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WIRELESS COMMUNICATION BASED ON COAL MINING SAFETY SYSTEM USING AVR CONTROLLER

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ABSTRACT

The most important aspect of the mining workers Act is providing reliable communication for miner's accidents. Reliable communication has always been a challenge in underground mines due to changing topologies and environment. It's mainly detect the human heart beat by using the pulse sensor. In addition, disasters disable wired communication in occurs due to the fire cause. These may damage the communication infrastructure which rescue efforts and endanger lives. Therefore, durable wireless solutions using advanced communication and sensor network technologies have been investigated to applied reliable communications in underground mines.

In this paper, it designs a monitoring system for coal mine safety based on RF to RF modules with sensors. In this system it consists main module for RF transceiver based device which would cooperate together in order to transport disaster information. This system provides an efficient, faster and reliable communication even when disaster occurred. The designed coal mine safety monitoring system based on wireless sensor network, RF transceiver will improve the level of monitoring production safety and reduceAccidents in the coal mine. ATMEGA328 processor is used to RF transceiver information is passing of order to speed up the processing of data.

KEYWORDS

RF transceiver and receiver, ATMEGA328,Coal mine monitoring system, Pulse sensor, WSN.

INTRODUCTION

Industrial safety is one of the main aspects of industry especially in mining industry. In the mining industry safety is a very vital factor. To avoid loss of material and damaging of human health, protection system as well as faithful communication system is necessary inside the underground mines. To ensure both safety and productivity in mines, a reliable communication must be established between workers, moving in the mine, and a fixed base station. Inside mines, wired communication system is not so effective, because wires can be damaged inside mines.

Initially only camera is used to identify the problems in mines. Hence we cannot analyse changes in temperature, humidity, gas leakages. To overcome this ZigBee wireless sensor network which helps to alert the people if there is any change in temperature, humidity and gas leakage using specific sensors. ZigBee has simple and easy network, applicable only for shorter distance. To overcome this problem RF communication is used and it is a suitable and reliable communication system for safety application in coal mines. RF is used for longer distance communication.

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In this project ZigBee is replaced by RF, in addition to this pulse sensor is used. Pulse sensor helps to detect human heart beat so if there is any abnormality in person's heartbeat we can detect and save their life

Likewise, the excavators who work in different fields under mines need to endure numerous ecological difficulties like noxious gasses, sudden temperature varieties, and so forth. To dodge these conditions we are planning a security system. The system comprises of different sensors that are associated with the micro-controller (ATMEGA 328) and this micro-controller is associated with control room by means of RF network. Any risky condition around the worker can be promptly checked by the control room. A signal is given to send a crisis message to the control room if the specialist detects threat or having some emergency.

BLOCK DIAGRAM

EXISTING SYSTEM

In the existing system, the parameters like temperature, humidity and hazardous methane gas are going to be monitored and if any abnormality happens it will be intimated through voice alert within the mine and transmitted to the monitoring section via ZigBee communication module. For that we are using a micro-controller interfaced with sensors. Here a voiceIC named APR9600 is used for intimating the abnormal status in voice format.

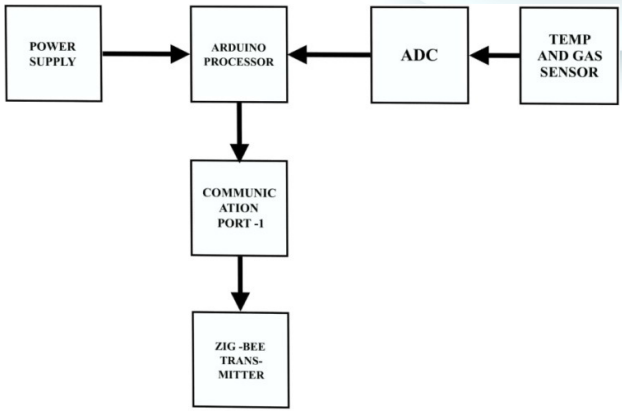

Figure.1.Block diagram of transmitter section

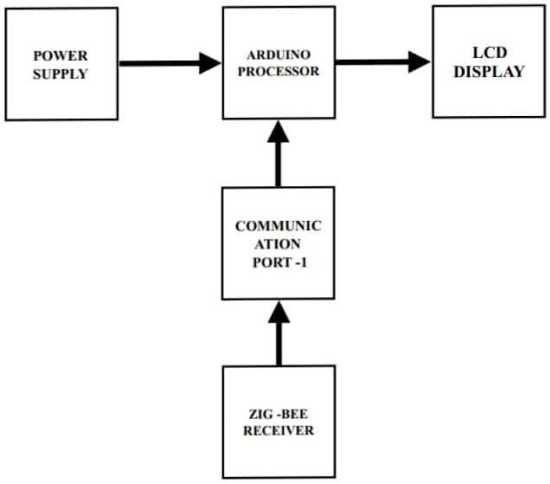

Figure.2.Block diagram of receiver section

ZigBee devices can transmit data over short distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.)

Disadvantages of Existing system:

- It requires knowledge about the system to operate ZigBee complaint devices.
- It is not a secured system which prone to attack from unauthorised people
- Replacement cost is high
- Coverage is limited hence it is not suitable for mining.

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PROPOSED BLOCK DIAGRAM

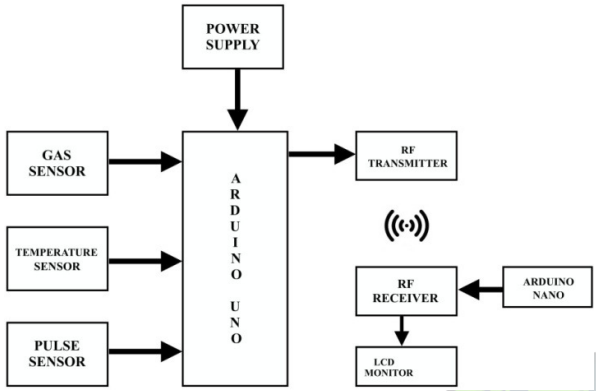


Figure.3. block diagram of RF transmitter and receiver section

In this proposed system it designs a monitoring system for coal mine safety based on, RF to RF modules with sensors. It consists main module for RF transceiver based device which would cooperate together in order to transport disaster information. This system provides a efficient, faster and reliable communication even when disaster occurred. The designed coal mine safety monitoring system based on wireless sensor network, RF transceiver will improve the level of monitoring production safety and reduce accident in the coal mine. ATMEGA328 processor is used to RF transceiver information is passing of order to speed up the processing of data.

REQUIRED COMPONENTS

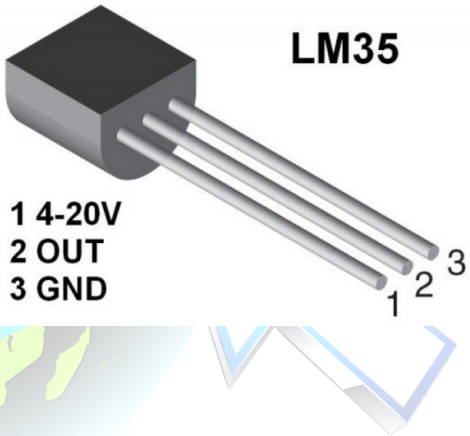
- Power supply
- Temperature sensor
- Gas sensor
- Pulse sensor
- Humidity sensor
- Arduino processor
- LCD Display
- RF transmitter and receiver

POWER SUPPLY

The power supply unit is provided on the transmitter unit. It's a constant voltage of 5V.

TEMPERATURE SENSOR

It is used to measure the temperature in underground coal mining. Information is passed through RF transceiver. The temperature is LM35



Figurer.4. Temperature sensor

GAS SENSOR

It is used to detect the dangerous LPG leaking in environmental air. It has good sensitivity and quick response time. Carbon monoxide is used in mining industries the sensor output values can be both analog and digital

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Figure.5. Gas sensor

PULSE SENSOR

It works on the principle of light modulation by blood flow through finger at each pulse. When heartbeat detector is working, LED flashes in unison with each heartbeat. This digital output is connected to micro-controller to measure BPM rate

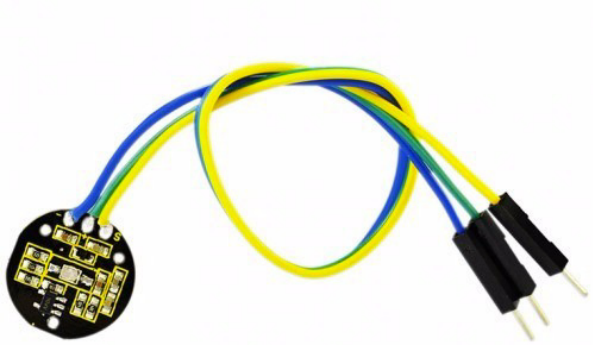

Figure.7. Pulse sensor

ARDUINO UNO

Arduino Uno is a micro-controller board based on the ATMEGA328P (data sheet). It has 14 digital input/ output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the micro-controller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

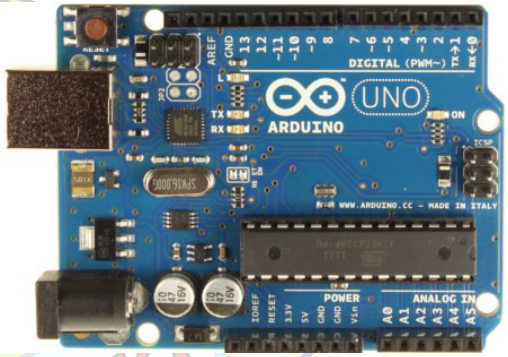

Figure.6. Arduino UNO

ARDUINO NANO

The Arduino Nano is a small, complete, and breadboard- f r i endly board based on t he ATMEGA328 (Arduino Nano 3.0) or ATMEGA168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Nano was designed and is being produced by gravitech.The Arduino Nano can be powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage

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source.The FTDI FT232RL chip on the Nano is only powered if the board is being powered over USB.

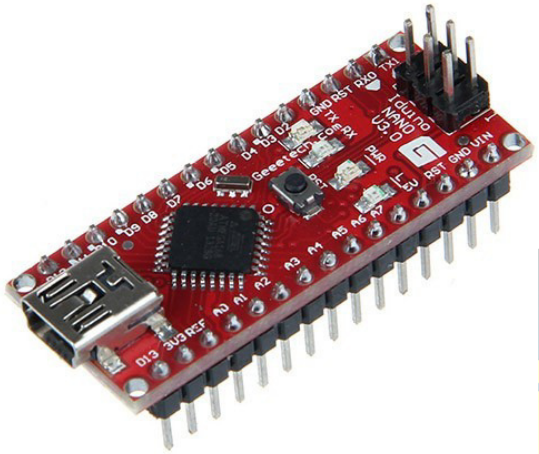

Figure.8.Arduino NANO

LCD DISPLAY

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in colour or monochrome.

LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

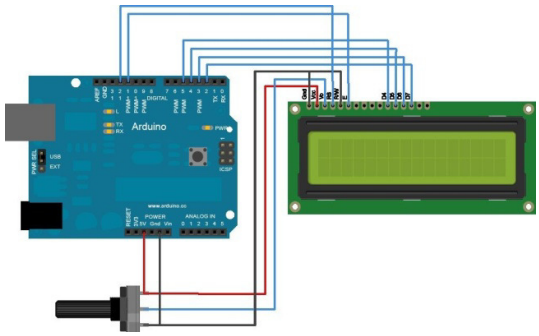

Figure.9. LCD display

RF TRANSMITTER AND RECEIVER

An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and a receiver. They are of various types and ranges. Some can transmit up to 500 feet.

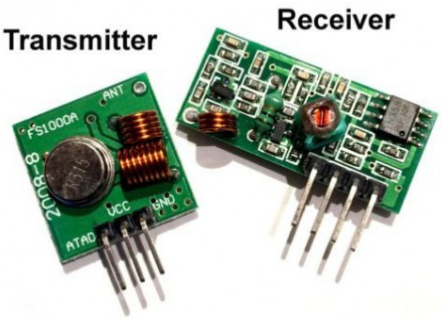

Figure .10.transmitter and receiver

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SOFTWARE ARCHITECTURE

The software used to control the micro-controller is Arduino. It is open source software and is very reliable and user friendly. The transmitter is initialised by first the header files of the sensors programming. Then each of the sensors is initialised and connected with a specific pin of the controller for its output. Then the RF module is initialised and programmed to transfer the above observations to other controller.

The receiver is initialised by the headers files first. Then the LCD display is initialised with the connected pins. All the sensor inputs are given to make a specific pin high and on that the output is given to the buzzer and the LCD display. For example, when the worker is in emergency, sensors detects and make the alert sound pin 3 of the receiver controller becomes high and a message is displayed on the LCD "WORKER IS IN TROUBLE".

WORKING

When the worker enters the mine, he turns the helmet circuitry ON. The connection between helmet and control room is established through RF communication and is tested for proper communication.The transmitter equipped in the helmet and the receiver equipped in control room. The temperature sensor DS 1820 observes the surrounding temperature and continuously transmits to the control room.

Hence when temperature conditions become unfavourable for the worker safety measures could be taken. The gas sensor detects poisonous gases like ethane, methane, butane, etc. and if such gas is detected an emergency signal is transmitted to the control room with message "POISONOUS GAS DETECTED" and buzzer is turned ON. This helps in avoiding the exposure of workers to the harmful toxic gases.

An Emergency switch is equipped in the helmet which gives a distress signal to the control room with message "WORKER IN TROUBLE". Whenever the worker doesn't feel physically healthy or encounters some problem on pressing this switch the control room will get alert and immediate actions can be taken for him.

A LDR circuit along with timer IC 555 and LED lights is equipped to the circuit. When the main connection line breaks during hazards and complete blackout occurs LED lights can be used for emergency. They automatically turn ON and proper measures can be taken afterwards. An IR receiver is connected to the helmet. Several IR transmitters are connected in the mine which continuously transmits signal. Whenever the worker enters a specific range the receiver detects the signal and transmits the exact location of the helmet to the control room. E.g. consider fig 3, there are two lanes namely lane1 and lane2.when the worker enters lane 1 it detects signal from IR transmitter 1 and send a message to the control room "WORKER IS IN LANE 1". When the worker enters lane 2 it detects signal from IR transmitter 2 and send a message to the control room "WORKER IS IN LANE 2".

CONCLUSION

A real time monitoring system is developed to provide clearer and more point to point perspective of the underground mine.This system is displaying the parameters on the LCD at the underground section where sensor unit is installed as well as on the monitoring unit, it will be helpful to all miners present inside the mine to save their life before any casualty occurs.Alarm triggers when sensor values crosses the threshold level.

This system also stores all the data in the computer for future inspection Sensor nodes can reconfigure remotely over a wireless network and most of the processing done in software on computer side.The calibration equations of gas sensors may have affected the accuracy of the ppm results.This is a low cost and lifelong system.

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APPLICATIONS

- Coal Mining Area
- Under ground drainage water system
- Wireless data transmission in forest area
- Robotics application

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