

SURAKSHA KAVACH-A SMART HELMET FOR COAL MINERS USING ZIGBEE TECHNOLOGY

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Abstract—In recent days coal mining has been a very dangerous activity for coal miners that can also results adverse effects on the environment. Our project aims at developing a smart helmet real time surveillance for coal miners using Zigbee technology. In this project we are detecting harmful gases like methane, carbon monoxide, temperature and humidity which are harmful for the coal miners. All these parameters are detected and monitored continuously to safe guard the coal miner's life. The values of different sensors are continuously monitored and transmitted by ZigBee transmitter to the control station. If any parameter value crosses the PReDEFINED limit, then the user gets alert as the buzzer will automatically turn on, the alarm indicates the person to come out from that hazardous place and also the persons who are monitoring at the control station will intimate to appropriate fire and ambulance services to provide first aid. This proposed project is coal mine supervising system which is based on the cost effective Zigbee technology.

Keywords—Smart helmet, ZigBee Technology, Gas sensor, Humidity sensor, temperature sensor, coal miner's safety.

I. INTRODUCTION

As India is the third largest nation to produce coal in the world, there will be many people working in Coal mines. The persons who are working in coal mining has to face various environmental parameters while working, the danger can be from various gases like methane, carbon monoxide and other parameters like temperature, humidity and sometimes a roof collapse. In earlier days, LED type helmets are extensively deployed in large and medium-sized coal mines because of their flexibility of light weight and low power, but these cannot provide early warning on dangerous gases, so we need to provide strong security for the workers, in order to rescue the persons from hazardous situations this project will give a solution. This proposed project is a wireless communication and safety monitoring system with four sensors namely MQ4, MQ7, temperature and humidity sensors these sensors monitor different parameters such as temperature, humidity level, methane and carbon monoxide gas continuously, and the sensed values will be transferred to central control station through wireless Zigbee module. The improved safety features in our system dramatically increased life expectancy of the coal miners by alerting them about the hazards. If there is any hazardous situation in the mine the helmet gives the information to the control station through the Zigbee transmitter and the control station will alert the coal miner using the ZigBee receiver by making the buzzer alarm active which is positioned in the helmet of the coal miner. So that, a coal miner can rescue his life from the hazard's situations occur during working in coal mines.

II.WORKING

The smart security system consists of a helmet, which is mounted with sensor circuits. The transmitter section contains micro controller which receives input from various sensors like gas sensor, temperature sensor, humidity sensor, and transmit these sensors output values to the receiver section through Zigbee transmitter. If the values exceed threshold levels then buzzer placed on the helmet will alert the coal miner and parallely the same information is transferred through the ZigBee receiver to the control station. The monitor person at the control station will provide appropriate first aid by intimating to the appropriate fire and medical services, which are necessary for the coal miners. So that the coal miner's life can be rescued. This can be possible from serial monitoring of sensed

values at the receiver section that is flash magic is the software used for serial monitoring of sensed values at receiver section of control unit.

III SYSTEM ARCHITECTURE

This developed smart system contains two parts, those are transmitter section and receiver section, transmitter section will have mainly micro controller (AT89S52), analog to digital converter (MCP 3208), 16X2 liquid crystal display, buzzer, MQ4 sensor, MQ7 sensor, temperature sensor (LM35), humidity sensor and MAX 232, transmitter ZigBee module. Receiver section contains receiver ZigBee module and computer for serial monitoring of sensed values. Every component in this plays a unique major role. At transmitter side the components are placed on the helmet which was wore by the coal miner. The placed sensors will detect the harmful gases occurrence in the coal mines while working, in analog form and send this information to the micro controller, as micro controller can't understand the analog inputs there we require a ADC to convert in to digital form. Micro controller will process the sensor output values, then the Transmitter ZigBee will transmit those values to the receiver ZigBee module for the serial monitoring at the receiver section.

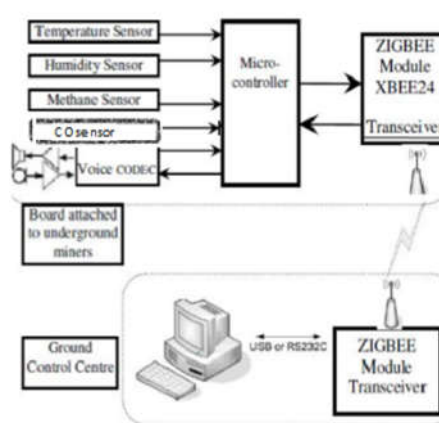


Fig.1a. Block diagram

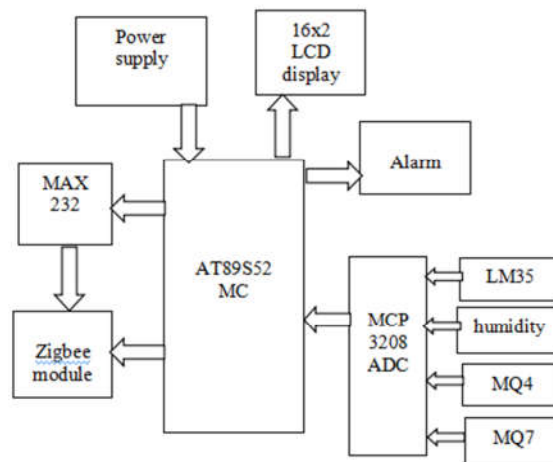


Fig.1b. Block diagram of transmitter unit

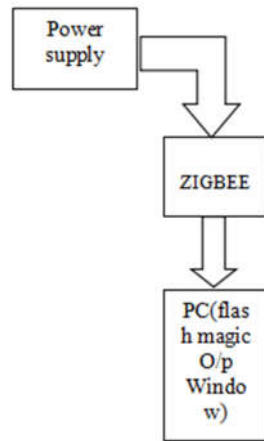


Fig.2. Block Diagram of Receiver unit

This developed smart system contains two parts, those are transmitter section and receiver section, transmitter section will have mainly micro controller (AT89S52), analog to digital converter (MCP 3208), 16X2 liquid crystal display, buzzer, MQ4 sensor, MQ7 sensor, temperature sensor (LM35), humidity sensor and MAX 232, transmitter ZigBee module. Receiver section contains receiver ZigBee module and computer for serial monitoring of sensed values. Every component in this plays a unique major role. At transmitter side the components are placed on the helmet which was wore by the coal miner. The placed sensors will detect the harmful gases occurrence in the coal mines while working, in analog form and send this information to the micro controller, as micro controller can't understand the analog inputs there we require a ADC to convert in to digital form. Micro controller will process the sensor output values, then the Transmitter ZigBee will transmit those values to the receiver ZigBee module for the serial monitoring at the receiver section.

IV Hardware units

Micro controller AT89S52:

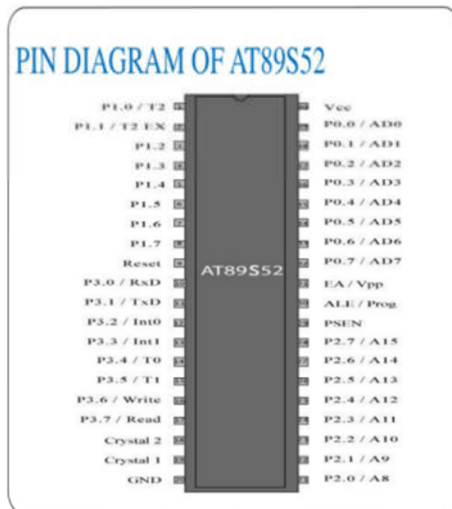


Fig.3. AT89S52 Micro controller

Micro controller is a small computer on a single integrated circuit. 8051 is the micro controller's family name. In our system we used AT89S52 device's which is a typical 8051 micro controller manufactured by ATMEL. The 89S52 has 4 different ports, each port has 8 Input/output lines providing a total of 32 I/O lines. Those ports can be used to output DATA and orders to other devices, or to read the state of a sensor, or a switch. Most of the ports of the 89S52 have 'dual function' meaning that they can be used for two different functions.

LM35 sensor:

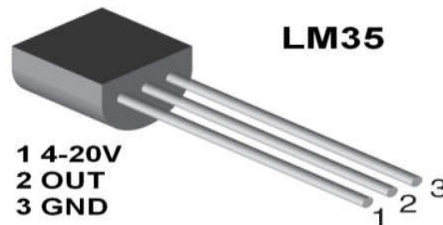


Fig.4: Temperature Sensor (LM 35)

LM35 is a Temperature sensor LM means linear monolithic. It checks the temperature variations in the coal mines and if any fluctuations occur in temperature in hazardous condition it gives the approximation about temperature. The normal temperature Range of underground coal mine is 50 to 60 degree Celsius, and at the explosion area it is above 70 degree Celsius.

Humidity sensor:

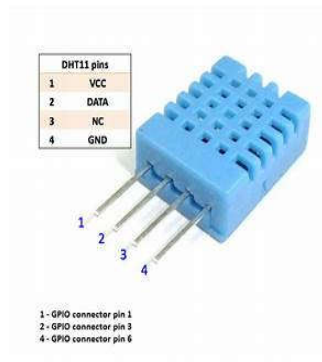


Fig.5: Humidity Sensor

Humidity Sensor checks humidity in air. The quantity of water presented in the air is humidity. It can operate at a range of 0 to 60 degree. This sensor gives approximation. It is Compatible with automatized assembly processes, including wave soldering re flow and water immersion. Humidity measurement accuracy $\pm 0.3\%$ RH.

Technical specifications:

Measurement: 20

Range: 20%

Operating Temp.: -40-100 0C

Storage Temp.: -40-125 0C

Supply Voltage: 10Vac, Accuracy: 5%

MQ4:**Fig.6.MQ4 sensor**

In MQ4, MQ means in Chinese ‘sensitive’ means ‘Mingan’ and ‘Gas to’ means ‘Q i lai’.so MQ means the sensors having sensitivity towards gas. Sensor detects the natural gas (methane, CH₄) concentrations anywhere from 200 to 10000ppm.this sensor has a high sensitivity and fast response time. The sensors output is an analog.

MQ7:**Fig.7.MQ7 sensor**

MQ7 is a sensor suitable for sensing carbon monoxide concentration (PPM) in the air.it can measure CO concentrations ranging from 20 to 2000ppm

ZIGBEE:

Zigbee is a latest advantageous wireless technology, an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Its low power consumption limits transmission distances to 10–100 meters line of sight, depending on power output and environmental characteristics. Zigbee operates in the industrial, scientific and medical (ISM) radio bands: 2.4 GHz in most jurisdictions worldwide; though some devices also use 784 MHz in China, 868 MHz in Europe and 915 MHz in the USA and Australia, however even those regions and countries still use 2.4 GHz for most commercial Zigbee devices for home use. Data rates vary from 20 k bit/s (868 MHz band) to 250 k bit/s (2.4 GHz band).

CO:

CO gas is very toxic, it is a colourless, odourless, tasteless gas .it is slightly higher than air.it burns with air, even a small quantity presence of carbon monoxide in body will cause a severe health hazards, there are certain pollutant concentration break points(ppbs), based on these ppbs there will be different health issues in one’s body. The minimum acceptable CO ppb is 0-12 we consider this as very good category. if it crosses the ppb range of 31-51, consider this as very poor category. It affects haemoglobin of the blood,

heart diseases will arise and blurred vision poses times based on the concentration of CO in air(ppm) are, if it is 9ppm it is a short term ex-poser, presence is 35ppm then the breathing time will be 8 hours, for 200ppm breathing time is in 2-3 hours, if the concentrations are 800ppm,1600ppm,3200ppm,6400ppm and 12800ppm then the person can die within 2-3 hours,1 hour,25-30 minutes,1-3 minutes respectively.

CH4:

Methane is the abundant gas released in coal mines, it is also a colourless, odourless, tasteless, flammable gas, methane is lighter than air. Methane is a mixture of small traces of ethane(C₂H₆), and other hydrocarbons, such as propane(C₃H₈) and butane(C₄H₁₀).the presence of methane will reduce the oxygen quantity in body, if that reduces to 12% ,the individual can get to be unconscious and leads to death in some cases.

V Results

Flow of execution at transmitter side:

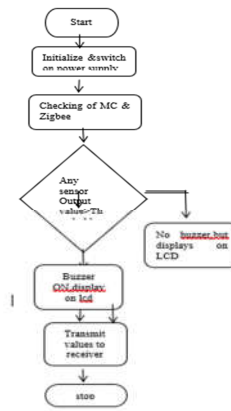


Fig.8 Flow of execution at transmitter side

Flow of execution at receiver side:

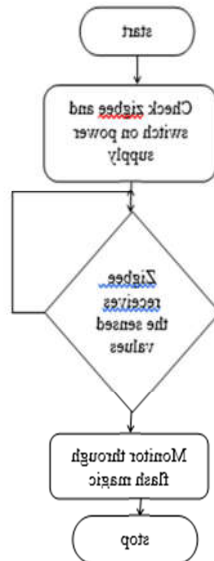


Fig .9 Flow of execution at receiver side

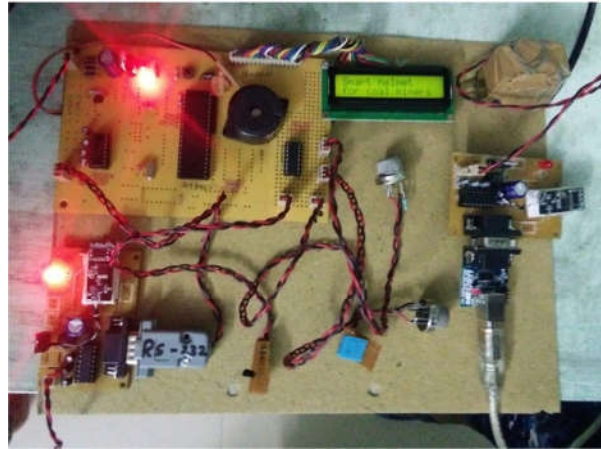


Fig10: Overall hardware implementation kit

VI Future scope

This proposed system can also have further extension, with ZigBee wireless image transmission facility in future. It will improve scalability of underground environment and extend accurate position of miners. and we can also give the warning instructions to the coal miners through voice from control station, it will be some more effective.

VII Conclusion

This ZigBee wireless smart helmet is very helpful to provide safety for the underground coal mine workers, by monitoring the hazardous situations and alerting them about those hazardous situations to save their lives. The availability of required components makes the implementation easy, because of having low cost and low power ZigBee module, the cost of the system reduced. This project can also find usage in many fields, where ever required the workers to work in undergrounds.

References

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