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IOT Based Smart Surveillance Robot for Industrial Application

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Abstract:- The main objective behind this paper is to develop a robot to perform the act of surveillance in industries. Nowadays robot plays a vital role in our day to day life activities thus reducing human labor and human error. Robots can be manually controlled or can be automatic based on the requirement. The purpose of this robot is to roam around industries environment information from the given environment and to send that obtained information to the user.

In this paper, one can control the robot with the help of mobile or laptop through Internet of Things (IoT) and also can get gas, temperature and fire detection both in daytime as well as at night with the help of sensor from the robot. The robot can be controlled both in manual as well as in automated mode with the help of ESP32 microcontroller. This robot also uses various sensors that collects data and sends it to the ESP32 microcontroller which controls the robot behavior. Along with the obtained live data output. Thus the action of surveillance can be performed. Further advancement in our project can provide surveillance even in industrial and defense areas.

Keywords:- *ESP32-S2, BLYNK.*

I. INTRODUCTION

India is a large country with rich coals. However, the current safe production level of coal mine is still low, especially in recent years, disasters in coal mine occur frequently, which lead to great loss of possession and life. The safety problems of coal mine has gradually become to the focus that the nation and society concern on. The disasters happening in coal mine are due to the complexity of mine environment and the variety of work condition of coal mine, so it is very necessary to monitor mine working environment. Traditional coal mine monitoring systems tend to be wired network systems, which play an important role in coal mine safe production. With continuous enlarging of exploiting areas and extension of depth in coal mine, many laneways become blind areas, where in there are lots of hidden dangers.

Moreover, it is inconvenient to lay cables which are expensive and consume time. In order to solve the problems, we will design a coal mine safety monitoring system based on wireless sensor network, which can improve the level of monitoring production safety and reduce accident in the coal mines Wireless sensor networks is composed of a large number of micro-sensor nodes which have small volume and low cost. It possesses self-organized capability by wireless Communication. In recent years, it is widely used in the fields of our lives, scientific research, military, intelligent traffic.

A. Existing System:

- Already existing systems use robots that have limited range of communication as they are based on RF Technology, Zigbee and Bluetooth.
- Some existing projects use short range wireless camera. Some existing robots can only be controlled with a manual mode which needs human supervision throughout the whole surveillance process.
- Some existing system use short range wireless camera.

➢ *Existing Ststem Disadvantage:*

- Design Cost is high
- Low distance communication
- Power consumption is low
- Design complexity is high

B. Proposed System:

Security based industrial monitoring system is proposed. The proposed system monitors the industrial workers conditions in every situation. The proposed system is system consisting of gas sensor, temperature sensor, Temperature level and gas level is always monitored in the industrial environment. Hazardous gases like carbon monoxide, carbon dioxide contents are present more in underground. If the gases are detected more than the threshold value, It will monitored in the monitoring center.

In both condition, information will send to the monitoring center through IoT. Along with these temperature level also monitored. If it increased and decreased from the threshold value, In case of land slide situation, By this we can able to know the critical situations of the coal mine workers immediately. Also in case of emergency we can able to give immediate treatment for them.

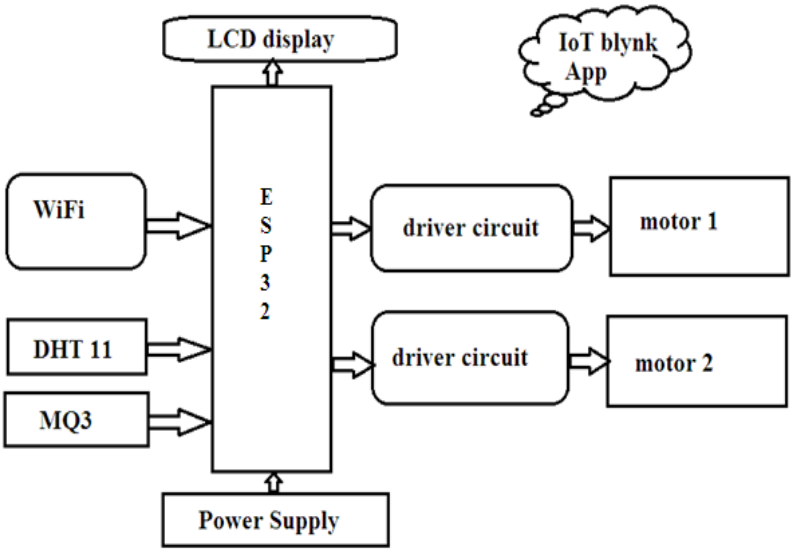

Fig 1:- Block Diagram

➢ *Proposed System Advantage:*

- By interfacing Wi-Fi module with ESP32, we can get unlimited range of operation.
- The communication with the robot occurs in more secured manner.
- Robots can be operated in both manual and automatic modes.
- The design cost is low.
- High Efficiency.
- Low complexity design.
- High speed processing.

II. SYSTEM DESIGN

The system consists of two major sections - one is the user section and other is the robot section. In that the user section can possess laptop or mobile for communicating with the robot end. Thus by using a laptop or a mobile the user section can be a portable one compared to those that uses a typical stationary computer system. The communication can be performed with RF technology or by using a Zigbee device or by using a Bluetooth technology, but that comes at the cost of limited range. Thus in order to implement the idea of increasing the range we can go connecting the user section with the internet which is the main concept of Internet of Things. For connecting the user system with the internet, the blynk software is used.

At the robot end, we are using an Arduino microcontroller placed on the body or the chassis of the robot, which is the integral part of the robotic vehicle. Below the chassis, the wheels are connected with DC motors that are of 30 rpm each. Each motor requires 12v supply, supplied by means of an external battery source. The motors are interfaced with the Arduino through relay driver. Four relay drivers are employed for two motors and they are used for amplification purpose. The microcontroller is coded with IDE software in order to operate the robot in appropriate directions. This is the manual mode operation associated with it. Several sensors such as ultrasonic sensor, infrared sensor are also used which are interfaced with the microcontroller in the respective I/O pins.

III. HARDWARE USED

This surveillance robot requires a lot of essential hardware components for proper functioning. Due to advancement in technology, these surveillance robots are used in remote as well as domestic areas. The main components used in our project and their specifications and functions are as follows,

A. ESP 32:

ESP32 is a single chip 2.4 GHz Wi-Fi and Bluetooth combo chip designed with TSMC ultra-low power 40 nm technology. It is designed and optimized for the best power performance, RF performance, robustness, versatility, features, and reliability, for a wide variety of applications, and different power profiles.

The ESP32 is the most integrated solution for Wi-Fi + Bluetooth applications in the industry with less than 10 external components. ESP32 integrates the antenna switch, RF balun, power amplifier, low noise receive amplifier, filters, and power management modules. As such, the entire solution occupies minimal Printed Circuit Board (PCB) area.

B. WIFI MODULE:

The ESP32 Wi-Fi Module is a self-contained soc with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP32 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP32 Module comes pre-programmed with an AI command set firmware, meaning, you can simply look this up to your Arduino device and get about as much Wi-Fi ability as a Wi-Fi shield offers. The ESP32 module is an extremely cost-effective board with huge and ever growing, community.

This module has powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specified device through is GPIOs with minimal development up front and minimal loading during runtime. This is high degree of on chip integration allows for minimal external circuitry. Including the front-end-module is designed to occupy minimal PCB area. The ESP32 SPPORT APSD for IP application and Bluetooth co-existence interface. It contains a self-calibrated RI allowing it to work under a operating conditions, and requires a external RF parts.

C. POWER SUPPLY

In most of our electronic products or projects we need a power supply for converting mains AC voltage to a regulated DC voltage. For making a power supply designing of each and every component is essential. Here I'm going to discuss the designing of regulated 5V Power Supply.

➢ *Component List :*

- Step down transformer
- Voltage regulator
- Capacitors
- Diodes

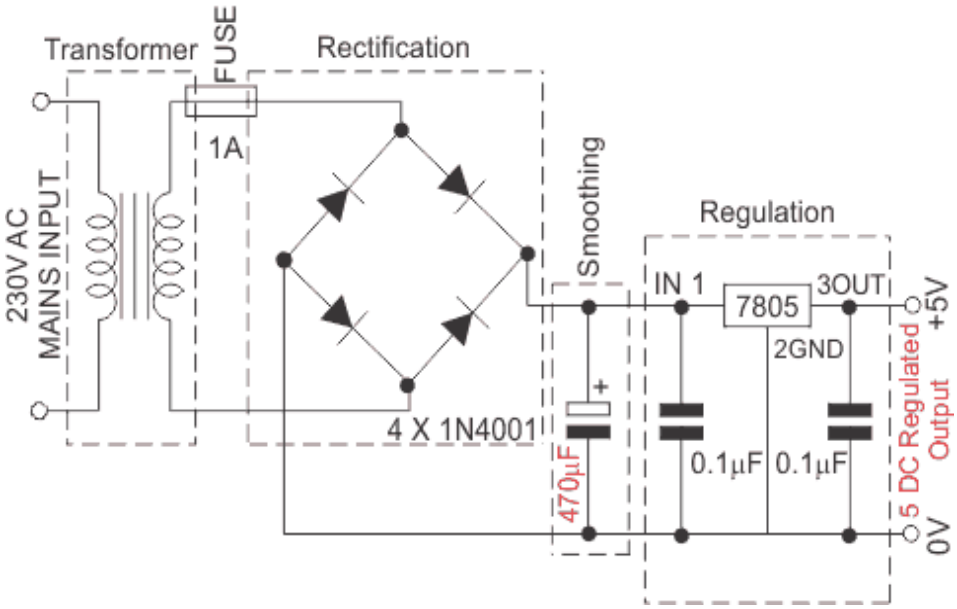

Fig 2:- Power Supply Circuit

D. RELAY:

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (*IC*). The l293d can drive small and quiet big motors as well, check the Voltage Specification at the end of this page for more info. You can Buy L293D IC in any electronic shop very easily and it costs around 70 Rupees (INR) or around 1 $ Dollar (approx Cost) or even lesser cost. You can find the necessary pin diagram, working, a circuit diagram, Logic description and Project as you read through. It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor.

E. DHT11:

Fig 3

The DHT11 sensor can either be purchased as a sensor or as a module. Either way, the performance of the sensor is same. The sensor will come as a 4-pin package out of which only three pins will be used whereas the module will come with three pins as shown above. The only difference between the sensor and module is that the module will have a filtering capacitor and pull-up resistor inbuilt, and for the sensor, you have to use them externally if required. The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature.

To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers. The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second. DHT11 is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA. This sensor is used in various applications such as measuring humidity and temperature values in heating, ventilation and air conditioning systems. Weather stations also use these sensors to predict weather conditions. The humidity sensor is used as a preventive measure in homes where people are affected by humidity. Offices, cars, museums, greenhouses and industries use this sensor for measuring humidity values and as a safety measure.

F. Gas Sensor:

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a methane gas sensor that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element. This adsorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current. What is this sensing element? Is it kept in some chamber or is kept exposed? How does it get current and how it is taken out? Let's find out in this Insight!!!

The gas sensor module consists of a steel exoskeleton under which a sensing element is housed. This sensing element is subjected to current through connecting leads. the sensing element which alters the value of the current going out of it. connecting leads.

Fig 4

IV. SOFTWARE USED

A. ARDUINO

Arduino is a cross-platform IDE that works in conjunction with an Arduino controller in order to write, compile and upload code to the board. The software provides support for a wide array of Arduino boards, including Arduino Uno, Nano, Mega, Esplora, Ethernet, Fio, Pro or Pro Mini, as well as LilyPad Arduino. The universal languages for Arduino are C and C++, thus the software is fit for professionals who are familiar with these two. Features such as syntax highlighting, automatic indentation and brace matching makes it a modern alternative to other IDEs. Wrapped inside a streamlined interface, the software features both the looks and the functionality that appeal to Arduino developers, paving the way to a successful output via the debugging modules. All of its features are hosted inside a few buttons and menus that are easy to navigate and understand, especially for professional programmers. Also, the built-in collection of examples might be of great help for Arduino first timers. Provided that you've connected the Arduino board to

the computer and installed all the necessary drivers, one of the first steps we see fit is to choose the model you'll be working with using the Tools menu of the application. Then, you can start writing the programs using the comfortable environment that Arduino offers.

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project is based on microcontroller board designs, manufactured by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields") and other circuits.

The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on the Processing project, which includes support for the C and C++ programming languages.

B. BLYNK SERVER:

Blynk is a Platform with IOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for our project by simply dragging and dropping widgets. It's really simple to set everything up and you'll start tinkering in less than 5 mins. Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choice. Whether your Arduino or Raspberry Pi is linked to the Internet over Wi-Fi, Ethernet or this new ESP8266 chip, Blynk will get you online and ready for the Internet of Your Things. Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things. There are three major components in the platform:

- **Blynk App** - allows to you create amazing interfaces for your projects using various widgets we provide.
- **Blynk Server** - responsible for all the communications between the smart phone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. Its open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.
- **Blynk Libraries** - for all the popular hardware platforms - enable communication with the server and process all the incoming and out coming commands.

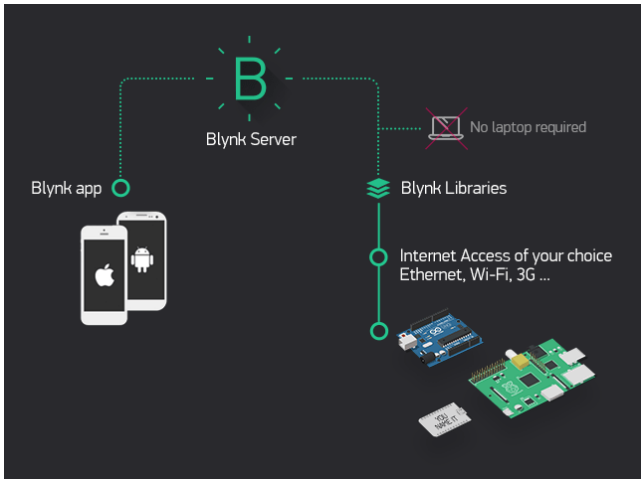

Fig 5:- Blynk Server Architecture

Now imagine, every time you press a Button in the Blynk app, the message travels to the Blynk Cloud, where it magically finds its way to your hardware. It works the same in the opposite direction and everything happens in a blynk of an eye.

V. RESULT AND DISCUSSION

The system reduced human effort by providing automation on transformer monitoring and controlling in a simple and cost effective method. the system can be used for automatic controlling depends Wifi. in this method iot technology is used for data transmission effectively for monitoring robot through mobile phone with help android application.

VI. CONCLUSION

The project is aimed at providing human safety for the rescue team in hazardous environments such as coal mines. This is a prototype which can be implemented in real time by using components with better range and efficiency. This robot enters into hazardous environments and provides data like the content of gases after the explosive has occurred and also the temperature based on which the rescue team will be sent with necessary precautionary measures in order to make sure that the rescue team does not come to any harm.

In future by the use of higher transmission range transceivers so that it can travel for a greater distance and can be used in different environments based on the transmission range. Development can also be made in the number of sensors incorporated in the robot. Various other sensors like O2 sensor, humidity sensor can be added and thus helping to get a much improved image of the environments inside. Implementation of an arm on the robot can help the robot pick up samples or removes small debris from path.

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