Design and Simulation of Smart Helmet for Coal Miners using Zigbee Technology

Hem Chandra Joshi and Satyajit Das
Department of Electronics and Communication,
Amrapali Institute of Technology and Sciences, Haldwani, (Uttarakhand), India.

ABSTRACT: The basic object of this paper is to design and Simulation of smart helmet for coal miners using zigbee technology. The primary objective of this thesis is making use of smart helmet, management of accident events can be a real-time monitoring system. This system utilizes zigbee and sensor technology to connect to the server to transfer the specific data to the data centre In this paper we are going to use zig-bee technology and three sensors like temperature , humidity and gas sensor. Three sensors will observe the change in environment parameters and they will give the information to micro controller .Then micro controller will Verify this values up to date, if any of the value exceeds than rated, it will alert to person through the buzzer. This information is passed to the base station through the zig -bee module. Then the department at the base station will take saftey precautions to safe the persons who are working in the coal mining.

I. INTRODUCTION

The persons who are working in the coal mining has to face various environmental parameters in their mining. They have the danger from the methane, carbon monoxide, and temperature. So we need to provide a strong security for the people who are working in the coal mining. The purpose of this project is to provide a solution to mining by wireless communication and safety monitoring. The person must use the helmet while working in the coal mining. Here we have to arrange our total circuit within the kit to provide safety to the person who is working in coal mining.In recent days coal mining has been very dangerous activity that can result in a number of adverse effects on the environment for example during mining operations methane, a known greenhouse gas, may be released into the air. Underground mining hazards include suffocation, gas poisoning, roof collapse and gas explosions. Keeping all these aspects in mind we designed a system, i.e. smart helmet using zigbee technology for monitoring the hazardous gases, abnormal temperature conditions and the humidity levels in the air. The improved safety features in our system dramatically increased life expectancy of the coal miners by alerting them about the hazards. In our system, the helmet is having the circuit with three sensors i.e. temperature, humidity and gas to monitor the conditions in coal mine. 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 active which is positioned in the helmet so that a miner can have a chance to rescue his life from the hazards occurred in coal mines (1,3).
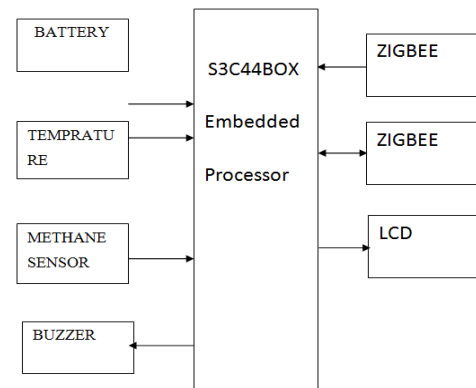
Principle of working

Fig. 1.

As shown in Fig. 1, intelligent wireless helmet is composed of embedded processors (S3C44B0X)**,** Zigbee communication module (CC2420), sensor modules(humidity sensor Sensor methane sensor, temperature sensor), LCD, battery.
S3C44B0X processor circuit is the core of system which collects temperature, humidity, and gas

concentration signals and the calculated data is transmitted to control centre using Zigbee module. (1).

Description of hardware module for design and Simulation of smart helmet for coal miners using zigbee technology

5V DC Supply given from the Battery for The Micro controller and LCD.Three sensors (temperature, humidity ,gas sensor are sensing the environment continuously. This gives output in analog form where ADC convert it into digital, that will be given to micro controller. The micro controller verify this values , if any parameter exceeds then it will alert the buzzer. The Resultant Information is passed to the control unit through the zibbee. The corresponding action takes place there only.

II. CIRCUIT COMPONENTS

S3C44B0X MICROPROCESSOR

SAMSUNG's S3C44B0X 16/32-bit RISC microprocessor is designed to provide a cost-effective and high performance micro-controller solution for hand-held devices and general applications. To reduce total system cost, S3C44B0X also provides the following: 8KB cache, optional internal SRAM, LCD controller, 2-channel UART with handshake, 4-channel DMA, System manager (chip select logic, FP/ EDO/SDRAM controller), 5-channel timers with PWM, I/O ports, RTC, 8-channel 10-bit ADC, IIC-BUS interface, IIS-BUS interface, Sync. SIO interface and PLL for clock

FEATURES

2.5V Static ARM7TDMI CPU core with 8KB cache . (SAMBA II bus architecture up to 66MHz)

External memory controller. (FP/EDO/SDRAM Control, Chip Select logic)

LCD controller (up to 256 color DSTN) with 1-ch LCD-dedicated DMA

2-ch general DMAs / 2-ch peripheral DMAs with external request pins

2-ch UART with handshake(IrDA1.0, 16-byte FIFO) / 1-ch SIO

1-ch multi-master IIC-BUS controller

1-ch IIS-BUS controller

5-ch PWM timers & 1-ch internal timer

Watch Dog Timer

71 general purpose I/O ports / 8-ch external interrupt source

Power control: Normal, Slow, Idle, and Stop mode

8-ch 10-bit ADC.

RTC with calendar function.

On-chip clock generator with PLL.

III. ZIGBEE MODULE

Zigbee is a low power spin off of wife. It is a specification for small, low power radio based on IEEE 802.15.4. It is a wireless protocol designed for small, low power device like sensors for data communication.The standard specifies the lower protocol layers—the physical layer (PHY), and the medium access control (MAC) portion of the data link layer (DLL). This standard specifies operation in the unlicensed 2.4 GHz, 915 MHz and 868 MHz ISM bands. In the 2.4 GHz band there are 16 Zigbee channels, with each channel requiring 5 MHz of bandwidth (1) (2) (3).
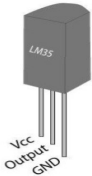

Zigbee S2

LCD. These are less in priceThey consumes less power. A seven segment display requires 140W.Operating voltage is 3-20V.Life time is limited to 50,000 hours.It has 10 I/O lines.This LCD consist of two glass plates each coated with the tin oxide, inside with transparent electrodes separated by a liquid crystal layer of 5um.
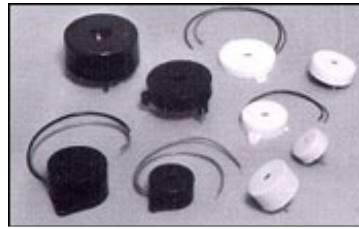
TEMPERATURE SENSOR. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1/4°C at room temperature and ±3/4°C over a full -55 to +150°C temperature range. (5)
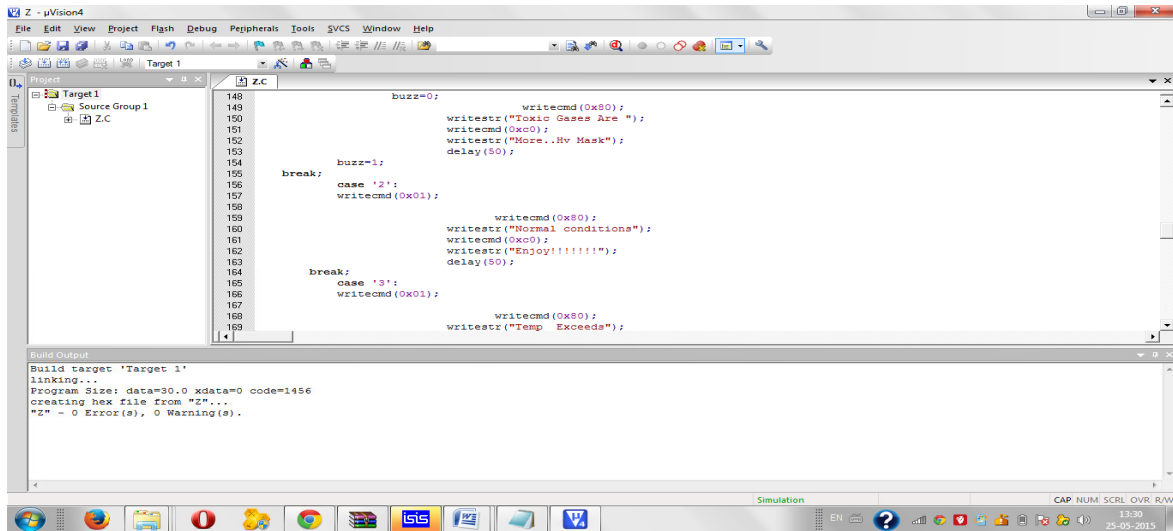

BUZZER. Buzzer is a signaling device, usually electronic, typically used in automobiles. It mostly consist of a number of switches or sensors connected to a control unit. These buzzers are offered in lightweight compact sizes from the smallest diameter of 12mm to large Pezos electric sounders. Today, piezoelectric sound components are used in many ways such as home appliances, OA equipment, audio equipment telephones, etc. types of Buzzers as shown.

Description of software for Design and simulation of smart helmet for Coal miners using zigbee technology

KEIL μVISION4 IDE. The μVision4 IDE is a Windows-based software development platform that combines a robust editor, project manager, and makes facility. μVision4 integrates all tools including the C compiler, large-scale assembler, linker/locator, & HEX file creator (6, 7).
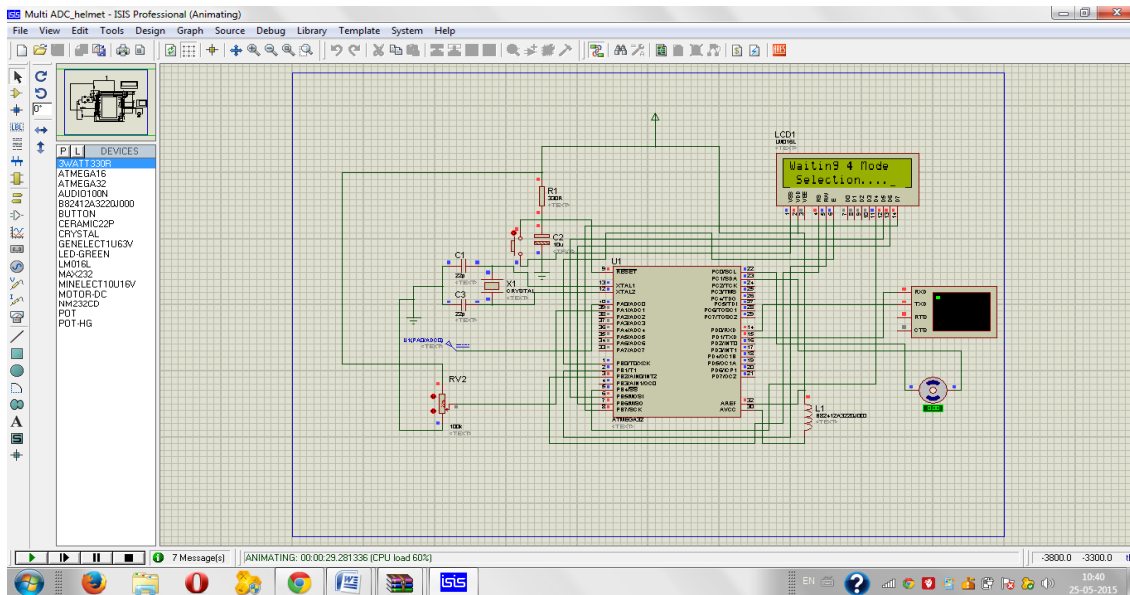

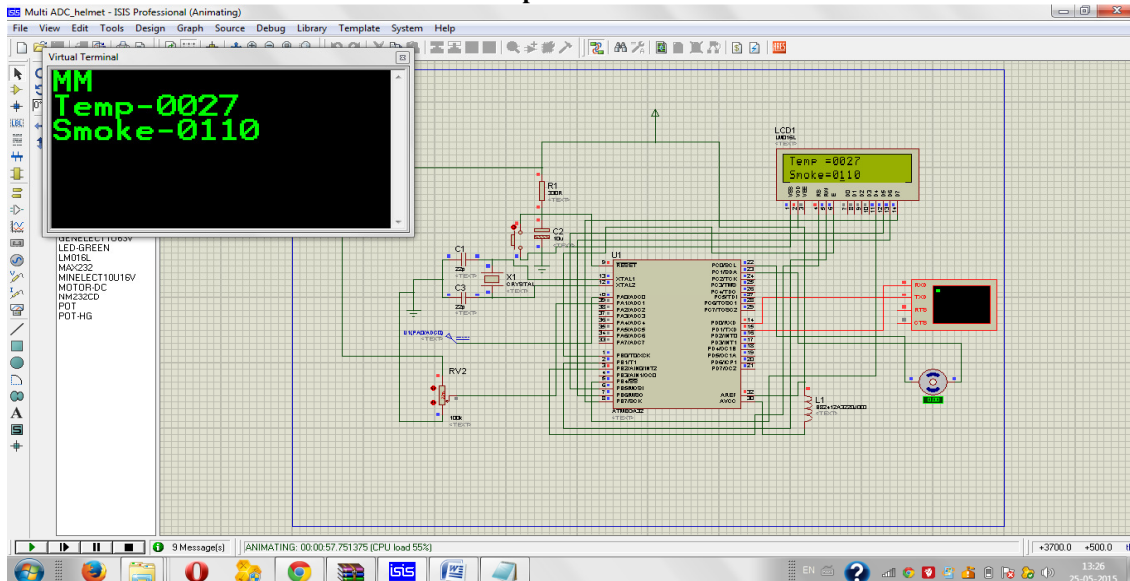**Snapshot of Proteus KEIL μVISION4 IDE**

PROTEUS. Proteus is a best simulation software develop by Lab center for various designs with microcontroller. It is mainly popular because of availability of almost all microcontrollers and interfacing device such as on screen indicator LED and LCD display, motor and actuator such as switch & button etc in it. So it is a handy tool to test programs and embedded designs for electronics hobbyist. You can simulate your programming of microcontroller in Proteus 8 Simulation Software.

After Simulating your circuit in Proteus Software you can directly make PCB design with it so it could be a all in one package for students and hobbyists (8).

Snapshot of Proteus

Snapshot of Proteus with message

III. ADVANTAGES AND APPLICATIONS

ADVANTAGES

-Safety monitoring of the environment.
-Improved Services in coal mining .
-Providing Wireless connection security
-Faster Checked Out/In
-Prevent from the high temperature, humidity and harmful gases
-Quick Searching and can able to give the warning.
-Cost Avoidance.

APPLICATIONS

(i) Can be applied to the persons who are working in the underground.
(ii) Can be applied at any weather Conditions.

IV. CONCLUSION

The working person of coal mines has to face various environmental parameters in their work place. They have the danger from methane, carbon monoxide and temperature. So the above project provide a strong security for the people who are working in the coal mining the purpose of this paper is to provide a solution to mining a wireless communication and safety monitoring .Here we have to arrange our total circuit within the kit to provide safety to the person who is working in coal mining.

It is a new wireless technology guided by IEEE 802.15.40 it is currently operates 2.4 GHZ in worldwide at a maximum data rate up to 250 kbps. The major advantages are provide noise free communication, low power consumption battery life ranging from month to years and applicable for up to thirty feet distance

Joshi and Das   **199**

REFERENCES

[1]. Kiran Kishore et al "Smart Helmet For Coal Miners Using Zigbee Technology" I*nternational Journal for Research in Science & Advanced Technologies* Issue-2, Volume-**2**, 067-069

[2]. A. Geetha "Intelligent Helmet for Coal Miners with Voice over Zigbee and Environmental Monitoring" *Middle-East Journal of Scientific Research* **20** (7): 825-827, 2014 ISSN 1990-9233- 2014

[3]. Monika Prasad et al "Safety Helmets For Coal Miners Using Zigbee Technology*" IJREAT International Journal of Research in Engineering & Advanced Technology,* Volume **3**, Issue 2, April-May, 2015

[4]. S. Jayabratha et al "Wearable Real Time Health and Security Monitoring Scheme for Coal mine Workers" *International Journal on Recent and Innovation Trends in Computing and Communication* ISSN: 2321-8169 Volume: **3** Issue: 3

[5]. G. Ahalya et al "Development Of Coal Mine Safety System Using Wireless Sensor Networks"[IJESAT] [*International Journal of Engineering Science & Advanced Technology*] Volume-**3**, Issue-3, 74-78 ISSN: 2250-3676

[6]. Shirish Gaidhane et al "Smart Helmet for Coal Miners using Zigbee Technology" *Imperial Journal of Interdisciplinary Research (IJIR)* Vol. **2**, Issue-6, 2016ISSN: 2454-1362.

[7]. http://www.keil.com/dd/docs/datashts/philips/p89v51rd2.pdf

[8]. http://www.keil.com/uvision/uv4.asp

[9]. http://www.labcenter.com

[10]. http://www.cisium.com/portfolio/technologies/processors/118-samsung-s3c44b0x