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sDEVELOPMENT OF COAL MINE SAFETY SYSTEM USING WIRELESS SENSOR NETWORKS

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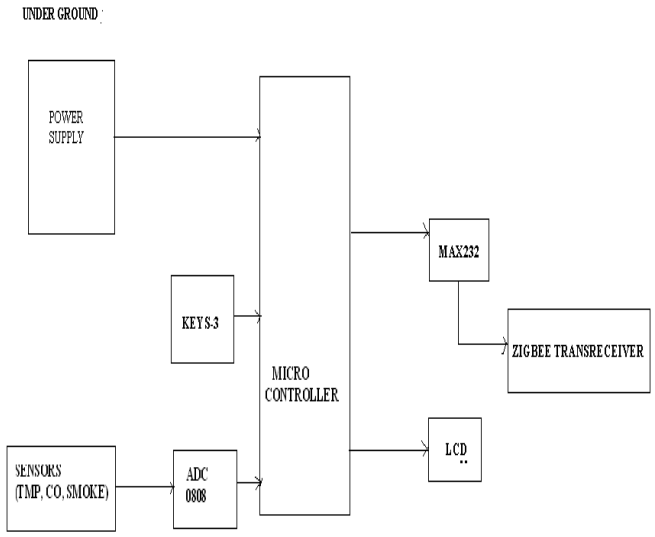
Abstract

In this work, a system is proposed for safe Coal Mine Monitoring, which plays an important role in coal mine safe production. With continuous enlarging of exploiting areas and extension of depth in coal mine, many laneways become monitoring blind areas, where are lots of hidden dangers. It is very difficult to lay cables which are not reliable and not effective. For to overcome this, a new system is proposed with the help of Zigbee technology. Which can improve the level of monitoring production safety and reduce accident in the coal mine. And this paper proposes a low complexity parameter to determine the optimal placement of sensor nodes.

Index Terms: *Zigbee, GSM ,Kurtosis Index.*

I INTRODUCTION

Sensor networks have been proposed for various applications due to its ability for monitoring and detecting a possible hazardous event in underground mines such as fire, flammable, explosive, toxic gas; where judicious deployment of fixed anchors (node with known positions) is to be considered. In emergencies wireless communication may become vital for survival, for example, during a disaster such as a fire, rock falls, the conventional wired communication system [5] may become unreliable, necessitating a wireless radio system. A wireless sensor network is composed of sensors which are deployed across a geographical area. The proposed system consists of two sections, shown in Fig 1, the first section is underground section and another section is ground section. In underground section the sensors will sense the environment conditions such as temperature, gas etc.., and this information is send to the micro controller. Micro controller displays this information in the LCD and sends through Zigbee transmitter. In ground section Zigbee receiver [1] take that information and sends it to the controller and controller sends the information to GSM modem and as well as displaying on the LCD. Here GSM modem sends the [7] message to mobile when the sensors exits there threshold level.



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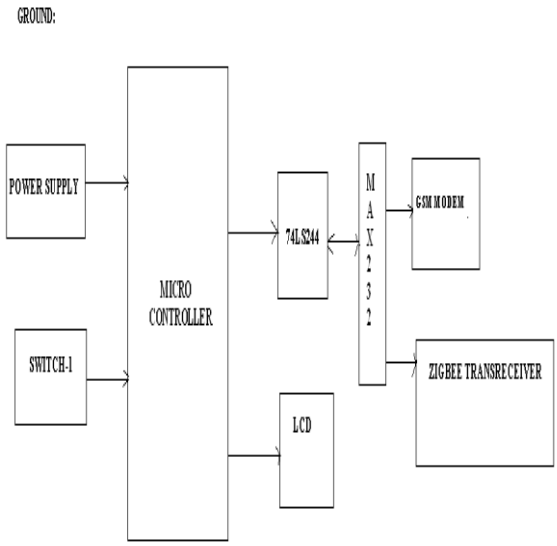

Fig-1: Underground section and ground section

II RELATED WORK

Kurtosis Index κ is a low complexity parameter able to precisely discriminate channels. More over the parameter κ does not need any application of estimation algorithms on the received signal because it is calculated directly by the received signal sample.

It is defined as "A statistical parameter that indicates the fourth order moment of the received signal amplitude"

$$\kappa(x) = \frac{1}{\sigma^4} \frac{\sum_i (x_i - \bar{x})^4}{N}$$

Where x_i is received signal

N is number of samples

σ^2 is variance and $\sigma^2 = \frac{\sum_i (x_i - \bar{x})^2}{N}$

$\bar{x}$ is the mean

As the variance parameter is in denominator of the kurtosis index, it is possible to differentiate the channels precisely, for the low variance values also.

In the case of considering only best signal strength or only best SNR measures, [6] we may get many similar values to decide from, whereas using kurtosis index as the parameter, less number of similar values occur, making the decision of optimum receiver position easier.

III HARDWARE DESCRIPTION

Power supply

In this system we are using 5V power supply for microcontroller of Transmitter section as well as receiver section. We use rectifiers for converting the A.C. into D.C and a step down transformer to step down the voltage.

Microcontroller

In this work the micro-controller is playing a major role. Micro-controllers were originally used as components in complicated process-control systems. However, because of their small size and low price, Micro-controllers are now also being used in regulators for individual control loops. The purpose of this work is to present control theory that is relevant to the analysis and design of Micro-controller system with an emphasis on basic concept and ideas. It is assumed that a Microcontroller with reasonable software is available for computations and simulations [3] so that many tedious details can be left to the Microcontroller. The control system design is also carried out up to the stage of implementation in the form of controller programs in assembly language OR in C-Language.

Max232

The data which we are entering in to the hyper terminal editor is available at the COM1 port. Then the data enters in to the MAX232 voltage converter via the RS232 cable. [5]The MAX232 converts the voltage levels of the RS232 to the TTL level and then sends to the UART of the microcontroller. So the main duty of the max232 is for the voltage conversions.

LCD Display Section

This section is basically meant to show up the status of the work. This work makes use of Liquid Crystal Display to display / prompt for necessary information.

Zigbee Module

ZigBee is an established set of specifications for wireless personal area networking (WPAN), i.e. digital radio connections between computers and related devices.WPAN Low Rate or ZigBee provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. Fig 2, ZigBee makes possible completely networked homes where all devices are able to communicate and be controlled by a single unit.

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Fig-2: Zigbee module

Two Zigbee modules are used for the transmitter and the receiver. The experiment is done as per the IEEE 802.15.4a channel models i.e. for R (LOS and NLOS) and IO (LOS and NLOS). Prior to doing the experiment each Zigbee module is connected to each PC and the X-CTU software is installed in those PC's.

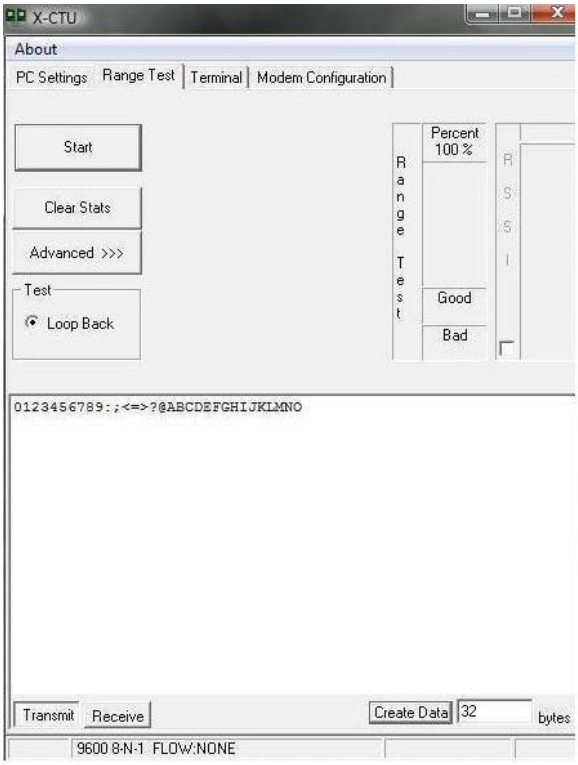

Fig-3: X-CTU Window

CO Sensor

Carbon monoxide detectors trigger an alarm based on an accumulation of carbon monoxide over time. Detectors may be based on a chemical reaction causing a color change, an electrochemical reaction that produces current to trigger an alarm, or a semiconductor sensor that changes its electrical resistance in the presence of CO. Fig 4,Most carbon monoxide detectors require a continuous power supply, so if the power cuts off then the alarm becomes ineffective.

Fig-4: CO Sensor

Smoke sensor

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 higher along with the gas concentration rising. Fig 5, 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-5: Smoke sensor

GSM Modem

A GSM modem can be an external modem device, Insert a GSM SIM card into this modem, and connect the modem to an available serial port on your computer. Or, A GSM modem can be a PC Card installed in a notebook computer, such as the Nokia Card Phone. A GSM modem could also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port on your computer.
Fig 6, A dedicated GSM modem (external or PC Card) is usually preferable to a GSM mobile phone. This is because of

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some compatibility issues that can exist with mobile phones. For example, if you wish to be able to receive inbound MMS messages with your gateway, and you are using a mobile phone as your modem, you must utilize a mobile phone that does not support WAP push or MMS. This is because the mobile phone automatically processes these messages, without forwarding them via the modem interface. Similarly some mobile phones will not allow you to correctly receive SMS text messages longer than 160 bytes (known as "concatenated SMS" or "long SMS"). This is because these long messages are actually sent as separate SMS messages, and the phone attempts to reassemble the message before forwarding via the modem interface.

When you install your GSM modem, or connect your GSM mobile phone to the computer, be sure to install the appropriate Windows modem driver from the device manufacturer. To simplify configuration, the Now SMS/MMS Gateway will communicate with the device via this driver. An additional benefit of utilizing this driver is that you can use Windows diagnostics to ensure that the modem is communicating properly with the computer. Now the SMS/MMS gateway can simultaneously support multiple modems, provided that your computer hardware has the available communications port resources.

Fig-6: GSM modem

IV SIMULATION

Software's used here are Keil software for C programming, Express PCB for lay out design and Express SCH for schematic design.

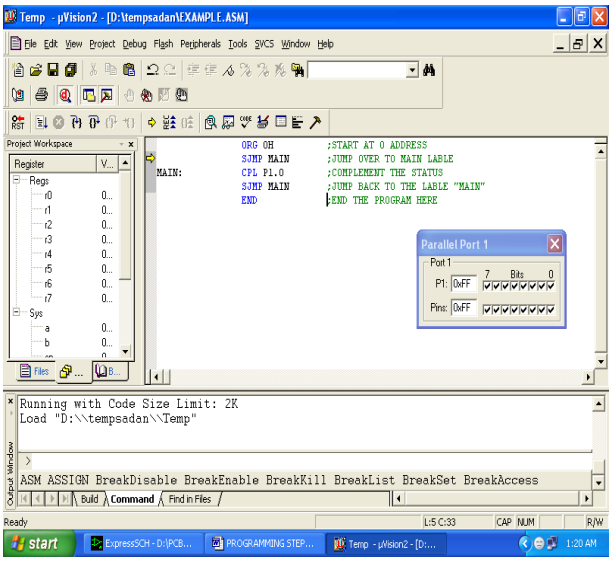

Fig-7: Snapshot of µVision

After entering into Keil µ Vision i.e. after starting new project, the program can be written in C language or ASM. Fig 7, then the program has to be run successfully. The computer stores the parameters in the hard disk and ground staff can [2] choose any of the parameters for recording and replaying. When it is found that the parameters received have exceeded the limit set, the microcontroller will control the alarm buzzer to ring in time, and the computer at ground control centre also gives the alarm ring and the alarm pictures.

V CONCLUSION

A safety system is developed for Cole mine workers using wireless sensor networks. A larger area and more depth inside hazardous underground mines are now can be covered and potential accidents can be controlled effectively. And also in this paper a low complexity parameter, kurtosis index is proposed to identify the best node placement in wireless sensor network environments.

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BIOGRAPHIES

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