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IOT Surveillance Robot Using ESP-32 Wi-Fi CAM & Arduino

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ABSTRACT
At present the surveillance of International border areas is a difficult task. The border guarding forces are patrolling the border seriously, but it is not possible to watch the border at each and every moment. An essential requirement of this situation is a robot which automatically detects trespasser in the border and report nearby border security control unit. Many of the military departments now utilize the robots to carry out risky jobs that cannot be done by the soldiers. In this present work, a Raspbian operating system based spy robot plat form with remote monitoring and control algorithm through Internet of Things has been developed which will save human live, reduces manual error and protect the country from enemies. The spy robot system comprises the Raspberry Pi (small single-board computer), night vision pi camera and sensors. The information regarding the detection of living objects by PIR sensor is sent to the users through the web server and pi camera capture the moving object which is posted in side the webpage simultaneously. The user in control room able to access the robot with wheel drive control buttons on the webpage. The movement of a robot is also controlled automatically through obstacle detecting sensors to avoiding the collision. This surveillance system using spy robot can be customized for various fields like industries, banks and shopping malls.

Keywords: Mobile robot, Raspberry Pi board, PIR sensor, Metal Detector, Humidity Sensor, Temperature Sensor, Gas Sensor, Camera, military surveillance, Spy Robot.

1. Introduction

Embedded Technology is now in its prime and the wealth of knowledge available is mind blowing. However, most embedded systems engineers have a common complaint. There are no comprehensive resources available over the internet which deal with the various design and implementation issues of this technology. Intellectual property regulations of many corporations are partly to blame for this and also the tendency to keep technical know-how within a restricted group of researchers. An embedded computer is frequently a computer that is implemented for a particular purpose[1-2]. In contrast, an average PC computer usually serves a number of purposes: checking email, surfing the internet, listening to music, word processing [3-5].However, embedded systems usually only have a single task, or a very small number of related tasks that they are programmed to perform [6].

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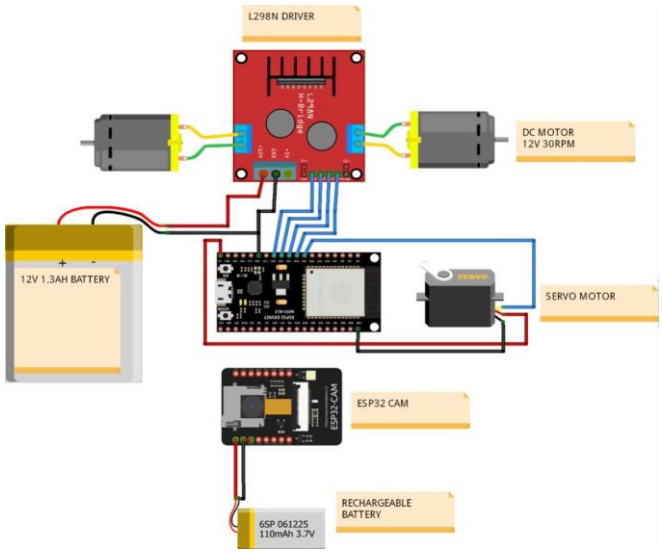

Fig.1: Block diagram of ESP 32

1.1: Hardware requirements

Node MCU is an open source IoT plat form It includes firmware which runs on the ESP32 Wi-Fi SoC from Espresso if Systems, and hardware which is based on the ESP-12module [6-9]. The term "Node MCU" by default refers to the firmware rather than the development kits [10-14]. The firmware uses the Lua scripting language. It is based on the eLua project and built on the Express if Non-OSSDK for ESP32[9]. It uses many open source projects Arduino microcontroller is based on UNO AtMega328. It is used to receive commands sent by the user via the internet and processes according to the code and also used to control the motors. Wi-Fi module ESP8266 is also connected with the arduino so that Wi-Fi facility can be provided to the robot [15-21].

DC Motors

Motors that operate on 12V DC power supply are used. These are rotary electrical machine that converts direct

Current electrical energy into mechanical energy [22-26]. The motors used are of 30 rpm speed of operation.

Ultrasonic Sensor

Ultrasonic sensor is a device that can measure the distance to an object (obstacle) by using sound waves at a particular frequency. It provides a 3cm to 3m range. It can work in any lighting conditions. Thus the robot easily dodges obstacles present on its way [27-31].

Infrared Sensor

An infrared sensor is used to sense and determine the nature and aspects of the surroundings by emitting infrared radiation. This sensor has the ability to emit infrared radiation and detects the reflected radiation that is being reflected by an object or the surroundings [32]. The range is between 2 cm to 30 cm and the operating voltage is around 3v to 5v. This infrared sensor is attached to the robot to detect edges present on its path [33].

Lead Acid Battery

Two 6V batteries are connected in series to provide a 12V power supply for the motors. From these batteries power supply is also given to the arduino and other parts that re -quire power supply for their effective performance [34]. They are used in back-up power supplies for

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alarm and smaller computer systems (particularly in uninterruptible power supplies; UPS) and for electric scooters, electric wheel chairs, electrified bicycles, marine applications, battery electric vehicles or micro hybrid vehicles, and motor cycles. Lead-acid batteries were used to supply the filament (heater) voltage, with 2V common in early vacuum tube (valve) radio receivers. Portable batteries for miners' cap lamps headlamps typically have two or three cells [35].

Wi-Fi Module

The ESP-32 module which is low cost, self contained chip consists of TCP/IP protocol stack that is used to provide network access to any microcontroller. It is highly compact in size and is easily a portable one and thus this is interfaced with the arduino to provide the robot with Wi-Fi facility [36].

1.2 Software Requirements

IDE stands for Integrated Development Environment. Pretty fancy sounding, and should make you feel smart any time you use it. The IDE is a text editor-like program that allows you to write Arduino code. When you open the Arduino program, you are opening the IDE. It is intentionally streamlined to keep things as simple and straight forward as possible. When you save a file in Arduino, the file is called a sketch – a sketch is where you save the computer code you have written [37]. The coding language that Arduino uses is very much like C++, which is a common language in the world of computing. The code you learn to write for Arduino will be very similar to the code you write in any other computer language. All the basic concepts remain the same it is just a matter of learning a new dialect should you pursue other programming languages [38].

2. 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 ESP-32 device or by using a Wi-Fi 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. Blynk software is nothing but an object relation.

Mapping, which is used to design prototypes and develop IOT applications. Thus through this Blynk software, we can send commands and can easily control the robotic vehicle. At the robot end, we are using an ESP 32 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. Ultrasonic sensor operates by reflection principle, that is by transmission and reception of signals obstacles are detected. In short, it follows the principle of bats termed as echo location. Similarly, Infrared sensors are used to emit and detect infrared radiations, so that the surrounding temperature changes can be detected.

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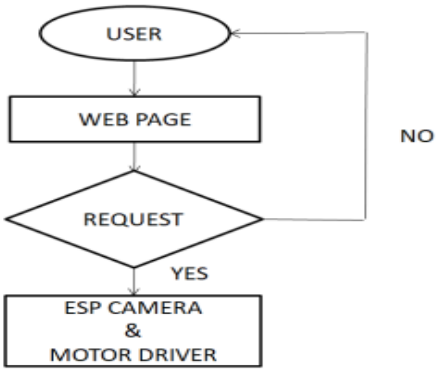

Fig.2: Flow chart 1

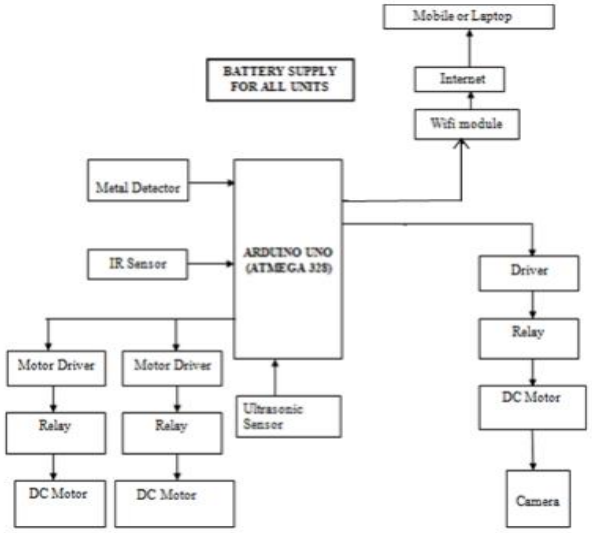

Fig 3: Working Flow chart

3. Results and Discussions

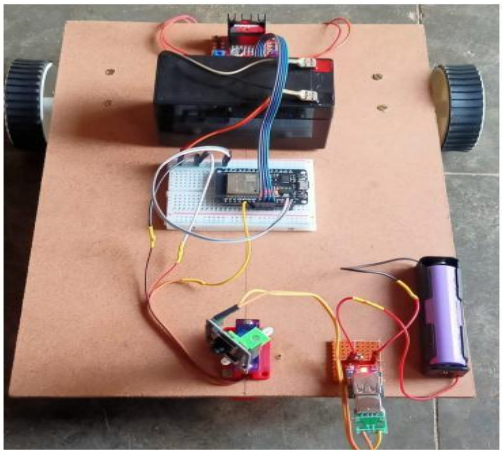

Fig.4: Assembled Modules

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Fig 5: Image taken from blynk app

By combining camera features with the robot we can easily monitor indoor as well as outdoor locations during daytime and at night. Remote areas can also be explored. Used to record and send video output of the required environment. Lead acid batteries were used to supply the filament (heater) voltage, with 2 V common in early vacuum tube (valve) radio receivers. Portable batteries for miners' cap lamps headlamps typically have two or three cells.
It minimizes human effort because IoT devices connect and communicate with one another and perform a variety of tasks without the need for human intervention. It can assist in the smarter control of homes and cities via mobile phones. It enhances security and offers personal protection. By automating activities, it saves us a lot of time. Information is easily accessible, even if we are far away from our actual location, and it is updated frequently in real time.

4. Conclusion

In this paper, the framework for making a robot for surveillance purpose is proposed. It overcomes the problem of limited range surveillance by using the concept of IOT. We can control the robot with the help of laptop/mobile manually. Automatic monitoring can also be done. Our proposed robot is small in size thus maneuvering into area where human access is impossible. Wireless technology is one of the most integral technologies in the electronics field. This technology is used to serve our project as a supreme part of surveillance act. This provides highly efficient and a cost effective robot that replaces human work and reduces human labor and performing monitoring works in a well effective manner.

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