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HTTPS Webpage Controlled DC Surveillance Robo-Car

[1]Sarvadnya Avhad, [2] Shreyas Chikhale, [3] Rupesh Chougale, [4] Dr. H.B. Magar
[1]Student, [2]Student, [3]Student, [4]Assistant Professor
[1]Electronics and Telecommunication,
[1]AISSMS Institute of Information Technology, Pune, India

Abstract: This study focuses on creating a webpage that allows a ESP-32 Cam to control a small robot. If people can't physically move to the designated areas, the robot can still navigate within a specific zone and stream real-time video back to a manually hosted webpage. Additionally, the program can be accessed through Secure Shell (SSH) for instant, wireless programming. By using a USB camera, we can capture live video data, and the robot's movement can be controlled in a specific environment. The robot is compact and primarily designed for wireless data transmission and reception, utilizing a built-in WiFi module that can be accessed and managed remotely. In today's world, security is a top priority, as it's crucial to protect your surroundings for your own safety and that of your family. However, traditional security cameras come with several limitations; they need to be positioned at specific angles for optimal viewing and often don't cover large areas. Plus, they can only be accessed from certain devices and may not alert users during unexpected events. Therefore, we need a more effective solution, and a web-controlled surveillance robot proves to be a much more practical option compared to conventional security cameras.

Keywords- Controlled Surveillance Robot, ESP-32 Cam Module, Real-Time Video Streaming, Wireless Navigation, Remote Monitoring, Secure Shell (SSH), WiFi Communication, USB Camera Integration, IoT Security System.

I. INTRODUCTION

"Webpage Controlled DC Surveillance Robo-Car" aims to create a smart robotic car for surveillance. It uses modern technology like microcontrollers and web interfaces to allow real-time control and monitoring. The main component is the ESP32-CAM module, which streams live video securely, ensuring data privacy. Powered by a 12V battery, the RoboCar is equipped with DC motors that let it move around easily. Users can control it through a simple webpage that shows the video feed and has buttons for navigation, making it accessible from any internet-connected device. This project showcases how hardware and software can work together to create a secure and effective surveillance system, suitable for various applications like home security and industrial monitoring. It's built with affordable, available components, making it a practical solution for modern surveillance needs.

The application of wireless communication is crucial in various fields like automation, healthcare, and security, and the use of manually controlled robots is on the rise. In many scenarios, humans are being replaced by unmanned devices that gather data and transmit it back to a central station. Embedded systems are essential in these devices, allowing them to monitor and interact with ongoing tasks from a single base station. Wireless surveillance robots have become an integral part of our daily lives.

Nowadays, the use of wireless sensor networks for different applications has become standardized. For instance, a smart surveillance monitoring system has been developed for home security, utilizing an ESP32-CAM module and a PIR sensor. This system automatically records video when it detects motion and alerts the owner via mobile notifications, either through an alarm or a message. Naga Jyothi and colleagues created a real-time security surveillance system based on IoT principles and a motion detection algorithm implemented in Python.

When motion is detected, it sends an alert SMS to the owner using a GSM module and captures an image from the ESP32-CAM module**.**

II. Literature Review

[1] This paper focuses on the design and construction of a webpage that allows for the control of a mini robot using a Raspberry Pi. It's particularly useful in situations where humans can't easily navigate certain areas, enabling the robot to explore its environment while streaming real-time video back to a manually hosted webpage. Additionally, the program can be accessed via an SSH (Secure Shell) connection, allowing for wireless real-time programming. By utilizing a USB camera, we can capture live video data and control the robot's movements within its surroundings. The robot itself is compact and boasts the key feature of wireless data transmission and reception through its built-in Wi-Fi module, which can be managed and monitored via the webpage hosted on the Raspberry Pi's IP address.

[2] In this paper, we delve into the exciting project of creating a reconnaissance robot that's specifically designed to navigate through highly dangerous areas without alerting its surroundings to its presence (hence the name reconnaissance robot). This

robot will gather information about its environment and send it back to a remote server, which may also be in control of it, providing a live video feed. So, how does this robot transmit the video feed? It will be equipped with a camera to capture what it sees. Much like a human eye, this sensor continuously sends signals to the brain about its surroundings.

[3] Surveillance is crucial for national security. In this paper, we introduce an innovative approach to surveillance in remote and border areas, utilizing a multifunctional robot powered by IoT technology for defense and military purposes. This smart surveillance robot can effectively take the place of a soldier in border regions, providing oversight in critical situations. The robotic vehicle operates as a manually controlled unit, using internet communication to function.

[4] An autonomous robotic vehicle (ARV) is essentially a self-driving vehicle that leverages cutting-edge technology to navigate its surroundings without needing human intervention. These vehicles have a wide range of applications, from transportation and logistics to surveillance and exploration. Route planning (RP) involves figuring out the safest and most efficient path for a vehicle, pedestrian, or any other mode of transport to reach its destination. On the other hand, route management focuses on selecting a path that avoids collisions, which can be quite challenging in crowded environments. That's why providing a solid RP solution for robotic systems is crucial. The particle swarm optimization (PSO) method mimics the cooperative behavior of a flock and its predatory instincts to tackle route modeling challenges. Meanwhile, the Dijkstra algorithm (DA) helps find the shortest path between the closest points from the source to the destination. In this process, inertia weight is also considered to determine the best route. By analyzing various algorithms, we introduced a combination technique for RP. To ensure a reliable route planning method, we proposed the weight-controlled particle swarm-optimized Dijkstra algorithm (WCPSODA). We ran simulations using MATLAB and evaluated the results with conventional tools.

[5] Robot perception is the capability of a robot to estimate and understand its surroundings to the degree that enables it to navigate and interact with the environment Right at the core of robot perception lies the problem of building an internal model of the robot's surroundings using onboard sensor data and prior knowledge., Although the internal model of the environment can be purely geometric (e.g., a point cloud)—as in traditional simultaneous localization and mapping (SLAM)—it can also contain higher-level structures, such as objects and other semantic elements of the scene (e.g., buildings, roads, pedestrians In this sense, robot perception is related to the topic of scene understanding in the computer vision literature. Due to its crucial role in enabling robotics applications, ranging from navigation to manipulation and human–robot interaction, robot perception has been at the center stage of robotics research.

III. SYSTEM DESIGN

The HTTPS Webpage Controlled DC Surveillance RoboCar is architected to combine wireless mobility with live video streaming and secure, remote control functionality. The system follows a distributed processing model, where all critical operations—video acquisition, motion control, and user interaction—are centralized in a lightweight embedded system, yet are managed over a network interface accessible via HTTPS.

The design ensures platform independence and minimal setup requirements, allowing users to control the RoboCar from any standard web browser, eliminating the need for specialized software or apps. It supports bidirectional communication, enabling real-time transmission of video data from the RoboCar to the user and reception of navigation commands from the user to the robot.

The system operates in three key functional layers

1. Perception Layer

This layer deals with environmental awareness, primarily through real-time video captured and served by the ESP32-CAM. This visual feedback is crucial for user decision-making during remote navigation. The continuous video stream is made accessible through a secure, browser-compatible web interface.

2. Control Layer

The control logic is handled directly on the ESP32-CAM microcontroller, which interprets user input from the web interface and translates it into motion commands. This layer ensures command responsiveness and stability, processing actions such as move forward, reverse, turn, and stop, with precise signal timing to the drive system.

3. Interface & Communication Layer

This layer enables secure, real-time communication between the user and the RoboCar. It includes an embedded HTTPS web server hosted on the ESP32-CAM that handles both the video stream and command interface. The design uses client-server architecture, where the ESP32-CAM acts as a server and the user device acts as a client.

IV. SYSTEM DESCRIPTION

Main Components and Functionality:

Bluetooth hc05:
The HC-05 is a popular Bluetooth module that allows for wireless communication between devices. It's often used in projects requiring serial communication and is a favorite among hobbyists for embedded systems, IoT projects, and automation. Here's a breakdown of its key information and uses:
Key Features of the HC-05 Module: Bluetooth Standard: Bluetooth v2.0+EDR (Enhanced Data Rate), which supports up to 3 Mbps of wireless communication speed.
Frequency Range: Operates in the 2.4 GHz ISM band.
Communication Protocol: Uses UART (Universal Asynchronous Receiver-Transmitter) for serial communication, typically at baud rates of 9600 bps by default.

Arduino Nano:
The Arduino Nano is a tiny, compact microcontroller board that runs on either the ATmega328P or the ATmega168. It's a popular choice for embedded systems, IoT applications, and various electronics projects. While it offers similar functionality to the Arduino Uno, its smaller size makes it a perfect fit for projects where space is at a premium. Key Features: - Microcontroller: ATmega328P (in newer models) or ATmega168 (in older models). - Operating Voltage: 5V. - Input Voltage: 7-12V (via the Vin pin) or 5V through USB. - Digital I/O Pins: 14 (with 6 capable of PWM output). - Analog Input Pins: 8.

L298d motor driver :
The L298D is a well-known dual H-bridge motor driver that lets you control both the speed and direction of two DC motors or even a stepper motor It's commonly used in robotics and automation projects for driving motors with higher current ratings than the microcontroller can handle directly. Dual H-Bridge: The L298D has two H-bridge circuits, which allow it to control two DC motors independently or one stepper motor. Each H-bridge can be controlled separately, allowing you to control the direction and speed of the motors Voltage Range: Motor supply voltage (Vss): 4.5V to 46V. Logic supply voltage (Vss): 5V. The driver can be

powered from a 5V logic supply and a higher voltage (up to 46V) for the motors.

Ftdi to ttl converter 7805 :

FTDI Chip: This converter typically uses the FT232RL chip from FTDI, which handles the conversion of USB data to TTL serial communication. USB Interface: One end of the converter is a USB interface (Mini or Micro USB), which plugs into the computer. TTL Serial Pins: The other side of the module has TTL-level pins (TXD, RXD, GND, VCC, RTS, and CTS), which connect to the

microcontroller or device that needs serial communication.

Voltages: Commonly supports 3.3V and 5V logic levels for TTL communication. This makes it versatile for working with a variety of microcontrollers, which can run at either of these voltage levels

Esp cam module :

The ESP32-CAM module is a powerful, low-cost microcontroller with a built-in camera and Wi-Fi connectivity. It is ideal for applications that require video streaming, image capture, and wireless data transmission. The ESP32-CAM is based on the ESP32-S microcontroller, which integrates Wi-Fi and Bluetooth, and comes with a built-in camera module like the OV2640.

Key Features of the ESP32-CAM:

ESP32 Chip Dual core 32-bit LX6 microprocessor. Clock speed up to 240 MHz. Built-in Wi-Fi 802.11 b/g/n and Bluetooth 4.2 Led

Camera: Typically comes with the OV2640 camera module, capable of capturing im- ages at 2 megapixels (1600x1200). Supports various image formats such as JPEG, BMP, and grayscale.

Flash Storage: It comes with 4MB of PSRAM for storing data. Plus, there's an SD card slot that lets you expand your storage, making it easy to save images and videos. This device can detect oxygen levels in the air, as well as flammable and hazardous gases. It's incredibly versatile and finds applications in various settings, including industries and homes.

The HTTPS Webpage Controlled DC Surveillance Robo-Car was successfully developed, enabling secure remote control, real-time video streaming, and environmental monitoring via an HTTPS-based interface. The USB camera provided a live feed, while ultrasonic, temperature, gas, and fire sensors ensured obstacle detection and security alerts. The Wi-Fi-enabled ESP-32 Cam processed commands with minimal latency, and the L298D motor driver ensured smooth movement. The system operated efficiently with low power consumption and stable performance. This project demonstrates a cost-effective, mobile alternative to traditional surveillance systems, enhancing security and real-time monitoring with future potential for extended connectivity

V . Result and Discussion

AI-Based Object Detection & Tracking

Integrating AI and Machine Learning for facial recognition, motion tracking, and anomaly detection to enhance surveillance capabilities.

4G/5G & IoT Integration

Implementing 4G/5G modules for long-range remote control beyond Wi-Fi limitations.

IoT-based cloud storage to save and analyze surveillance footage in real-time.

Night Vision & Thermal Imaging Adding infrared cameras or thermal sensors to improve surveillance in low-light or hazardous environments.

Autonomous Navigation & Patrol Mode

Using LIDAR and GPS for self-driving capabilities, enabling the robot to patrol predefined areas without manual control.

Multi-Robot Coordination Developing a system where multiple robots work together, improving area coverage and data-sharing for enhanced security

Figure 1 Hardware Model

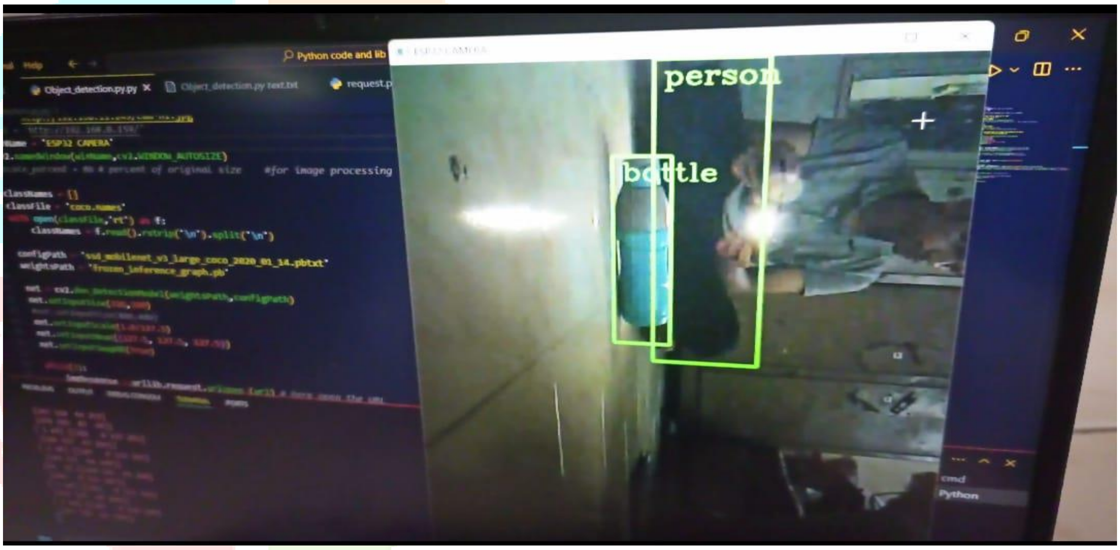

Figure 2 Software Model

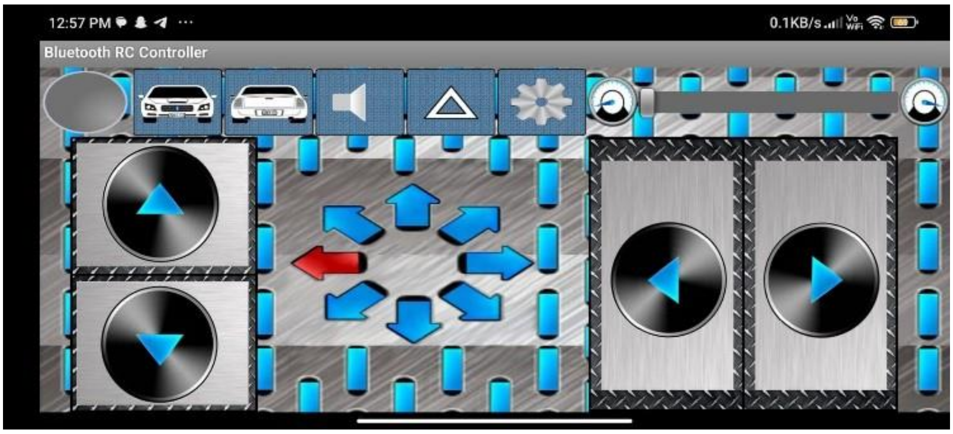

Figure 3 Remote Integration

VI . CONCLUSION

In this project, we dive into the fascinating world of Robotics, proposing a robotic car packed with a variety of functionalities. This innovative model is designed to detect any obstacles in its path and skillfully maneuver around them. Additionally, it incorporates explosion sensing through a clever combination of sensors, including gas detectors. Throughout the project, we thoroughly explore the workings of the Arduino Nano and a range of sensors, gaining a solid understanding of their applications. Our coding and design skills serve as the foundation for this endeavor. This project offers deep insights into various technologies and tools that enhance the development process. Working with software like Arduino IDE and Proteus has broadened our knowledge significantly. There's plenty of room for improvement, particularly in communication range and reducing processing time. By opting for Bluetooth technology instead of the more commonly used alternatives, we can extend the communication range and boost the overall performance of our robotic model.

VII . REFERENCES

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