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Design and Implementation of a WiFi Controlled Obstacle Avoidance RC Car

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Abstract: *This paper presents the design and implementation of a WiFi controlled obstacle avoidance RC car using embedded systems and IoT technology. The system is developed using a microcontroller, WiFi communication module, ultrasonic sensor, motor driver, and DC motors. The vehicle can be controlled wirelessly through a mobile device while also detecting nearby obstacles automatically using ultrasonic sensing technology. The proposed system demonstrates low-cost robotic automation suitable for educational and small-scale surveillance applications. Experimental testing shows reliable movement control and effective obstacle detection in indoor environments.*

Keywords: IoT, RC Car, Obstacle Avoidance, WiFi Control, Robotics, Ultrasonic Sensor, Embedded System, ESP32.

I. INTRODUCTION

Robotics and IoT technologies are becoming increasingly important in modern engineering applications. Smart robotic vehicles are widely used in automation, surveillance, industrial monitoring, and educational projects. Obstacle avoidance systems help robotic vehicles move safely by detecting objects in their path.

The objective of this project is to design and develop a WiFi controlled RC car capable of obstacle detection and avoidance. The system combines wireless communication and sensor-based automation to improve vehicle safety and control. The project also helps students understand practical implementation of embedded systems, IoT communication, and robotics.

II. LITERATURE SURVEY

Several obstacle avoidance robotic systems have been developed using ultrasonic sensors and wireless communication technologies. Existing robotic vehicles commonly use Bluetooth, RF communication, or WiFi modules for remote operation.

Previous studies show that ultrasonic sensors are effective for short-distance obstacle detection due to their low cost and accuracy. WiFi-based robotic systems provide better communication range and mobile control flexibility compared to traditional wired systems.

This project focuses on implementing a low-cost WiFi controlled obstacle avoidance vehicle using easily available electronic components.

III. OBJECTIVE OF THE PROJECT

The main objectives of the project are:

- To design a WiFi controlled RC vehicle.
- To implement obstacle detection using an ultrasonic sensor.
- To control vehicle movement wirelessly using a mobile device.
- To improve safety during movement by avoiding collisions.
- To develop a low-cost educational robotics system.

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IV. COMPONENTS USED

Component	Purpose
ESP32-S3	WiFi communication and control
HC-SR04 Ultrasonic Sensor	Obstacle detection
2 × L298N Motor Drivers	Motor control
4 DC Motors	Vehicle movement
RC Chassis	Mechanical structure
Buck Converter	Voltage regulation
Batteries	Power supply
LED Indicators	Indication
Jumper Wires	Electrical connections

V. SYSTEM ARCHITECTURE

The system consists of an ESP32-S3 WiFi-enabled microcontroller connected to dual L298N motor drivers, HC-SR04 ultrasonic sensor, LED indicators, and four DC motors mounted on a car chassis. The mobile device sends control commands through WiFi communication. The ultrasonic sensor continuously measures the distance between the vehicle and nearby objects. If an obstacle is detected within a predefined distance, the vehicle stops or changes direction automatically.

Working Principle

1. The user connects the mobile device to the WiFi module.
2. Control commands are transmitted wirelessly.
3. The microcontroller processes the commands.
4. The motor driver controls motor movement.
5. The ultrasonic sensor detects obstacles.
6. The vehicle avoids collision automatically.

VI. CIRCUIT DIAGRAM & BLOCK DIAGRAM

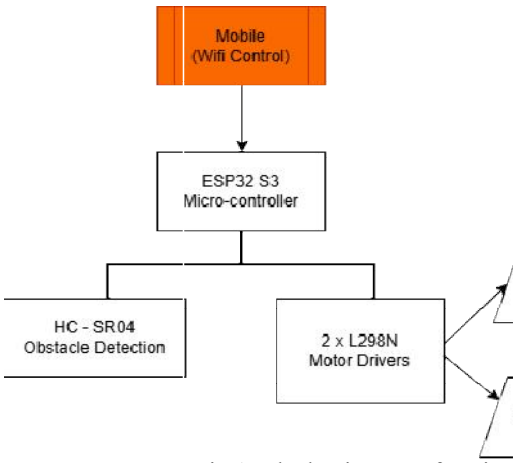

Fig 1. Block Diagram of Project

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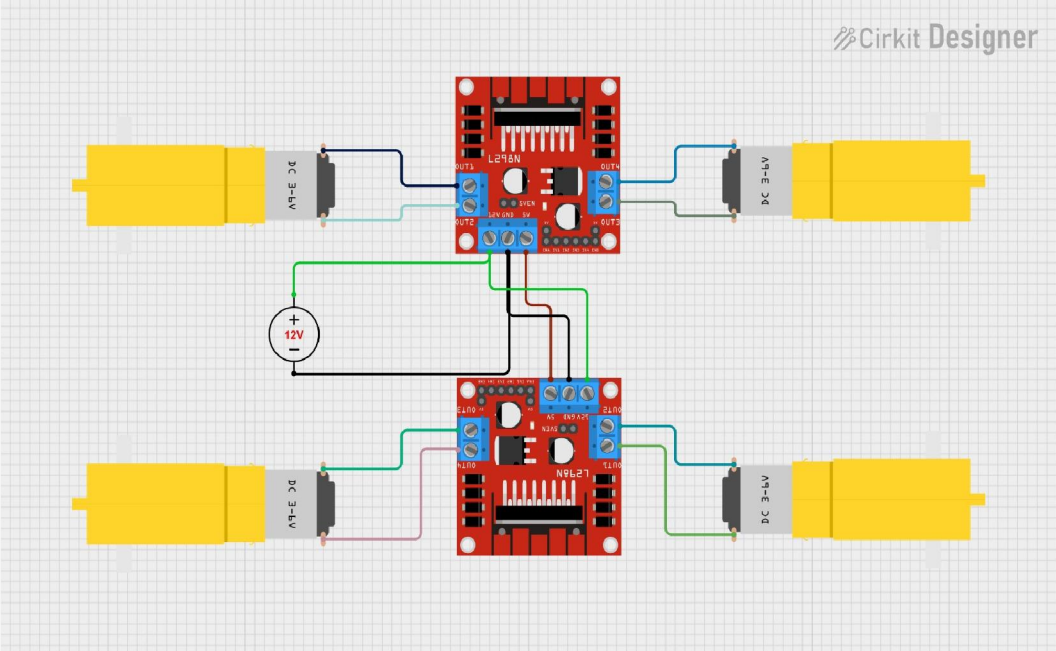

Fig 2. Circuit diagram for 4 DC Motors and 2 L298n Motor Drivers.

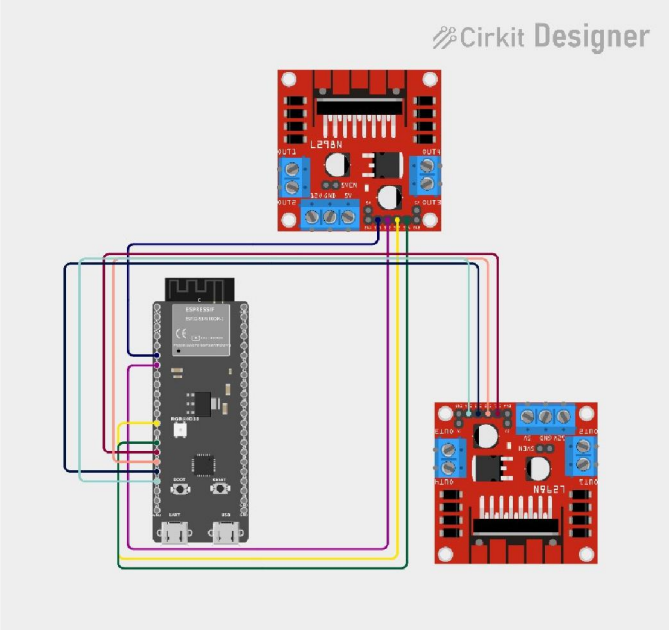

Fig 3. Connection for ESP32S3 and L298N Motor Driver

VII. SOFTWARE IMPLEMENTATION

The project is programmed using Arduino IDE. The ESP32 S3 microcontroller processes sensor data and controls the movement of the motors.

Basic functions implemented:

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- Forward movement
- Backward movement
- Left turn
- Right turn
- Stop function
- Obstacle detection
- Automatic stopping

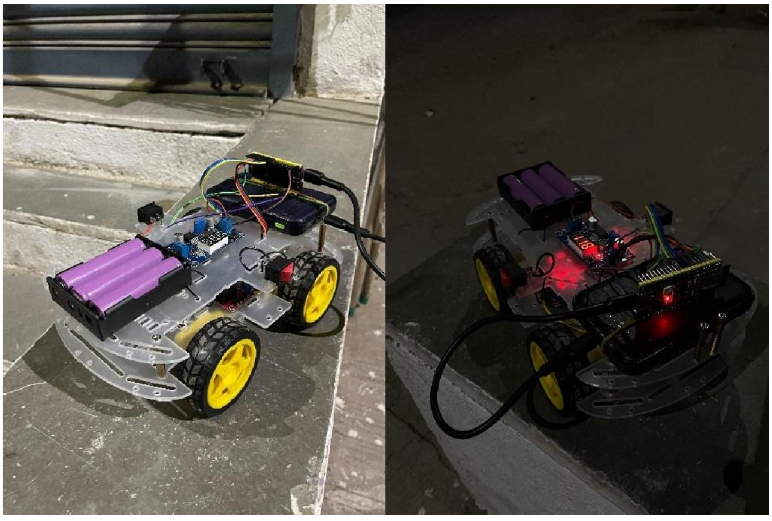
VIII. RESULTS AND TESTING

The developed RC car was tested in indoor environments with multiple obstacles. The ultrasonic sensor successfully detected objects within a short distance range. The WiFi communication provided stable wireless control using a mobile device.

The vehicle demonstrated:

- Smooth movement control
- Accurate obstacle detection
- Reliable wireless communication
- Low power consumption

Images of project :



IX. ADVANTAGES

- Low-cost implementation
- Easy wireless control
- Simple obstacle avoidance
- Educational learning application
- Compact design

Features	Capability
Wireless Control	YES

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Obstacle Detection	YES
WiFi Based	YES
Low Cost	YES
Mobile Controlled	YES

X. LIMITATIONS

- Limited obstacle sensing range
- Indoor testing only
- Dependent on WiFi signal strength
- Basic obstacle avoidance algorithm

XI. FUTURE SCOPE

Future improvements can include:

- Camera integration
- AI-based object detection
- GPS tracking
- Voice control
- Mobile application development
- Autonomous navigation

XII. CONCLUSION

This paper presented the design and implementation of a WiFi controlled obstacle avoidance RC car using IoT and embedded system technology. The system successfully achieved wireless vehicle control and automatic obstacle detection using ultrasonic sensing. The project demonstrates a low-cost and effective robotic solution suitable for educational and basic automation applications.

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