



ACOUSTIC BASED SAFETY APPLICATION IN UNDERGROUND MINING

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Abstract— Mining exploration play a major role in global economy. Communication play a vital role in mining operation to ensure the personal safety, process optimization and enhancing operation efficiency. This surroundings underground mining process still constitute an unsafe area for miners due to bad visibility conditions. In this paper, we present a novel model for the acoustic based safety application for the human and hazardous environment. This system contains many sensors, zigbee (transmitter, receiver), analog to digital converter and lcd display to provide communication between miners and supervisors.

Keywords—underground mining, zigbee, safety application, sensors.

I. INTRODUCTION

Underground hard rock mining refers to various underground mining techniques used to excavate hard minerals, mainly those containing metals such as gold, silver and etc., but also involves using the same technique for excavating ores of gems such as diamond. The underground mining is an extremely hash and dangerous business. The estimated size of mining process equipment is about \$45 billion. When an accident happened, the sensors were damaged fatally so it couldn't provide information for detection events.

In underground mining process there were lot of accident had occurred: In 19th century, 1872 pelsall Hall Colliery disaster in pelsall nearly 23 peoples were died. In 1899 sumitomo besshi bronze mine area ,landside with debris floe disaster ,Niihama ,shikoku ,japan ,about 512 peoples were died. In 20th century, March 10, 1906: couriers mine disaster in countries, France. 1,099 workers died, including children, in the worst mine accident in Europe. In 21st century, may 13, 2014 :Soma mine disaster took place in soma, Turkey. The accident, called the worst mining accident ever in Turkey, and it is the worst mining accident in the 21st century so far, nearly 301 people were died. The main of our project is to avoid the

accident and protect the human from the underground accident.

In our project , four sensors are used i.e. gas sensor, Acoustic sensor, Obstacle sensor , IR based sensor . The information will be transmitted and received through the Zigbee module. In this system it is capable of tracking and monitoring miners and equipment in underground. The IR based heart rate sensor used for checking the human pulse rate. If the pulse is normal ,automatically send the information through Zigbee. Acoustic sensor for producing sound wave when the machine is in problem and the output information is voice signal.

The gas sensor is used to detect the poison gas inside the undermining process to avoid the miners death. Because more poison gas will be detected in the underground environment. The obstacle sensor is used to detect the miners path to avoid the accident inside the undermining area. This sensor will sense the miners path and transmit the information to the receiver with he help of Zigbee.



Fig. 1. Underground mining place

II. BLOCK DIAGRAM

A. Microcontroller:

A microcontroller is a single chip computer or a cpu with the peripherals like RAM, ROM, I/O ports, timers etc. This section basically consists of microcontroller with its associated circuitry like crystal with capacitor, reset circuitry and so on. It forms the control unit of whole project. It is the heart of the project because it controls the device being interfaced and communicates with the device according to the program.

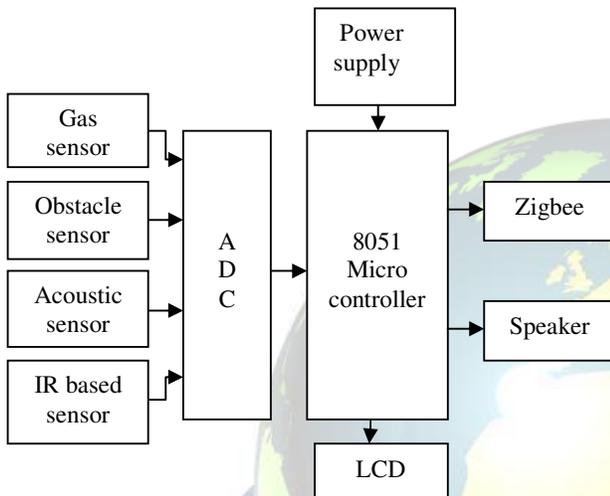


Fig.2. Block diagram of our work

B. Zigbee

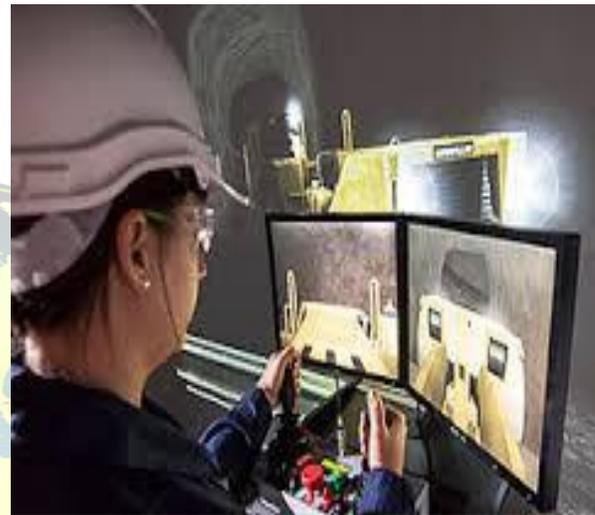
Zigbee is more suitable for data collection. It has its own standards. It is a new wireless network technology with short range and low rate. It is a technology between labeling technology and Bluetooth, and the cost is much lower than Bluetooth. The sensors sent the data to computer by multi-hop method, and the communication efficiency is very high. Underground data collection and transmission layer can be divided into the Zigbee data collection network and information receiving and processing terminal. The system can be divided into monitoring management layer, underground data collection and transmission layer according to the location.

C. Liquid-Crystal Display(LCD)

It is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. They use the same technology except that arbitrary images are made up of large number of small pixels. LCD'S available to display fixed images which can be displayed are hidden, such as digits, preset words, and 7 segment displays as in digital clock.

D. Gas sensor

A gas detector is a device that detects the presence of gases in an area, often as a part of a safety system. This type of equipment is used to detect a gas leak and interface with a control system so a process can be automatically shut down. A gas detector can sound an alarm to operate in the area where the leak is occurring, giving them opportunity to leave.



(a)



(b)



Fig.3. Application of our work

by its bandwidth and its signal to noise ratio. The actual bandwidth of an ADC is characterised by its sampling rate and lesser extent and handles error such as aliasing.

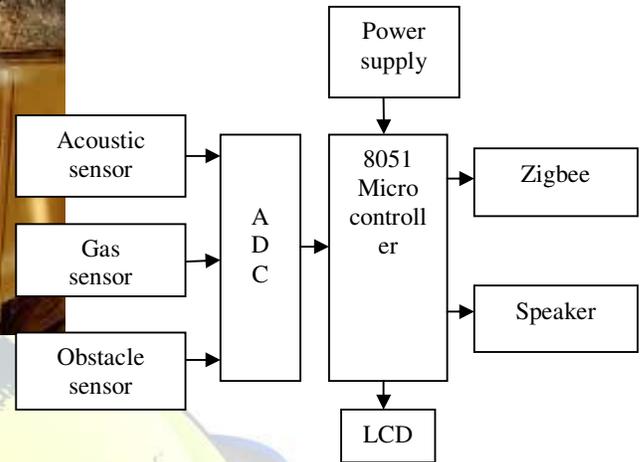


Fig.4. Mining section

E. Acoustic sensor :

The sensor transducers an input electrical signal into a Mechanical wave which, unlike an electrical signal. An acoustic source produces a pulsating acoustic source of 30 KHz to 50 KHz sweep at a 60Hz rate. Surface acoustic wave technology takes advantage of piezoelectric effect in its operation. Most of the surface noise wave sensors use an input interdigitated transducer(IDT) to convert an electrical signal into an acoustic wave.

F. Obstacle sensor

Near infrared region-700nm to 1400nm-IR sensors, fiber Optic. For optical sensing and optical communication. Photo optics technologies is used in the near infrared region as a light is less complex than RF when implemented as a source of signal. Optical communication is done with IR data transmission for short range applications.

G. IR Based HB Sensor

While the heart is beating, it is actually pumping blood throughout the body and that makes the blood volume inside the finger artery to change too. The sensor unit consists of an infrared light emitting diode(IR LED) and a photo diode placed side by side and the fingertip is placed over the sensor assembly. The IR LED transmits an infrared light into the fingertip, a part of which is reflected back from the blood inside the finger arteries.

H. ADC Converter

An analog to digital converter is a device that converts continues physical quantity to a digital number that represents the quantity's amplitude. The conversion involves quantization of the input ,so it necessarily introduces the small amount of error. In electronics ,an analog to digital converter is a device for converting an analog signal to a digital code, usually binary. In real world ,most of the signals sensed and processed by humans are analog signals. An ADC is defined

III. BLOCK EXPLANATION OF MINING SECTION

An acoustic wave sensor is an electronic device that can measure the sound levels. Any changes to the characteristics of this travelling path affect the velocity and amplitude of the wave. Practically all acoustic wave devices and sensors uses a piezo electric material to generates the acoustic waves are sensitive to changes from many different physical parameter.

A Gas sensor is a subclass of chemical sensors. Gas sensor interacts with a gas to measure its concentration. Each gas has a unique breakdown voltage i.e. the electric field at which it is ionized. This insight covers a methane gas sensor that can sense gases such as ammonia which might get produced from methane, when a gas interacts with this sensor; it is first ionized into its constituents and is then adsorbed by the sensing element.

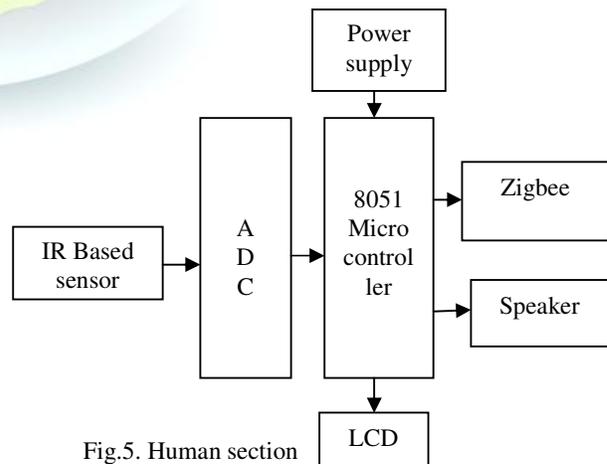


Fig.5. Human section



An obstacle sensor placed in the transmitter to detect the path of the miners, Hence it is placed in the underground mining. The basic concept of obstacle detection is to transmit the IR signal in a direction and a signal is received at the IR receiver when they IR radiation bounce back from the surface of the object. ADC stands for analog to digital converter and hence is used to convert the continuous signal into digital form. In this process the ADC is connected to the Microcontroller. Microcontroller is the heart of the embedded project. 8051 microcontroller is an 8 bit device and it is connected to Zigbee unit. Zigbee will transmit the information to the receiver through the LCD and Speaker.

IV. EXPLANATION OF THE HUMAN SECTION

The IR based sensor is connected to the ADC and hence this sensor is placed in the Human to detect the human pulse rate and their health condition. If the miner is not in normal condition automatically the information will be transmitted to the control room or to the receiver. The information in this section will be sent to the control room and to the supervisor of the undermining process. This information will be sent through the Zigbee and also this information will be displayed through the LCD screen.

The IR based sensor is connected with the ADC and this converter will be connected with the 8051 microcontroller of the process. LCD stands for Liquid Crystal Display and it has two sections: one is command and other one is Data. Command will provide a special instruction and the data will provide the information of the process. The power supply is given to the circuit is 5v and this actually provides 230v but this will convert them as 5v which is required for the circuit of the project.

V. SOFTWARE EXPLANATION

The Keil C51 C Compiler for the 8051 microcontroller is the most popular 8051 C compiler in the world. It provides more features than any other 8051 C compiler available today. The use of C language to program microcontrollers is becoming too common. And most of the time it's not easy to build an application in assembly which instead you can make easily in C. So it's important that you know C language for microcontroller which is commonly known as Embedded C. As we are going to use Keil C51 Compiler, hence we also call it Keil C.

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems.

Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic

features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations.

The Keil C is the software used to write the coding for the system using the embedded C program. Embedded is the combination of Hardware and software to perform a particular task till end of its life and microcontroller plays an important role in the embedded system, it is considered as the heart of the embedded system.

The Zigbee transmits the information continuously in the output window. And the coding consists of the command and data, Register select line, Read/write command in the coding.

Rs(0)-Register select line read operation

Rs(1) -Register select line Write operation

VI. CONCLUSION

In Existing system, only acoustic sensor is used to detect the sound waves in the underground mining process. The pulse-compression technique with linear chirps is used as a basis for precise and accurate positioning even if the surrounding noise is louder than the measurement signals. In the proposed model, three sensors are used to detect the underground mining environment and another one sensor is used for the measure the human pulse rate and their health condition. The information will be transmitted through the Zigbee from the transmitter to the receiver of the system. The proposed model will detect both the human condition and the undermining environment. Scope of the proposed system is to improve the productivity, reduce fatal collision accident and speedy rescue operation.

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