

Coal Mine Monitoring Robot

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ABSTRACT

As one of the largest coal producers and, India is also one of the related accidents that frequently happened in countries like gas explosion, floods, fire outbreaks during coal mines exploitation. The Coal Mine Detection Robot can replace or partially replace emergency workers to enter the mine shaft disaster site and detect hazardous gas and perform some environmental reconnaissance and surveying tasks. Coal Mine Detection Robot uses gas sensor, temperature sensor, humidity sensor and PIR motion sensor to detect hazardous gas, temperature rise, humidity fall and PIR for light sight. The advantages of this type of hazardous gas detection are: simultaneous and fast detection of methane, CO and high sensitivity, good selectivity, fast response and use of fire extinguisher to extinguish the unexpected fire. Otherwise, due to its simple and light structure, it is easy to be taken by robots, has a larger detection range, and the probe is not easy to poison and age.

Keywords: Farming, Agriculture, IoT, Irrigation and Fertilized system.

I. INTRODUCTION

Coal mines can face major accidents due to a lack of communication and a poor alert system. This can be lessened or even avoid by using a Coal mine Monitoring Robot. This robot will monitor the current temperature, and humidity level and update the data. This will also look for fire accidents using flame and gas sensors. More than in primary accidents, these robots are more suitable for secondary accidents since the human intervention in a coal mine after an accident might be dangerous and unnecessary[1]. So in order to save the lives of many people, a single robot can be sent inside the mine and can be used to extract

the data from the site. This can help to minimize the loss of equipment and human lives, hence it is cost-efficient. Another advantage of the monitoring robot is that instead of using separate sensors for each factor for the safety measures, a single robot can wear all the necessary sensors which can save time and is more effective.

The two main types of coal mining are open-pit mining and underground mining, with underground mining being one of the riskiest jobs in the world. Coal is still a very important component of the world's energy grid. After a mining catastrophe, an emergency rescue operation must be conducted[2]. However, there are

unique difficulties in underground coal mine rescue compared to ground rescue.

The basic working principle of the coal mine monitoring robot is to supervise the mine from any fire accident. To detect fire totally three types of sensors are used namely temperature sensor, gas sensor, and flame sensor. These three sensors are used to detect various forms of fire. In case of any fire accident, this will give an alert to the workers as well as to the supervisors outside the mine since a buzzer is connected to the system[3]. This robot not only gives caution to the workers but also tries to extinguish the fire. This will be possible if a water tank is attached to the robot which can be controlled by an application externally.

II. EXISTING METHOD

According to the requirement of coal mine rescue robot, in order to achieve various functions, A system with clear level, modularity, high reliability, strong functionality, good flexibility, powerful portability, strong expansibility and good robustness must be built which can be boarded on the coal mine rescue robot. Distributed and modular thought was used to build measuring and control system of coal mine rescue robot, which is separated into three layers: sensing and signal processing layer, decision control layer and execution control layer of movement. In line with the overall design of measuring and control system for coal mine rescue robot, the structure of software system for coal mine rescue robot is divided into three layers. From the bottom to top, they are hardware layer, communication protocol layer and core control layer.

III. PROPOSED SOLUTION AND MODEL

A proposed solution to establish a coal mine robot is to add a sensors to detect the hazardous gas, temperature, humidity of the mine and the PIR is used for light vision of the mine. The water pump present in the robot is mainly used to extinguish the fire as fire detected and it automatically detect the fire and do the

process. The caliberation of camera is used in the robot to see the live scenario in the coal mine to avoid accident. The protection glass is used to protect the sensor in the robot.

IV. PROPOSED SYSTEM DESIGN

A. Temperature and humidity Sensor:

Temperature and humidity sensor measures the humidity in the air using a thermistor and a capacitive humidity sensor, and it outputs a digital signal on the data pin. Although reasonably easy to operate, data collection requires precise timing. Sensors that measure temperature come in a wide variety. The temperature of an object can be measured indirectly by some temperature sensors, while others need direct contact with the monitored object.

Operating voltage	3.5v to 5.5v
Operating current	0.3mA(measuring) 60uA(standby)
Output	Serial data
Temperature range	0 degree c to 50 degree c
Humidity range	20% to 90%

Table 1.1 Specification of temperature and humidity sensor

B. Gas Sensor:

Gas sensors are used in manufacturing facilities and factories to find gas leaks and to detect smoke and carbon monoxide in residential buildings. They frequently function as a component of a larger embedded system, such as security and hazmat systems, and are typically connected to an interface or audible alarm.

Operating Voltage	+5v
Analog output voltage	0V to 5V
Digital Output Voltage	0V or 5V (TTL Logic)
Preheat duration	20 sec

Table 1.2 Specification of Gas Sensor

C. Flame sensor:

A sensor which is most sensitive to a normal light is known as a flame sensor. This sensor detects flame otherwise wavelength within the range of 760 nm – 1100 nm from the light source. This sensor can be easily damaged to high temperature. So this sensor can be placed at a certain distance from the flame. The flame detection can be done from a 100cm distance and the detection angle will be 600. The output of this sensor is an analog signal or digital signal. These sensors are used in firefighting robots like as a flame alarm.

Operating voltage	4.75-5V
Working Current	20mA
Spectral Bandwidth range	760-1100nm
Detection Range	0 – 1m

Table 1.3 Specification of flame sensor

V. Coal Mine Robot

The Coal Mine Monitoring Robot is used in the coal mine in order to avoid accident in the rescue team. Before sending the rescuers into the coal mine, this coal mine monitoring robot sent inside so that accident can be avoided. It works on two main application, to control the wheel it contains one application and to control the water pump and sensor, it contain another one application. The application used in this Blynk IOT and Bluetooth RC Controller.

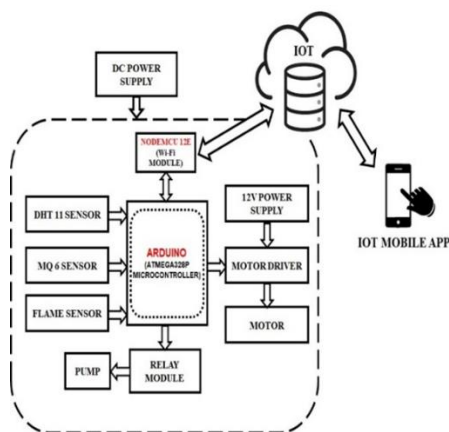


Fig 1.1 Block diagram of coal mine monitoring

A. Blynk IOT

Blynk is an IOT platform for iOS or Android smartphones that is used to control Arduino, Raspberry Pi and Node MCU via the internet.

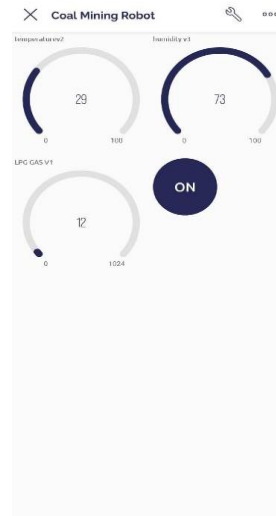


Fig 1.2 Sensor setup

When connected with the temperature and humidity sensor, gas sensor and flame sensor through the node MCU, the Blynk app managed to show the current reading of the temperature, humidity and in case of fire or smoke it will indicate through the flame sensor. The sensor can automatically turn ON and OFF using a smartphone or laptop. And the readings can be recorded periodically.

B. Bluetooth RC Controller

The Bluetooth RC Controller allows to control a microcontroller and Bluetooth fitted RC car with a smartphone.

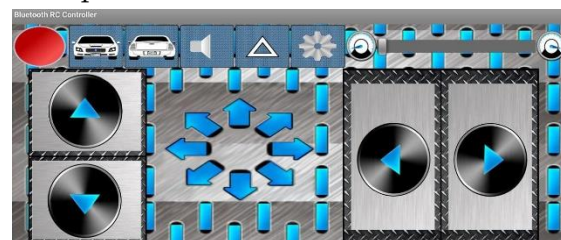


Fig 1.3 Bluetooth RC Controller

A Bluetooth RC (remote control) controller is a device that allows you to wirelessly control a robot using Bluetooth technology. With a Bluetooth RC controller, you can easily send commands to the robot from your smartphone, tablet, or computer.

Typically, a Bluetooth RC controller will consist of a handheld device or an app that connects to the robot via Bluetooth. The controller may have a joystick or other types of controls that allow you to move the robot in different directions, control its speed, and adjust other parameters such as arm movements, camera direction, or sensor readings.

One of the key advantages of using a Bluetooth RC controller is its flexibility and ease of use. You can operate the robot from a distance without worrying about wires or cables. Additionally, with the growing popularity of Bluetooth technology, most modern devices have built-in Bluetooth support, making it easy to connect the controller to your smartphone, tablet, or computer.

Overall, using a Bluetooth RC controller in a robot can enhance its functionality and make it more user-friendly, allowing for a range of applications such as exploration, surveillance, and entertainment.

C. THE FEATURE OF CAMERA OV2640 OF ESP32 MODULE

The ESP32 CAM Wi-Fi Module Bluetooth with OV2640 Camera Module 2MP For Face Recognition has a very competitive small-size camera module that can operate independently as a minimum system with a footprint of only 40 x 27 mm; a deep sleep current of up to 6mA and is widely used in various IoT applications.

It is suitable for home smart devices, industrial wireless control, wireless monitoring, and other IoT applications.

This module adopts a DIP package and can be directly inserted into the backplane to realize rapid production of products, providing customers with high-reliability connection mode, which is convenient for application in various IoT hardware terminals.

ESP integrates Wi-Fi, traditional Bluetooth, and BLE Beacon, with 2 high-performance 32-bit LX6 CPUs, 7-stage pipeline architecture. It has the main frequency adjustment range of 80MHz to 240MHz, on-chip sensor, Hall sensor, temperature sensor, etc.

Input Voltage	5
Operating Temperature	-20 ~ 85
Wi-Fi	802.11b/g/n/
RAM	520kbSRAM+4MB PSRAM

Table 1.4 Specification of ov2640 camera

VI. HARDWARE IMPLEMENTATION

The working model of coal mining robot is that it contains two applications. To control the wheels, it contains one application and to control the water pump and sensors, it contains another one application. The application used in this is Blynk IOT and Bluetooth RC Controller. Most of the IOT projects are done by the Blynk IOT application.

Working model of the Sensor and Water Pump: The Sensor used in this coal mining robot is gas sensor, humidity or temperature sensor, flame sensor. The sensors and the water Pump are being controlled by the Blynk server. At first, the user has to turn on the Bluetooth and the Personal Hotspot.

After this the device will get connected and the Bluetooth range will be shown in the Bluetooth setting. It should be connected and after connecting this the Blynk server has ON/OFF button. By using this the water pump will get controlled. If we On the Water pump, the water flow occurs in it. If we OFF the Water pump, the water flow stops. The usage of the water pump is that when the coal mine has fire inside then this water pump is extinguish the water so that there will be no loss of life. This Bluetooth RC Controlled app will be present in the play store. It is the open-source application so that any of the user can download it from the play store.

VII. HARDWARE RESULT

The hardware result of the coal mine monitoring robot is that by using two software application it is being controlled and output is shown in the blynk software.

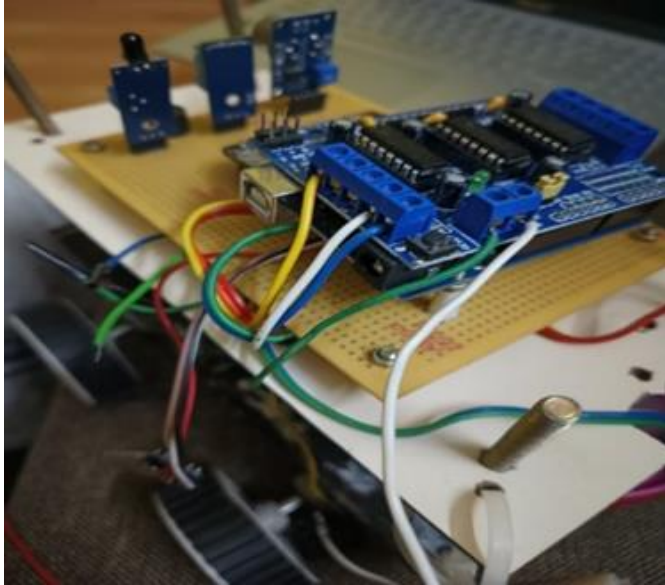


Fig 1.4 Hardware setup

This picture shows the temperature sensor, gas sensor humidity sensor values. It allows to create amazing interfaces for projects using various widgets which are provided. The values are automatically taken through the blynk- app by using Bluetooth, Hotspot or location.

Distance	Temperature	Humidity	Pump
10m	20degree c	100%	-
30m	28degree c	91%	-
50m	41degree c	85%	-
70m	65degree c	84%	-
90m	94degree c	76%	ON
100m	60degree c	71%	-

Table 1.5 Sensor details



Fig 1.5 Output of sensor

VIII. CONCLUSION

The experiment demonstrates how harmful gases released from coal mines are found using rescue robots. In the rescue efforts following a tragedy, rescue robots are essential. Although they have not lived up to promises, certain rescue robots are currently in development and some have already been used in select emerging circumstances. The industry's task is to create rescue robots that are more sophisticated, intelligent, and have sturdy, dependable hardware to operate in crucial zones in such a way. The use of this method benefits coal mine workers. This robot goes into dangerous situations and offers data on different gases. A coal mine rescue robot (CMRR) is capable of bringing the right number of first aid items and a variety of sensors.

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