PROJECT REPORT

MOBILE CONTROLLED RC CAR WITH ESP32 CAM WIFI MODULE VIA L298N MOTOR DRIVER

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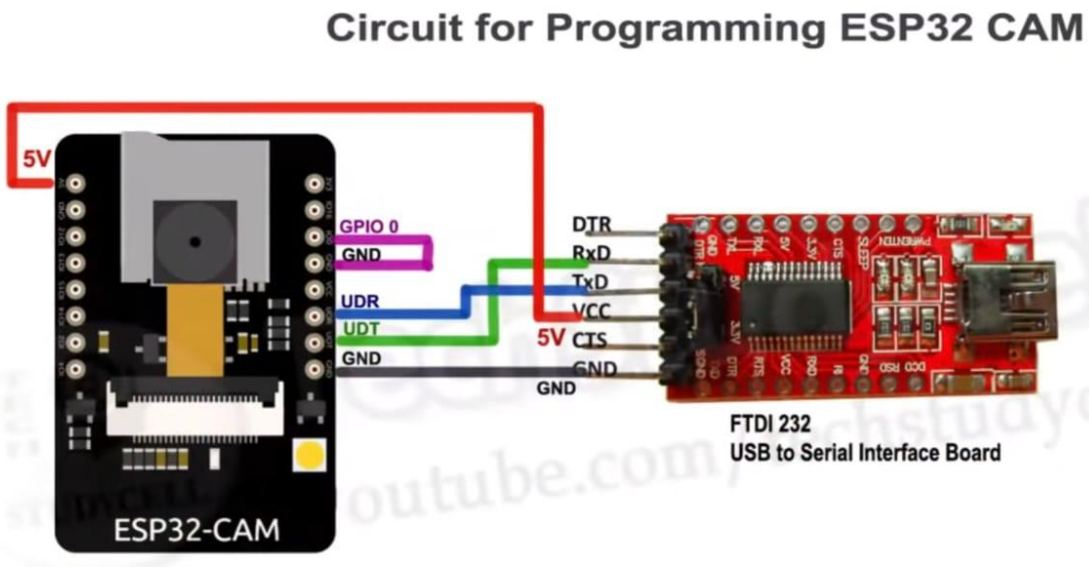
INTRODUCTION

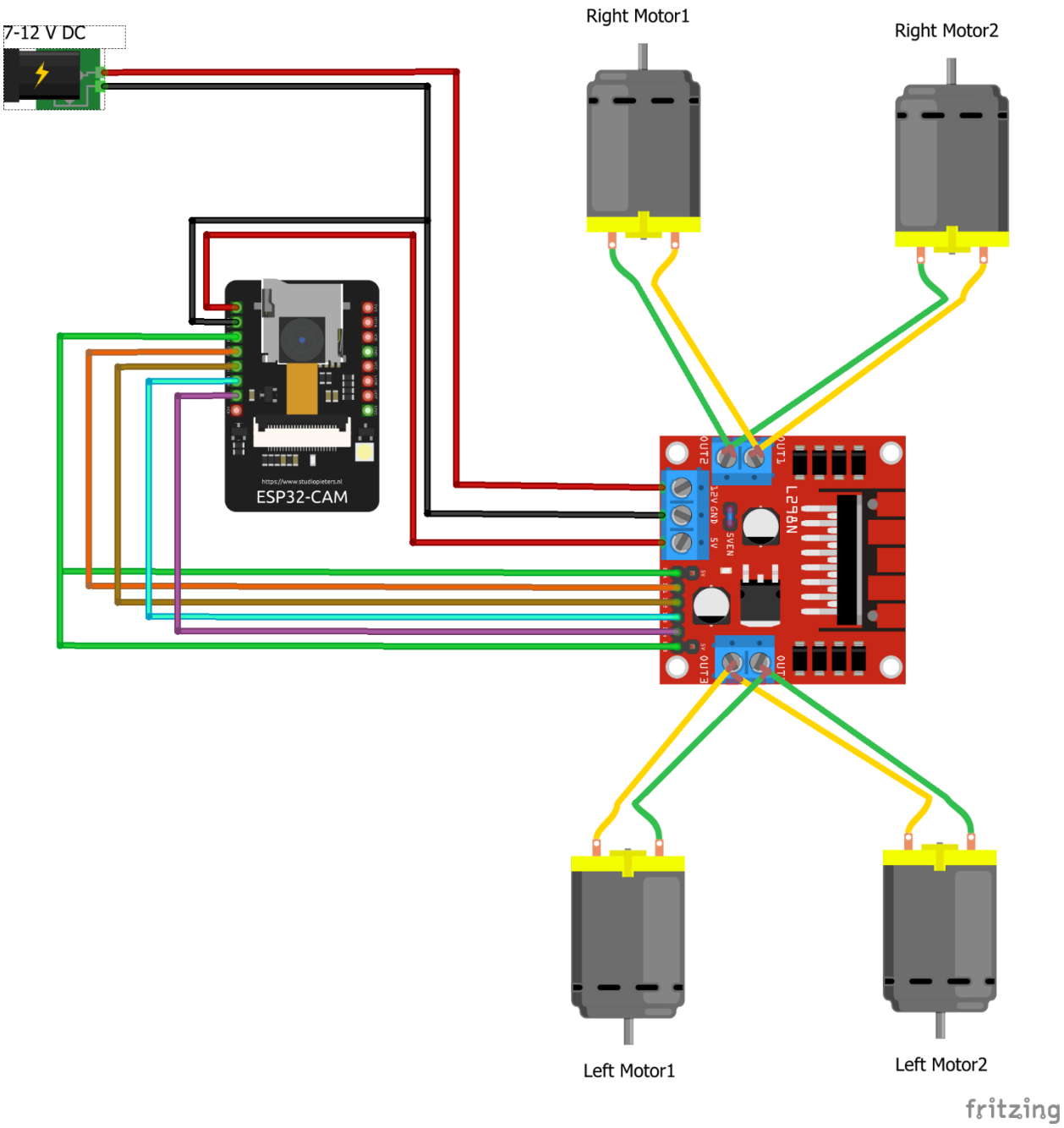
In the era of rapid technological advancements, the integration of mobile devices with electronic systems has become increasingly popular. The project focuses on developing a Remote Controlled (RC) car that can be controlled using a mobile device through a WiFi connection facilitated by an ESP32 module. The mobility aspect of the project is achieved through the utilization of an L298N motor driver, enabling the control of the car's motors.

ACKNOWLEDGEMENT

We extend our heartfelt gratitude to all those who have contributed to the successful completion of this project. Special thanks to [Vaishali Salve], for their valuable guidance and support throughout the project duration.

CIRCUIT DIAGRAM :





COMPONENT LIST

ESP32 WiFi CAM Module
FTDI 232 programmer
L298N Motor Driver
RC Car Chassis
Wheels and Motors
Smartphone
Jumper Wires
Power Source (Battery Pack)

WORKING

The Mobile controlled RC Car with ESP32 WiFi CAM module through L298N Motor Driver operates as follows:

The ESP32 WiFi CAM module establishes a connection with the user's smartphone through a WiFi network.

The smartphone sends control signals via the WiFi network to the ESP32 module, specifying desired actions for the RC car (forward, backward, left, right).

Meanwhile, streaming the live footage from the in-built camera.

The ESP32 processes these signals and sends corresponding commands to the L298N Motor Driver. The L298N Motor Driver controls the motors of the RC car based on the received commands, causing the car to move accordingly.

The user can control the RC car's movements remotely using a custom-designed mobile application interfaced with the ESP32 module.

COMPONENT INFORMATION

ESP32 WiFi CAM Module: A powerful microcontroller with built-in WiFi connectivity and 2 MP camera, capable of handling network communication tasks.

L298N Motor Driver: A dual H-bridge motor driver module capable of controlling the direction and speed of DC motors.

RC Car Chassis: The structural framework of the RC car, providing support for mounting motors, wheels, and other components.

Wheels and Motors: The driving force of the RC car, responsible for its locomotion.

Smartphone: Acts as the remote-control device, sending commands to the RC car via WiFi.

Jumper Wires: Used for establishing electrical connections between components.

Power Source: Provides electrical power to the entire system, typically a battery pack.

PROGRAM

```
#include "esp_camera.h"
#include <Arduino.h>
#include <WiFi.h>
#include <AsyncTCP.h>
#include <ESPAsyncWebServer.h>
#include <iostream>
#include <sstream>

struct MOTOR_PINS
{
  int pinEn;
  int pinIN1;
  int pinIN2;
};

std::vector<MOTOR_PINS> motorPins =
{
  {12, 13, 15},  //RIGHT_MOTOR Pins (EnA, IN1, IN2)
  {12, 14, 2},  //LEFT_MOTOR  Pins (EnB, IN3, IN4)
};
#define LIGHT_PIN 4

#define UP 1
#define DOWN 2
#define LEFT 3
#define RIGHT 4
#define STOP 0

#define RIGHT_MOTOR 0
#define LEFT_MOTOR 1

#define FORWARD 1
#define BACKWARD -1

const int PWMFreq = 1000; /* 1 KHz */
const int PWMResolution = 8;
const int PWMSpeedChannel = 2;
const int PWMLightChannel = 3;

//Camera related constants
#define PWDN_GPIO_NUM     32
#define RESET_GPIO_NUM    -1
#define XCLK_GPIO_NUM      0
```

```
#define SIOD_GPIO_NUM     26
#define SIOC_GPIO_NUM     27
#define Y9_GPIO_NUM       35
#define Y8_GPIO_NUM       34
#define Y7_GPIO_NUM       39
#define Y6_GPIO_NUM       36
#define Y5_GPIO_NUM       21
#define Y4_GPIO_NUM       19
#define Y3_GPIO_NUM       18
#define Y2_GPIO_NUM        5
#define VSYNC_GPIO_NUM    25
#define HREF_GPIO_NUM     23
#define PCLK_GPIO_NUM     22

const char* ssid     = "MAHADEV";
const char* password = "123456789";

AsyncWebServer server(80);
AsyncWebSocket wsCamera("/Camera");
AsyncWebSocket wsCarInput("/CarInput");
uint32_t cameraClientId = 0;

const char* htmlHomePage PROGMEM = R"HTMLHOMEPAGE(
<!DOCTYPE html>
<html>
 <head>
 <meta name="viewport" content="width=device-width, initial-scale=1, maximum-scale=1, user-
scalable=no">
   <style>
   .arrows {
     font-size:40px;
     color:red;
   }
   td.button {
     background-color:black;
     border-radius:25%;
     box-shadow: 5px 5px #888888;
   }
   td.button:active {
     transform: translate(5px,5px);
     box-shadow: none;
   }

   .noselect {
```

```
  -webkit-touch-callout: none; /* iOS Safari */
    -webkit-user-select: none; /* Safari */
     -khtml-user-select: none; /* Konqueror HTML */
       -moz-user-select: none; /* Firefox */
        -ms-user-select: none; /* Internet Explorer/Edge */
            user-select: none; /* Non-prefixed version, currently
                                  supported by Chrome and Opera */
}

.slidecontainer {
  width: 100%;
}

.slider {
  -webkit-appearance: none;
  width: 100%;
  height: 15px;
  border-radius: 5px;
  background: #d3d3d3;
  outline: none;
  opacity: 0.7;
  -webkit-transition: .2s;
  transition: opacity .2s;
}

.slider:hover {
  opacity: 1;
}

.slider::-webkit-slider-thumb {
  -webkit-appearance: none;
  appearance: none;
  width: 25px;
  height: 25px;
  border-radius: 50%;
  background: red;
  cursor: pointer;
}

.slider::-moz-range-thumb {
  width: 25px;
  height: 25px;
  border-radius: 50%;
  background: red;
```

```
    cursor: pointer;
   }

   </style>

 </head>
 <body class="noselect" align="center" style="background-color:white">

    <h1 style="color: teal;text-align:center;">Car Model</h1>
    <h2 style="color: teal;text-align:center;">By Using ESP32 CAM MODULE And L298N Motor
Driver</h2>
    <h3 style="color: teal;text-align:left;">MADE BY :</h3>
    <p style="color:black;text-align:left;">Roll No : 2131  Name : Samrat Sawant</p>
    <p style="color:black;text-align:left;">Roll No : 2134  Name : Onkar Shelke</p>

   <!--h2 style="color: teal;text-align:center;">Wi-Fi Camera &#128663; Control</h2-->

   <table id="mainTable" style="width:400px;margin:auto;table-layout:fixed" CELLSPACING=10>
     <tr>
      <img id="cameraImage" src="" style="width:400px;height:250px"></td>
     </tr>
     <tr>
      <td></td>
      <td class="button" ontouchstart='sendButtonInput("MoveCar","1")'
ontouchend='sendButtonInput("MoveCar","0")'><span class="arrows" >&#8679;</span></td>
      <td></td>
     </tr>
     <tr>
      <td class="button" ontouchstart='sendButtonInput("MoveCar","3")'
ontouchend='sendButtonInput("MoveCar","0")'><span class="arrows" >&#8678;</span></td>
      <td class="button"></td>
      <td class="button" ontouchstart='sendButtonInput("MoveCar","4")'
ontouchend='sendButtonInput("MoveCar","0")'><span class="arrows" >&#8680;</span></td>
     </tr>
     <tr>
      <td></td>
      <td class="button" ontouchstart='sendButtonInput("MoveCar","2")'
ontouchend='sendButtonInput("MoveCar","0")'><span class="arrows" >&#8681;</span></td>
      <td></td>
     </tr>
     <tr/><tr/>
     <tr>
      <td style="text-align:left"><b>Speed:</b></td>
      <td colspan=2>
```

```
      <div class="slidecontainer">
        <input type="range" min="0" max="255" value="150" class="slider" id="Speed"
oninput='sendButtonInput("Speed",value)'>
      </div>
     </td>
    </tr>
    <tr>
     <td style="text-align:left"><b>Light:</b></td>
     <td colspan=2>
      <div class="slidecontainer">
        <input type="range" min="0" max="255" value="0" class="slider" id="Light"
oninput='sendButtonInput("Light",value)'>
      </div>
     </td>
    </tr>
   </table>

   <script>
    var webSocketCameraUrl = "ws:\/\/" + window.location.hostname + "/Camera";
    var webSocketCarInputUrl = "ws:\/\/" + window.location.hostname + "/CarInput";
    var websocketCamera;
    var websocketCarInput;

    function initCameraWebSocket()
    {
     websocketCamera = new WebSocket(webSocketCameraUrl);
     websocketCamera.binaryType = 'blob';
     websocketCamera.onopen    = function(event){};
     websocketCamera.onclose   = function(event){setTimeout(initCameraWebSocket, 2000);};
     websocketCamera.onmessage = function(event)
     {
      var imageId = document.getElementById("cameraImage");
      imageId.src = URL.createObjectURL(event.data);
     };
    }

    function initCarInputWebSocket()
    {
     websocketCarInput = new WebSocket(webSocketCarInputUrl);
     websocketCarInput.onopen    = function(event)
     {
      var speedButton = document.getElementById("Speed");
      sendButtonInput("Speed", speedButton.value);
      var lightButton = document.getElementById("Light");
```

```
      sendButtonInput("Light", lightButton.value);
     };
     websocketCarInput.onclose   = function(event){setTimeout(initCarInputWebSocket, 2000);};
     websocketCarInput.onmessage = function(event){};
    }

    function initWebSocket()
    {
     initCameraWebSocket ();
     initCarInputWebSocket();
    }

    function sendButtonInput(key, value)
    {
     var data = key + "," + value;
     websocketCarInput.send(data);
    }

    window.onload = initWebSocket;
    document.getElementById("mainTable").addEventListener("touchend", function(event){
     event.preventDefault()
    });
   </script>
  </body>
</html>
)HTMLHOMEPAGE";

void rotateMotor(int motorNumber, int motorDirection)
{
 if (motorDirection == FORWARD)
 {
  digitalWrite(motorPins[motorNumber].pinIN1, HIGH);
  digitalWrite(motorPins[motorNumber].pinIN2, LOW);
 }
 else if (motorDirection == BACKWARD)
 {
  digitalWrite(motorPins[motorNumber].pinIN1, LOW);
  digitalWrite(motorPins[motorNumber].pinIN2, HIGH);
 }
 else
 {
  digitalWrite(motorPins[motorNumber].pinIN1, LOW);
  digitalWrite(motorPins[motorNumber].pinIN2, LOW);
 }
```

```
}

void moveCar(int inputValue)
{
 Serial.printf("Got value as %d\n", inputValue);
 switch(inputValue)
 {

   case UP:
    rotateMotor(RIGHT_MOTOR, FORWARD);
    rotateMotor(LEFT_MOTOR, FORWARD);
    break;

   case DOWN:
    rotateMotor(RIGHT_MOTOR, BACKWARD);
    rotateMotor(LEFT_MOTOR, BACKWARD);
    break;

   case LEFT:
    rotateMotor(RIGHT_MOTOR, FORWARD);
    rotateMotor(LEFT_MOTOR, BACKWARD);
    break;

   case RIGHT:
    rotateMotor(RIGHT_MOTOR, BACKWARD);
    rotateMotor(LEFT_MOTOR, FORWARD);
    break;

   case STOP:
    rotateMotor(RIGHT_MOTOR, STOP);
    rotateMotor(LEFT_MOTOR, STOP);
    break;

   default:
    rotateMotor(RIGHT_MOTOR, STOP);
    rotateMotor(LEFT_MOTOR, STOP);
    break;
 }
}

void handleRoot(AsyncWebServerRequest *request)
{
 request->send_P(200, "text/html", htmlHomePage);
}
```

```
void handleNotFound(AsyncWebServerRequest *request)
{
   request->send(404, "text/plain", "File Not Found");
}

void onCarInputWebSocketEvent(AsyncWebSocket *server,
                  AsyncWebSocketClient *client,
                  AwsEventType type,
                  void *arg,
                  uint8_t *data,
                  size_t len)
{
  switch (type)
  {
    case WS_EVT_CONNECT:
     Serial.printf("WebSocket client #%u connected from %s\n", client->id(), client-
>remoteIP().toString().c_str());
     break;
    case WS_EVT_DISCONNECT:
     Serial.printf("WebSocket client #%u disconnected\n", client->id());
     moveCar(0);
     ledcWrite(PWMLightChannel, 0);
     break;
    case WS_EVT_DATA:
     AwsFrameInfo *info;
     info = (AwsFrameInfo*)arg;
     if (info->final && info->index == 0 && info->len == len && info->opcode == WS_TEXT)
     {
       std::string myData = "";
       myData.assign((char *)data, len);
       std::istringstream ss(myData);
       std::string key, value;
       std::getline(ss, key, ',');
       std::getline(ss, value, ',');
       Serial.printf("Key [%s] Value[%s]\n", key.c_str(), value.c_str());
       int valueInt = atoi(value.c_str());
       if (key == "MoveCar")
       {
         moveCar(valueInt);
       }
       else if (key == "Speed")
       {
         ledcWrite(PWMSpeedChannel, valueInt);
```

```
      }
      else if (key == "Light")
      {
        ledcWrite(PWMLightChannel, valueInt);
      }
     }
     break;
   case WS_EVT_PONG:
   case WS_EVT_ERROR:
     break;
   default:
     break;
 }
}

void onCameraWebSocketEvent(AsyncWebSocket *server,
                  AsyncWebSocketClient *client,
                  AwsEventType type,
                  void *arg,
                  uint8_t *data,
                  size_t len)
{
 switch (type)
 {
   case WS_EVT_CONNECT:
     Serial.printf("WebSocket client #%u connected from %s\n", client->id(), client-
>remoteIP().toString().c_str());
     cameraClientId = client->id();
     break;
   case WS_EVT_DISCONNECT:
     Serial.printf("WebSocket client #%u disconnected\n", client->id());
     cameraClientId = 0;
     break;
   case WS_EVT_DATA:
     break;
   case WS_EVT_PONG:
   case WS_EVT_ERROR:
     break;
   default:
     break;
 }
}

void setupCamera()
```

```
{
  camera_config_t config;
  config.ledc_channel = LEDC_CHANNEL_0;
  config.ledc_timer = LEDC_TIMER_0;
  config.pin_d0 = Y2_GPIO_NUM;
  config.pin_d1 = Y3_GPIO_NUM;
  config.pin_d2 = Y4_GPIO_NUM;
  config.pin_d3 = Y5_GPIO_NUM;
  config.pin_d4 = Y6_GPIO_NUM;
  config.pin_d5 = Y7_GPIO_NUM;
  config.pin_d6 = Y8_GPIO_NUM;
  config.pin_d7 = Y9_GPIO_NUM;
  config.pin_xclk = XCLK_GPIO_NUM;
  config.pin_pclk = PCLK_GPIO_NUM;
  config.pin_vsync = VSYNC_GPIO_NUM;
  config.pin_href = HREF_GPIO_NUM;
  config.pin_sscb_sda = SIOD_GPIO_NUM;
  config.pin_sscb_scl = SIOC_GPIO_NUM;
  config.pin_pwdn = PWDN_GPIO_NUM;
  config.pin_reset = RESET_GPIO_NUM;
  config.xclk_freq_hz = 20000000;
  config.pixel_format = PIXFORMAT_JPEG;

  config.frame_size = FRAMESIZE_VGA;
  config.jpeg_quality = 10;
  config.fb_count = 1;

  // camera init
  esp_err_t err = esp_camera_init(&config);
  if (err != ESP_OK)
  {
    Serial.printf("Camera init failed with error 0x%x", err);
    return;
  }

  if (psramFound())
  {
    heap_caps_malloc_extmem_enable(20000);
    Serial.printf("PSRAM initialized. malloc to take memory from psram above this size");
  }
}

void sendCameraPicture()
{
```

```
 if (cameraClientId == 0)
 {
  return;
 }
 unsigned long  startTime1 = millis();
 //capture a frame
 camera_fb_t * fb = esp_camera_fb_get();
 if (!fb)
 {
    Serial.println("Frame buffer could not be acquired");
    return;
 }

 unsigned long  startTime2 = millis();
 wsCamera.binary(cameraClientId, fb->buf, fb->len);
 esp_camera_fb_return(fb);

 //Wait for message to be delivered
 while (true)
 {
  AsyncWebSocketClient * clientPointer = wsCamera.client(cameraClientId);
  if (!clientPointer || !(clientPointer->queueIsFull()))
  {
   break;
  }
  delay(1);
 }

 unsigned long  startTime3 = millis();
 Serial.printf("Time taken Total: %d|%d|%d\n",startTime3 - startTime1, startTime2 - startTime1,
startTime3-startTime2 );
}

void setUpPinModes()
{
 //Set up PWM
 ledcSetup(PWMSpeedChannel, PWMFreq, PWMResolution);
 ledcSetup(PWMLightChannel, PWMFreq, PWMResolution);

 for (int i = 0; i < motorPins.size(); i++)
 {
  pinMode(motorPins[i].pinEn, OUTPUT);
  pinMode(motorPins[i].pinIN1, OUTPUT);
  pinMode(motorPins[i].pinIN2, OUTPUT);
```

```
    /* Attach the PWM Channel to the motor enb Pin */
    ledcAttachPin(motorPins[i].pinEn, PWMSpeedChannel);
  }
  moveCar(STOP);

  pinMode(LIGHT_PIN, OUTPUT);
  ledcAttachPin(LIGHT_PIN, PWMLightChannel);
}

void setup(void)
{
  setUpPinModes();
  Serial.begin(115200);

  WiFi.softAP(ssid, password);
  IPAddress IP = WiFi.softAPIP();
  Serial.print("AP IP address: ");
  Serial.println(IP);

  server.on("/", HTTP_GET, handleRoot);
  server.onNotFound(handleNotFound);

  wsCamera.onEvent(onCameraWebSocketEvent);
  server.addHandler(&wsCamera);

  wsCarInput.onEvent(onCarInputWebSocketEvent);
  server.addHandler(&wsCarInput);

  server.begin();
  Serial.println("HTTP server started");

  setupCamera();
}

void loop()
{
  wsCamera.cleanupClients();
  wsCarInput.cleanupClients();
  sendCameraPicture();
  Serial.printf("SPIRam Total heap %d, SPIRam Free Heap %d\n", ESP.getPsramSize(), ESP.getFreePsram());
}
```

APPLICATION

The Mobile controlled RC Car with ESP32 WiFi CAM module through L298N Motor Driver finds applications in various domains such as:
Education: Demonstrating principles of wireless communication, microcontroller programming, and motor control.
Entertainment: Remote-controlled gaming and competitions involving maneuvering the RC car through obstacles.
Surveillance: Equipping the RC car with cameras for remote monitoring in inaccessible or hazardous areas. Research and Development: Prototyping and testing autonomous navigation algorithms for future robotic applications.

FUTURE SCOPE

Integration of Sensors: Incorporating sensors such as ultrasonic sensors or infrared sensors for obstacle detection and avoidance.
Enhanced Control Interface: Developing a more intuitive and feature-rich mobile application for better user experience.
Autonomous Navigation: Implementing algorithms for autonomous navigation, enabling the RC car to navigate predefined paths without manual control.
IoT Integration: Integrating the RC car into the Internet of Things (IoT) ecosystem for remote monitoring and control over the internet.

CONCLUSION

The Mobile controlled RC Car with ESP32 WiFi CAM module through L298N Motor Driver project demonstrates the integration of modern technologies to create a versatile and remotely controllable RC car. By leveraging WiFi connectivity and powerful microcontrollers, the project showcases the potential applications of wireless communication and motor control in various fields. With further enhancements and developments, this project lays the foundation for future advancements in remote-controlled and autonomous vehicles.

REFERENCES

https://chat.openai.com https://www.youtube.com
https://www.google.com