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Surveillance Robot for Military Application

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Abstract- The use of robotic surveillance systems for reasons such as border monitoring or in remote locations like war zones is discussed in this study. The system can replace the border guard soldier in charge of providing surveillance. The robotic vehicle can autonomously recognise human presence and transmit information to the control station. Both surveillance and reconnaissance situations are catered for by this technology. Every human being must have security. The need for security has grown along with the population. But adequate security cannot be set up for want of finances. The research's goal was to develop a smart robot that can offer high-quality security as a long-term solution to the issue at hand. The objective was to create and put into action a rover that makes use of contemporary technology, enabling it to travel with the help of a distant control room, search the region, and warn the control centre once any abnormality has been found. If a person is found, the information is sent to the control room. The robot also has a smart camera that, when necessary, may be used to record live video and take pictures of an intruder. While we operate on border areas, surveillance plays a big part. To do this, a robot will have employed a metal sensor to detect land mines in the surrounding area.

Index Terms - *Sensors, Surveillance, Camera, Metal Sensor, Ultrasonic Sensor, DC Motor, Robot.*

Introduction

Real-time data gathering, analysis, and prompt information distribution to the operator are all components of surveillance. In defence applications, surveillance is crucial to keeping an eye out for potential threats so that required action can be taken to protect citizens. Monitoring a group of circumstances, a region, or a person is the task of surveillance. This typically happens in a military setting where monitoring enemy territory, hostage situations, or conflict zones is essential to a country's security. In close proximity to sensitive sites, skilled workers conduct human surveillance to continuously look for changes. However, there is always a chance to lose workers if you are discovered by your enemy. With the development of technology in recent years, it is now possible to remotely monitor important locations using robots rather than people. Physical and elegant robots can be used to identify subtle features that are not obvious to people, in addition to the benefits of not losing any work forces that have already been mentioned. It is doable to obtain data about the targeted location remotely by equipping the robots with high resolution cameras and various sorts of sensors. A surveillance robot is a semi automated machine that follows instructions, gathers necessary data, strives to reach its target, and streams or captures photos that can be examined by the operator while avoiding obstacles. Our goal in this paper is to offer a solution or example for a wirelessly controlled robot vehicle that can recognise an object, gauge how far away a human is from the vehicle, and wirelessly feed video of its surroundings to the operator.

Literature Survey

1] Title: SPY Night Vision Robot with Moving Wireless Video Camera & Ultrasonic Sensor

Author:Mr. Lokesh Mehta, Mr. Pawan Sharma

The article is to develop a surveillance robot that will allow us to watch the location that interests us.The robot's size makes it easier for it to be utilised as a spy robot. We should be able to alter the robot's path as needed in order to develop it. These signals are used for encoding, after which the signal is transferred through the transmitter. These received signals are processed at the receiver end and sent as input to power the motor. This will enable us to control the robot in the way that we desire. We can see the robot's move path thanks to a video transmitter that is positioned on its top.

[2] title: Smart phone based robotic control for surveillance applications

Author:M.Selvam

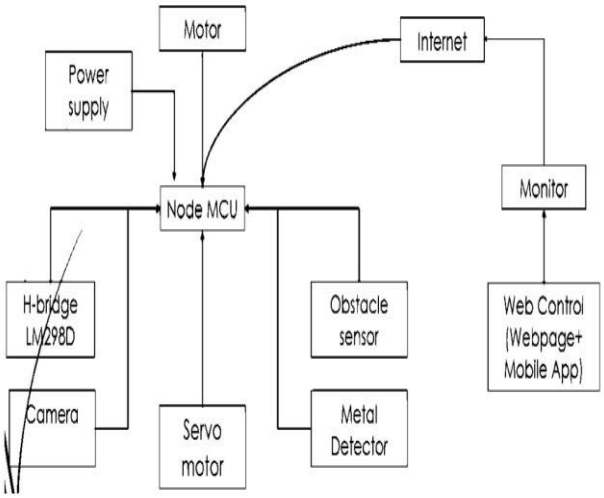
The concept aims to use an Android app to steer a robotic vehicle. To sense the signals sent by the Android application, a Bluetooth device is connected to the robot's control unit. The control unit receives this information and moves the robot as needed. In this project, the control device is an Atmel 89C51 microcontroller.

Existing Systems

The majority of widely used surveillance systems operate autonomously using DTMF[1][4] and RF[4]-based communication for data transmission. Because RF has a very limited communication range compared to other current communication technologies, its use limits the operational range. Due to line of sight operation, it is not entirely suitable for use around barriers or in environments like forests. Since humans are always required to man oeuvre robots, using DTMF to regulate movement makes the robot semi-autonomous. Robotic systems that are intended to use mobile phones for data collecting and transmission increase the cost of the system because a high-quality mobile device is expensive, and such systems are not realistic.

Proposed System Architecture and Implementation

The robotic vehicle in our suggested system examines the region during hostage situations and provides precise data to the operator so they can take preventative measures to stop the loss of life or property. Metal and ultrasonic sensors are two of the vehicle's two types of sensors. The ultrasonic sensor locates a human or a barrier that could hurt the robot, while the metal sensor finds land mines. A website that provides instructions to the processor on how to manoeuvre the robot in the FORWARD, BACKWARD, LEFT, and RIGHT directions controls the robotic vehicle wirelessly from any location.



With the use of a wireless camera, a live stream would also be accessible on the same website. The robot moves only in response to decisions about obstacles, and occasionally because of impediments in the path of the destination that the user has specified. The robot benefits from using a smart camera with human identification and alarm features that can be wirelessly operated by an app, making it simple to use and keep an eye on. The multifunctional robot is broken down into modules, each of which has a distinct function and is managed by a central controlling system. The system is depicted in blocks in the above diagram. The system is composed of an autonomous robot and a control station.

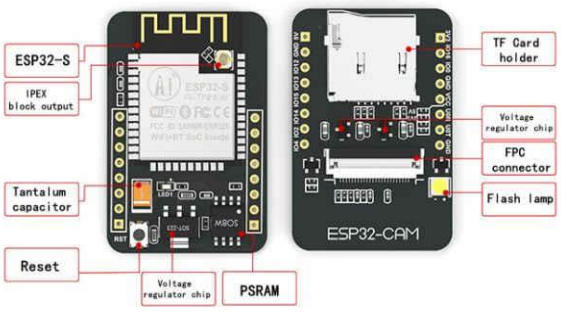
System Description

I. Node MCU

A LUA-based open-source firmware called NodeMCU was created for the ESP8266 wifi chip. NodeMCU firmware is included with the ESP8266 Development board/kit, also known as the NodeMCU Development board, in order to explore ESP8266 chip capability. Since NodeMCU is an open-source platform, anyone can edit, tweak, or manufacture its hardware. The NodeMCU Development Board includes serial communication protocols, analogue and digital pins, and wifi functionality. We may easily obtain our own NodeMCU firmware using the web custom builds that are readily available. The NodeMCU is often programmed using Lua scripts. On top of the C programming language, Lua is an open-source, compact, embeddable scripting language. Here is another method for creating NodeMCU projects using the Arduino IDE, a well-known IDE. Using the Arduino development environment, we can also create applications for NodeMCU. For Arduino developers, this makes it simpler than learning a new language and IDE for NodeMCU.

II. ESP32-Camera:

Numerous IoT applications can utilise the ESP32-CAM. It is appropriate for IoT applications such as wireless positioning system signals, industrial wireless control, wireless monitoring, QR wireless identification, and smart home gadgets. For IoT applications, it is the perfect answer. Open source prototype board designs are available for the open source firmware NodeMCU.



➢ Features

- Onboard ESP32-S module, supports WiFi + Bluetooth
- OV2640 camera with flash
- Onboard TF card slot, supports up to 4G TF card for data storage
- Supports WiFi video monitoring and WiFi image upload
- Supports multiple sleep modes, deep sleep current as low as 6mA
- Control interface is accessible via pinheader, easily embedded into user product.

➢ Specifications

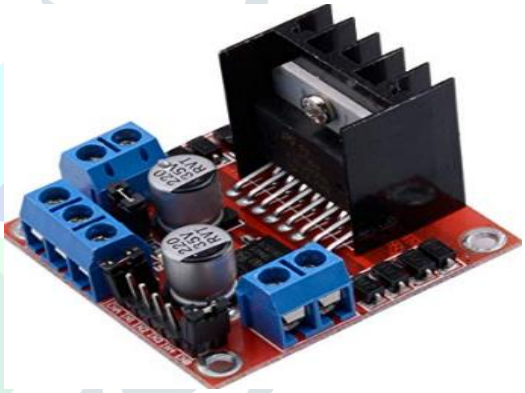
- WIFI module: ESP-32S
- Processor: ESP32-D0WD
- Built-in Flash: 32Mbit
- RAM: Internal 512KB + External 4M PSRAM
- Antenna: Onboard PCB antenna
- WiFi protocol: IEEE 802.11 b/g/n/e/i
- Bluetooth: Bluetooth 4.2 BR/EDR and BLE
- WIFI mode: Station / SoftAP / SoftAP+Station
- Security: WPA/WPA2/WPA2-Enterprise/WPS
- Output image format: JPEG (OV2640 support only), BMP, GRAYSCALE
- Supported TF card: up to 4G
- Peripheral interface: UART/SPI/I2C/PWM
- IO port: 9
- UART baudrate rate: default 115200bps
- Power supply: 5V
- Transmitting power:
  - 11b: 17 ±2dBm(@11Mbps)
  - 11g: 14 ±2dBm(@54Mbps)
  - 11n: 13 ±2dBm(@HT20,MCS7)
- Power consumption:
  - Flash off: 180mA@5V
  - Flash on and brightness max: 310mA@5V
  - Deep-Sleep: as low as 6mA@5V
  - Modern-Sleep: as low as 20mA@5V
  - Light-Sleep: as low as 6.7mA@5V
- Operating temperature: -20 ℃ ~ 85 ℃
- Storage environment: -40 ℃ ~ 90 ℃, <90%RH
- Dimensions: 40.5mm x 27mm x 4.5mm

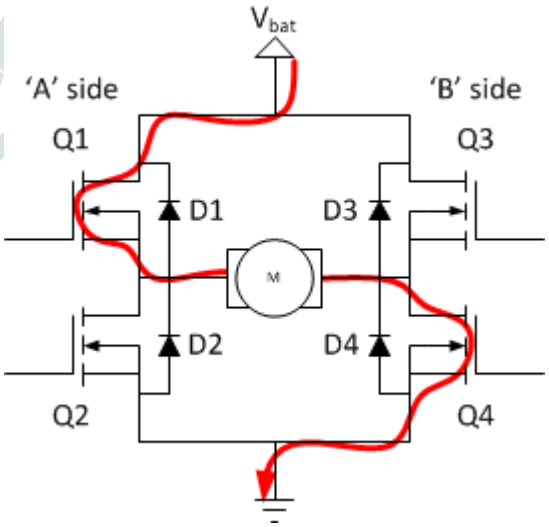
III. Metal Detector Sensor:

An electronic gadget known as a metal detector was created specifically to find metal objects that were buried underneath. Depending on the device type and technology, they assist in detecting any metal object buried at varied depths. Although describing how metal detectors operate can be challenging, the basic idea is fairly straightforward: metal detectors transmit an electromagnetic field toward the ground and then examine a reflected magnetic field that is returned from the area where the signal was initially transmitted after colliding with a metal object

IV. H-bridge:

An electrical circuit known as an H-bridge changes the polarity of a voltage applied to a load. To enable DC motors to move forward or backward, these circuits are frequently employed in robotics and other applications. The name is derived from its typical schematic diagram depiction, in which the load is connected as the crossbar and the four switching elements are arranged as the branches of the letter "H."





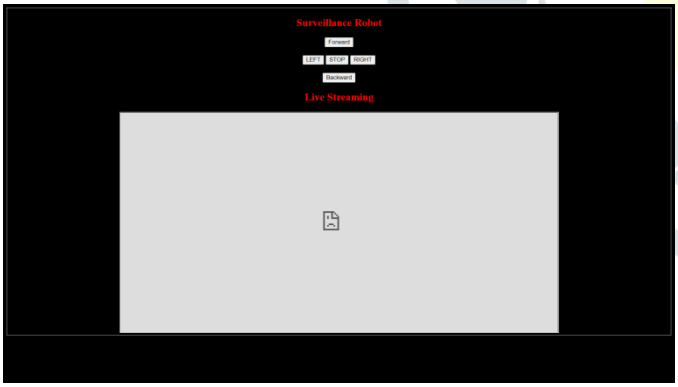
Bi-polar or FET transistors, or IGBTs in some high-voltage applications, typically serve as the switching elements (Q1–Q4). The catch diodes (D1..D4) are typically Schottky-type semiconductor devices. The bridge's bottom end is grounded, while the top end is wired to a power source (a battery, for instance). Although there are certain obvious limitations, generally speaking, all four switching parts can be separately turned on and off.

V. Ultrasonic Sensor:

An ultrasonic sensor is a piece of technology that uses ultrasonic sound waves to measure a target object's distance and then turns the sound that is reflected back into an electrical signal. The transmitter, which generates sound using piezoelectric crystals, and the receiver are the two primary parts of an ultrasonic sensor. Most often, proximity sensors are combined with ultrasonic sensors. Robotic obstacle detection systems and manufacturing technology both use ultrasonic sensors.

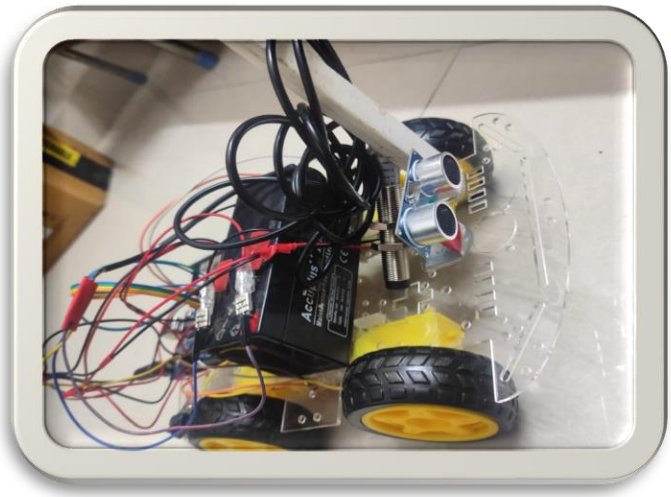
Result

This bot can be controlled by using our website or our application, it gives the user complete access to control it. The website and application have an option of live feed where you can watch the live streaming of the bot. There is an alarm feedback associated with the website and application where if any metal or object detected will generate a pop up stating that metal has been detected or an object is in front of it. The website overlook is as shown underneath.



System Prototype

The results of the system's presentation are depicted in the figure below, where the surveillance robot prototype is on exhibit. The system consists of a sensor, Node MCU, a battery for power, an ESP32-CAM, and an H-Bridge to control the motion of a DC motor.



Conclusion

In order to create a system that can fulfill the duties of a security guard without the possibility of human error, this research combined various current technologies, including wireless communication, neural networks, and hardware controllers. The robot can move around alone, avoid obstructions, and notify the control room of any irregularities. It is autonomous. This makes it possible to reduce human work and hardship while also eliminating human errors. Additionally, the robot is more advanced in terms of viability while costing a fraction of what comparable items on the market do. The robot will soon employ effective charging techniques and cutting-edge strategies to provide greater battery life and, ultimately, longer patrolling periods. The camera must be enclosed in a protective polycarbonate shell to keep the outside world out while maintaining the camera's accuracy and operation. The robot's controls will be made simpler so that everyone can operate it more easily. The actions of the robot are to be tracked and managed using an app. The robot must be prepared for operation in adverse weather conditions so that it can operate in environments where people find it challenging to spend extended periods of time. Drones can be integrated into the robot's security system to enable safer surveillance of intruders from heights that the robot's camera is unable to access.

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