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Wireless Communication Based on Coal Mining Safety System with Arduino

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Abstract: *The most important aspect of the mining workers Act is providing reliable communication for miners accidents. Reliable communication has always been a challenge in underground mines due to changing topologies and environment. Its 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 , Zig-bee to zig-bee modules with sensors. In this system it consists main module for zig-bee 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, zig-bee transceiver will improve the level of monitoring production safety and reduce accident in the coal mine. ATMEGA328 processor is used to Zig-bee transceiver information is passing of order to speed up the processing of data.*

Keywords: *Zig-bee transceiver, ATMEGA328, Coal mine monitoring system, Pulse sensor, WSN.*

I. INTRODUCTION

Safety is the important role of many industry. In any hazardous work environment mines, safety of human life is an important concern, Negligence in the safety part may cause damaging of high quality equipment hampering of production or may cause loss of human life also in extreme cases. In the mining industry safety and security is a fundamental aspect of all. To avoid any types of unwanted signal all mining industry follows some basic precaution and signal. Communication is the most vital key factor today, to monitor different parameters continuously and to take necessary actions accordingly to avoid any types of hazards related to production, security, managing of human resources. To avoid loss of material and damaging of human health, security and safety system as well as reliable continuous faithful communication system is important in the interior of the underground coal mines. To enhance security, safety and productivity in underground coal mines, a reliable communication system must be established between workers, moving in the mine, and a fixed base station. It is very difficult to install the wired communication system inside mines after a landslide or damage due to many reason. If due to some reason any wire of the communication network damages, it may cause temporary interruption of the continuous process or may cause a long term break down of the system. To improve life safety, many systems has been designed, and have even been implementing the system in some countries today and many countries are to develop the safety system in the all over world.

II. RELATED WORK

The working for a sensors operation, microprocessor, and network technology, a reliable technological condition has been provided for our automatic real-time monitoring of coal mine safety system. Plenty of researches were done in developing different applications among them are listed given below:

If we look to in monitoring system has a sensor module consisting of some MEMS based on sensors that measures real-time underground parameters like temperature, human heart beat of different gases, vibration inside mines etc. A microprocessor is used with the sensors to receive the sensor outputs and to take the necessary decision. When gas concentration crosses the safety level, microprocessor decodes the LCD displayed. In all such cases, this will send an LCD display through an urgent message to the ground control terminal through zig-bee. The microprocessor used here is ATMEGA328 with 20MHz operating frequency. It has

three I/O ports, inbuilt A/D input channels and 368 bytes data memory. Digimake XBEE24 product is used here for transmitting and receiving data wirelessly. Microprocessor ATMEGA328, zig-bee MC13193 and variety of sensor are used for coal monitoring. A variety of sensors equipped with sensors with sensing human heart beat, temperature and poisonous gases and a wireless zig-bee transceiver. It can navigate through a mine and send back information to the person monitoring its movement from a safe place outside, all that is happening inside the mine and even warn the workers regarding the places that may actually be life threatening.

III. HARDWARE SCHEME

The hardware platform of wireless gateway is made up of two parts: ATMEGA328 processor that integrates a 2.4 GHz, Zig-bee IEEE 802.15.4-compliant transceiver and harmful gas detecting sensors based on application.

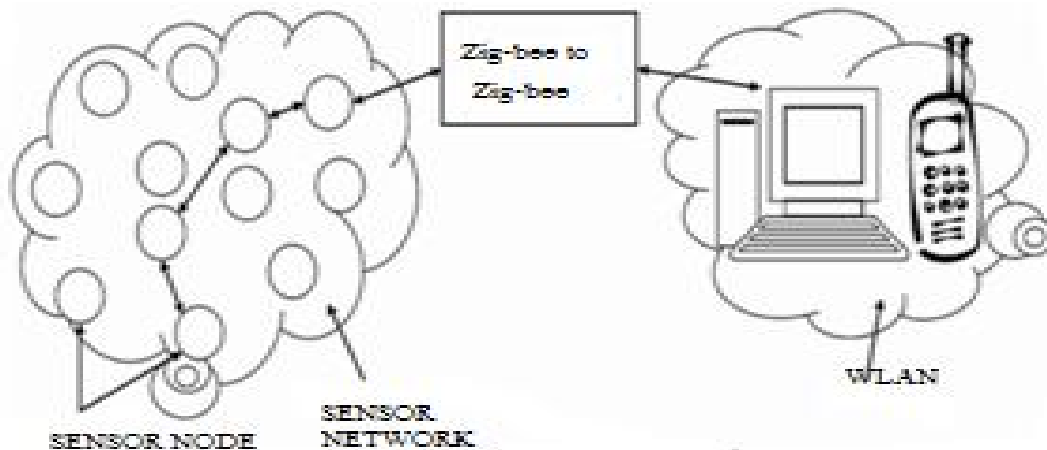


Figure 1. The communication model between Zig-bee network and WLAN

There are many types of devices has been developed, they are Zig-bee transceiver devices is meant for manager, mining sardar, overman, assistant manager who are responsible for monitoring the area, manages the worker and tests the site weather it is safe to continue work or evacuate the area. The transmitter block diagram and receiver is a given below:

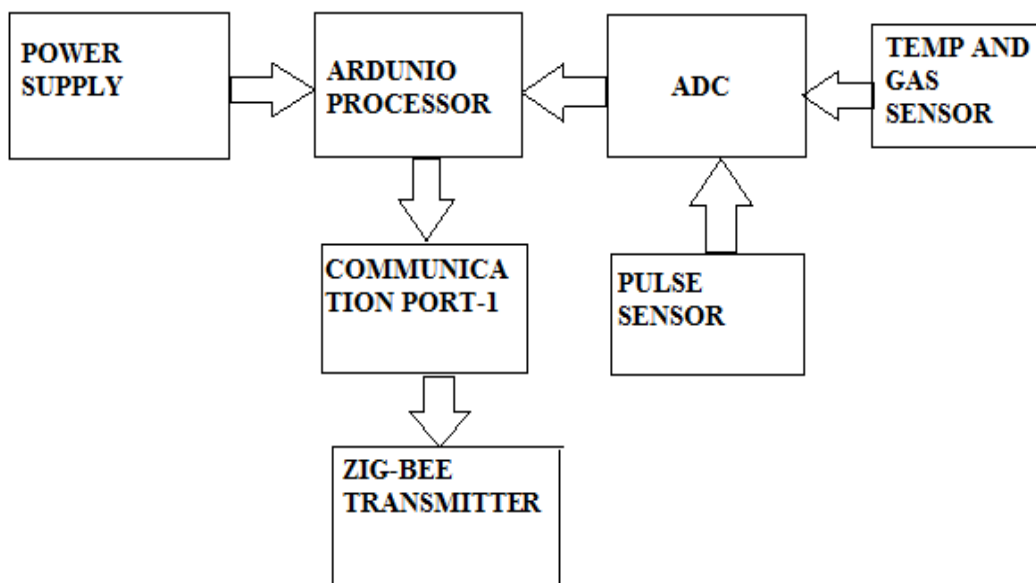


Figure 2. Block diagram of transmitter section

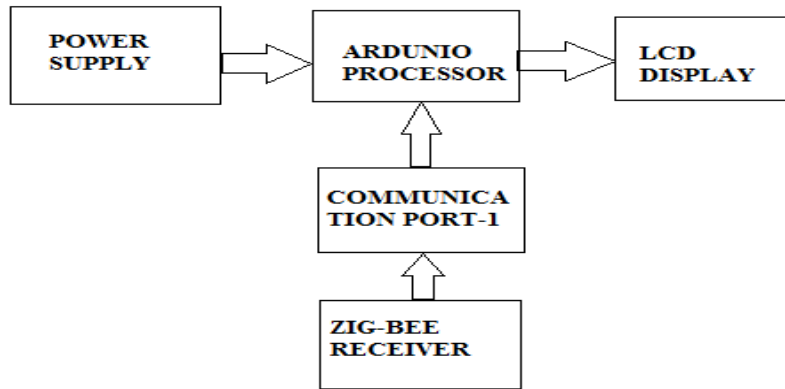


Figure 3. Block diagram of receiver

A. The transmitter and receiver in main block of listed is given below

- 1) POWER SUPPLY
- 2) TEMPERATURE SENSOR
- 3) GAS SENSOR
- 4) PULSE SENSOR
- 5) ADC
- 6) ARDUNIO PROCESSOR
- 7) COMMUNICATION PORT
- 8) ZIG-BEE
- 9) LCD DISPLAY

- 1) Power Supply The power supply unit is mainly provided the on the hole transmitter unit. It's a constant voltage for 5V. The power supply is used for stepdown transformer(230V to 12V). Then used for regulator IC 7805 and filter units.
- 2) Temperature Sensor Temperature sensor is used for the measuring the underground coal mining in temperature. The information is passed through the Zig-bee transceiver. The temperature sensor is LM35.



Figure 4 Temperature sensor device

- 3) Gas Sensor Gas sensor is used to detect the presence of a dangerous LPG leakage in environmental air and outputs the reading as an analog voltage. The sensor has excellent sensitivity combined with a quick response time. Signal conditioning circuit is used to convert the change of conductivity to corresponding output signal with the input gas concentration. The sensor can also sense iso-butane, propane, LNG and cigarette smoke. Carbon monoxide sensor for use in industrial or mining applications. The MQ-6 gas module is mounted on a pcb board which has an operating voltage of 5VDC. The sensor output values can be get by means of both analog and digital.



Figure 5. Gas sensor device

- 4) Pulse Sensor There are three sensors used in the transmitter module. They are the, Heartbeat Sensor, Pressure Sensor and Drug detection Sensor. The heart beat sensor used here is 1157 Heart beat sensor. This sensor is designed to give digital output of heart beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heartbeat. This digital output can be connected to microcontroller directly to measure the Beats per Minute (BPM) rate. It works on the principle of Light modulation by blood flow through finger at each pulse.



Figure 6. Pulse sensor device.

- 5) Adc Adc is stands for Anlog to digital convetor. Its operation for the anlog signals are convert into the digital signal because of ARDUNIO processor is accept the only digital signal.
- 6) Arduinio Processor The Arduino Ethernet Shield allows an Arduino Board to connect to the internet. It is based on the Wiz net W5500 Ethernet chip. The Wiz net W5500 provides a network stack capable of both TCP and UDP. It supports up to eight simultaneous socket connections. Use the Ethernet library to write sketches that connect to the Internet using the Shield. The Ethernet Shield 2 connects to an Arduino Board using long wire-wrap headers extending through the Shield. This keeps the pin layout intact and allows another Shield to be stacked on top of it. The Ethernet Shield 2 has a standard RJ-45 connection, with

an integrated line transformer and Power over Ethernet enabled. The current Shield supports a Power over Ethernet module designed to extract power from a conventional twisted pair Category 5 Ethernet cable.



Figure 7. Arduino Shield device

- 7) Communication Port RS-232 (Recommended Standard - 232) is a telecommunications standard for binary serial communications between devices. It supplies the roadmap for the way devices speak to each other using serial ports. Updated designations for the RS-232 protocol have included EIA-232 (Electronic Industries Alliance) and the more current EIA/TIA-232 (Telecommunications Industry Association). These organizations have voluntarily taken on the protocol and the task of improving it. The MAX232 from Maxim was the first IC which in one package contains the necessary drivers (two) and receivers (also two), to adapt the RS-232 signal voltage levels to TTL logic. It became popular, because it just needs one voltage (+5V) and generates the necessary RS-232 voltage levels (approx. -10V and +10V) internally. This greatly simplified the design of circuitry. Circuitry designers no longer need to design and build a power supply with three voltages (e.g. -12V, +5V, and +12V), but could just provide one +5V power supply, e.g. with the help of a simple 78x05 voltage converter.
- 8) Zig-Bee Zigbee is the set of specs built around the IEEE 802.15.4 wireless protocol. The IEEE is the Institute of Electrical and Electronics Engineers. They are a non-profit organization dedicated to furthering technology involving electronics and electronic devices. The 802 group is the section of the IEEE involved in Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks including mid-sized networks. Group 15.4 deals specifically with wireless networking (Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (WPANs)) technologies.
- 9) Lcd Display More microprocessor devices are using 'smart LCD' displays to output visual information. The following discussion covers the connection of a Hitachi LCD display to a ATMEGA328. LCD displays designed around Hitachi's LCD HD44780 module, are inexpensive, easy to use, and it is even possible to produce a readout using the 8 x 80 pixels of the display. Hitachi LCD displays have a standard ASCII set of characters plus Japanese, Greek . It's a output device.

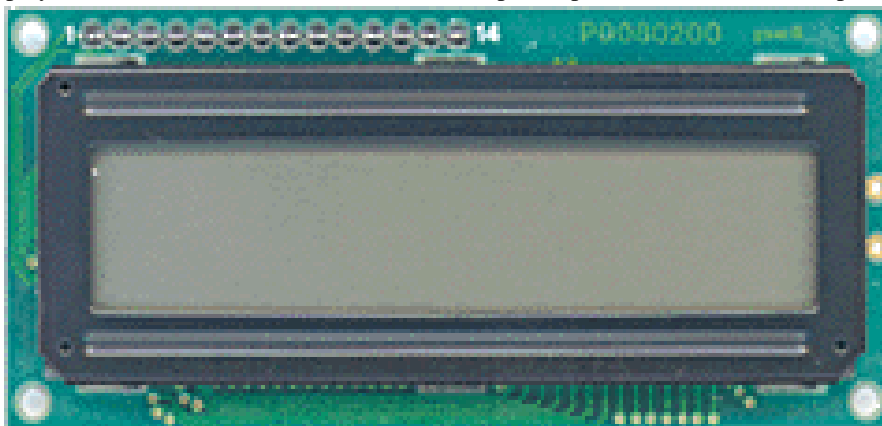


Figure 8. LCD display device`

IV. SOFTWARE DESIGN

In software design, communication protocol layers have the energy conservation for the center. Take the communication between the sensor nodes and the network coordinator as an example to introduce the flow of communication between the Zig-Bee modules. Before making communication, ZigBee module need effective initialization. During initialization, the network coordinator issues an active signaling request to connect the sensor nodes. After the sensor nodes successfully receive and verify a data frame and MAC command frames. Return Acknowledgment frame to the sink node, the sensor node's Zig-Bee module is in sleep mode. After initialization, Zig-Bee module information processing. The network coordinator is from the working mode to waiting for connection request signaling for the response of the sensor node, and on the regular time, the sensor nodes take the initiative request to connect the network coordinator and report the detected security information inside the mine to the network coordinator. miners in underground mine tunnels. Wireless sensor networks applied in monitoring coal mine security breaks through the traditional methods and ideas, which improves the practical ability and flexibility of monitoring system. The flow chart diagram shown below:

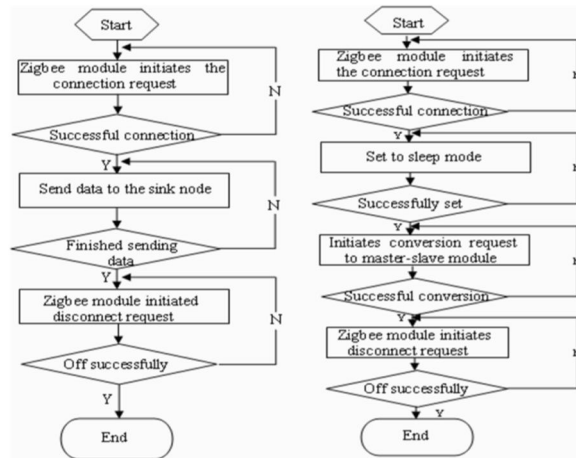


Figure 9 Design flow for initialization and processing

V. OUTPUT RESULT

A. The output of collection figure is given below

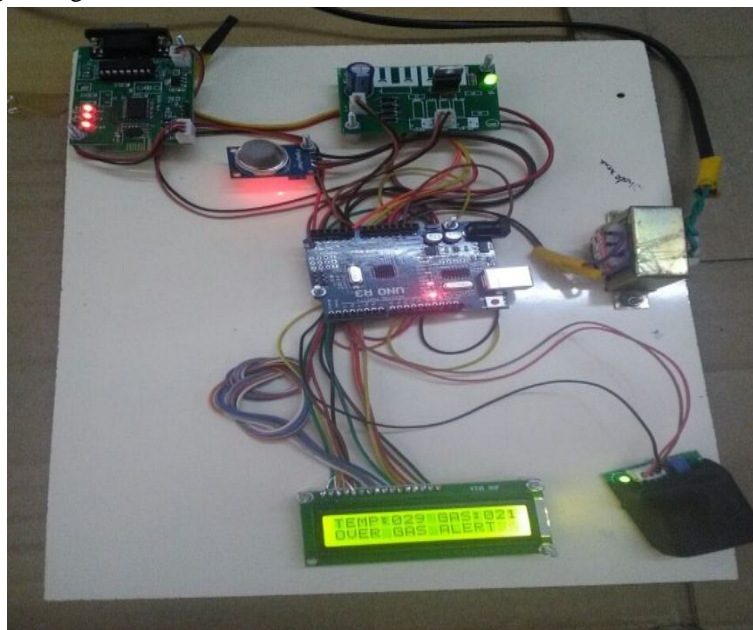


Figure 9. Transmitter section.

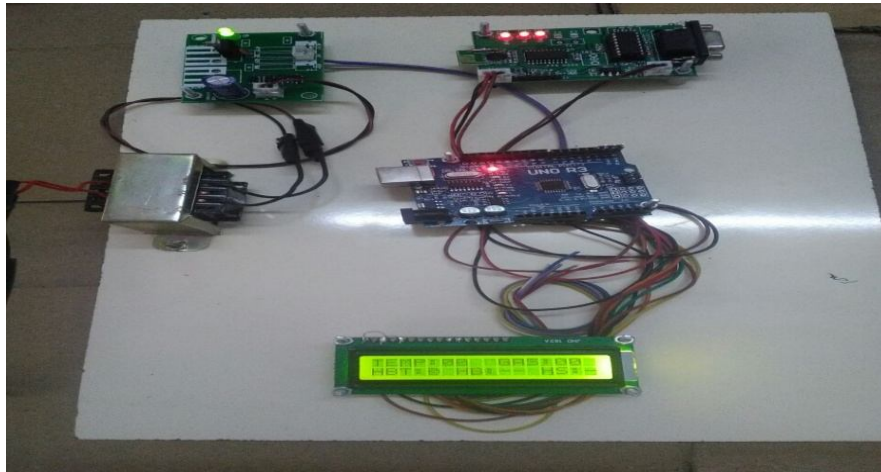


Figure 10. Receiver section

VI. CONCLUSION

This system can be used to monitor all kinds of parameters under the coal mine, but also can alarm automatically when environment parameters are abnormal to exceed the limitation, which help improve the level of monitoring safety production and reduce accident in the coal mine. Therefore, the coal mine Safety Monitoring system put forward in this article quite meets the need of coal mine safety monitoring. Traditional mine safety can be effectively replaced by surveillance and safety system proposed in this paper. Along with Temperature and Humidity used get the alerts regarding moistures and hazardous gases if detected at the Site of the Sensor node. This System can extend for multiple tunnels by using sensor network and every worker; vehicle information can be monitored on base station through web page. Web based online monitoring and operation of vehicle can be further extended in future.

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