Surveillance and Safety System for Underground Coal Mines

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Abstract: Coal is mainly used to produce electricity and also it is one of the major economies of the country. There are thousands of mine workers were lost their lives every year due to many hazardous incidents takes place under coal mine. These hazardous incidents are caused due to the leakage of toxic gas in the mine. The complexity of the mining environment results in difficult to monitor the working environment. To reduce this complexity and to concern the miner's safety the new advanced system which monitors the coal mine such as temperature, amount of toxic gas present in the mine. The analysed data isreporting to server through IoT if any critical situation occurs like high temperature or the oxygen shortage, the immediate action will be taken by releasing oxygen or by releasing co_2 to save the life of miners.

Keywords: Coal mine, Monitoring system, Auto rescue coal mine system, monitoring with life saver

I.INTRODUCTION

Coal plays a major role in electricity generation worldwide. Most of the global electricity is powered by coal. Million tons of coal is mined every year and the requirement is increasing day by day. Coals are mined in underground and opencast pits where underground mining is hazardous due to leakage of gases and mind collapse. Most of the accidents go unreported as mines mainly consist of random passages and branch tunnels. This structure makes it difficult for the deployment of any network. Due to presence of CH_4 gas, and coal powder, Coal mining is considered significantly more dangerous than hard rock mining.So, safety is the necessary factor to be considered in mining industry.Thus, the mining safety is done through IoT. Internet of Things (IoT) is nothing but the devices(things) communicating with each other by using the internet.European Research Cluster on the Internet of Things classifies major IoT applications as smart buildings, smart transportation, Smart energy, smart industry, smart health and the smart city as major areas. IoT is a trend-setting innovation in which all the data from sensors is stored in the cloud where it can be easily accessed from the cloud. Sensors and actuators are used for gathering the data and sending across the internet. We use cloud not only to store data but also for data analysis, gathering, visualization.

II.LITERATURE SURVEY

Lihui et al [1] implemented a system, where temperature, humidity, methane values of the coal mine are collected by the sensor nodes and the information is collected by ARM controller for processing, for communication purpose Zigbee is utilized. If any esteems go high, then an SMS is sent to maintain the safety of the workers. Al [2] described a system that is based on ARM controller and different sensors like temperature sensor, humidity sensor and the gas sensor. An IR sensor is placed in the mine to check the conditions. Wakode et al [3] suggested a system that mainly used to monitor the concentration of dangerous

gases in the coal mines. To provide safety the systems give the alerts that will be helpful to the workers in the mine to save their lives. An alert switch is placed at the transceivers and receivers' side for emergency purpose. Aarti et al [4] developed a system that monitors temperature, humidity, methane values in the coal mine and all the values are sent to the ARM9 processor and a using a Wi-Fi module the values are continuously updated in the webpage.Dong et al [5] proposed a coal Mine safety Monitoring framework dependent on Zigbee and GPRS remote transmission was established. WithGPRS innovation,remoteinformation transmission was accomplished and informed through the short message sent to his cell phone, which adds to the early ID of genuine mishaps and continuous treatment, subsequently expanding the security of coal mining.Madhu et al [6] developed a coal mine safety monitoring system by utilizing Temperature, humidity and the amount of carbon-dioxide present are checked. If any uncertain condition occurs, then message is sentwith the help of GSM to the forest and fire departments. Yogendra S Do hare [7] Google Scholar, Indian School Of Mines, Dhanbad. This paper examines recent technical advances in the field of communication and environmental monitoring in underground coal mines. It emphasizes the suitability of using a recently established wireless sensor network for this purpose, as recommended by several academics from around the world. Yongping Wu, Jasmine Kavitha, Sundar, Rajesh [8] A Bluetooth-based underground mine monitoring system monitors and transmits real-time changes in gas concentration over a wireless communication network. In order for the person to be able to deal with the risk.TanmoyMaity and ParthaSarathi Das [9] a microcontroller is utilized to collect data and make decisions, after which mine workers are notified via alarm and voice system. The voice system, which includes both a microphone and a speaker, converts to a digital signal and communicates with the ground control centre computer wirelessly.But in his concept, there many drawbacks to safe the life of miners.

III. PROPOSED WORK

The coal mine safety systems has different gas sensor modules, temperature/humidity sensor, fire sensor, buzzer, O_2 cylinder and CO_2 cylinder to extinguish the fire. We integrate all the sensors to the Atmega328p microcontroller. First, we need to create an account in the thingespeak platform. In this system we mainly have monitoring and controlling systems monitoring system we monitor all the data from different sensors. Gas sensor detects the toxic gas in the coal mine environment, if the gas like SO_2, CH4exceeds the normal level then the buzzer gets high so that the mine workers get notified and the oxygen cylinder will be open. These sensor values are continuously uploaded to the cloudfor analysis and for further use. The temperature and humidity values are also he monitored inside the coalmine. In case any fire accidents occur, then immediately fire alert messages are sent to the authorized person's mail and the link of the location is shared. Controlling system is completely done using thingspeak platform. In the thingspeak platform, we create widgets .by using the widgets we control buzzer manually.Choosing a sensor is a toughestone, according to the application requirements we mustselect sensors, if the system has to sustain for long time sensors should work accurately, they should be reliable**.**

IV.METHODOLOGY

This whole system is used to analyse the working environment at various locations in the mining industry. The block diagram fig1. Shows, the consists of sensors and a display unit. The Atmega328p absorbs the observed data from the sensors placed in the mining unit and stores it in the cloud. An alarm message is issued to the control room if the mining parameters exceed the threshold level. If a hint of flame is found, the buzzer will sound to tell the miners and the fire extinguisher will be turn on and oxygen cylinder will be open if it is needed.

The fire will be occurred only by the flammable gas inside the coal. So, the MQ5 sensor reads the presence of flammable and toxic gases continuously and send the data through IoT to the Thinger platform and the system protect from that toxic substance by releasing CO_2 and O_2.

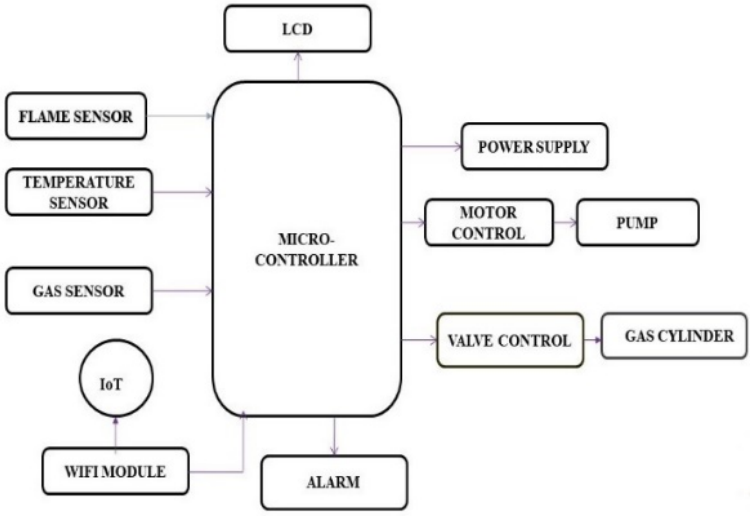
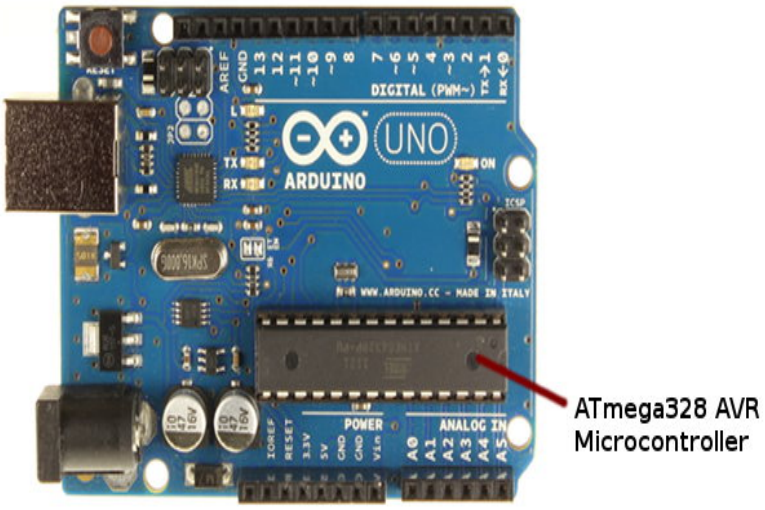


Fig1. Block diagram of proposed system

MICROCONTROLLER (ATMEGA 328):



This is one of our concepts heart of the system to control all the parameters as well as other microcontrollers to rescue and safeguard the coal miners life. A miniaturized scale controller may be a little PC on a solitary coordinated circuit containing a processor centre, memory, and programmable info/yield peripherals. A microcontroller contains the processor (which all PCs have) and memory, and some information/yield sticks that you can control. (Regularly called GPIO - General Purpose Input Output Pins). We will utilize the Arduino Uno board. This consolidates a small-scale controller alongside the entirety of the additional items to make it simple for you to fabricate and investigate your activities. The Uno is a micro controller board dependent on the ATmega328P. It has 14 computerized input/yield pins (of which 6 can be utilized as PWM yields), 6 simple data sources, a 16 MHz quartz precious stone, a USB association, a force jack, an ICSP header and a reset button. It contains everything expected to help the micro controller; just associate it to a PC with a USB link or force it with an AC-to-DC connector or battery to begin. You'll tinker together with your UNO without stressing tons over accomplishing something incorrectly, most dire outcome imaginable you'll substitute the chip for a few of dollars and begin once more. "Uno" signifies one in Italian and was picked to check the arrival of Arduino Software (IDE) 1.0. The Uno board and form 1.0 of Arduino Software (IDE) were the reference variants of Arduino, presently advanced to more up to date discharges. The Uno

board is the first in a progression of USB Arduino sheets, and the reference model for the Arduino stage; for a broad rundown of current, past or obsolete sheets see the Arduino list of sheets. This is a moderately simple approach to make circuits rapidly. Breadboards are made for doing brisk trials. They are not known for keeping circuits together for quite a while. At the point when you are prepared to make an undertaking that you need to remain around for some time, you should consider an elective strategy, for example, wirewrapping or fastening or in any event, making a printed circuit load up (PCB). The principal thing you should see about the breadboard is the entirety of the openings. These are separated into 2 arrangements of segments and a lot of lines (the columns are partitioned in the middle). The sections are named a, b, c, d, e, f, g, h, I, and j (from left to right). The columns are numbered 1 - 30. (Through and through). The segments on the edges don't have letters or numbers. The segments on the edges are associated start to finish within the breadboard to make it simple to supply force and ground. (You can consider ground the negative side of a battery and the force as the positive side.) For this book our capacity will be +5 volts. Within the breadboard, the openings in each line are associated up to the break in the board. For Example: a1, b1, c1, d1, e1 all have a wire within the breadboard to associate them. At that point f1, g1, h1, i1, and j1 are completely associated. However, a1 can't to f1. This may sound confounding now; however, it will immediately come to bode well as we wire up circuits.

TEMPERATURE SENSOR (DHT 11):

The Arduino temperature sensor transforms the ambient temperature to electricity. It also converts the voltage to Celsius, then to Fahrenheit, and displays the Fahrenheit temperature on the LCD panel. We'll utilise a low-voltage temperature sensor (TMP 36).

- The DHT22 sensor has a better resolution and a wider temperature and humidity measurement range.
- Temperature range: 0^0C to 50^0C.

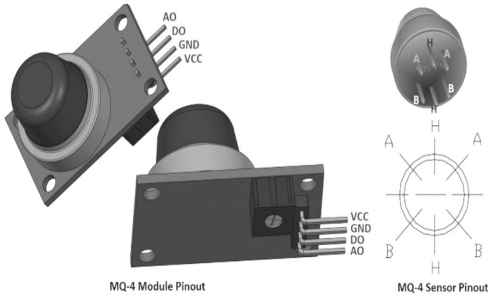
The first and third pin is used for the purpose of power supply and middle pin is used for sending data in form of Analog signals.

FLAME SENSOR

The Functioning of Flame Sensors and Their Applications. A flame sensor is a sensor this is maximum touchy to everyday light. This is why flame alarms rent this sensor module. This sensor detects flame while the light source emits among 760 and 1100nm. Here we are using to detect the fire inside the coal mine and extinguish that with the help of CO_2 and water.

GAS SENSOR

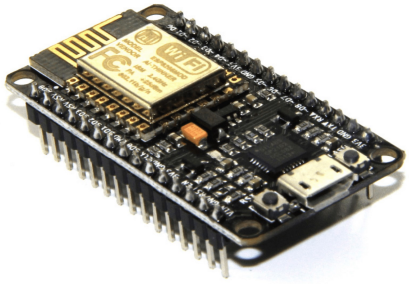
The gas sensor is classified into different types but in our concept, we use MQ5 gas sensor to sense the toxic and flammable gas and if the system finds the presence of that gases the immediate action will be taken to safeguard the coal miners.



A gas finder is a gadget that recognizes the nearness of gases in a territory, frequently as a major aspect of a wellbeing framework. This kind of hardware is utilized to recognize a gas spill or different outflows and can interface with a control framework so a procedure can be consequently closed. A gas identifier can sound a caution to administrators in the region where the hole is happening, allowing them the chance to leave. This kind of gadget is significant in light of the fact that there are numerous gases that can be destructive to natural life, for example, people or creatures. Gas locators can be utilized to distinguish ignitable, combustible and lethal gases, and oxygen exhaustion. This sort of gadget is utilized broadly in industry and can be found in areas, for example, on oil rigs, to screen fabricate forms and rising advances, for example, photovoltaic. They might be utilized in firefighting. Gas spill location is the way toward distinguishing conceivably unsafe gas

spills by sensors. Furthermore, a visual recognizable proof should be possible utilizing a warm camera these sensors as a rule utilize a perceptible caution to alarm individuals when a perilous gas has been identified. Presentation to lethal gases can likewise happen in tasks, for example, painting, fumigation, fuel filling, development, exhuming of debased soils, landfill activities, entering bound spaces, and so forth. Regular sensors incorporate burnable gas sensors, photoionization locators, infrared point sensors, ultrasonic sensors, electrochemical gas sensors, and metal-oxide-semiconductor sensors (MOS sensors). Infrared imaging sensors have come into utilization. These sensors are utilized for a wide scope of uses and can be found in mechanical plants, processing plants, pharmaceutical assembling, fumigation offices, paper mash factories, airplane and shipbuilding offices, hazardous materials activities, squander water treatment offices, vehicles, indoor air quality testing and homes.

ESP 8266 NODE MCU

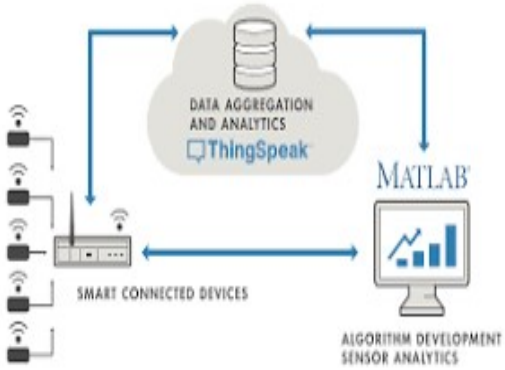


To begin, it can use the command to see if it is already connected to one: This will show the IP address of our ESP-01 module's station. Here we are used as microcontroller for sensors and used as wireless communicator to monitor the parameters inside the coal to protect the coal miners. If the previous command does not return an IP address, try the following command to connect to your network: To connect to your Wi-Fi network, type its name and password.

SOLENOID VALVE

A solenoid valve is an electromechanically operated valve.In our daily life we are using solenoid valve in Home electric appliances such as washing machine, reverse osmosis (RO), etc. In our project we are using this valve to open the oxygen cylinder to protect the coal miner's life. Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid, and the type and characteristics of fluid they control. The mechanism varies from linear action, plunger-type actuators to pivoted-armature actuators and rocker actuators. The valve can use a two-port design to regulate a flow or use a three or more port design to switch flows between ports. Multiple solenoid valves can be placed together on a manifold. Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high-reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

THINGSPEAK



The Internet of Things (IoT) in education includes data storage, processing, and data visualization. In our project we are using this platform to monitor the sensors results and take the action to protect the life of coal miners. ThingSpeak™ has a simple interface that makes it easy to learn cloud analytics and teach IoT. Then use ThingSpeak communities to provide support for your cloud education curriculum. ThingSpeak also supports and integrates with Arduino®, RPI, and other hardware.

This valve works automatically by the relay which is connected to microcontroller.

LIFE SAVING GAS

O_2 and CO_2 gas cylinders are used to protect the life of coal miners with the results of sensor values. If fire is detected the CO_2 will be released and the O2 cylinder will be opened when the miner needs oxygen.

RESULT

The physical trends of temperature and humidity, mild depth cost, and gas molecule interest are detected inside the mining surroundings and saved at the cloud the ones consequences can be plotted on the ThingSpeak internet web page or app, and that they may be saved for later examination. If there's any doubt, speedy movement can be taken. ThingSpeak is an open-supply internet of devices utility and API for storing and retrieving records from topics over the internet or through a neighbourhood location community utilising the HTTP and MQTT protocols. ThingSpeak offers channels for storing data retrieved the use of IOT technologies. Each channel has 8 records fields, 3 vicinity fields, and one popularity area. The information is stored within the ThingSpeak channel as quickly as its miles allocated, and it could be stored for future have a have a look at.

CONCLUSION

The essential cause to plot this challenge is nicely being of man or woman who paintings in coal mineshaft. We will provide confirmation that approximately the security of the person who're in large part working in coal mineshaft. In future this individual who paintings in exceptional coal mineshafts can recognize the extraordinary gases and temperature. Or then again about surprising inadequacy everyday mishaps which

occurs by and large in coal mineshaft. So, we defeat this making use of "coal mine protection system" framework. This is best for coal diggers and any location the underground works are finished through the workers.

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