Wirelessly Controlled Surveillance Car

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ABSTRACT

As we advance further into the 21st century, smartphones have entrenched themselves as indispensable tools in our daily lives. Android-based smartphones, in particular, have surged in power and versatility, boasting an array of accessories that prove invaluable for robotics applications.This paper focuses on the development of a surveillance vehicle designed for monitoring inaccessible or hazardous areas. The vehicle is controlled and monitored through a custom Android application, enabling users to provide directional commands and observe the surroundings via live video streaming. At the core of the system an Arduino Uno, ESP32 Cam Module inbuilt with WiFi, and Motor Base shield. The HC05 facilitates communication between the mobile application and the vehicle, receiving directional inputs from the user and transmitting them serially to the Arduino. ESP 32 Cam handles the transmission of video signals to an Android device via WiFi.

Keywords:

Surveillance, Wi-Fi , Security

1. INTRODUCTION

Surveillance entails the monitoring of environments or individuals, typically with the goal of ensuring safety and security. It serves a crucial function in overseeing sensitive locations, such as warehouses, hazardous sites, or inaccessible areas, all while minimizing risks to human life. Surveillance can be broadly classified into two categories: outdoor and indoor. Outdoor surveillance typically involves monitoring properties, public spaces, or areas impacted by natural disasters and the most important i.e Remote Places. On the other hand, indoor surveillance focuses on overseeing environments like factories, warehouses, or garages. Gathering data from hazardous or inaccessible areas presents significant challenges for humans due to physical limitations and the inherent value placed on human life. This is where surveillance vehicles offer a solution. Equipped with mounted cameras, these vehicles can effectively fulfill the task, minimizing the need to endanger human lives.

By employing surveillance vehicles, the risks associated with sending individuals into such environments are greatly reduced, as operations can be conducted remotely without human presence on-site. When devising a surveillance vehicle, various crucial elements must be taken into account. Foremost among these considerations is the selection of technology for transmitting live video. Equally important is determining the method for controlling the vehicle. It is essential that users can use both a mobile application to simultaneously operate the car and watch the video feed.While additional functionalities such as location tracking could be integrated, this research paper will concentrate solely on the aforementioned aspects.

2. Literature review

The literature survey for a wirelessly controlled surveillance car encompasses a multidisciplinary exploration of key areas. In wireless communication protocols, studies delve into the suitability of Bluetooth, lora and Wi-Fi for remote control applications.

Research on remote control mechanisms covers diverse methods, including smartphone apps, dedicated remote controllers, & computer based systems. Surveillance technology literature focuses on advancements in camera relevant to a surveillance vehicle. Security and encryption methodologies are scrutinized to safeguard wireless communications, emphasizing privacy and preventing unauthorized access.

3. State Of the Art

Wireless Communication

Surveillance vehicles commonly employ
wireless protocols like Wi-Fi, Bluetooth, for remote control and data transmission.

Camera Systems

Surveillance vehicles often integrate high- definition (HD) cameras for real-time video streaming and image capture.

Remote Control Interface

Operators can remotely control surveillance vehicles through dedicated remote controllers, smartphone apps, or computer interfaces. These interfaces typically offer intuitive controls for vehicle maneuvering and camera adjustment.

Live Streaming and Recording

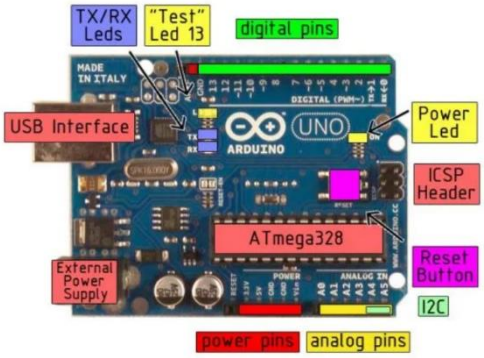
Surveillance vehicles can stream live video footage to remote operators or store recordings for later analysis. Integration with cloud storage services allows convenient access to captured footage from anywhere with internet connectivity.

Power Source and Endurance

Surveillance vehicles may be powered by rechargeable batteries or wired power sources. Battery-powered models often incorporate efficient power management systems to maximize endurance and operational time between charges.

4. System Description

The hardware and software components of the system design can be separated apart. The microcontroller and other modules that are utilised in the hardware unit help the project reach its objective. The software unit is made up of the IDEs and programming languages needed to create a custom Android application and utilise it to operate the surveillance car.



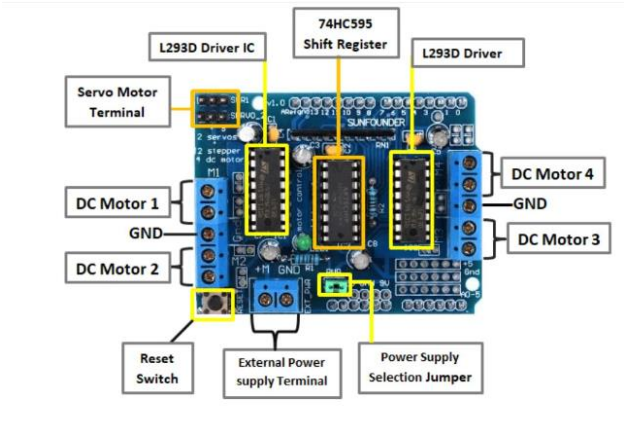
A.Hardware Overview

4.1.1 Arduino Uno Microcontroller

The core of the system is the Arduino Uno. On the Atmega328, this microcontroller is based. There are 14 digital GPIO pins on the Arduino board, some of which have specific uses. The pins with specific functions are: x PWM: 3, 5, 6, 9, 10, and 11 x External Interrupts: Pins 2 & 3 x Serial: Pins 0 & 1. Furthermore, it features six analogue inputs, a 16 MHz crystal oscillator, and a USB port for uploading code from a computer. The Arduino software needs to be installed on the PC. For it to function, a 5V source is needed. Below, Figure 2 displays the Arduino Uno board.

4.1.2 L293D Motor Driver Shield:

Powering Movement in Your Wireless Surveillance Bot. The L293D motor driver shield is an essential component for enabling the mobility and maneuverability of our wireless surveillance bot. This versatile shield interfaces seamlessly with microcontroller we used i.e Arduino.



4.1.3 HC-05 module Information:

indicating whether Bluetooth is active or inactive. This red LED continually and periodically blinks before being connected to the HC-05 module. This module runs on 3.3V, thus when it connects to another Bluetooth device, its blinking slows down to two seconds. Since the module contains a 5 to 3.3 V regulator on board, we may also attach a 5V supply voltage. There is no need to adjust the HC-05 Bluetooth module's transmit level because it has a 3.3V level

for RX/TX and the microcontroller can detect that level. However, we must change the transmit voltage level from the microcontroller to the HC-05 module's RX. The module's data transfer rate can fluctuate up to 1Mbps in the range of 10 meters. The HC-05 Bluetooth Module's specifications include Bluetooth 2.0 and enhanced data rate, or EDR. ISM band frequency is 2.4 GHz.

4.1.4. BO Gear Motor 300rpm:

A Reliable Workhorse for Your Wireless Surveillance Bot. The BO gear motor 300rpm is a popular choice for powering the wheels of wireless surveillance bots due to its dependability, balance of speed and torque, and suitability for moderate loads. Here's a break-down of its key features and how it aligns with the requirements of a surveillance bot: Core Characteristics: Moderate speed: 300rpm (rotations per minute)provides a good balance between maneuverability and coverage area in typical surveillance scenarios. Sufficient torque: Capable of handling the weight of a basic surveillance bot chassis, a small camera payload, and potential sensors without excessive strain .Gear reduction: The built-in gear box translates the motor's high-speed rotation into slower, higher-torque output at the wheel, suitable for driving the bot efficiently. Compact size: Generally small and light weight, fitting well within the constraints of most bot designs .Cost-effective: Offers a balance of performance

4.1.5 ESP32-CAM Module

Eyes and Brains for Your Wireless Surveillance Bot The ESP32-CAM module is a powerful combination of microcontroller and camera, making it a star player in the world of wireless surveillance bots. Here's a plagiarism-free exploration of its features and how it brings your bot to life: Core Functionality: Microcontroller powerhouse: Boasts the ESP32 chip, offering dual-core processing, Wi-Fi and Bluetooth connectivity, and ample GPIO pins for interfacing with various sensors and actuators. Built-in camera: Houses a camera module (usually OV2640 or OV3640) capable of capturing images and videos, the lifeblood of your bot's vision. Extensive programming options: Supports Arduino IDE, Micro Python, and the official ESP-IDF platform, providing flexibility in crafting your bot's control logic.

5. SOFTWARE OVERVIEW

5.1 Developing Android Application:

The developed android application aimed at controlling the car wirelessly through Bluetooth connectivity. The application was developed using Android Studio, leveraging its robust development environment to create a user-friendly interface for seamless control of the car. The application features a navigation drawer with two primary options: "Connectivity" and "Controls". In the "Connectivity" section, users are provided with options to interact with Bluetooth functionalities. Here, users can activate Bluetooth functionality with a single button, streamlining the process of connecting to external devices. Additionally, users can access a list of paired Bluetooth devices, simplifying the selection process for connecting to the specific device controlling the miniature car— typically identified as 'HC05' within the list of available devices. The "Controls" section of the application comprises two segments. The top segment displays a live video feed captured by a camera mounted on the car, providing users with real-time visual feedback of the car's surroundings. The bottom segment houses four intuitive buttons, facilitating smooth navigation and control of the car. The "Live Feed" section enhances the application's functionality by enabling users to access live video streams from an ESP32 Cam module mounted on the miniature car. This section utilizes a web activity to seamlessly integrate the live feed into the application, providing users with real-time visual feedback during operation. Programming the Microcontroller Arduino IDE is used to program Arduino. A logic is written in C to decode the directional commands received from the smartphone (in the form of strings) and control the motors accordingly. If the command received is Forward, the motors rotate in clockwise direction simultaneously. Similarly, a logic for left, right and reverse is implemented.

4.1.1.Methodology

A wirelessly controlled surveillance car typically works by establishing a connection between the car and a mobile app via Wi-Fi or Bluetooth. The app sends control commands to the car, such as forward, backward, left, and right movements. Meanwhile, the car streams live video footage back to the app, allowing the user to see what the car's camera sees in real-time. This video feed is often used for surveillance purposes, enabling users to monitor areas remotely.

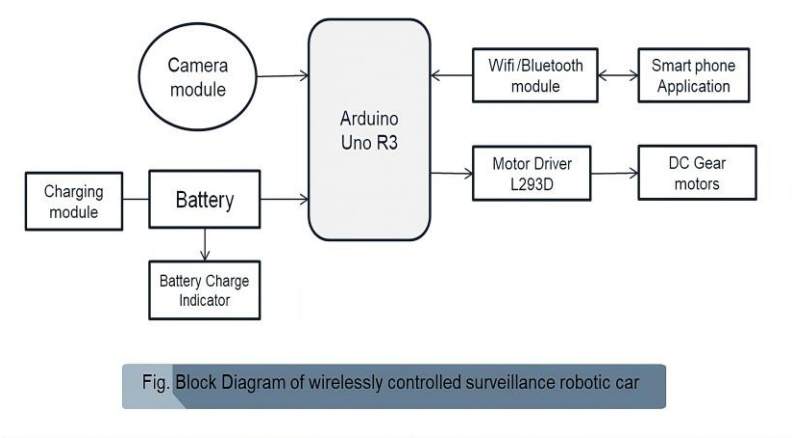
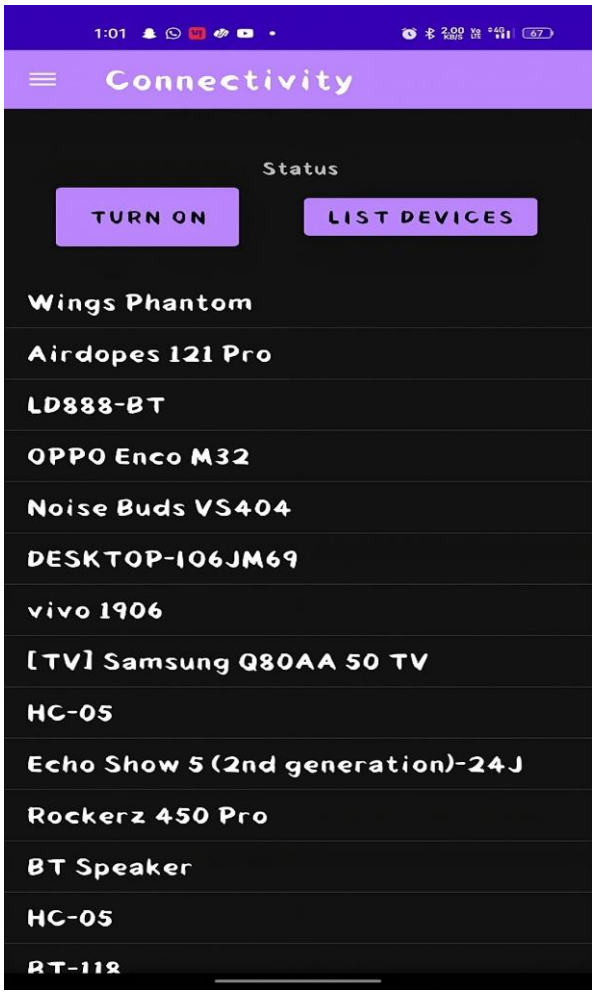
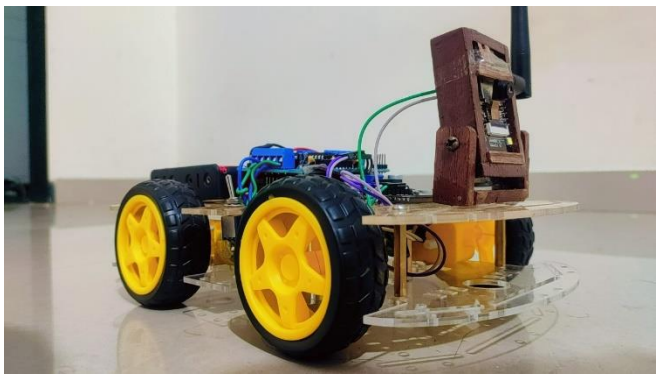


Fig. Block Diagram of wirelessly controlled surveillance robotic car

5.1.2 Implemented Module and App Interface





6. CONCLUSION AND FUTURE SCOPE:

In conclusion this wirelessly controlled surveillance robotic vehicle utilizes a combination of hardware and software to achieve its functionality. Four-wheel gear motors powered by an L293D motor shield are controlled by an Arduino Uno, which receives commands wirelessly via Bluetooth from a custom developed app. Additionally, an ESP32-Cam module provides WiFi-operated video streaming for real-time surveillance. This combination of hardware and software enables the robotic vehicle to maneuver through various environments and capture video footage remotely, making it suitable for applications such as security monitoring, disaster reconnaissance, and remote inspection.

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