

AUTOMATIC FIRE DETECTION AND PREVENTION DEVICE IN MINING INDUSTRY

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ABSTRACT: Coal mining is extremely important in most developing countries in order to meet their energy demands. But at the same time the mining industry is facing many problems which mainly include the mine worker's safety. The underground mine environment is very complex. The major hazards such as Fire accidents in coal mines and the emissions of toxic gases like methane and carbon monoxide always occur in coal mines. The machine learning method is useful for determining whether or not the conditions are favorable for working in an underground mine. This project proposes a design of a RTOS with the help of a controller which is able to monitor the temperature, humidity, gas and status of smoke act as a fire extinguisher in an underground mine. This project proposes a mine safety monitoring system based on ATmega328P and ZigBee to achieve the safety factors. This system utilizes low power, cost effective a temperature sensor LM35, gas sensor and humidity sensor for sensing the environment condition in the coal mine and transmit the data to the workers and data monitoring unit. This system monitors the dangerous environment condition and simultaneously it acts as a fire extinguisher. The device provides a range of benefits in terms of monitoring, managing mine production, and safety management, as well as being a low-power platform.

KEYWORDS: Arduino UNO, ZigBee module, Temperature sensor LM35, Gas sensor, Humidity sensor, LCD, Relay, Motor, MOSFET, Pump ,Battery.

I. INTRODUCTION

When it comes to worker safety and health, underground mining activities tend to be a risky proposition. These dangers arise as a result of the various methods used to remove various minerals. The greater risk, the deeper mine. These issues of safety are of great concern, especially in the coal industry. As a result, worker protection should be a top priority in every form of mining, whether it's coal or other minerals. A public health policy based on the concept of occupational health reflects a skewed view

of health that leads to the exclusion of the workplace and work life from public health considerations. The reasons for this are that people are no longer seen as employees, but rather as customers, and work is being moved out of the healthcare sector. When it comes to coordinating healthcare systems, this allows workplace health to become divorced from public health. The manufacturing activities process is the most common source of problems in terms of worker health and safety.

Coal mine safety issues have steadily grown to be a major source of concern for society and the nation. The harsh climate and complex working conditions in coal mines are the primary causes of disasters. As a result, mine surveillance systems must be implemented for security reasons. Wired network systems are expected to become a standard in conventional coal mines, where they have played an important role in ensuring healthy output. Laneways have become blind zones, where various unknown threats are hidden out, as exploiting areas and depths have continued to expand. Furthermore, costly cables are difficult to obtain there, which is time consuming. As a result, it's critical to have a wireless sensor network mine monitoring system that can be installed in such mines to ensure safe production. In the current situation, this robot has gotten a lot of worldwide coverage. It's often used in medical, environmental, science, and military settings.

II. LITERATURE SURVEY

Robot with a sensor detects toxic gases and rescues people in the tunnel. It provides safety against fire explosions, poisoned gases like CO, CO₂, CH₄ and increased temperature level and it alerts people in tunnels. Gas concentration is meant for the fuel gases like methane and carbon-monoxide, carbon dioxide. A microcontroller is used with the sensors to receive the sensor outputs and to take the necessary decision. Once temperature is more than the safety level the buzzer activates. Again, once the measured carbon dioxide gas value is more than the safety level, it activates buzzer. It has dangerous accidents such as

collapse, gas explosion, CO, CO₂ poison gas, low O₂ content, high temperature, smoke, fire, water, etc. All these accidents can kill people easily. One such design is to send a robot inside a coal mine. A robot equipped with sensors for detecting various poisonous gases and a wireless transmitter and receiver can be used to monitor such an environment. The ZigBee had much better range than Bluetooth and hence it could transmit commands and receive data from long distance from the tunnel. LM35 has been used as a temperature sensor in the system. The operating temperature range is -55°C to 150°C. Gas sensor detect hazardous gases in coal mine.

In the hazardous environment, industrialized accidents occur. Due to which consequence may be very serious and it causes loss of environment, property and life. For moral, legal, & financial reasons hazardous environmental safety & security is more important wireless sensor network in industrial sites, the deployment of distributed point source where the dangerous parameters used, produced and stored is described seven characteristics, fundamental aspects for estimating and mission method were identified. For measurement of temperature using Virtual Instrumentation is by Automatic Process Control in many industries. Some project sources in WSN systems that monitor firework places are as follows:

III. PROPOSED SYSTEM

The environment's dangerous conditions such as temperature, gas, smoke, and humidity are the main key features of the proposed intelligent security system monitors. The robot enters and passes through the coal mine, detecting dangerous gas and providing protection against explosions, poisoned gases such as CO, CO₂, and CH₄, as well as alerting people in the tunnel.

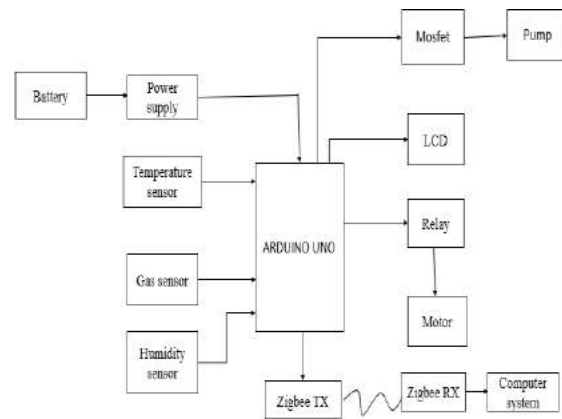


Figure 1 Block Diagram

A. ARDUINO UNO



Figure 2 Arduino UNO

Arduino is (shown in Figure 2) a single-board microcontroller designed to simplify the development of interactive objects and environments. It's intended to make using electronics in multidisciplinary projects more available. Arduino can sense its surroundings by collecting data from a variety of sensors. It can be used to power lights, engines, and other activated devices. The Arduino software IDE can be used to programme the Arduino Uno (integrated development environment). The Arduino Uno's Atmega328 is pre-burned with a Bootloader, allowing users to upload new code without the use of an external hardware programmer. The Arduino IDE is platform-agnostic.



B. ZIGBEE

Figure 3 Zigbee Module

Zigbee is (is shown in Figure 3) a low-cost, low-power wireless IoT network technology that was developed as an open global standard. The IEEE 802.15.4 physical radio specification underpins the Zigbee standard, which operates in unlicensed bands such as 2.4 GHz, 900 MHz, and 868 MHz. Z

C. TEMPERATURE SENSOR

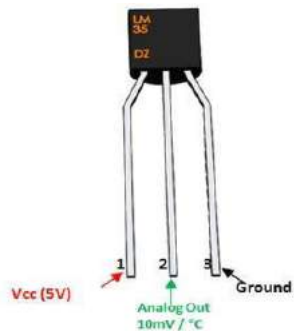


Figure 4 Temperature sensor

The LM35 is a temperature sensor (shown in Figure 4) that produces a proportional analogue signal to the current temperature. The output voltage can be easily translated into a Celsius temperature reading. The advantage of the lm35 over the thermistor is that it does not need to be calibrated externally. It's also protected from self-heating thanks to the coating. It is popular among hobbyists, DIY circuit makers, and students because of its low cost (approximately \$0.95) and higher accuracy. Many low-cost products take advantage of the LM35's low cost and increased

accuracy. Although the sensor has been around for over 15 years, it is still in use in a variety of products.



D. GAS SENSOR

Figure 5 Gas Sensor

The MQ2 gas sensor is (shown in Figure 5) one of the most widely used in the MQ sensor series. It's a Metal Oxide Semiconductor (MOS) type Gas Sensor, also known as Chemi-resistors, because the detection is based on a change in the sensing material's resistance when the Gas comes into contact with it. Gas concentrations can be detected using a simple voltage divider network. The MQ2 Gas Sensor runs on 5V DC and consumes about 800mW. It has a detection range of 200 to 10000ppm for LPG, Smoke, Alcohol, Propane, Hydrogen, Methane, and Carbon Monoxide.

E. HUMIDITY SENSOR



Figure 6 Humidity Sensor

A humidity sensor is (shown in Figure 6) an electronic device that detects humidity in its surroundings and converts the data into an electrical signal. Moisture is measured and reported using a humidity sensor.

Humidity sensors come in a variety of sizes and functions.

F. RELAY



Figure 7 Relay

A relay is (shown in Figure 7) an electromechanical device that makes or breaks an electrical connection. It consists of a flexible moving mechanical part that can be controlled electronically through an electromagnet; in other words, a relay is similar to a mechanical switch, but instead of manually turning it on or off, you can control it with an electronic signal. This relay working principle is only applicable to electromechanical relays.

G. LIQUID-CRYSTAL DISPLAY



Figure 8 LCD

A liquid-crystal display (LCD) is (shown in Figure 8) a flat-panel display or other electronically modulated optical device that uses liquid crystals and polarizers to modulate light. Liquid crystals do not directly emit light; instead, they use a backlight or reflector to create colour or monochrome images.

H. DC MOTOR



Figure 9 Motor

A DC motor is (shown in Figure 9) an electric machine that converts electrical energy into mechanical energy. DC motors use direct current to convert electrical energy into mechanical rotation.

I. METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR



Figure 10 MOSFET

The MOSFET (P55NF06) is (shown in Figure 10) a three-terminal N-channel silicon MOSFET with a current conduction capability of around 50A and a fast switching speed. Low on-state resistance, 60V breakdown voltage, and 4V maximum threshold voltages. The thin semi 50N06 is a three-terminal silicon device with a current conduction capability of approximately 50A and a fast switching speed. Low on-state resistance, 60V breakdown voltage, and 4V maximum threshold voltages. Electronic ballasts and low-power switching mode power appliances are the most common applications.

J. MOTOR PUMP



Figure11 Pump

A motor pump is (shown in Figure 11) a mechanical system that uses mechanical action to transfer liquids or gases from one location to another. The water pump transforms the motor's energy from mechanical to fluid flow as its operating concept. Mechanical pumps are used in a wide variety of applications, including water pumping from wells, aquarium and pond filtering, and in industries such as automotive, energy, and medicine.

RESULT



1. LM35 and humidity sensors can be used to monitor temperature and humidity levels.
2. A gas sensor is used to identify hazardous gases.
3. In a coal mine, when a flame is detected by a temperature sensor, the Robot extinguishes it.

4. Using Zigbee wireless technology, the computer device displays the temperature, humidity, and gas values.

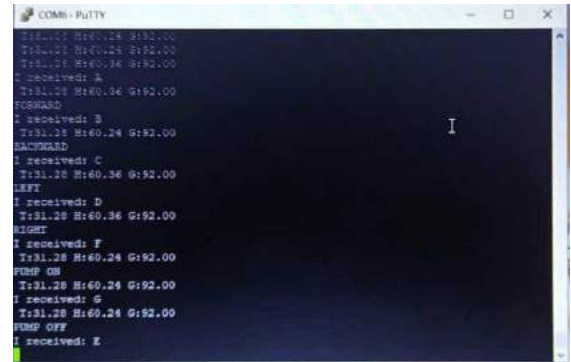


Figure 11 software result

IV. CONCLUSION

This scheme is beneficial to coal mine employees. This robot enters unsafe conditions and gathers data on different gases. This prototype device includes a temperature sensor that senses and extinguishes a coal mine fire. LM 35 sensor robots use MQ135 to identify environmental hazards in coal mines by monitoring physical parameters, which are then observed.

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