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IoT Based Coal Mine Safety System Using Wireless Sensor Network

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Abstract: - *Safety is the most vital part of any type of industry. In the mining industry safety and security is a fundamental aspect of all. To avoid any types of accidents mining industry follows some basic precautions. Still accidents take place in underground mines due to rise in temperature, increased water level, and methane gas leakage. Here we provide safety to worker. When worker in danger he can press panic switch inform security. To enhance safety in underground mines, a reliable communication system must be established between workers in underground mines and fixed ground my system. The communication network must not be interrupted at any moment and at any condition. A cost-effective ZigBee based wireless mine supervising system with early-warning intelligence is proposed in this project. Worker status can be monitor over IoT.*

Keywords: - Temperature Sensor, Arduino UNO, Gas Sensor, Flow Sensor. LCD, ZigBee, etc.

I. INTRODUCTION

Mines are the world's most dangerous place to work because in the mines, explosion often happens and thousand people are dying. And a recent report state that in such mine accidents an average of around 12,000 people have died. Coal is a non-sustainable origin that cannot be widely replaced by humans, there are several mishaps of coalmines occurring in the mines, and the diggers are putting their lives at risk, by working in the coal mines, even once in a while they end up losing their lives in the coal mines that are an unfortunate part. Mainly such mishaps happen as a direct result of the old equipment and wired devices, resulting in the end, mishandling spillage of the noxious gases in the coal mines, pose tremendous hazards to the excavators inside the coal mines. So, we've designed the coalmine protection system to stay away from this problem. We tackled the issues in our research by testing each of the information collected by the sensors, we use and finishing the analysis using the Thinger system. Controlling can be done automatically or manually.

II. LITERATURE SURVEY

The rise of internet and internet of things technology has brought new opportunities for the construction of smart mines. This paper proposes a new type of coal mine safety production monitoring system based on IPv6 network transmission, aiming at the problems such as the transmission distance and the small system capacity encountered in the existing coal mine safety production monitoring system based on bus transmission. IPv6, as the core technology adopted by the next-generation Internet, will be applied to the transmission of coal mine safety monitoring systems, which can effectively realize underground coal mine safety production monitoring and solve the problems encountered in bus transmission. This paper proposes a coal mine safety production monitoring system based on IPv6 network transmission. The system adopts 6LoWPAN protocol, which mainly includes three parts: sensor, transmission network and client.

III. METHODOLOGY

A. Temperature Sensor:

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Temperature sensors are vital to a variety of everyday products. For example, household ovens, refrigerators, and thermostats all rely on temperature maintenance and control in order to function properly. Temperature control also has applications in chemical engineering. Examples of this include maintaining the temperature of a chemical reactor at the ideal set-point, monitoring the temperature of a possible runaway reaction to ensure the safety of employees, and maintaining the temperature of streams released to the environment to minimize harmful environmental impact. While temperature is generally sensed by humans as “hot”, “neutral”, or “cold”, chemical engineering requires precise, quantitative measurements of temperature in order to accurately control a process. This is achieved through the use of temperature sensors, and temperature regulators which process the signals they receive from sensors. From a thermodynamics perspective, temperature changes as a function of the average energy of molecular movement. As heat is added to a system, molecular motion increases and the system experiences an increase in temperature. It is difficult, however, to directly measure the energy of molecular movement, so temperature sensors are generally designed to measure a property which changes in response to temperature. The devices are then calibrated to traditional temperature scales using a standard (i.e., the boiling point of water at known pressure). The following sections discuss the various types of sensors and regulators.

Temperature sensors are devices used to measure the temperature of a medium. There are 2 kinds on temperature sensors: 1) contact sensors and 2) noncontact sensors. However, the 3 main types are thermometers, resistance temperature detectors, and thermocouples. All three of these sensors measure a physical property (i.e., volume of a liquid, current through a wire), which changes as a function of temperature.

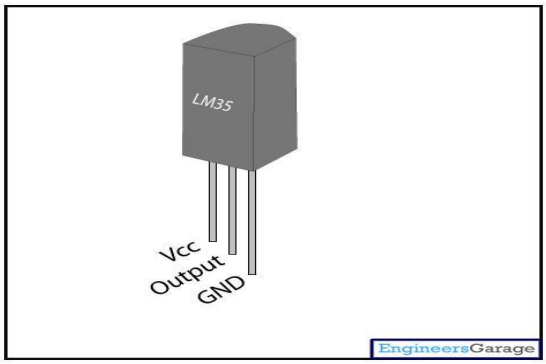

Figure 1: Temperature Sensor

B. Arduino UNO:

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to serial converter. & quot; Uno & quot; means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

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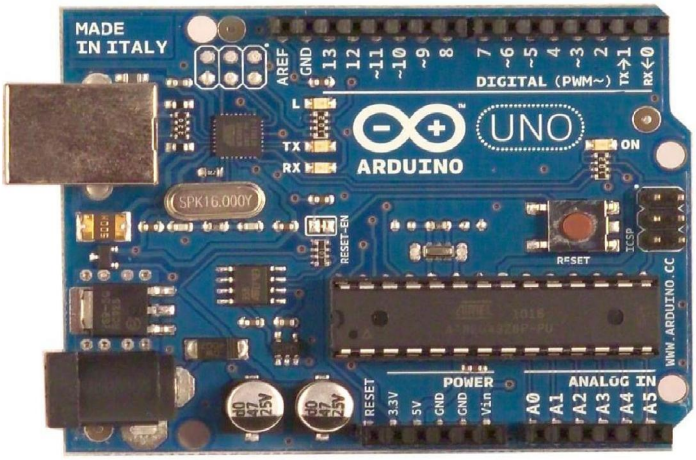

Figure 2: Arduino UNO

C. Gas Sensor:

Using a MQ sensor it detects a gas is very easy. You can either use the digital pin or the analog pin to accomplish this. Simply power the module with 5V and you should notice the power LED on the module to glow and when no gas it detected the output LED will remain turned off meaning the digital output pin will be 0V. Remember that these sensors have to be kept on for pre-heating time (mentioned in features above) before you can actually work with it. Now, introduce the sensor to the gas you want to detect and you should see the output LED to go high along with the digital pin, if not use the potentiometer until the output gets high. Now every time your sensor gets introduced to this gas at this particular concentration the digital pin will go high (5V) else will remain low (0V). You can also use the analog pin to achieve the same thing. Read the analog values (0-5V) using a microcontroller, this value will be directly proportional to the concentration of the gas to which the sensor detects. You can experiment with these values and check how the sensor reacts to different.

Figure 3: Gas Sensor

D. LCD (Liquid Crystal Display)

This is the first interfacing example for the Parallel Port. We will start with something simple. This example doesn't use the Bi-directional feature found on newer ports, thus it should work with most, if not all Parallel Ports. It however doesn't show the use of the Status Port as an input for a 16 Character x 2 Line LCD Module to the Parallel Port. These LCD Modules are very common these days, and are quite simple to work with, as all the logic required running them is on board.

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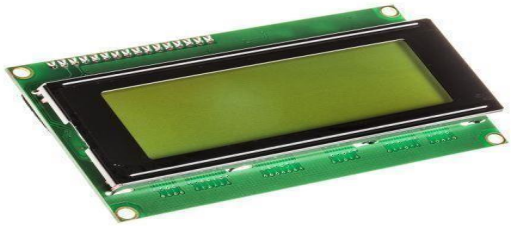

Figure 4: Liquid Crystal Display

E. Zigbee:

ZigBee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory. ZigBee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. Data transmission rates vary from 20 to 900 kilobits/second. The ZigBee network layer natively supports both star and tree typical networks, and generic mesh networks.

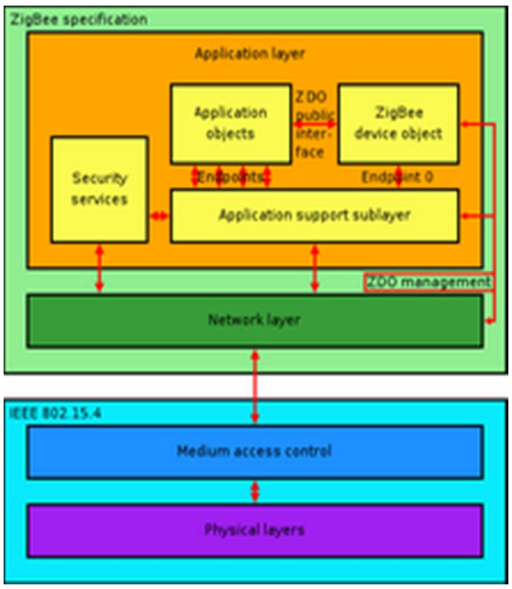

Figure 5: Zigbee

Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level.

ZigBee builds upon the physical layer and medium access control defined in IEEE standard 802.15.4 (2003 version) for low-rate WPANs. The specification goes on to complete the standard by adding four main components: network layer, application layer, ZigBee device objects (ZDOs) and manufacturer-defined application objects which allow for customization and favor total integration. Besides adding two high-level network layers to the underlying structure, the most significant improvement is the introduction of ZDOs. These are responsible for a number of tasks, which include keeping of device roles, management of requests to join a network, device discovery and security.

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IV. System Design

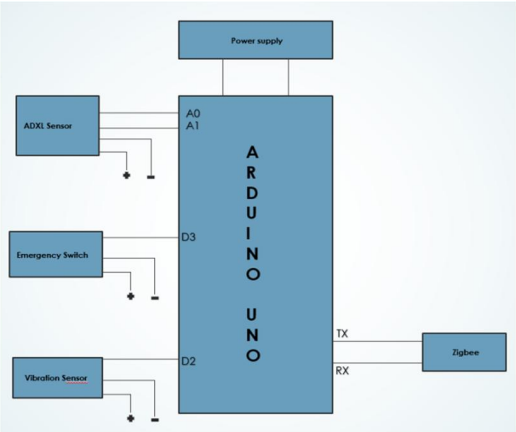


Figure 6: Block Diagram of Transmitter Side of Smart Helmet

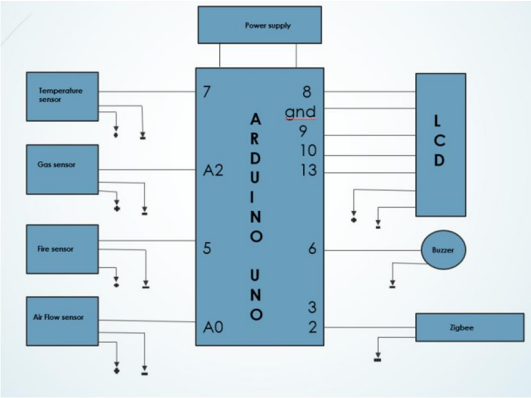
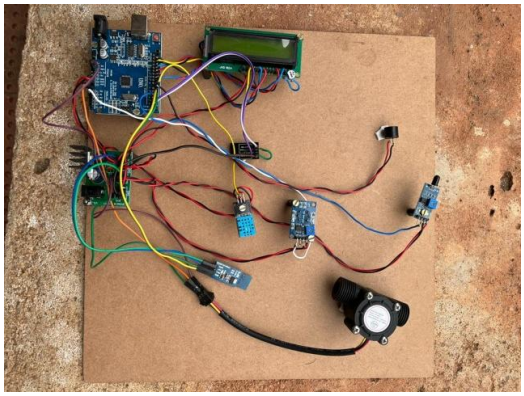


Figure 7: Block Diagram of Receiver Side of Base Station

V. Snapshots



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VI. CONCLUSION

Coal mine safety frame work is actualized utilizing Gas sensor, Temperature sensor, LCD and Zigbee technology to expand the well-being of the coal mine shift representatives and to guard them. The use of IoT in this device allows for continuous monitoring of the coal mine and alerting the workers. This device both reliable and cost effective.

With the installation of a real-time observation device, a clearer and additional objective is given for assessing mine point perspective, which leads to greater accuracy. In this case, this technique will display the parameters on the monitoring screen. Everybody who is currently working in the mine, as well as any worker, will profit from this proposal., who will be able to use it to avoid losing their lives in a work-related accident. When sensing element values have crossed the alarm threshold, the alarm goes off.

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