

# A COAL MINE SAFETY SYSTEM USING WIRELESS SENSOR NETWORK

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## ABSTRACT

*The propose coal mine safety system using wireless sensor network replaces traditional coal mine safety which is wired system. This monitoring system is based on Wireless Sensor Network using ZIGBEE. So there is important development in coal mine safety production which is safe. Apart from this it is unsuitable to lay the cables which is costly and consumes more time. To solve this problem there is need to design and develop a Coal Mine Safety System using WSN. In this project there are two sections. The first section is underground section and second is ground section. In underground section the sensor senses the environmental parameters such a temperature, humidity, gas, vibration etc. This information is send to the controller. The controller output is then send to the ground section. For the communication between underground section and ground section we used WSN which is Zigbee. Ground section consists of server consisting of graphical user interface (GUI) which is created by NeatBeans platform using Java.*

**IndeTerms:** *Wireless sensor Network, Zigbee, LPC2148*

## I. INTRODUCTION

The existing monitoring systems underground of coal mine mostly use cable network and the use wireless sensor networks but can't provide the details of the number of personnel in the mines. 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. In this application, 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.

This article designs a monitoring system based on zigbee technology to build wireless sensor network. The sensor nodes in the underground section will send the collected data to an embedded network controller based on ARM kernel.

## DESIGN AND PROPOSAL FOR SYSTEM

In this project there are two sections. The first section is underground section and another section is ground section.

Under Ground Section

In the underground section, the parameters temperature, humidity and gas are measured by means of respective sensors and the output voltage measured by them is directly connected to the ADC of the ARM, 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. During a hazard this information will be useful to know whether there are any people remained inside the coalmine.

the received parameters are beyond the ultra limit, then a Buzzer will be ON, giving warning to the people. The parameters are displayed on the LCD screen and as well as transmitted to the Ground Section through the Zigbee Transceiver.

#### Ground Section

In the Ground Section, the Zigbee Transceiver receives the information and sends to the ARM controller. The LCD connected to the controller displays the information in the Ground Section. The controller is connected to the zigbee modem through RS232. The controller is connected to PC; the measured values are continuously displayed and stored in the PC for future use.

## **II.LITERATURE REVIEW**

The existing monitoring system underground of coalmine mostly use cable network. This kind of network has a poor performance of expansion. The cable are easy 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 a installation and maintenance is needed.

When an incident happened especially explosion, The sensors and cable visually were damage faulty and could not provide information for reuse search and detection event.

Wireless sensors network can solve the key issues of communication bandwidth. Mobile data transmission staff oriented, synchronization monitoring.

The application of wireless sensor network will improve the safety system. Hence we uses a wireless sensor network Which is having following advantages.

1. The wireless network are more flexible and can provide trouble of rewiring because wireless network can meet the moving and changing of topology.
2. It will be greatly improve the performance and efficient of data transmission of mine safety system and reduce the cost of extending the system.

### III. DESIGN OF PROPOSED HARDWARE SYSTEM

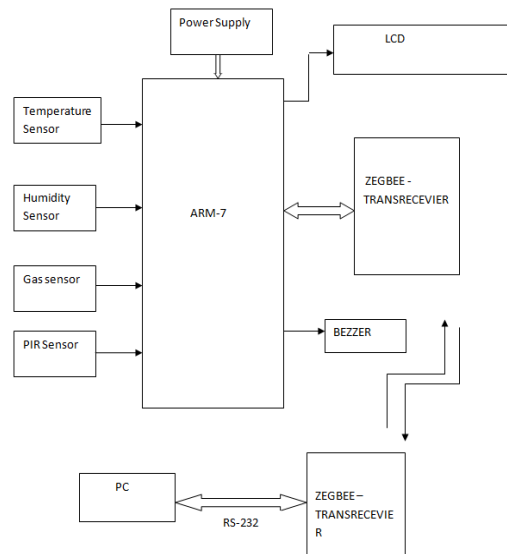


Fig1. BLOCK DIAGRAM

### IV. UNITS

The proposed system consists of two sections as a discussed earlier one is Underground Section and Ground Section. The block diagram of Underground section is shown above which consist of Sensor section consisting of Temperature sensor that is Thermistor, Humidity sensor, Gas Sensor, Vibration sensor. And Controller is also used for controlling purpose. It consists of Device driver and Zigbee transmitter. The Underground section consists of Zigbee Receiver, PC, camera attached to PC, and Android Phone. Brief description of each block is given below.

#### 1. Temperature sensor

In this system we used temperature sensor as a thermistor. The name thermistor is formed by thermal resistor which is a temperature sensitive resistor. This thermistor detects small change in temperature. The change in small change in temperature. The change in temperature is measured by change in resistance of the device. Here it may be noted NTC thermistor has a resistance of about  $10k\Omega$  and  $100k\Omega$  at  $50^{\circ}C$  to  $150^{\circ}C$ . It is connected to PIN no 13 that is p0.28

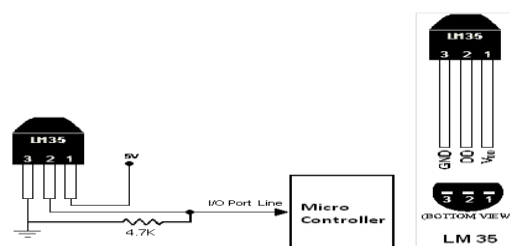


Fig2. LM35 Sensor

## 2. Humidity

The amount of water vapor is expressed in terms of humidity. Here we used SY-HS-220 humidity sensor. This module converts the relative humidity to the output voltage. In daily language humidity is normally taken to mean relative humidity. Relative humidity is defined as the ratio of partial pressure of water vapor to saturated vapor pressure as prescribed temperature. Humidity sensor is on pin no 15 that is P0.30.

## 3. Gas sensor

In hazardous environment, there are number of toxic gases are present which causes accident. In coal mines, methane, carbon monoxide are present. So for the detection of these gases MQ6 sensor is used in this project. This sensor has a fast response. It is a stable sensor and have a long life. It requires simple drive circuit. This sensor is used in gas leakage detection of equipments in industry and suitable for detection of LPG, iso-butane, propane, LNG. MQ6 is interfaced to the one pin of LPC 2148.

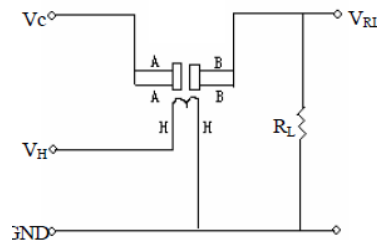


Fig3.basic test ckt of mq6

## 4. PIR Sensor

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors.

PIRs are basically made of a pyroelectric sensor (which you can see above as the round metal can with a rectangular crystal in the center), which can detect levels of infrared radiation.



Fig4. PIR SENSOR

## 5.ARM7

The ARM7 is part of the Advanced RISC Machines (ARM) family of general purpose 32-bit microprocessors, which offer very low power consumption and price for high performance devices. The architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are

much simpler in comparison with micro programmed Complex Instruction Set Computers. This results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective chip.

Features:-

16/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.

16 Kb/40 Kb of on-chip static RAM and 64 Kb/512Kb of on-chip flash program memory.

128-bit wide interface/accelerator enables high-speed 60 MHz operation.

In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot-loader software. Single flash sector or full chip erase in 400 ms and programming of 256 bytes in 1 ms .

Embedded ICE RT and Embedded Trace interfaces offer real-time debugging with the on-chip Real Monitor software and high-speed tracing of instruction execution

## 6.ZigBee

The XBee family of ZigBee/802.15.4 RF modules is the premiere choice for OEMs looking for excellent wireless performance in a cost-effective, small form factor solution. Each XBee module comes in either a regular or long-range “-PRO” version\*. All XBee modules are pin-for-pin compatible with the exception of a few varying I/O features, which provides a standard.

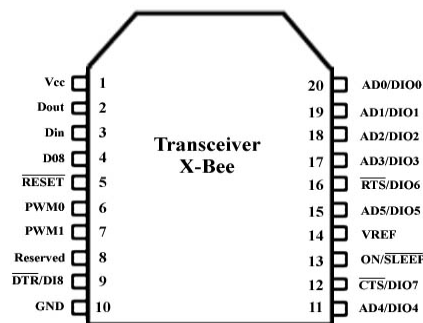


Fig5.zigbee pin diagram

Zigbee is a new wireless technology guided by the IEEE 802.15.4 Personnel Area Networks Standard. It is primarily designed for wide ranging automation applications. It currently operates in 868 MHz band at a data rate of 20kbps in Europe, 914 MHz band at 40Kbps in USA and 2.4Ghz ISM band worldwide at a maximum data rate of 250kbps. The Zigbee specification operates in 2.4 GHz radio band- the same band as 802.11b standard, Bluetooth, microwave & some other devices. It is capable of connecting 255 devices Range of transceiver is 30-70m in urban areas and 1 to 1.5km in outdoor i.e line of sight. The transceiver has an on-chip antenna & it operates t a frequency of 2.4 GHz Zigbee technology is slower than 802.11b but it consumes significantly low power.

## 7. Buzzer

Whenever the toxic gases , temperature, humidity and vibration crosses its threshold level then buzzers ON for giving warning to the people alerting the people present in coal mines.

## 8. Power supply

In this we used Arm as controller which require 3.3VPower supply. So the 230V ac is fed to the step-down transformer output of this is given to the bridge rectifier. The output is given to the filter capacitor. The

capacitor used here is 1000uf capacitor. The output of this filter is then applied to the regulator. Here we used LM7812 and LM7805. For other modules power is regulated by variable regulated supply.

## V. SOFTWARE DESIGN

The software platform used for software designing is as follows-

A. Keil microvision 4

B. Flash program utility

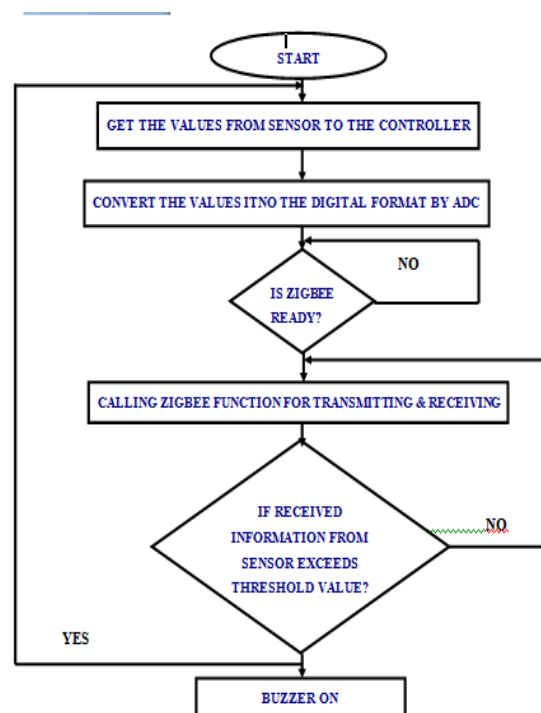
A. Keil microvision 4

Window based software development platform is microvision 4. It consist of robust and modern editor with project manager and make facility tool. For developing embedded applications it consist of different tools such as C/C++ compiler, assembler, Linker locator, Hex file generator. Microvision 4 provides Integrated Development environment for the development process of embedded applications. Keil can be used to create sources file automatically compile, link and convert using option set with an easy to use user interface. And finally simulate or perform the debugging on the hardware with the access to C variables and memory. KIEL Greatly simplifies the process of creating and testing an embedded applications.

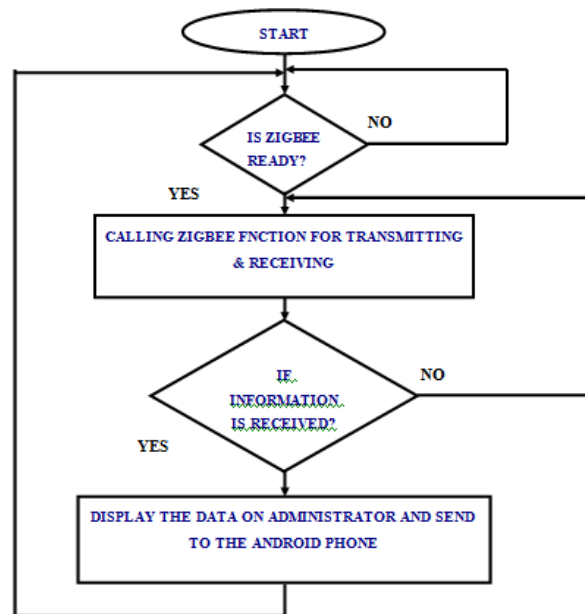
B. Flash program utility

For downloading the application program into ROM Flash program utility tool is necessary. The program code generated in C language after processing produces object code in hex form. It is referred as . hex file. To burn this hex code in the Flash ROM of the controller the facility is provided with Kiel microvisison 4.

## VI. DESIGN FLOW



Flowchart 1 for Underground section



FLOW-CHART 2 FOR GROUND SECTION

## APPLICATION

Using wireless sensor network it is possible a safety issue could monitor such as temp, humidity.

Wireless sensor network can solve the key issues of communication bandwidth working surface real-time monitoring,

The application of wireless sensor network can realize the real-time monitoring of working region.

## VII. RESULT & CONCLUSION

1. Result for Normal conditions from underground section .

I. SR.NO	II. NAME OF SENSOR	III. HARDWARE CHANGES	IV. REMARK
V. 1.	VI. TEMPERATURE	VII. BUZZER OFF	VIII. IN SAFE CONDITION
IX. 2.	X. GAS	XI. BUZZER OFF	XII. IN SAFE CONDITION
XIII. 3.	XIV. HUMIDITY	XV. BUZZER	XVI. IN SAFE

		OFF	CONDITION
XVII. 4.	XVIII. PIR	XIX. BUZZER OFF	XX. IN SAFE CONDITION

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