body. When the robot reaches the explosive coal mine site, it detect and sends the environmental conditions such as temperature, presence of poisonous and dangerous gases.[3] A robot equipped with different sensors for detecting various poisonous gases and if value of hazardous gases crosses set limit then system provide safety to workers who are working in coal mine.

II. LITERATURE REVIEW

Robot with sensor detects toxic gases and rescue people in the tunnel. It provide safety against fire explosion, poisoned gases like CO,CO_2 , CH_4 and increased temperature level it alert people in tunnel. Gas concentration is meant for the fuel gases like methane and carbon-monoxide,   carbon dioxide. 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 buzzer activate. Again, once the measured carbon dioxide gas value is more than the safety level , it activate buzzer. It has dangerous accidents as collapse, gas explosion, CO, CO2 poison gas, low O2 content, high temperature, smoke, coal dust, fire, water, etc. All these accidents can kill people easily. One such design is to send a robot inside a coal mine. A robot equipped with sensors for detecting various poisonous gases and a wireless transmitter and receiver can be used to monitor such an environment.

The ZigBee had much better range than Blue Tooth and hence it could transmit commands and receive data from long distance from the tunnel. LM35 has been used as a temperature sensor in the system. The operating temperature range is -55℃ to 150℃. Gas sensor detect hazardous gases in coal mine.

TABLE: 1.1 Comparisons of Wireless Technologies

Feature	Wi-Fi	Bluetooth	ZigBee
Battery Life Time	Several hours	Several days	Several years
Complexity	High	Complex	Simple
Nodes Number	32	7	65,000
Time for network	3 seconds	10 seconds	30 milliseconds
Coverage	100m	10m	10m-several Km
Extension	Roaming enable	No	Yes
Data Rate	11 Mbps	1 Mbps	250 Kbps
Security	SSID	64 bit, 12 bit	128 bits
IEEE Specification	802.11.ab	802.15.1	802.15.4
Frequency band	2.4 & 5 GHz	2.4 GHz	2.4 GHz

TABLE:1.2 Comparison of Microcontrollers

Features	PIC -18	Atmega-8	8051	MSP430
Architecture	8-bit	8-bit	8-bit	16 bit
Operating Speed	4-20Mhz	8-16Mhz	11-20Mhz	32Mhz
Sleep mode	2 ma	2 ma	2.4 ma	1.3 ma
Wakeup mode	2.20 ma	2 ma	2.4 ma	2.4 ma
Wakeup time	16 ms	2 ms	20 ms	6 ms

III. METHODOLOGY

As shown in project set up, hardware at local site is composed of microcontroller ATMEGA 8A , Zigbee module transceiver, sensors such as LM35 for temperature detection, co2 gas sensor, MQ135 for carbon dioxide gas detection, driver IC, RS 232connector PC Monitor display, buzzer for alert [1]

Various sensors like carbon dioxide MQ135,temperature sensor LM-35,IR sensor are taking analog measurement from local site of various parameter such as carbon monoxide, increasing temperature, different water level and through ADC give digital output to the microcontroller ATMEGA 8A.Zigbee transmits this digital sensor data to the remote monitoring site located at maximum distance from local site (30m). Zigbee can be used inside mines at router as shown in figure 3. Remote monitoring site (pc) continuously monitoring sensor data in the designed format of GUI as shown in figure 3. Whenever the sensor data exceeds the specified threshold (preset) value of temperature, carbon monoxide and water level, the zigbee module at remote monitoring site is transmit alert signal to local site by blowing buzzer continuously.
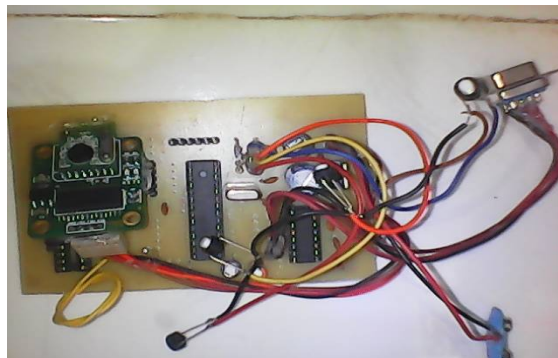
Fig.1 Project complete setup

Fig. 2 Zigbee circuit

In this project there are two sections. The first section is under Coal Mine Section and another section is Coal Mine Section. The overall block diagram of the system is as shown in Fig.1.The designed systems are placed in different parts of the mine and connected by means of Zigbee. In under Coal Mine Section the sensors will sense the environment conditions such as temperature, Methane gas, gas etc.., and this information is send to ADC of the micro controller, the number of members inside the coalmine is also obtained by means of IR sensor. Microcontroller displays this information in the monitor display and sends through Zigbee transmitter. In Coal Mine Section Zigbee receiver take that information and send to the controller and controller sends the information to Zigbee and as well as displaying on the GUI display. Here GUI sends the message and Store data of various parameter in data log.

Coal Mine Side Under Coal Mine Section

In the under Coal Mine Section, the parameters temperature, Methane gas and gas are measured by means of respective sensors and the output voltage measured by them is directly connected to the ADC of the ATMEGA 8A, as the output voltage never exceeds 5V, there is no need of connecting a signal conditioning circuit. The number of people inside the coalmine is monitored by the help of IR sensor,LM35,MQ135sensor. During a hazard this information will be useful to know whether there are any people remained inside the coalmine. Information regarding the safety measures like wearing oxygen helmets etc., will be already given to the workers so that they can save their life. If any of the received parameters are beyond the set limit, then a Buzzer will be ON, giving warning to the people. The parameters are displayed on the Monitor display and as well as transmitted to the Coal Mine Section through the Zigbee Transceiver.
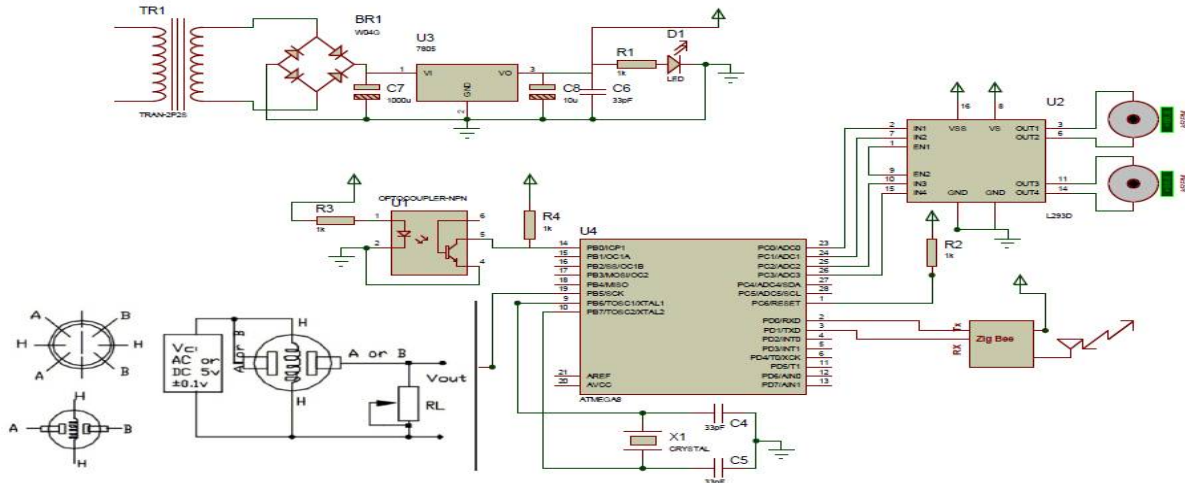
Fig. 3 Circuit Diagram

Control Unit Side Coal Mine Section

In the Coal Mine Section, the Zigbee Transceiver receives the information and sends to the ATMEGA 8A controller. The personal computer monitor to the controller displays the information in the Coal Mine Section. The controller is communicated thr. Zigbee through RS232.Control unit having control of Robot movement I e left,right,up,down movement in coal mine.in addition the controller is connected to PC; the measured values are continuously displayed and stored in the PC for future use.
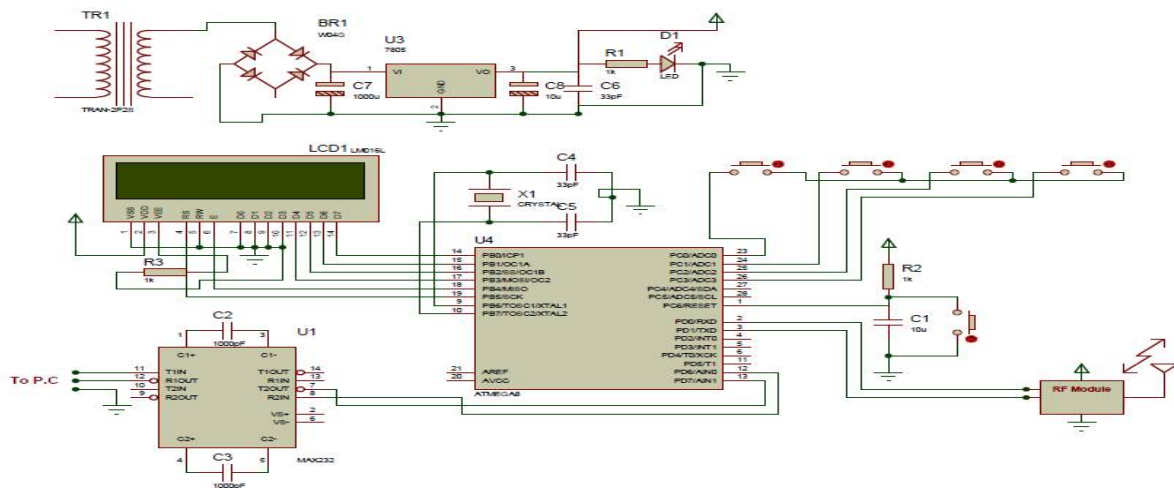
Fig. 4 Circuit Diagram of Monitoring Section
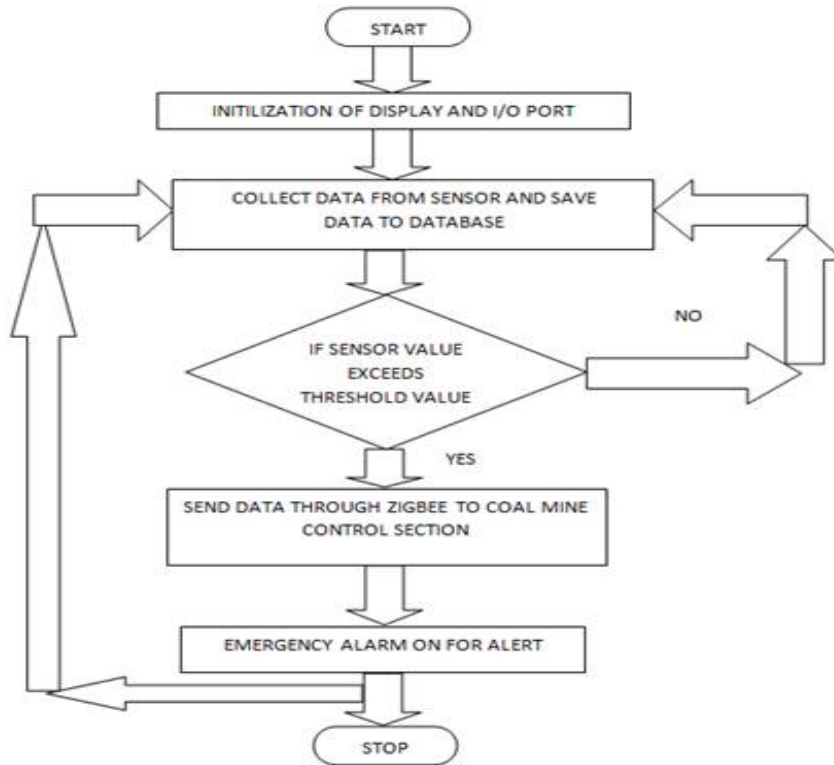
FLOW CHART

Fig. 5 Flow chart

IV. ROBOT STRUCTURE
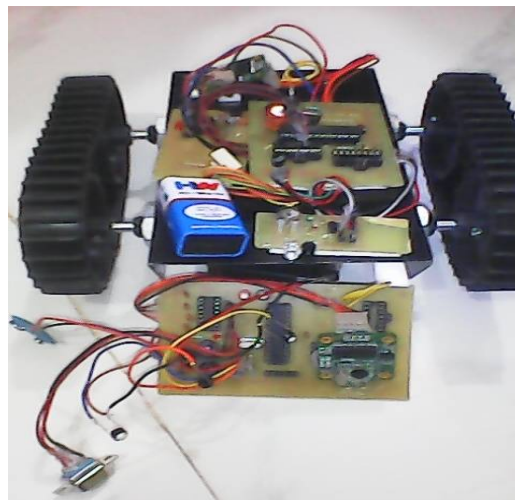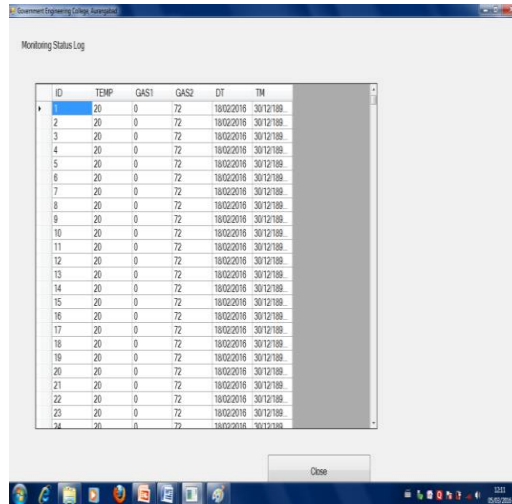
Fig. 6 Coal mine robot physical structure
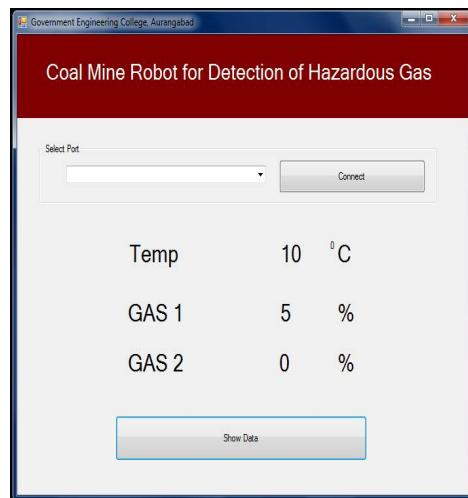
Fig.7: Data Log Results

Fig.8 GUI Display Monitor Window

V. CONCLUSION

Coal mine workers are benefited using this system. This robot enters into hazardous environments and provides various gases data. This prototype system provides at ATMEGA 8A alert when hazardous gas level increases. By using MQ135, LM 35 sensor robot detect environment in the underground mines by monitoring physical parameter and parameters are observed using monitor status log and display, and increase life safety of coal mine workers.

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