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INTELLIGENT HELMET SAFETY SYSTEM FOR MINE WORKERS

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ABSTRACT

This project proposed an embedded system for mine worker's safety purpose using ARM7.A smart helmet has been developed that is able to detection of hazardous events in the mines industry. In the development of helmet, we have considered the four main types of hazards such as air quality, temperature and humidity and smoke detection. The first is the level of the hazardous gases such as methane, butane, etc. for which MQ4 gas sensor is used. The second hazardous level is a temperature to measure temperature LM35 is used .Third level is humidity in the mine, to measure humidity HSM-20G is used. The fourth hazardous level is smoke detection for smoke detection MQ2 sensor is used. This data will be transmitted to the control room through zigbee wireless network. If these parameters crossed their limit, it will alert the workers by turning ON the buzzer which is situated on helmet then information can provide to control room using zigbee transmitter and receiver. When buzzer is on the mine workers have to chance to safety his life from the hazards levels occurs in coal mines.

INTRODUCTION

This project is designed to provide Intelligent Helmet and safety monitoring for Coal miners. Various parameters like Methane gas, Carbon monoxide gas, Temperature and Humidity are monitored for the safety of coal miners. These sensors should be fitted in the helmet of the coal miners. Whenever any parameter crosses a particular threshold value, a buzzer is turned on so as to indicate the miner about the danger. Thus this system performs function of miners safety monitoring and controlling system. To avoid loss of material and damaging to human health, security and safety system as well as reliable communication system is essential in the underground mines. To enhance security, safety and productivity in underground mines, a reliable communication system must be established between workers, moving in the mine, and a fixed base station. The communication network must not be interrupted at any moment and at any condition. Inside underground mines, the wired communication network system is not so effective. Coal mine safety monitoring system based on wireless zigbee network can timely and accurately reflect dynamic situation of staff in the underground regions to ground computer system

BLOCK DIAGRAM

The implementation of proposed system mainly involves four sensors, which are Gas sensor , Smoke sensor, Humidity sensor and Temperature sensor of smart helmet using ARM microcontroller based on zigbee module. The block diagram of the system is shown in Figure.

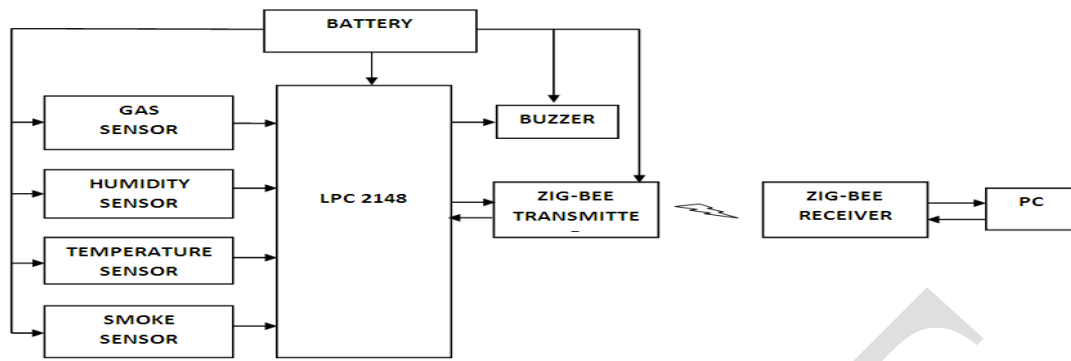

Fig.1. Block Diagram

BLOCK DIAGRAM EXPLANATION
1. POWER SUPPLY UNIT (BATTERY)

When working with electronics, you always need one basic thing: Power. In every electronic circuit power supply is required. The proper working of each and every component, it is important to supply the exact amount of voltage and current. If the power exceeds its limit, it can be fatal.

We are using 5V, 2A rechargeable battery for our system .The LPC2148 requires 3.3V, to obtain 3.3V supply we are using LM117 3-terminal adjustable regulator IC .The all sensor requires 5V supply.

2. LPC 2148

The LPC2148 microcontrollers are based on a 32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support that combine the microcontroller with embedded high-speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty.

Fig 2 is the pin out diagram of the lpc 2148 controller. The lpc 2148 is a 32-bit ARM7TDMI-S microcontroller based on the advance RISC architecture. 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory. One or two (LPC2141/42 vs. LPC2144/46/48) 10-bit ADCs provide a total of 6/14 analog inputs, with conversion times as low as 2.44 μs per channel.USB 2.0 Full-speed compliant device controller with 2 kB of endpoint RAM. Single 10-bit DAC provides variable analog output .Two 32-bit timers/external event counters .Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.
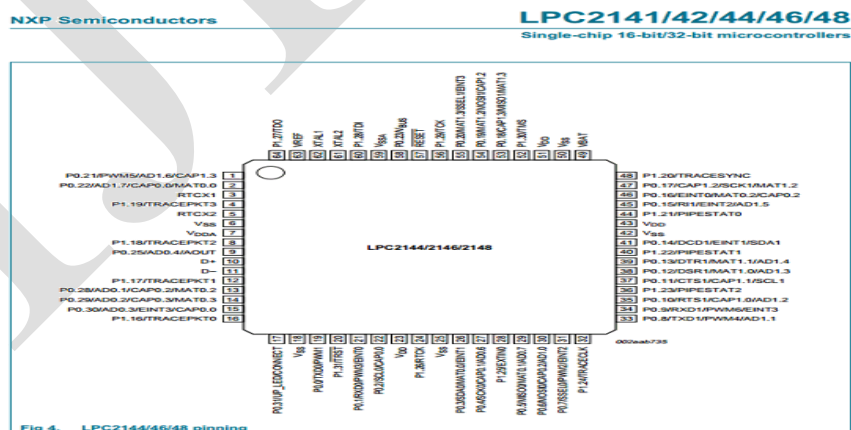

Fig.2. lpc 2148

3. GAS SENSOR (MQ-4)

Sensitive material of MQ-4 gas sensor is SnO2, which with lower conductivity in clean air. The sensor's conductivity is higher gas concentration rising. MQ-4 gas sensor has high sensitivity to Methane, also to Propane and Butane. The sensor could be used to detect different combustible gas, especially Methane, it is

with low cost and suitable for different application.MQ-4 have 6 pin, 4 pins are used to fetch signals, and other 2 pins are used for providing heating current.

Fig.3. gas sensor MQ4

4. SMOKE SENSOR (MQ-2)

Sensitive material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, The sensor's conductivity is more higher along with the gas concentration rising. MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application.

Fig.4. Smoke Sensor MQ2

5. HUMIDITY SENSOR (HSM20G)

The module of HSM-20G is essential for those applications where the relative humidity can be converted to standard voltage output.

Fig.6. Humidity Sensor

6. TEMPERATURE SENSOR (LM35)

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range.. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, As the LM35 device draws only 60 µA from the supply, it has very low self-heating. The LM35 device is rated to operate over a −55°C to 150°C temperature The LM35-series devices are available packaged in hermetic TO transistor packages
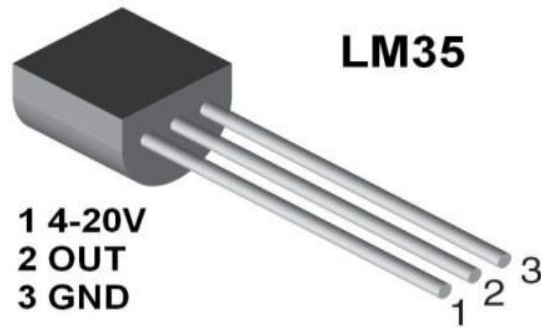
Fig.6. Temperature Sensor LM35

7 ZIG-BEE MODULE

ZigBee is a wireless networking standard that is aimed at remote control and sensor applications which is suitable for operation in harsh radio environments and in isolated locations. ZigBee technology builds on IEEE standard 802.15.4. ZigBee defines the application and security layer specifications. The distances that can be achieved transmitting from one station to the next extend up to about 70 meters, although very much greater distances may be reached by relaying data from one node to the next in a network.

Fig .7 ZigBee Module

8.BUZZER

Tone type: single
Operating voltage: 3-6V
DC rated voltage: 5V
DC current consumption: 25mA

Fig 8 Buzzer

WORKING

The paper consist proposal of Intelligent Helmet safety system for mine workers .The above proposed work is that it takes advantages of mine workers to protect from different hazardous conditions and hazardous gas present in the mine environment
The power supply can be achieved by using rechargeable battery. The system needs 5V supply for all sensors , controller and Zig-bee module

CONCLUSION

A smart mining helmet will be developed that will be able to detect four types of hazardous events like hazardous gases, temperature and humidity increase and smoke detection. This project will give a system to safety and security of underground mines The system combined the low power, low cost Zig-bee based high

frequency wireless data transmission technology with small size sensors. The sensor and Zig-bee module can be preferably installed over the helmet of mine worker. Proper monitoring and conversation is possible between the workers and the control room which can help to take appropriate actions more rapidly and smartly.

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