

Intelligent Helmet For Coal Miners Safety Using Wireless Communication

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Abstract-The communication network in coal mine underground is the foundation of colliery distributed monitoring system and plays an important role in transferring information when the production is in gear and events happens in coal mine underground. They brings forward a new project of the distributed monitoring system in coal mine based on wireless sensing network. This paper highlights the gains and weaknesses of wireless sensor network technology and address an economical, continuous monitoring system of covered mine worker security. The actual application shows that the zigbee technology can play an important role in underground personal information and security management. This paper has proposed a wireless sensor network based wireless monitoring method for coal mine. We introduced a two leveled network architecture for the WSN.

Keywords-ZigBee,, wireless network.

I. INTRODUCTION

In the global economy mining industry plays a vital role in national economy. In large amount of energy source is a coal. Since the 1880's coal is valued for its energy content, has been widely used for electricity generation. The safety is the most crucial part in coal mines. The monitoring of perilous environmental parameters and toxic gases are important for production because of coal mines are in underground. In our country the situation of safe production of coal mine is very serious.

To elevate security, safety and authenticity in underground mines, an adequate communication system must be inaugurate between workers moving in the mine, and a fixed base station on the earth. In order to ensure ore safety and realization between miners the improvement of mining helmet was done. Presently the mining helmet only protect the miners head against inherent perilous situations, miners generally does not remove helmets, therefore the purpose of the overview to modify the extant helmet to increase the safety by using WSN network. Due to the ability for supervising and identifying the perilous event in underground mines such as fire flammable, toxic gases, temperature, humidity the sensor network has been proposed.

The miners and control station must be communicate

through the communication system. The zigbee is used for wireless data transmission because of wire network is become composite for underground mining areas. Zigbee is used to provide near field and low power wireless communication technology. It is suitable for automatic control areas.

II. TECHNOLOGIES DESCRIPTION

1.1 Zigbee



ZigBee is one of the universal idea of communication protocol work out by the powerful task violence under the IEEE 802.15 working group. The fourth in the list, WPAN Low Rate/ZigBee is the recent and provides stipulation for devices that have low data rates employ very low power and are thus described by long battery life. Other specifications like Bluetooth and IrDA address high data rate utilizations such as voice, video and LAN communications.

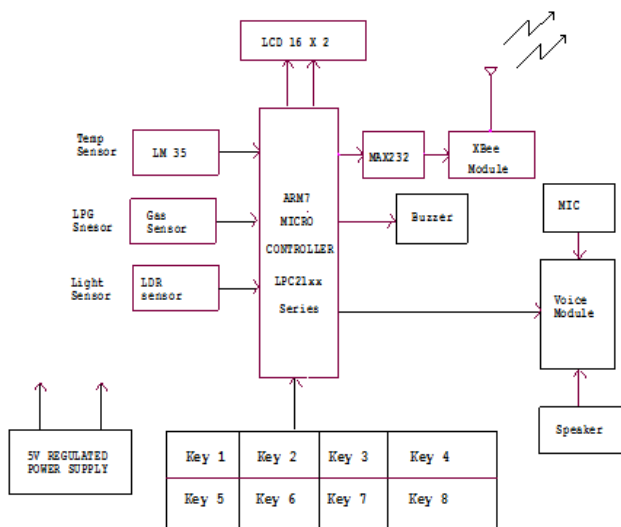
Its low power utilization restricts transmission distances to 10–100 meters line-of-sight, depending on power output and coincidental characteristics. ZigBee devices can transmit message over long distances by fleeting data through a mesh network of central devices to grasp more distant ones. ZigBee is commonly used in low data rate applications that require long battery life and protected networking (ZigBee networks are protected by 128 bit balanced encryption skeleton.) ZigBee has a characterize rate of 250 kbit/s, best fitted for periodic data communication from a sensor or input device.

Characteristics of zigbee:

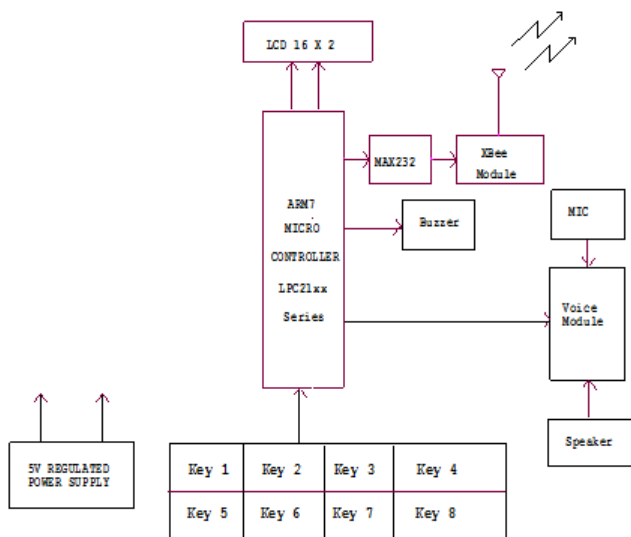
- 1) High throughput and low latency for low duty-cycle applications (<0.1%)
- 2) Channel access using Carrier Sense Multiple Access with Collision Avoidance (CSMA - CA)
- 3) Addressing space of up to 64 bit IEEE address devices, 65,535 networks
- 4) 50m typical range
- 5) Fully reliable “hand-shaked” data transfer protocol.

III. BLOCK DIAGRAM

Block Diagram For Transmitter Side



Block Diagram For Receiver Side



3.1 Block Diagram Explanation:

Transmitter Side

Above figure shows the block diagram of transmitter side which consists ARM7 microcontroller LPC 21XX series, Zigbee transmitter, Temperature sensor, LPG sensor, Light sensor, keypad, voice module and LCD. In this system sensors are used for monitoring of environmental parameters like temperature, gas and light intensity. Sensors has the analog output. This output is given to the ARM7 microcontroller. The microcontroller has inbuilt a ADC that converts the analog value coming from sensor will convert into digital form and display the output on LCD, this data will be send through zigbee transmitter to the control room. At transmitter section the minor will alert through buzzer, this section also consist the keypad and voice module that has pre-recorded messages that will send through the miners to the control section.

Receiver Side

The zigbee receiver will receive the output from zigbee transmitter then control section can identify the problem that occure in coal mine. LCD will display the sense parameter in coal mine and buzzer gets on for indication. Through voice module control section receives the voice message from coal miners and is used to give the reply to the miners. Microcontroller is works as same as transmitter section.

Hardware Details:

ARM7:

LPC2148 is the widely used IC from ARM-7 family. It is manufactured by Philips and it is pre-loaded with many inbuilt peripherals making it more efficient and a reliable option for the beginners as well as high end application developer.

Features of LPC2148:

- 1) 8 to 40 KB of on-chip static RAM and 32 to 512 KB of on-chip flash program memory.128 bit wide interface/accelerator enables high speed 60 MHz operation.
- 2) In-System/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 1ms.
- 3) 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.

- 4) USB 2.0 Full Speed compliant Device Controller with 2 KB of endpoint RAM. In addition, the LPC2146/8 provides 8 KB of on-chip RAM accessible to USB by DMA.
 - 5) One or two (**LPC2141/2 vs. LPC2144/6/8**) 10-bit A/D converters provide a total of 6/14 analog inputs, with conversion times as low as 2.44 us per channel.
 - 6) Single 10-bit D/A converter provides variable analog output.
 - 7) Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.
 - 8) Low power real-time clock with independent power and dedicated 32 kHz clock input.
 - 9) Multiple serial interfaces including two UARTs (16C550), two Fast I2C-bus (400 kbit/s), SPI and SSP with buffering and variable data length capabilities.
 - 10) Vectored interrupt controller with configurable priorities and vector addresses.
 - 11) Up to 45 of 5 V tolerant fast general purpose I/O pins in a tiny LQFP64 package.
 - 12) Up to nine edge or level sensitive external interrupt pins available.
 - 13) On-chip integrated oscillator operates with an external crystal in range from 1 MHz to 30 MHz and with an external oscillator up to 50 MHz.
 - 14) Power saving modes include Idle and Power-down.
 - 15) Individual enable/disable of peripheral functions as well as peripheral clock scaling for additional power optimization.
 - 16) Processor wake-up from Power-down mode via external interrupt, USB, Brown-Out Detect (BOD) or Real-Time Clock (RTC).
- 11 minutes of recording duration selectable in total 1,2,4,8 segments
 - Single chip, high quality voice recording and playback solution
 - User friendly, easy to use operation
 - Non - Volatile - flash memory technology, no battery backup required
 - Audio output to drive a speaker or audio out for public address system
 - Can record voice with the help of on-board microphone or via any audio input like PC

LCD

This is the display part of our system. All the changes or the required action needs to be taken will flash on this LCD. This LCD is of 16*2 configurations. That means they are having 16 columns and 2 rows. Each row and each column can be individually programmed to display the characters with the help of Microcontroller.



This is the pin diagram of a 16×2 Character LCD display. As in all devices it also has two inputs to give power Vcc and GND. Voltage at VEE determines the Contrast of the display. A 10K potentiometer whose fixed ends are connected to Vcc, GND and variable end is connected to VEE can be used to adjust contrast. A micro-controller needs to send two information to operate this LCD module, Data and Commands. Data represents the ASCII value (8 bits) of the character to be displayed and Command determines the other operations of LCD such as position to be displayed. Data and Commands are send through the same data lines, which are multiplexed using the RS (Register Select) input of LCD. When it is HIGH, LCD takes it as data to be displayed and when it is LOW, LCD takes it as a command. Data Strobe is given using E (Enable) input of the LCD. When the E (Enable) is HIGH, LCD takes it as valid data or command. The input signal R/W (Read or Write) determines whether data is written to or read from the LCD. In normal cases we need only

Voice Module:

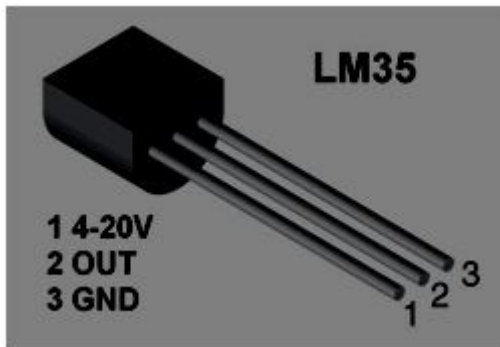
Based on APR33A3 IC, Upto Eight channels of recording. Offers true solid state storage capability and requires no software or microcontroller support. It provides high quality recording and playback with **11 minutes** audio at 8 Khz Sampling rate with 16 bit resolution. Using on board jumpers, total duration can be divided in individual triggers of 1,2,4 & 8 segments which can be triggered by onboard switches or external low trigger like microcontroller pins.

Features

writing hence it is tied to GROUND in circuits shown below.

The interface between this LCD and Micro-controller can be 8 bit or 4 bit and the difference between them is in how the data or commands are sent to LCD. In the 8 bit mode, 8 bit data and commands are sent through the data lines DB0 – DB7 and data strobe is given through E input of the LCD. But 4 bit mode uses only 4 data lines. In this 8 bit data and commands are splitted into 2 parts (4 bits each) and are sent sequentially through data lines DB4 – DB7 with its own data strobe through E input. The idea of 4 bit communication is introduced to save pins of a micro-controller. You may think that 4 bit mode will be slower than 8 bit. But the speed difference is only minimal. As LCDs are slow speed devices, the tiny speed difference between these modes is not significant. Just remember that micro-controller is operating at high speed in the range of MHz and we are viewing LCD with our eyes. Due to Persistence of Vision of our eyes we will not even feel the speed difference.

LM 35



An example for a temperature sensor is LM35. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius temperature. The LM35 operates at -55° to $+120^{\circ}\text{C}$. The basic centigrade temperature sensor ($+2^{\circ}\text{C}$ to $+150^{\circ}\text{C}$) is shown in figure below.

It has an output voltage that is proportional to the Celsius temperature. The scale factor is $.01\text{V}/^{\circ}\text{C}$. The LM35 does not require any external calibration or trimming and maintains an accuracy of $\pm 0.4^{\circ}\text{C}$ at room temperature and $\pm 0.8^{\circ}\text{C}$ over a range of 0°C to $+100^{\circ}\text{C}$. Another important characteristic of the LM35DZ is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1°C temperature rise in still air.

LPG gas sensor



Features:

1. high sensitivity to LPG, iso-butane ,propane
2. small sensitivity to alcohol and smoke
3. fast response
4. stable and long life
5. simple drive circuit

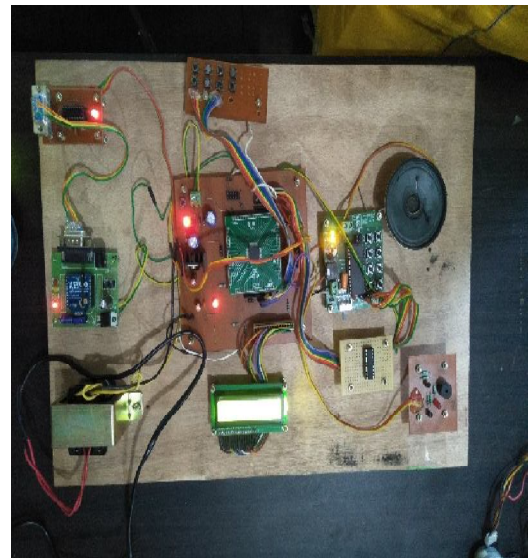
IV. ADVANTAGES

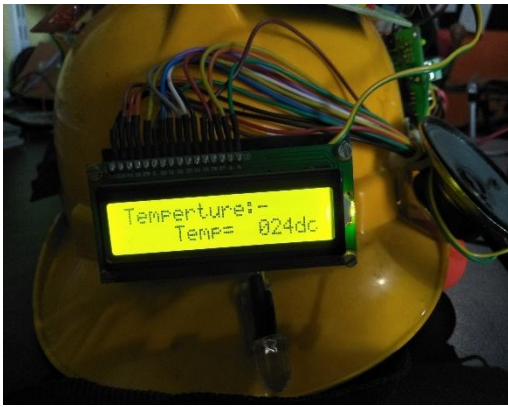
- 1) System will help to monitor the mine status
- 2) System will reduce the accident
- 3) System will help to improve work

V. APPLICATIONS

1. It is used in coal mine.
2. It can be used in industries where gas licking is happens

VI. RESULTS





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