

Automated Colliery Investigation System for Unprivileged Zones

R. Bharathy¹, U. Jhanani Shree¹, V. Bakyalakshmi², M. Anithamary¹

¹Assistant Professor (SS), Department of Electronics and Communication Engineering, Rajalakshmi Engineering College, Chennai, India.

²Assistant Professor, Department of Electronics and Communication Engineering, Rajalakshmi Engineering College, Chennai, India.

ABSTRACT

The automated colliery investigation system is an upgraded mobile system which can travel in all terrain and move easier for better accessibility of areas of an unprivileged zone, especially coal mine which contains toxic gases. To serve humanity and to know about the mineral density of ^{soil} present in the mines, the developed system will analyze the temperature, soil and atmospheric details. The idea of the system is to detect the parameters which can disturb human's reliability of working inside the mine. The sensors which are embedded in the system can investigate the accurate changes of the atmosphere in the mine. The improved notion is to develop the system for soil collection of samples for mineral assumption. Now it can analyze the soil moisture and can partially assume the minerals inside the mine. The temperature sensor can give the parametric changes in each zone of the mine so that humans can travel and work in mines.

KEYWORDS

Colliery Investigation, Toxic Gases, Sensors, Soil Moisture.

Introduction

Mining is characterized as the way toward acquiring coal or different minerals from a mine. The cycles completed to acquire these minerals have a hazardous component. The normal excavator is presented to compromising underground which can here and there lead to a physical issue or cause death toll. These conditions are hard to screen without setting somebody's life in danger. The more established techniques for mine condition observing included utilizing an individual to go down and report back. This strategy is anyway hazardous as the individual who is observing a particular peril could be hurt by that risk [10]. A number of capability tests are done, temperature and mugginess estimations have an exactness of 89.01% and 98.55%, and a goal of 0.105 °C, 0.12%. White moist, or carbon monoxide (CO), is a poisonous gas; as meager as 0.1% can cause perish inside a couple of moments [2]. Soil dampness likewise may prompt mishaps in mine. These mishaps can prompt misfortunes because of early retirements and expanded protection expenses for the mine.

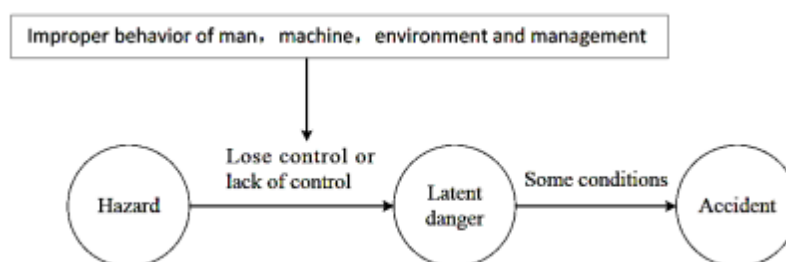


Figure 1.Relationship between Hazard, Latent Danger and an Accident

In this paper, a safest method is proposed to monitor the major factors inside the mine with an automated system to survey various underground areas. This helps to safeguard the lives of miners and also increase the mining industry's growth. The monitored values can be taken as precautions for the miners whether to wear protective suits or not.

The developed system looks like a rover and can go past rocks and gravels as it is built with the continuous track around its wheels at a speed of 300 rpm [4]. This rover is remote controlled by humans up to a certain range. It is powered by batteries and can send data wirelessly to the application. The camera view from the rover makes it easier to operate from a remote distance. It collects the values of temperature, humidity, soil moisture and carbon monoxide

from the mine within 10s. Although the mine may contain various gases such as methane, carbon dioxide, butane, benzene, etc., this model reads carbon monoxide as it is the most poisonous gas on earth. Other gases can also be monitored by integrating more gas sensors. The soil moisture inside the mine may lead to landslip. This mine system measures the soil moisture content in mine to ensure safety to miners [5].

This automated system is an IoT based application which is used to view the readings sent by the rover [6]. This model is very efficient and has no risk to humans as it is complete wireless and user friendly to operate the complete setup.

Existing System

There have been many methods to monitor the factors in mine but it was not remote controlled and a basic mine inspection static device can analyze the mines only to a particular level. These devices cannot go into the mines that are full of gravels, big and slippery rocks. These devices can be controlled live and may or may not be able to detect the hazards in there. In contrary, the existing system is not efficient and is unreliable method to inspect the major circumstances of the mine. These systems are mostly handheld and require live subjects to monitor the values and some are only for certain range [3]. Hence, the existing system cannot be trusted completely by keeping human lives at stake.

Furthermore, the existing system cannot send live data to the monitor and cannot travel through dangerous areas of the mine. These systems are not mobile and cannot test the moisture content in soil which greatly puts miner's life in danger. Thus, the existing system needs to be improved a lot more to safeguard the life of the miners.

Proposed System

The developed system has continuous track wheels that can move easily on gravels, big and slippery rocks. This method has a PPM carbon monoxide detector which detects the presence of carbon monoxide, an odorless, invisible gas which can be highly dangerous to humanity. In late investigation, working in a strangely sticky spot caused laborers serious mental worry, conversely with the moderate feelings of anxiety of laborers in a manufacturing plant of normal dampness. This framework additionally can dissect the dirt dampness which causes us in identification of the measure of water content. This system sends live status to monitor with the help of an automation which uses radio frequency [1]. The sensors are integrated on the device to sense every period of 10s. The place where there are abnormalities in the atmosphere can be calculated with the following distance formula shown in equation 1.1:

$$\text{Distance} = \text{Speed} \times \text{Time} \rightarrow 1.1.$$

The camera can be set-up using raspberry pi module and the readings are sent in an IoT based system where all the sensors are connected to the application.

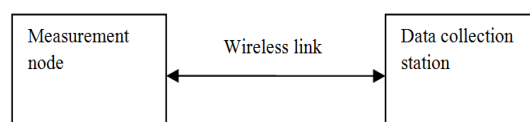


Figure 2. Automated Colliery Investigation System Functional Level Diagram

a. Device Operation: Figure 3 depicts the handling unit for information on the transmitter end, contains encoders and corresponding to-sequential converters which are appropriate for balancing the transporter wave. Information preparing unit is intended for remote control. The handling of information brings about the task of the ideal location to 16-piece input signals gave. The procedure of tweak utilized here is Amplitude Shift Keying (ASK) and the balance signal recurrence is 433MHz. The scope of balance can be expanded by utilizing VHF adjustment for long range working necessities. The low-pass channel (LPF) circuit present in the RF demodulator circuit performs incomplete transformation of simple to computerized signs and information handling unit present at the beneficiary side, will get these signs. Alluding to the recipient arrangement, the unit which measures the got information, comprises of a converter which gives an equal information yield in the wake of changing over sequential information which was given to it as an information, trailed by a decoder. The signs after interpreting will be ready to drive the other equipment present in the framework. Engine driver IC, strong state switch, bi-stable semiconductor switch, and

so on are a portion of the circuit components contained inside the control unit.

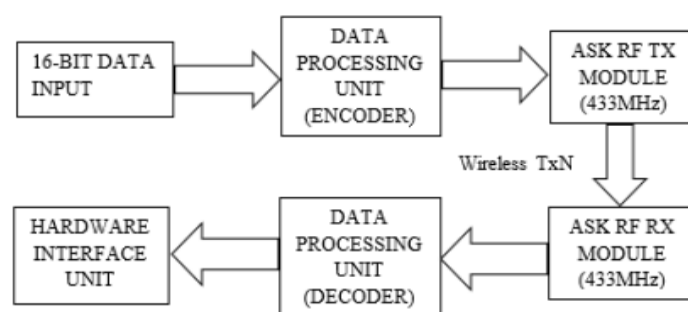


Figure 3.General Block Diagram of Rover Control

i) Transmitter Circuitry: The HT12E IC is a 12-piece encoder. Its primary use is very much established in Tx-Rx arrangements where the IC is combined with its translating partner i.e., with a 12-piece decoder. HT12E working cycle of the information includes the change of equal contribution to sequential yield. For helping out fruitful transmission of information through a RF transmitter, it is necessitated that the info equal information of 12 pieces be changed over to sequential information. The 12 pieces here are portioned into a location bit field of 8 pieces and an information bit field of 4 pieces. Concerning this paper, the referenced IC will change over 4-piece equal information to 4-piece sequential information as for an assigned location of decision as appeared in Figure 4.

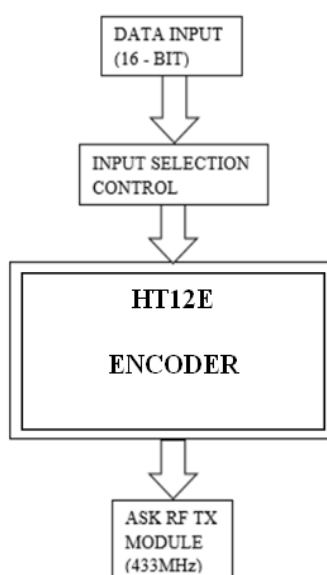


Figure 4.Transmitter Block Diagram

ii) Receiver Circuitry: The IC includes 18 pins which are dispensed with the going with tasks: 8 area sticks, a pin for consecutive data input, 4 pins that are required for equivalent data yield, VDD, VSS, osc1 and osc2 pins which are used for an inbuilt oscillator and for setting a decoder repeat, an authentic transmission pin which is used to screen the zenith and endorsement of transmission. The internal hardware of the IC is arranged so the data will be gotten at the data out pins, outfitted the area codes got organize with the decoder neighborhood to it as showed up in Figure 5.

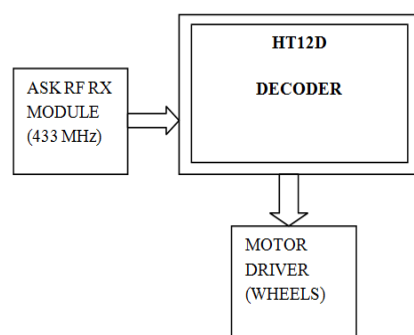


Figure 5.Receiver Block Diagram

b. Sensors: Sensors are attached to the device that is integrated with IoT for the monitoring purpose. The sensors present in the proposed system are shown in Figure 6.

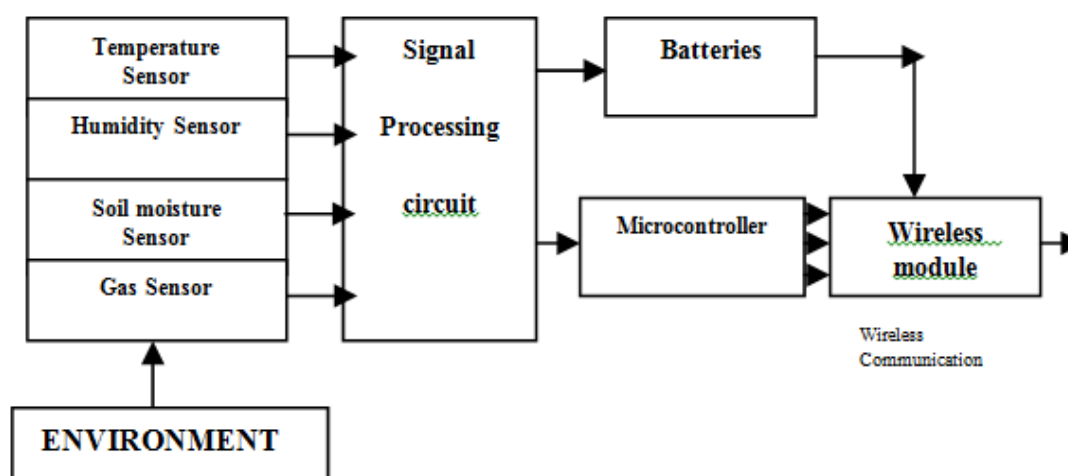


Figure 6.Sensory Interface Block Diagram

i) Temperature & Humidity Sensor Module: The temperature and moistness sensor utilized here is DHT11. This is the sensor which is utilized to quantify the surrounding air temperature and stickiness inside the mine. This is an ease module. The working voltage of this sensor is 3.3 V to 5.5 V and the current is 0.3mA (measuring) 60uA (Standby). The temperature and humidity range is 0°C to 50°C and 20% to 90% respectively. The output is in the form of serial data.

ii) Gas Sensor Module: The gas sensor module utilized here is MQ – 2 which can quantify gasses like LPG, Alcohol, Propane, Hydrogen, CO and even methane. It works when the gas in PPM the simple pin must be utilized, the simple pin additionally TTL driven and takes a shot at 5V and henceforth can be utilized with most regular microcontrollers. The working voltage is 5V and yield voltage is 0V to 5V.

iii) Soil Moisture Sensor: It is a fundamental breakout to evaluate the soddenness in soil and similar materials which is very straight forward to use. The two gigantic revealed pads function as tests for the sensor, together going about as a variable resistor. If more water present in the earth techniques the better the conductivity between the pads will be and will achieve a lower hindrance. The working voltage is around 3.3V to 5V.

iv) Microcontroller Unit: The module used here is Node MCU ESP8266, which is a simple to utilize and ease contraption to give web accessibility to applications. The module can work both as an Access Point and as a versatile station; along these lines it can without a doubt get data and move it to the web making Internet of Things as basic as could be normal the situation being what it is. It can in like manner bring data from web using API's thus application could get to any information that is open in the web. This module can be altered using the Arduino IDE which makes

it considerably more straightforward. The ESP8266 module works with 3.3V in a manner of speaking. This module is a natural low power 32-piece MCU which runs at 80 MHz and has 512kB gleam memory.

Result

Figure 7 shows the temperature graph sent from the device. When the temperature exceeds 36°C, there will be an alert indicated in the monitor.

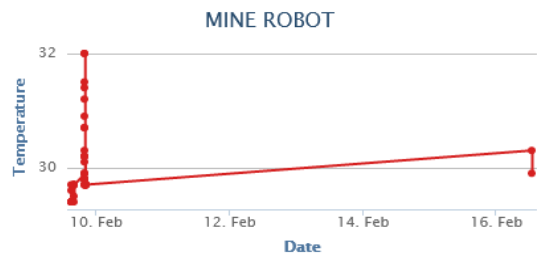


Figure 7. Temperature Graph

The humidity graph is shown in Figure 8 and it shows only the percentage of humidity inside the mine.

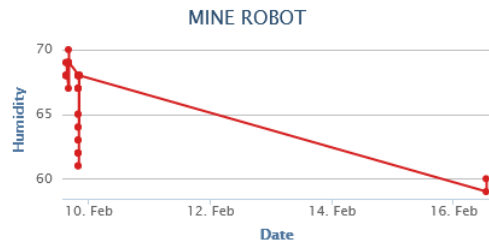


Figure 8. Humidity Graph

The CO level from the mine is shown in the Figure 9. Even though a small level of CO can affect a person, only above 685PPM is alerted as danger because this level is very threatening.

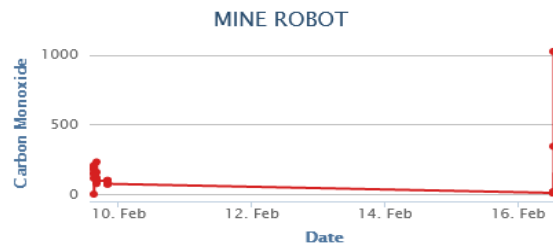


Figure 9. Carbon Monoxide Graph

Figure 10 shows the soil moisture level graph. This graph shows the water content in the soil.

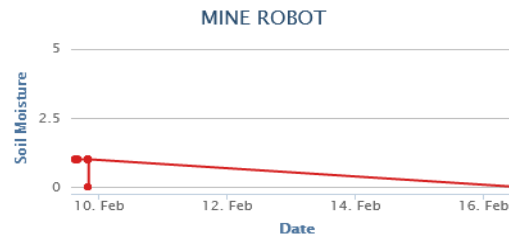


Figure 10. Soil Moisture Graph

Conclusion

The important aspect to build the mine survey robot is to save the life of miners by notifying beforehand about the hazardous factors and this paper is resulted to achieve it. Here, the automated system and working is elaborated in an understandable way. The graphs are used to monitor the changes of factors inside the mine. So that the miners can feel safe while on duty.

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