International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 4, Issue 6, June-2018

Integrated Mine Safety Monitoring and Alerting System for Coal Mine

R.Rajasri[1], Y.S.V.Raman[2]

[1]*M.Tech, Dept. of ECE, Lakireddy Bali Reddy College of Engineering, ramanolla.rajasri@gmail.com*
[2]*Professor, Dept. of ECE, Lakireddy Bali Reddy College of Engineering,ramanysv@hotmail.com*

Abstract*— Recently, in coal mine accidents have caused huge economic losses. Performance of global mining industry increases operational efficiency and improve overall mining safety. This paper proposes coal mine safety monitoring and controlling system based on Zigbee wireless sensor network. The monitoring system collects temperature, humidity, fire, earth quake and methane values underground of coal mine through Zigbee sensor hubs around the mine and transmits the information to ARM. The transmitter section sends the data to the ground through Ethernet, and then monitoring centre monitors the data and sends through LAN for the remote users. Public can access through internet to acquire the information related to the coal mine. Coal mine safety system will monitoring and control automatically and the performance has also been measured and analysed. Proposed coal mine system can reduce the costs efficiently and control the hazard automatically.

***Index Terms*—Coal mine safety, control automation, sensors, monitoring.**

I. INTRODUCTION

The existing monitoring systems underground of coal mine mostly use cable network. This kind of network has poor performance of expansion. The cables are easy to aging and wear, and have high incidence of failures. With the working surface expanded, a blind area for monitoring appears, and then the new cost for installation and maintenance is needed. When an accident happened, especially explosion, the sensors and cables usually were damaged fatally, and couldn't provide information for rescue search and detection events. Wireless sensor network can solve the key issues of communication bandwidth, mobile data transmission, staff orientation, working surface real-time monitoring, synchronization monitoring and so on.

Monitoring system based on Zigbee technology to build wireless sensor network. The sensor network will send the collected data to an embedded network controller based on ARM kernel through multi-hop method. And then the controller receives the data and sends them to the ground PC by the conversion of Zigbee protocol to Ethernet protocol. With the concept of M2M (machine to machine, machine to mobile, mobile to machine), the ground PC transmits the monitoring results to the mobile phones through GPRS, and the abnormal situations can be dealt with in time. In addition, the mobile inquiring service can also be supported.

II. METHODOLOGY

Simulation with Proteus

1. Start the program by click the ISIS 7 Professional icon in Start Menu.

2. Designing the connections: For designing the schematic diagram of the robot it is necessary to know the components required while designing. All the components can be picked place from the component library. The connections between the components can be given using wire pencil.

To select the component s, click on Library then Pick Device/Symbol or just press “P”. So the components used in this design are:

- ARM 7 Micro Controller Board.
- Servo motor. (MOTOR-PWM)
- Capacitor. (CAP)
- Crystal oscillator. (CRYSTAL)
- DC Motors(L293D)
- Power source.
- Grounding.

The selected component can be located on the left side window of the design diagram. To put the component to the design sheet, just left click the component and put it to the sheet. To move the components, simply right click on the component (the component will be red-lighted), and left click and drag the component to the desired location. For power terminal and ground, the component is NOT selected from the library. Select the "inter-sheet terminal" icon at the left-side toolbar. Select POWER for your Vcc and GROUND as ground. Each component need to be set according to the specifications. For example the servo motor or capacitor value

Need to define before any simulation can be done. To edit the component, select the component (right-click) and left-click to open the Edit Component dialog. The dialog is different according to the devices. Set the value of minimum and maximum angles in the box.

Sensor networks have been proposed for various applications due to its ability for monitoring and detecting a possible hazardous event in underground mines such as fire, flammable, explosive, toxic gas

Compared with the current wireless technology, Zigbee is to the ground through Ethernet, and then the monitoring centre more suitable for data collection. Zigbee is a new wireless network technology with short range and low rate. It is a technology between labeling technology and Bluetooth, and the cost is much lower than Bluetooth. It has its own standards. The sensors sent the data multi-hop method, and the communication efficiency is very high.

III. ARM LPC2148 SPECIFICATIONS

NXP's **ARM7**TDMI **LPC2148** MCU

Memory

512K Flash – Program Memory

32K+8K RAM – Data Memory

Clock

12MHz crystal for maximum (5xPLL = 60MHz CPU clock) | 32 KHz RTC crystal

On-Board Peripherals

- 8 Nos. Point LEDs
- 8 Nos. Digital Input(Slide Switch)
- 4x4 Matrix Keypad
- 2X16 Character LCD with back Light
- 4 Nos. 7-Segment Display (I2C)
- 2 Nos. Analog Input (Potentiometer)
- Temperature Sensor
- Fire Sensor
- Earth Quake Sensor
- Humidity sensor
- GAS sensor
- Stepper Motor Interface
- 2 Nos. of SPDT Relay
- RTC with Batter-Backup
- 2 Nos. UART(RS232)
- USB 2.0 device interface
- Buzzer (Alarm)
- PS/2 (keyboard interface)
- Digital/Analog Output
- Interrupts Study, Reset Button

Power

9-12V, AC/DC- Adaptors, Power form USB (+5V) (+3.3V, 800mA)

Compared with the current wireless technology, Zigbee is to the ground through Ethernet, and then the monitoring centre more suitable for data collection. Zigbee is a new wireless network technology with short range and low rate. It is a technology between labeling technology and Bluetooth, and the cost is much lower than Bluetooth. It has its own standards. The sensors sent the data multi-hop method, and the communication efficiency is very high.

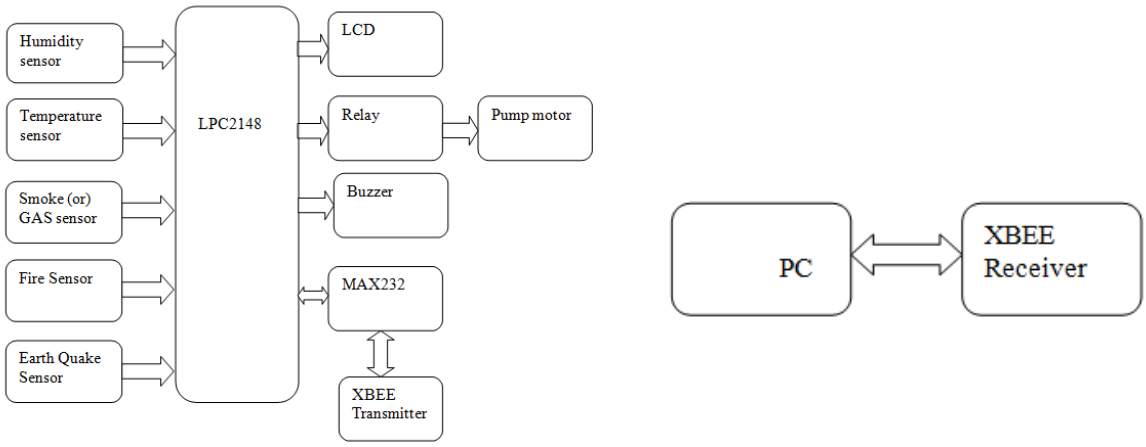

Fig.1: Architecture of Transmitter section and Receiver section

Description of the transmitter and receiver section:

The AC main Block is the power supply, which is of single-phase 230V ac. This should be give to step down transformer to reduce the 230V ac voltage to low voltage. i.e., to 6V or 12V ac this value depends on the transformer inner winding. The output of the transformer is give to the rectifier circuit.

This rectifier converts ac voltage to dc voltage. Nevertheless, the voltage may consist of ripples or harmonics. To avoid these ripples the output of the rectifier is connect to filter. The filter thus removes the harmonics. This is the exact dc voltage of the given specification. However, the circuit operates at 5V dc voltage. Therefore, we need a regulator to reduce the voltage. 7805 regulator produces 5V dc voltage. This 5V D.C voltage is give to the all blocks present in the block diagram. In this project we use LPC2148 microcontroller. This is the heart of this project. Sensors, Wi-Fi, LCD, GSM/GPRS modem, motor all are connected to this microcontroller.Here no. Of sensors are present

Temperature sensor - it is used for displaying environmental temperature value.

Humidity sensor - it is used for displaying the humidity values.

GAS sensor - it is used to detect the dangerous gases.

Fire Sensor - it is used to find the flame.

Earth Quake Sensor - it is used to detect the vibration/shake of the land.

it displays temperature, gases, humidity, fire.

1. Environmental temperature automatically measures the temperature sensor.
2. Humidity sensor is used to detect the moisture condition.
3. Gas sensor is used to identify the leakage dangerous gases.
4. Fire sensor is used to detect fire automatically.

IV. ZIGBEE TOPOLOGIES

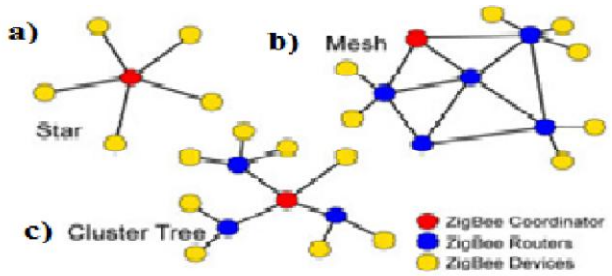

Fig 2: Zigbee topologies a) star topologies, b) mesh topologies, c)cluster tree topologies

In underground mines, wireless transmission attenuation is always influenced by various factors such as the corner, the damper, and the slope. Considering these factors, the locations of sensor node should be properly selected for the convenience of communication. Meanwhile, the layout density of nodes would be increased appropriately. However, too dense layoutDensity of nodes may lead to communication latency. Zigbee is a short- range and low-rate wireless network technology based on the IEEE 802.15.4 standard, which defines the network layer and the application layer in the protocol stack. The network comprises of a Zigbee coordinator and multiple Zigbee routers/end-devices, of which the former possesses the functions of initialization, maintenance and control and the latter (only the router) has a forwarding capability of sending the sensed data to a sink node. Zigbee network can support star, cluster-tree, and mesh topologies, but the transmission mechanism of different topologies is different. To be specific, multiple Zigbee end devices can be connected directly to the Zigbee coordinator in a star network, whereas communications must be conducted in a multi hop fashion through Zigbee routers in cluster tree and mesh networks.

Fig 3: Application of Zigbee technology

V. RESULTS

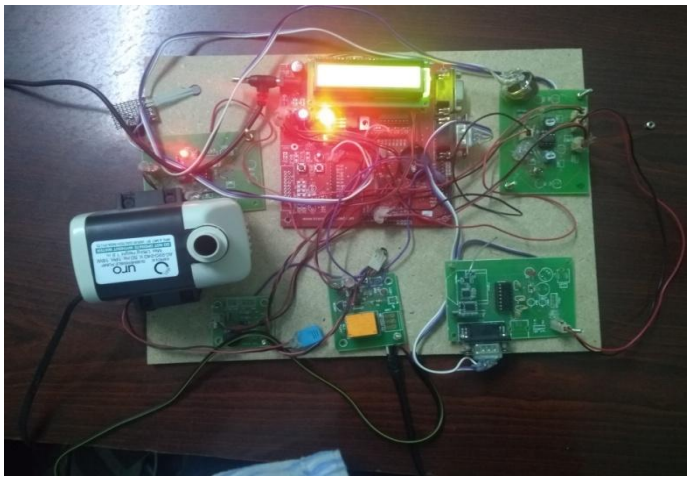

Fig 4: Kit diagram

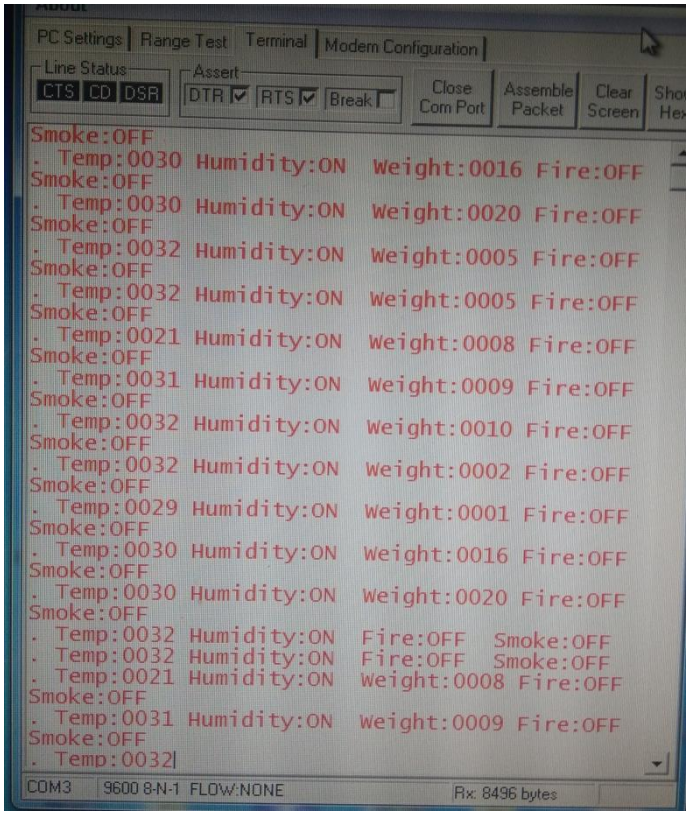

Fig 5: Software results

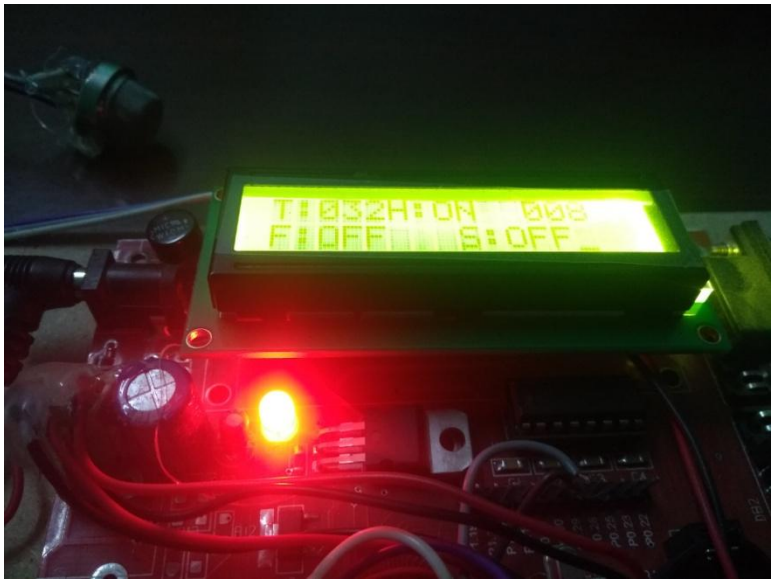

Fig 6: LCD display

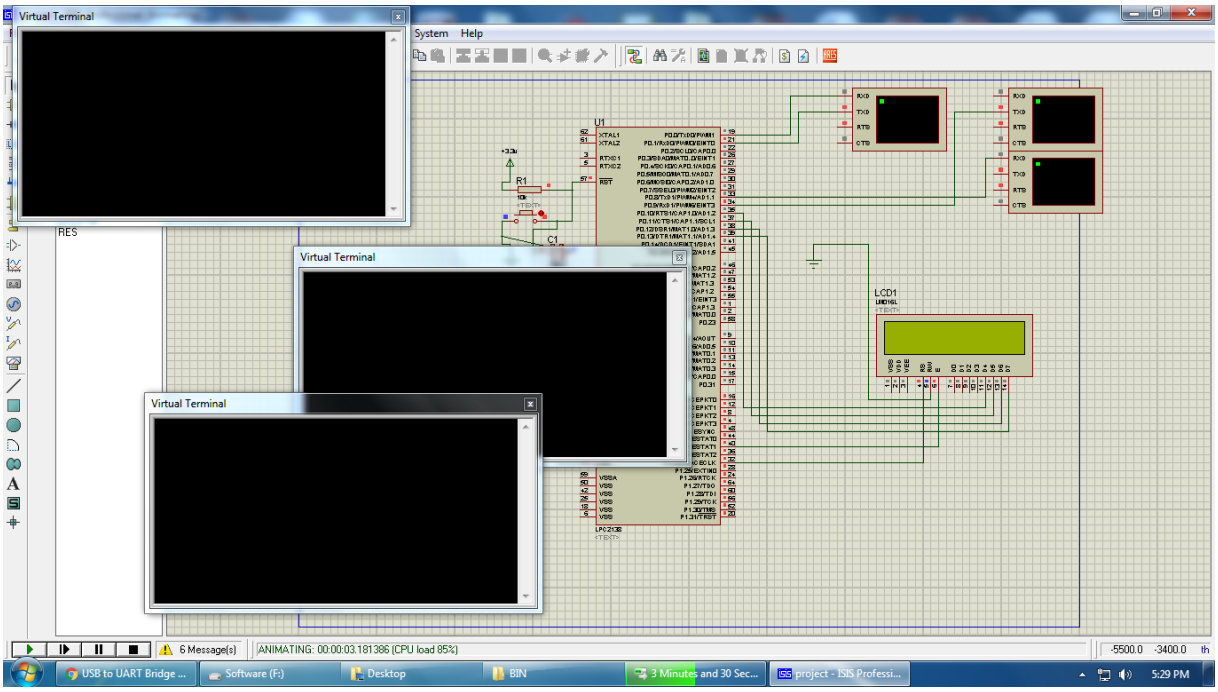

FIG 7: PROTEUS SOFTWARE RESULTS

VI. CONCLUSION

A complete mine safety system is compact and modular, with a combination of mechanical hardware, electronic hardware and specific software. Proposed system can measure characteristics inside the mine environment which communicate them between two nodes using the ZigBee communication protocol. Proposed system monitors coal mine safety and control visualization based on the design and implementation for underground ZigBee wireless sensor network which automatically controls the environment hazard.

VII. REFERENCES

[1] R. Tuchinda, C.-A. Knoblock, and P. Szekely, "Building mashups by example tuchinda," ACM Trans. Web, vol. 5, no. 3, pp. 1–45, 2011.

[2] Z. Yang, F. Yushun, H. Keman, T. Wei, and Z. Jia, "Time-aware service recommendation for mashup creation in an evolving service ecosystem," in Proc. IEEE Int. Conf. Web Serv. (ICWS), 2014, pp.25–32.

[3] D. Benslimane, S. Dustdar, and A. Sheth, "Services mashups: The new generation of web applications," IEEE Internet Comput., vol. 12, no. 5, pp. 13–15, Sep.–Oct. 2008.

[4] E. Maximilien, A. Ranabahu, and K. Gomadam, "An online platform for web APIs and service mashups," IEEE Internet Comput., vol. 12, no. 5, pp. 32–43, Sep.–Oct. 2008.

[5] J. Cao, Z. Wen, and T. Wei, "Dynamic control of data streaming and processing in a virtualized environment," IEEE Trans. Autom. Sci. Eng., vol. 9, no. 2, pp. 365–376, Apr. 2012.

[6] A. Bozzon, M. Brambilla, F. M. Facca, and T. Carughu, "A conceptual modeling approach to business service mashup development," in Proc. IEEE Int. Conf. Web Serv., 2009, pp. 751–758.

[7] Z. Wentao and L. Suqing, "Analysis of coal mine safety monitoring data based on column-oriented database," in Proc. 2nd Int. Conf. Artif. Intell., 2011, pp. 1920–1922.

[8] W. An and M. Li, "The research of coal-mining control configuration software's real-time database," in Proc. 3rd Int. Symp. Comput. Sci. Comput. Technol., 2010, pp. 074–076.

[9] Y. Tang, "Pervasive high reliable monitor and alert system based on EDA," in Proc. Joint Conf. Pervasive Comput., 2009, pp. 257–262.

[10] B. Yang, "The research on service-oriented virtual environment visualization platform for coal mine," Adv. Mater. Res., vol. 271–273, pp. 303–307, 2011.

[11] J. C. Ralston, D. W. Hainsworth, R. J. McPhee, D. C. Reid, and C. O. Hargrave, "Application of signal processing technology for automatic underground coal mining machinery," in Proc. IEEE Int. Conf. Acoust., Speech, Signal Process., 2003, pp. 249–52.