

Detection of Hazardous Parameters for Security Inside Coal Mines using Zigbee

Neha A. Ate¹ Prachi K. Bansode² Subhash A. Bhashakhetre³ Prof. K. M. Gaikwad⁴
^{1,2,3}B.E Student ⁴Assistant Professor

^{1,2,3,4}Department of Electronics and Telecommunication Engineering
^{1,2,3,4}Sinhgad Academy of Engineering, Pune443001

Abstract— This paper is based on monitoring of hazardous parameter in underground coal mines such as carbon monoxide, methane, temperature, humidity. A microcontroller is used which support serial interfacing so that we can apply wireless networking for long distance communication. All the sensors are connected to microcontroller so that the data from sensors will be collecting, storing data and safety level is monitored. Depending on output the workers are informed through alarm tone and LEDs of display section. Zigbee is IEEE 802.15.4 standard which is used for the transmission of data from mines to monitoring section. If the safety level is crossed the data will be displayed continuously on computer at control room. Due to this immediate rescue team is sent to mines.

Key words: Wireless communication, detection, protection

I. INTRODUCTION

Now a day's coal is the main resource for electricity generation. Coal is widely used in India as well as china for electricity generation. Lot of coal mines are these who are responsible for electricity generation as a resource. But inside coal mines lot of worker are working.

A Coal is a main source for hazardous gases .it releases gases like CO, CH₄, CO₂, etc. Human beings are most affected by these hazardous gases. We must avoid working in the mine with hazardous gases. Whenever the concentration of gas increases the amount of concentration of gases may lead to huge fire inside the mine.

For detection of these gases, this project may help. Detection of gases which are present inside the mines like CO, CH₄, CO₂, etc. helps the worker to keep away from danger. The MQ7, LM35& HS201 are used to detect carbon monoxide, methane, carbon dioxide. These sensors are connected to microcontroller and provide respected sensed values. Zigbee act as transceiver for transmission of sensed values.

II. OBJECTIVES

- 1) Detection and Protection: Detection of gases and parameters inside coal mines with sharp sensitivity and providing safety team.
- 2) Wireless communication: Zigbee is used to transmit the data from micro-controller system inside coal mine to control room very effectively and increasing distance of detection by using zigbee in API mode.
- 3) Monitoring: Cool term software is installed on computer on which the data received by zigbee is displayed and monitored so that the information is updated time to time.

III. WORKING OF THE SYSTEM

The system has two section i.e. transmitter side and receiver side. On the transmitter side the hardware is placed on the

pole in the mine at the fixed distance from each other. Hardware consist MQ7, LM35, MQ2, HS220, microcontroller, Zigbee module, LCD segment display, LEDs & buzzer.

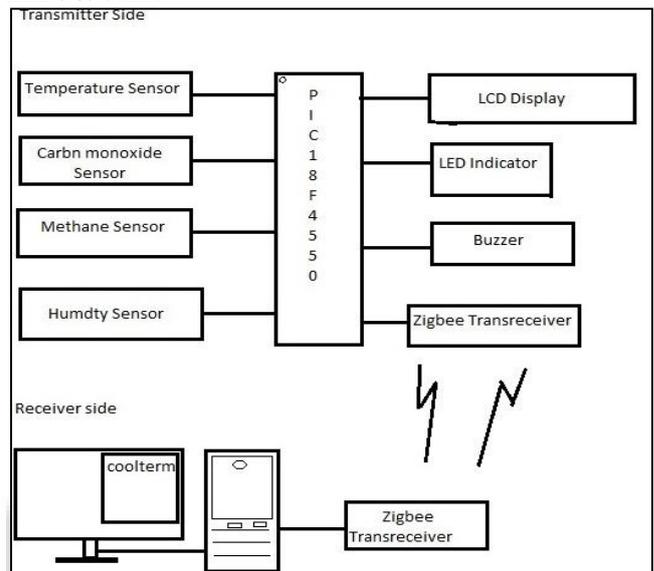


Fig. 1: Block diagram of system

All the transmitters are placed at the fixed distance. Zigbee is used as the router inside mine. The parameters inside the underground mines such as methane, carbon monoxide, temperature & humidity inside the mine are detected. The MQ2 sensor is used for methane detection, MQ7 is used for carbon monoxide, LM35 is used for temperature and HS220 is used for humidity detection. If any gas concentration or level of the sensor increases than the each sensor will check the value of itself .Then it will inform the microcontroller. Microcontroller is pre-programmed & has own decision taking commands. It will display the values on the LCD and it decodes the values and will blow respective LED and buzzer. The danger zone for the workers will informed by the buzzer to get out from the workers from that place and the message will be send to the control section/room through the zigbee.

The receiver section consists of the PC, Zigbee module and RS232 cable or USB cable.The microcontroller data is transmitted through the zigbee module and received at the receiver section. Continuous readings are displayed on the monitor in control room. Here the microcontroller used is PIC18F4550with operating frequency of the 12 MHz. It consists of 4 I/O ports, two 10 bit ADCs, a UART, etc. The sensors are connected to ADC pins as LM35 to ADC0 pin, CO to ADC1 pin, CH₄ to ADC2 pin and HS220 to ADC3 pin. Output will be displayed on LCD connected to port C and danger alert is indicated by respective LEDs and buzzer connected to RB0, RB1, RB2, RB3, RB4. Zigbee is interfaced using UART in API mode so that we can increase the detection range as much as possible. Zigbee connected to

PC acts as co-coordinator and all other acts as routers. Routers have destination address of co-coordinator zigbee so that they will communicate only with coordinator via other zigbee. All data transmitted from transmitter to receiver is packetized in a single frame consisting of start delimiter, length, frame type, frame ID, AT command, checksum and data. This data is combined in a frame and transmitted. In control room all this transmitted data is displayed on monitor using cool term software. It can show continues data reception and can store this data.

IV. UNDERGROUND COAL MINES WIRELESS NETWORK DESIGN

A. Zigbee Wireless Technology:

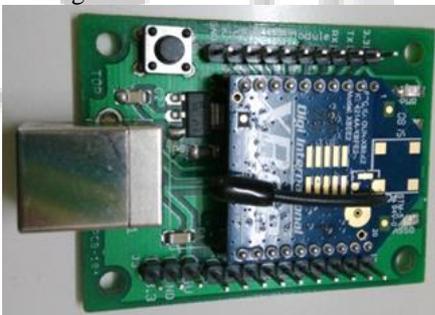
Zigbee is IEEE 802.15.4 standard wireless sensor network protocol. It works at 2.4 GHz in industrial sector, 915 in scientific and 868 MHz in medical frequency band. It has a low power, low cost, low maintenance monitoring and controlling system. We can use it in star, mesh, tree topologies. Zigbee transmission range is roughly 50 m. IEEE standard of zigbee has two different methods of operation:

- 1) Full Function Device (FFD)
- 2) Reduced Function Device (RFD)

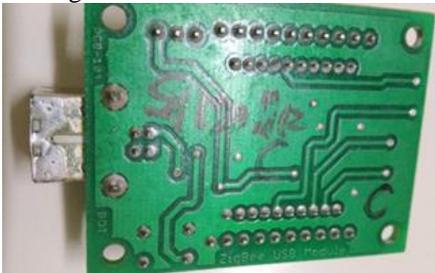
Both of them works in three different ways: Zigbee coordinator, Zigbee router and zigbee end device. Every router should have address of coordinator as destination address for data transmission on both sides. Zigbee can operate in two modes: AT mode and API mode. We are operating zigbee in API mode.

B. Zigbee Module:

Front view of Zigbee:



Back view of Zigbee:



V. LAYOUT OF ZIGBEE MODULE

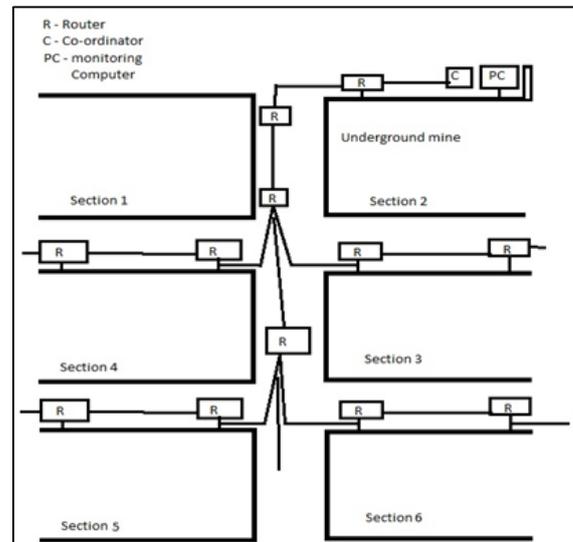
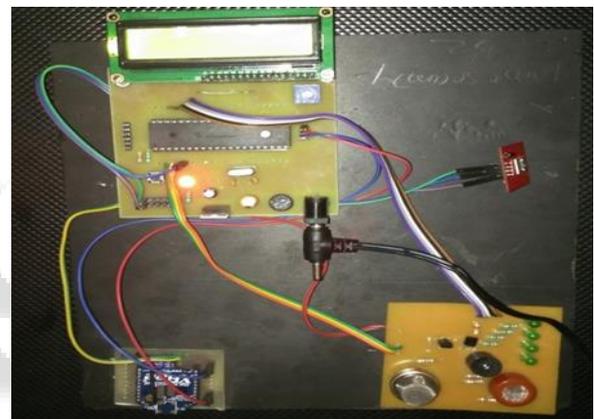


Fig. 1: Layout of Zigbee module

VI. HARDWARE USED



VII. Software USED

- 1) Proteus: For simulation of hardware.
- 2) Eagle: For schematic circuit design, PCB design and layout.
- 3) XCTU: It is a zigbee configuring unit software. We can configure zigbee module as coordinator and router in this software. The destination address and all other frames can be edited manually using XCTU software.
- 4) MPLABX_IDE: It provides a broad range of development tools like c compiler, macro assemblers, debuggers and simulators, IDE, the real-time operating systems and evaluation boards for 8051, PIC and ARM processors.
- 5) Coolterm: It is zigbee interfacing software used for displaying the data received by zigbee.

VIII. FUTURE SCOPE

- 1) The transmission of an image at the particular time can be achieved this system.
- 2) We can avoid railway, submarine accidents.
- 3) We can control any hazardous gas accidents like Bhopal Tragedy.

IX. CONCLUSION

This paper give us an idea about security and safety for underground mine. It is reliable, efficient, user friendly and faithful system. A larger area and more depth inside underground mines are covered and get protected from potential accidents. The traditional mine security system is replaced by safety system given in paper. The communication between the mine workers and monitoring section is done appropriately to check accurate and rapid action.

REFERENCES

- [1] Tanmoy Maity, Parth Sarathi Das and Mithun Mukherjee, "Rescue and Protection system for underground mine workers using Zigbee" Vol. 2 No. 2, Jun-Dec 2012.
- [2] Pranoti A. Salankar, Sheeja S. Suresh, "Zigbee based Underground mine parameters monitoring system for rescue and protection", Vol. No. 4, Issue No. 4, Ver. I, July-Aug 2014.
- [3] Cheng Qiang, Sun ji_ping, zhangzhe, zhang,"Zigbee based intelligent helmet for coal miners" CSIE2009.65, Feb 2009.

