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Zigbee Based Underground Coalmine Safety System with IOT Technology

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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 mine 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-

IOT based system, zigbee,, PIC Microcontroller ,wifi, zigbee ,temperature sensor , gas sensor , water level sensor

I. INTRODUCTION

The coal mining industry is inherently dangerous, with numerous hazards such as gas leaks, fire risks, temperature fluctuations, and humidity issues threatening the safety of workers. In the event of a coal mine disaster, it is often difficult for rescuers to assess the condition of the mine tunnels due to the risk of further explosions.

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 states that in such mine accidents an average of around 12,000 people have died. Coal is a nonsustainable 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. PROBLEM STATEMENT

Underground coal mining is inherently hazardous due to risks such as gas leaks, fires, cave-ins, and equipment failures. Traditional safety monitoring systems often rely on wired communication, which is prone to damage in harsh underground environments. Additionally, real-time monitoring and emergency response capabilities are limited, leading to delays in detecting and addressing potential threats. To address these challenges, a Zigbee-based Underground Coal Mine Safety System with IoT Technology is proposed. This system will utilize Zigbee wireless mining communication to create a reliable, low-power, and scalable sensor network for real-time monitoring of environmental conditions such as temperature, humidity, gas concentrations (methane, carbon monoxide), and worker location tracking. The collected data will be transmitted to an IoT platform, allowing remote monitoring and instant alerts for hazardous conditions. By integrating Zigbee technology with IoT, the system aims to improve mine safety, enhance emergency response times, and reduce the risk of -related accidents, ensuring a safer working environment for miners.

III. METHODOLOGY

System stores data for future analysis, auditing, and Hazard Identification and Risk Assessment Identify potential hazards in the mine, such as gas leaks, explosions, and rockfalls. Sensor Node Deployment Strategically deploy Zigbee sensor nodes throughout the mine to monitor environmental parameters**.** DataCollection and TransmissionSensor nodes collect data and transmit it to the IoTgateway using Zigbee communication protocol.

Data Processing and AnalysisIoT gateway processes and analyzes data, detecting anomalies and potential hazards.Alert and Notification System sends alerts and notifications to miners, supervisors, and safety personnel via the user interface. Real-time Monitoring and Control Authorized personnel can access real-time data and control the system remotely. Data Storage and Retrieval compliance purposes**.**

IV. BLOCK DIAGRAM

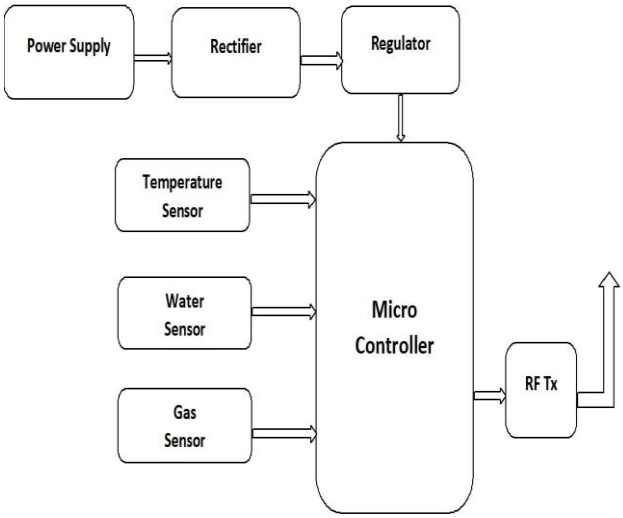

Fig : Block Diagram Of Transmitter

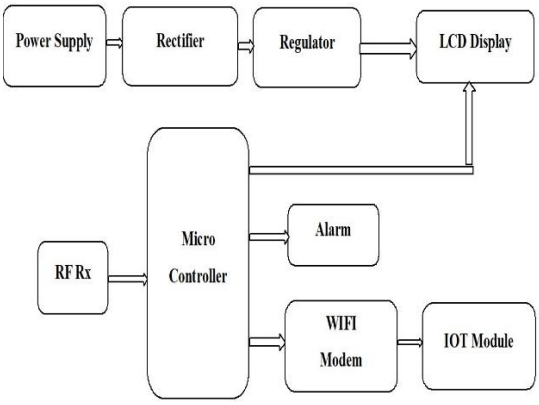

Fig : Block Diagram Of Receiver

V. COMPONENTS USED

1. ARDUINO NANO

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P (Arduino Nano 3.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 board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

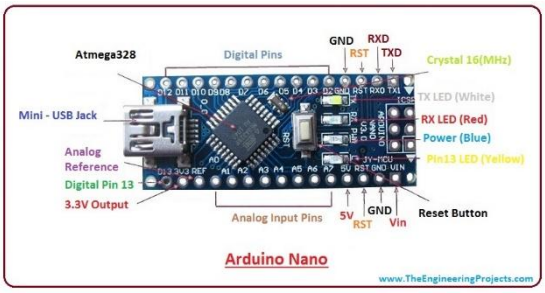

Fig: ARDUINO NANO

2.LED

A light-emitting diode (LED) is a semiconductor light source. LED's are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LED's emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness.

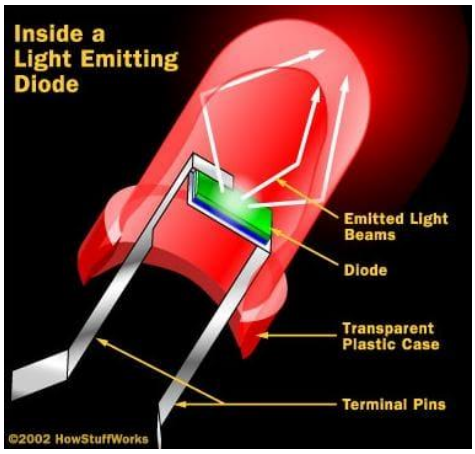

Fig : LED

3. TEMPERATURE SENSOR

Temperature is the most-measured process variable in industrial automation. Most commonly, a temperature sensor is used to convert temperature value to an electrical value. Temperature Sensors are the key to read temperatures correctly and to control temperature in industrials applications.A large distinction can be made between temperature sensor types. Sensors differ a lot in properties such as contact-way, temperature range, calibrating method and sensing element. The temperature sensors contain a sensing element enclosed in housings of plastic or metal. With the help of conditioning

Circuits,the sensor will reflect the change of environmental temperature.

Fig: TEMPERATURE SENSOR

4. GAS SENSOR

A gas sensor is a device which detects the presence of various gases within an area, usually as part of a safety system. This type of equipment is used to detect a gas leak and interface with a control system so a process can be automatically shut down. A gas detector can also sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave the area. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals.

Fig: GAS SENSOR

5. WATER LEVEL SENSOR

Water Level sensors are used to monitor and regulate levels of a particular free-flowing substance within a contained space. These substances are usually liquid, however level sensors can also be used to monitor some solids such as powdered substances. Level sensors are widely used industrially. Cars use liquid level sensors to monitor a variety of liquids, including fuel, oil and occasionally also specialist fluids such as power steering fluid. They can also be found in industrial storage tanks, for slurries, and in household appliances such as coffee machines. Basic level sensors can be used to identify the point at which a liquid falls below a minimum or rises above a maximum level. Many sensors can detail the specific amount of liquid in a container relative to the minimum/maximum levels, to provide a continuous measurement of volume.

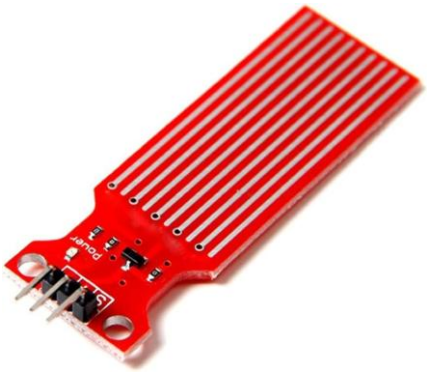

Fig: WATER LEVEL SENSOR

6. LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

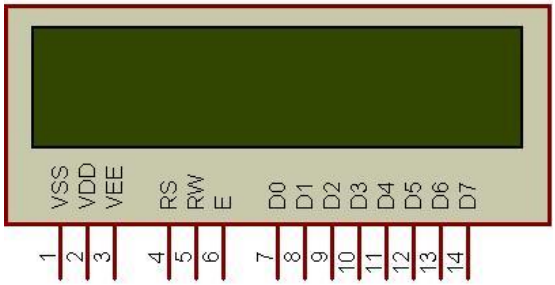

Fig: 16x2 LCD

7.BATTERY POWER SUPPLY

A battery is a type of linear power supply that offers benefits that traditional line-operated power supplies lack: mobility, portability and reliability. A battery consists of multiple electrochemical cells connected to provide the voltage desired

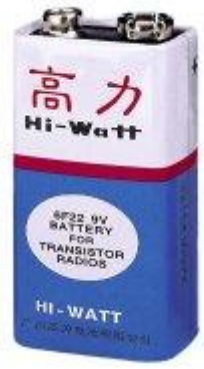

Fig: Hi-WATT 9V BATTERY

8. ZIGBEE

Zigbee is a wireless technology developed as an open global market connectivity standard to address the unique needs of low-cost, low-power wireless IOT data networks. It is designed to support wireless communications, monitoring, and control of battery-operated devices and sensor networks. Zigbee devices can transmit data over long 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.

Fig: ZIGBEE

RESULT: -

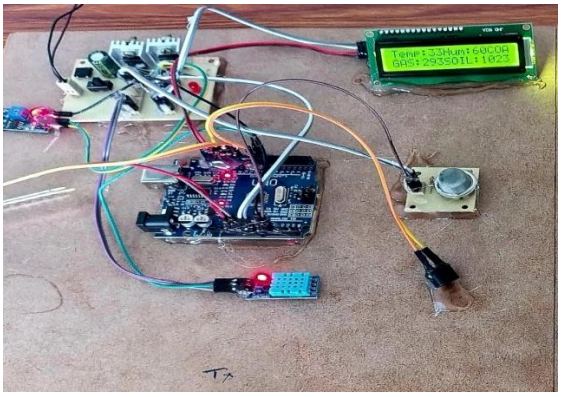

Fig : MINE UNIT

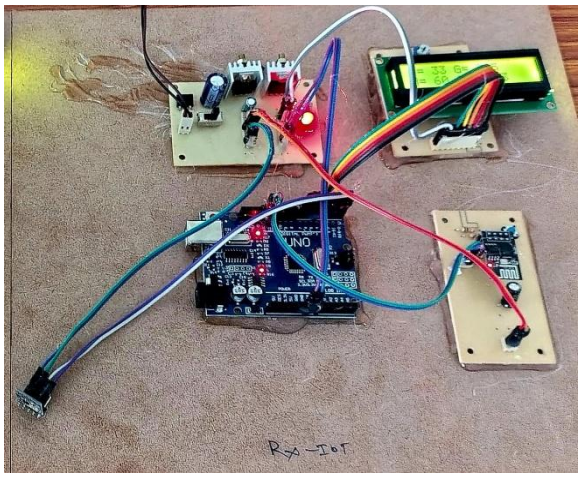

Fig**:** CONTROL UNIT

CONCLUSION: -

The proposed Zigbee-based underground coal mine safety system with IoT technology provides a reliable, efficient, and cost-effective solution for ensuring the safety of miners and preventing accidents. The system's ability to monitor environmental parameters, detect hazards, and alert authorities in real-time makes it an invaluable tool for enhancing mine safety.

The proposed system has the potential to revolutionize underground coal mine safety, and its implementation can significantly reduce the risk of accidents and improve the overall safety of miners.

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