Voice Control Smart Robot

Hardware Implementation Report

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Contents

1 Introduction

This report presents the hardware implementation of the Voice Control Smart Robot, focusing on the integration of components, assembly process, and system functionality. The objective is to ensure that the robot can accurately receive and execute voice commands through efficient hardware design and stop while detecting obstacles.

2 Hardware Components

- **ESP8266 NodeMCU**: A Wi-Fi-enabled microcontroller used for processing voice commands and controlling the robot via Firebase.
- **L298N Motor Driver Module**
  - Drive Voltage: 5V–35V
  - Drive Current: 2A per channel (MAX)
  - Max Power Output: 25W
  - Logic Current: 0mA–36mA
  - Dimensions: 43×43×27 mm
  - Weight: 30g
- **Yellow DC Gearbox Motors**: Lightweight DC motors with built-in gear reduction (Weight: 26g), used to drive the robot.
- **Wheels**: Attached to the DC motors to enable motion on flat surfaces.
- **Acrylic Chassis**: Custom-cut sheet used to mount all components, providing a stable base.
- **Three Lithium Battery Pack**: Powers motors and electronics with total voltage of 11 V; chosen to meet the voltage and current demands.
- **HC-SR04 Ultrasonic Sensor**: Used for obstacle detection by measuring distance via ultrasonic pulses.

3 Assembly and Integration

Electrical Connections

- **Motors and L298N**:
  - OUT1/OUT2 → Left motor, OUT3/OUT4 → Right motor
  - IN1 → D2, IN2 → D3 (Left motor)
  - IN3 → D6, IN4 → D7 (Right motor)
  - ENA → D1, ENB → D5 (PWM for speed)
- **Ultrasonic Sensor (HC-SR04)**:

– VCC → 3V3, GND → GND, TRIG → D8, ECHO → D0

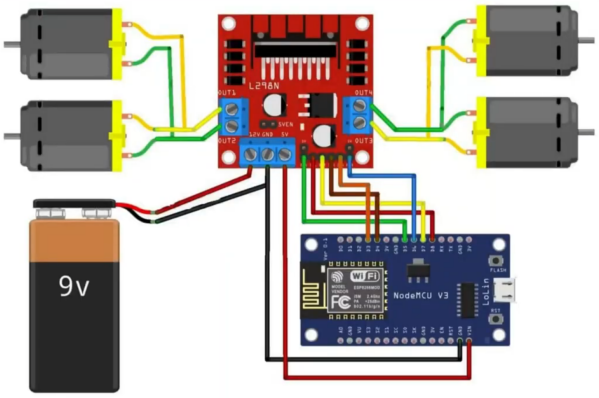

Figure 1: System Assembly

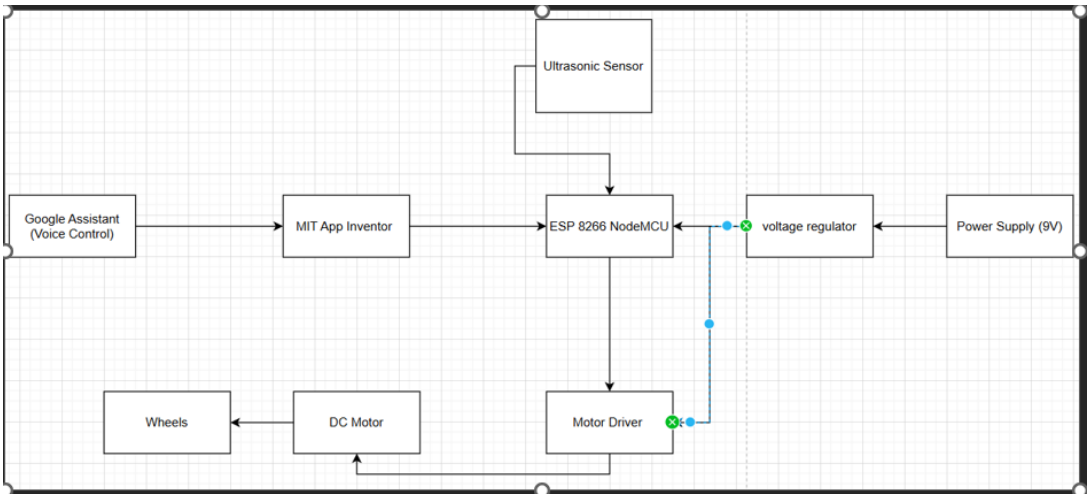

Figure 2: Functional block diagram

- **Power Supply**:
  - L298N VCC → Battery +
  - L298N GND → Common GND
  - L298N 5V → NodeMCU Vin

4 Hardware Implementation

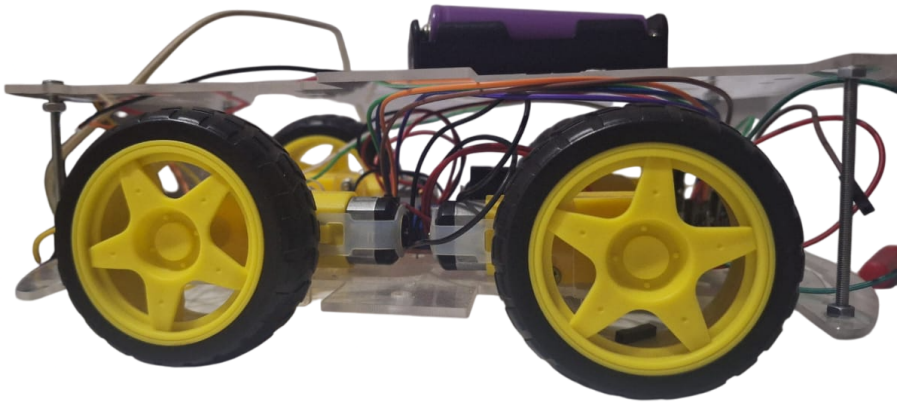

Figure 3: Robot body

ESP Code Overview

- Firebase Initialization and Wi-Fi Connection

```
#include <ESP8266WiFi.h>
#include <Firebase_ESP_Client.h>
#include "addons/RTDBHelper.h"
#include "addons/TokenHelper.h"

// ---------- Wi-Fi ----------
#define WIFI_SSID       "Galaxy A54 5G 18DF"
#define WIFI_PASSWORD   "30509291"

// ---------- Firebase Credentials ----------
#define API_KEY         ""
#define DATABASE_URL    "https://smartrobot-a6cc5-default-rtdb.firebaseio.com/"
```

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Figure 4: Firebase Initialization and Wi-Fi Connection

- Motor control via digital and PWM pins
- Obstacle detection using HC-SR04

5 Code Explanation

```
// ---------- Motor Control Pins ----------
#define PWM_L D1
#define IN1   D2
#define IN2   D3

#define PWM_R D5
#define IN3   D6
#define IN4   D7
```

Figure 5: Motor control pins

```
    // Obstacle detected – Stop motors and update Firebase
    controlMotor(0, PWM_L, IN1, IN2);
    controlMotor(0, PWM_R, IN3, IN4);

    Firebase.RTDB.setString(&fbdo, "/SmartRobotApp/status", "Barrier Detected");
    Serial.println("Obstacle too close! Motors stopped.");
  } else {
    // Read wheel speeds from Firebase
    if (Firebase.RTDB.getString(&fbdo, "/SmartRobotApp/Lwheel_speed")) {
      leftSpeed = fbdo.stringData().toInt();
    }
    if (Firebase.RTDB.getString(&fbdo, "/SmartRobotApp/Rwheel_speed")) {
      rightSpeed = fbdo.stringData().toInt();
    }

    controlMotor(leftSpeed, PWM_L, IN1, IN2);
    controlMotor(rightSpeed, PWM_R, IN3, IN4);

    Firebase.RTDB.setString(&fbdo, "/SmartRobotApp/status", "Running");
  }
}

delay(300);  // Small delay
}
```

Figure 6: Obstacle detection logic

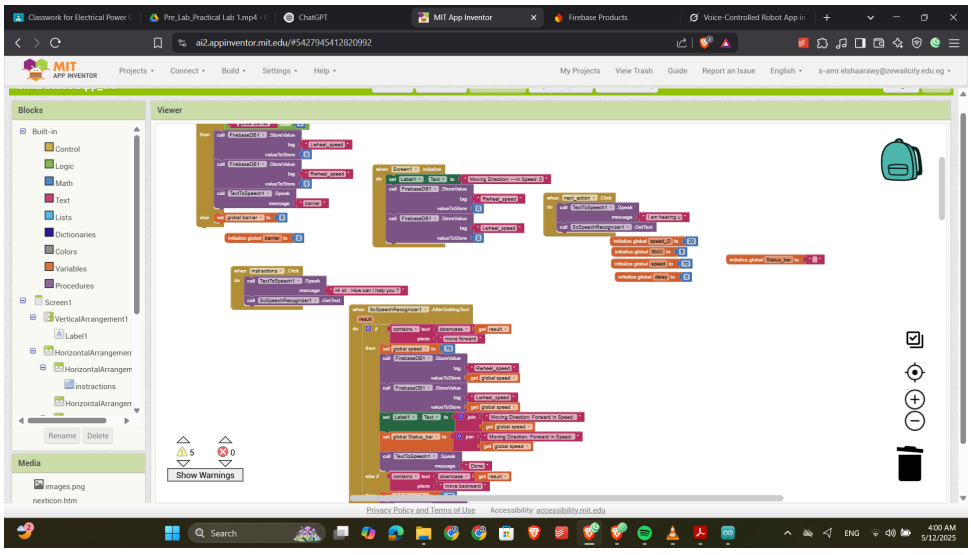

Figure 7: Part of App inventor code

For the App inventor code and demo video click here

6 Conclusion

The hardware assembly and integration enable the robot to receive voice commands and respond appropriately, including automatic obstacle avoidance using the ultrasonic sensor.

References

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