IoT based Coal Mine Safety Monitoring and Alerting System using Robotics

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Abstract: The country's coal mines are a vital part of the economy since coal is a key ingredient in the steel and cement production processes, which in turn extract iron from rocks and produce cement. It is imperative that all parameters, including methane gas, high temperatures, fire occurrences, etc., be monitored on a regular basis in the underground mining industry. Workplace safety must be strictly enforced in coal mines because of the wide range of tasks carried out there and the inherent complexity of the mining environment. In response to this, a system is in place to keep an eye on gas leaks, temperature and humidity levels, and fire sensors, among other fundamental safety precautions, in coal mines. The sensors are integrated into one unit and subsequently positioned within a coal mine.

Index Terms **- Alerting System, Safety Monitoring, Coal Mine Safety Monitoring.**

I. INTRODUCTION

Coal mine success is heavily dependent on conventional coal mine monitoring systems, which are typically wired association systems [1–5]. It is extremely difficult to repair or replace the wired network in the event of an explosion. Fixing those networks will be a time-consuming process. We devised and executed the Internet of Things–based coal mine safety measurement system to circumvent this. The device monitors the state of the underground mine by establishing a Wireless Sensor Network (WSN) with the help of an Arduino UNO controller [6-8].

This reduces coal mineshaft accidents and improves production safety control. While installing a link for subterranean inspection is a difficult, time-consuming, and expensive procedure, remote sensor networks consist of thousands of tiny sensor hubs that are cheap, lightweight, and portable [9–10].

In this model, one can find gas, temperature, humidity (AM2302), heart rate, vibration, MEMS, a power supply, an LED display, and a ringer, among other sensors [11–12].

II. COAL MINE SAFETY MONITORING AND ALERTING SYSTEM

The world's most plentiful fossil fuel is coal. The majority of the world's electricity comes from this source. Coal is a primary energy source for many large-scale companies, including those producing steel and cement, in addition to producing electricity.

Coal is obtained by means of mining. The history is littered with catastrophes and mishaps that happened during coal mining. Coal mine disasters killed over 12,000 people, according to a recent research. Disasters and catastrophes continue to occur, either as a result of the increasing warmth or the rise in water levels caused by the escape of toxic gas, despite the fact that the Mining Industry Authority has implemented numerous safety measures. The application of the conventional or antiquated approach also results in accidents.

Our team of Internet of Things experts has developed a "coal mine safety monitoring system"–based gadget to prevent such disasters. A slave controller and a master controller make up this system. Slave controllers are able to identify system problems by scanning their surroundings. The controller uses the RF module to alert the master controller of the problem once it has been identified. With the help of the IoT Gecko platform, the master controller module notifies the coal mine and sends an alert message through the IoT module.

The master controller circuit makes use of the ATMEGA 328 microcontroller. The circuit for the slave controllers makes use of the 8051 microcontrollers. The temperature, methane, water, and other sensors are all connected to the slave controller so that the monitoring may be done efficiently.

III. METHODOLOGY

A. Components for coal mine safety monitor system

Hardware Requirements

- Atmega Microcontroller
- RF Module
- Wi-Fi Module
- Temperature Sensor
- Water Sensor
- Methane Gas Sensors

- LCD Display
- Resistors
- Capacitors
- Transistors
- Diodes
- PCB and Breadboards
- LED
- Transformer/Adapter
- Push Buttons
- Switch
- IC and IC sockets
- Wires and Connectors

Software Requirements

- IOT Gecko
- C Programming Language

Advantages

- Completely autonomous system.
- Notifies the ground mining system instantly of any irregularities.
- Concurrently detects gas leaks, water level, and temperature.
- Totally cordless setup.

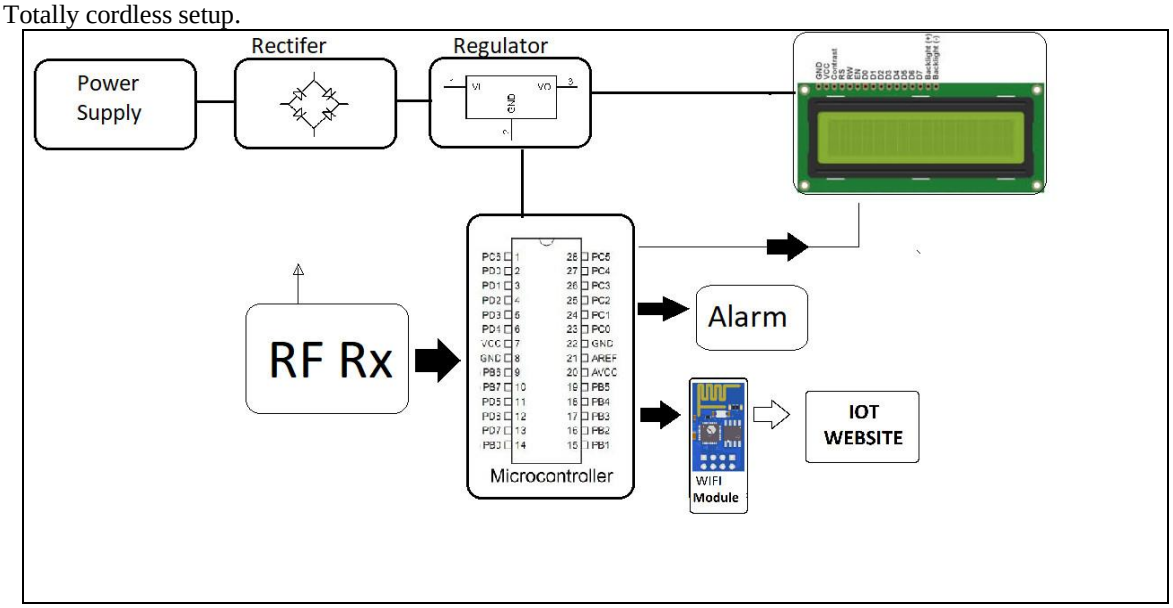

Figure 1. Transmitter block diagram of coal mine safety monitoring system

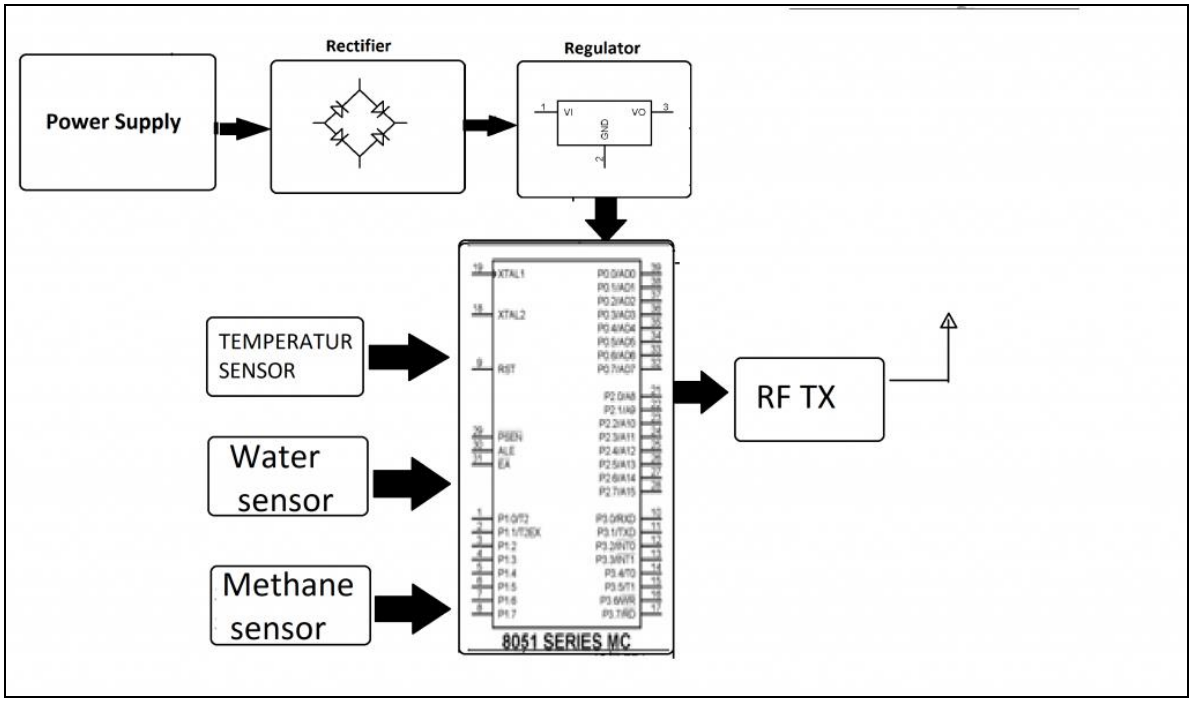

Figure 2. Receiver block diagram of coal mine safety monitoring system

IV. RESULTS AND DISCUSSION

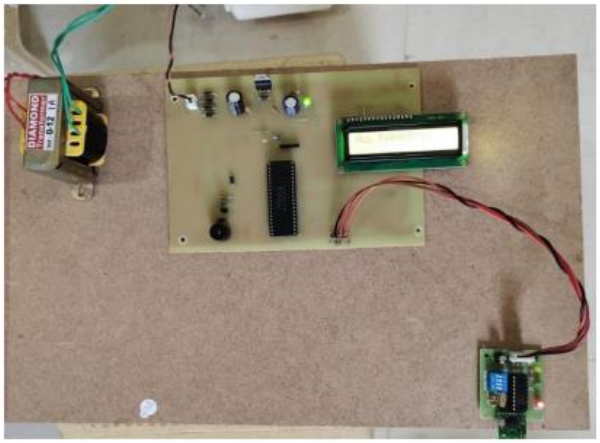

Figure 3. Control unit

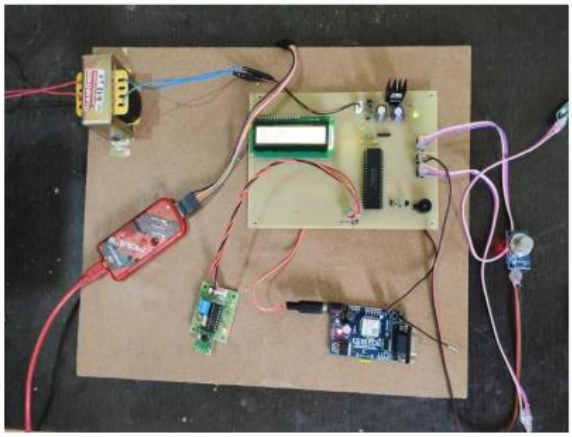

Figure 4. Mine unit

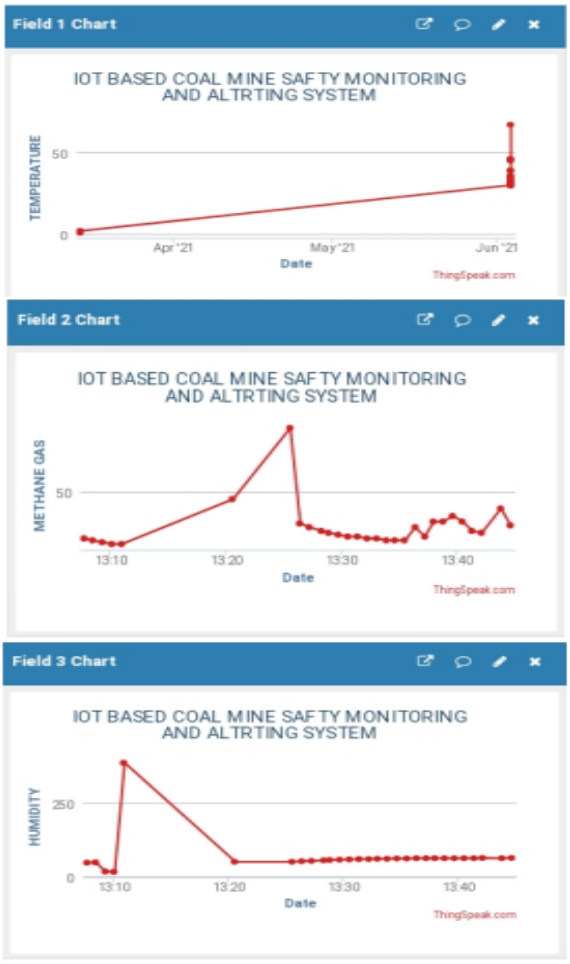

Fig.5 Output on IoT website

The above figure shows that the intended system will present an alert message on the LCD display and sound an alarm whenever the parameters surpass the preset limit. For example, if the temperature is 500C, the gas concentration is 50, or the humidity is 250, the system will sound an alarm. Internet of Things (IoT) websites also provide this data to remote individuals, which aids in the prevention of hazardous hazards.

V. CONCLUSION

This approach proposes using an Arduino microcontroller to build a model of a mine safety system. The hardware and software components that make up this gadget are interdependent. A number of sensors make up the hardware, while an Android app communicates with an Arduino board and other peripherals through the internet of things to power the software. Signals and a database are components of the android-based programme that display and insert sensor readings through hardware. One way to achieve both goals—improvement in mining safety and protection—is to leverage the wireless community. This study's overarching goal is to streamline the process of mining unit monitoring and update transmission over cellular networks. Every one of the sensors can communicate with this device's hardware parts. Using environmental sensors and a microcontroller to routinely turn on and off the buzzer in the event of an unstable condition, this project optimises the use of the mining subject without human intervention. Ensuring the protection and well-being of employees and property is now a necessity for maintaining mining operations. In order to monitor mining security and update data at the IoT websites, sensors integrated with arduino, petrol, temperature, and humidity are being used to enhance coal mine security for workers.

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