Surveillance Tele-Mobile UGV

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***Abstract* — This project presents the development of a Surveillance robot using an ESP 32 CAM Module and L293D Motor Driver. The primary objective is to design a mobile surveillance. So, it is better than normal traditional wall mounting static camera. And this can be achieved by UGV (Unmanned Ground Vehicle). Here the ESP 32 cam act as both camera module and controlling unit of the UGV. This UGV is connected to wi-fi router and through the IP address of the router we can control the UGV at anyplace. This UGV is a IoT based device.**

Index terms --- Mobile surveillance, ESP 32 Cam, UGV, IoT device

I. INTRODUCTION

Surveillance security plays a crucial role in maintaining public safety and protecting assets. It involves the use of cameras and monitoring systems to observe and record activities in various environments, such as public spaces, businesses, and private properties. This helps deter criminal activities, as the presence of surveillance can discourage potential offenders. Additionally, surveillance footage can provide valuable evidence in investigations, aiding law enforcement in solving crimes and ensuring justice.

This project has UGV (Unmanned ground vehicle) which contains a camera. This UGV is a IoT based device, it is controlled by web page through wi-fi. So, it is also known as tele-controlled UGV. The UGV is used for real-time monitoring and surveillance applications in household and industrial purpose and it also used in the areas that are difficult or hazardous for human access. By using ESP32 CAM's onboard camera and Wi-Fi capabilities, the system provides live video streaming, which can be accessed remotely on mobile devices or computers through web interface. low-cost surveillance robot using the ESP32-CAM Module.

II. METHODOLOGY

A. *WORKING MODE*:

- Station Mode
- Access Point Mode

Station Mode (STA): The ESP32 scans for available Wi-Fi networks which has internet connectivity and connects to a specified network using its SSID and password. Once connected, it is assigned an IP address by the router, allowing communication with other devices on the network. Through this IP address it creates the web page, and with help of this web page we can see the live streaming and also control the movement of the bot using this. In this mode we can control the bot from anywhere.

Station mode is a IoT applications because it allows the ESP32 to connect to a larger network. Through this network, the ESP32 can send data to and receive data from the cloud, enabling remote monitoring and control.

Access Point (AP): The ESP32 creates its own Wi-Fi network, allowing other devices to connect directly to it. In this mode, the ESP32 doesn't connect to an external router. The ESP32 provides an SSID and password for devices to connect to its network. Here you can communicate with the ESP32 locally without any external Wi-Fi network. The ESP32 can assign IP addresses of it owns. And through this we can control the bot and see the live streaming.

This mode is not a IoT based application because it is not dealing with internet (cloud serve). We can control the bot from a specific range from the bot (i.e. the ESP 32 create wi-fi range). So, it is a short distance communication.

B. *Programming the controller*

The ESP32 is interfaced with the laptop through a TTL module. This TTL module has 4 male pins to interface with ESP32 and USB port to interface with laptop.

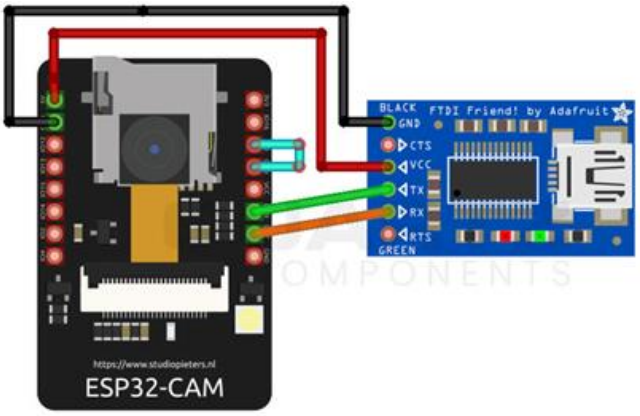

Fig 1: ESP32 Cam with TTL Module

C. *SYSTEM ARCHITECTURE*

A **Motor Driver** is a crucial component in a Wi-Fi-controlled car system as it serves as the interface between the microcontroller (NodeMCU or Arduino) and the motors. Microcontrollers typically cannot supply sufficient current to drive DC motors directly. The motor driver acts as an amplifier, receiving low-power control signals and generating higher-power signals to operate the motors.

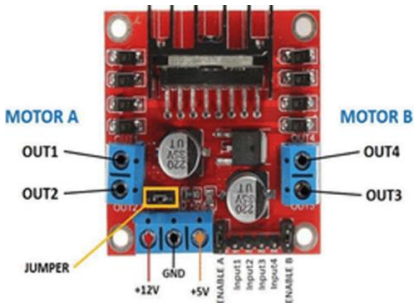

Fig 2: L293D Driver

The **ESP32-CAM module** is a cost-effective and compact development board designed for IoT and image processing applications. It features an ESP32 chip with integrated Wi-Fi and Bluetooth, a built-in OV2640 camera supporting resolutions up to 1600x1200, and MicroSD card support for storing captured images and videos. The board includes GPIO pins for interfacing with sensors and actuators, operates on a 5V power supply, and supports programming via Arduino IDE or ESP-IDF. Commonly used for surveillance, image recognition, and AI-powered projects, the ESP32-CAM combines affordability with versatility in a small form factor.

Fig 3: ESP32-CAM module

The **Battery** in a Wi-Fi-controlled car bot is one of the most critical components, as it provides the necessary power to the entire system, including the microcontroller (ESP32), motor driver, and motors. Selecting the right type of battery ensures the bot operates efficiently and for an adequate duration. Here we are using 12v battery

Fig 4: Battery

Motors - In a Wi-Fi-controlled car, the tires and DC motors are integral components that determine the bot's movement, speed, and maneuverability. These components work together to translate the control signals from the motor driver into physical motion. DC motors convert electrical energy into mechanical energy to drive the wheels. They enable the car to move forward, backward, and turn by varying the rotation direction and speed.

Fig 5: Motor with Wheel

D. CONNECTION DIAGRAM

This is the overall connection diagram of the bot.

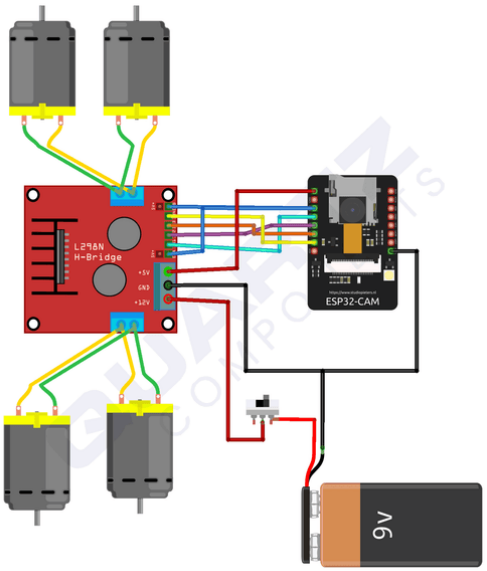

Fig 6: Circuit Diagram

E. Programming Software:

a. Software Overview: Arduino IDE

a) Arduino IDE is an open-source platform specifically designed for programming microcontrollers, like the Arduino board and compatible hardware like the ESP32. It provides a user-friendly interface for writing, compiling, anduploading code.

b) Programming Language: The IDE uses a simplified version of C/C++ and provides libraries to simplify complex functions, such as handling sensors or network connections.

III. RESULT

The surveillance UGV works efficiently according to the command given through smart phone. The user interface is available in the IP address of the router. capturing video by the camera is lively streaming in the user interface. Station mode says long distance controlling and access mode says short distance controlling of the UGV.

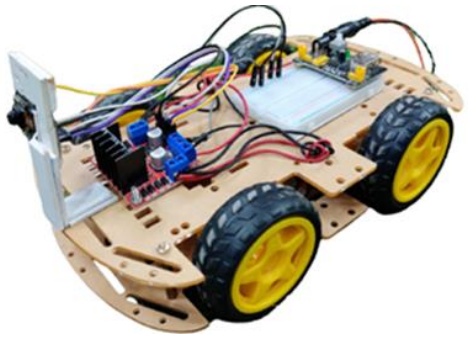

Fig 7: Hardware Setup

IV. APPLICATION

- It is used in domestic home surveillance
- Industrial application where human can't enter
- Spy activities
- Hazards area, where human can't survive
- Observation of enemy positions in military
- Security purpose

OUTPUT

The ESP32 serves a webpage that displays real-time video streaming and UGV movement controller with speed control and flash light control. Users can access this webpage via a web browser, allowing for easy monitoring of the system's performance.

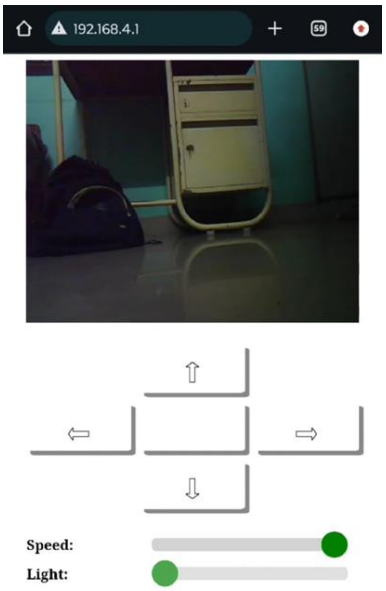

Fig 8: Webpage Output

V. CONCLUSION

In this project, we successfully developed a surveillance UGV that optimizes video capture through ESP32 cam module. By providing wi-fi, the bot can be controlled the website and the live streaming is projected in the same website like. It is a IoT based device.

By using access mode, we can control the UGV without any need of wi-fi or internet. In this mode the UGV is not a IoT based device. But this is a short distance controlling and we can't control for longer distance.

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