System architecture

This section provides a detailed description of the hardware wiring configuration between the Raspberry Pi 5, the motor driver modules (L298N), and the ultrasonic sensors (HC-SR04). The system utilizes two L298N motor drivers to independently control the four-wheel drive motors, while three ultrasonic sensors are used for real-time obstacle detection. Each module is connected to the Raspberry Pi's GPIO pins through designated physical pin mappings to ensure stable control and data acquisition. The wiring tables below outline the specific GPIO assignments for all modules.

1 L298N A Module Wiring

Function	L298N A Pin	Raspberry Pi GPIO (BCM)	Raspberry Pi Physical Pin
Left Front Wheel Direction Control 1	IN1	GPIO17	Pin 11
Left Front Wheel Direction Control 2	IN2	GPIO18	Pin 12
Right Front Wheel Direction Control 1	IN3	GPIO27	Pin 13
Right Front Wheel Direction Control 2	IN4	GPIO22	Pin 15
Left Front Wheel PWM (Speed Control)	ENA	GPIO12 (PWM)	Pin 32
Right Front Wheel PWM (Speed Control)	ENB	GPIO13 (PWM)	Pin 33
Motor Power Input	VCC	External Battery Positive	—
Motor Power Ground	GND	Raspberry Pi GND (Common Ground)	Pin 6 / 14 etc

2 L298N B Module Wiring

Function	L298N B Pin	Raspberry Pi GPIO (BCM)	Raspberry Pi Physical Pin
Left Rear Wheel Direction Control 1	IN1	GPIO5	Pin 29
Left Rear Wheel Direction Control 2	IN2	GPIO6	Pin 31
Right Rear Wheel Direction Control 1	IN3	GPIO19 (PWM)	Pin 35

Right Rear Wheel Direction Control 2	IN4	GPIO26	Pin 37
Left Rear Wheel PWM (Speed Control)	ENA	GPIO20 (PWM)	Pin 38
Right Rear Wheel PWM (Speed Control)	ENB	GPIO21 (PWM)	Pin 40
Motor Power Input	VCC	External Battery Positive	—
Motor Power Ground	GND	Raspberry Pi GND (Common Ground)	Pin 6 / 14 etc

3 Front Ultrasonic Sensor Wiring

Function	HC-SR04 Pin	Raspberry Pi GPIO (BCM)	Raspberry Pi Physical Pin
TRIG	TRIG	GPIO20	Pin 38
ECHO	ECHO (Voltage Divider)	GPIO21	Pin 40
Power	VCC	5V	Pin 2 / 4
Ground	GND	GND	Pin 6 / 14 / 39

4 Left Ultrasonic Sensor Wiring

Function	HC-SR04 Pin	Raspberry Pi GPIO (BCM)	Raspberry Pi Physical Pin
TRIG	TRIG	GPIO23	Pin 16
ECHO	ECHO (Voltage Divider)	GPIO24	Pin 18
Power	VCC	5V	Pin 2 / 4
Ground	GND	GND	Pin 6 / 14 / 39

5 Right Ultrasonic Sensor Wiring

Function	HC-SR04 Pin	Raspberry Pi GPIO (BCM)	Raspberry Pi Physical Pin
TRIG	TRIG	GPIO25	Pin 22
ECHO	ECHO (Voltage Divider)	GPIO26	Pin 37
Power	VCC	5V	Pin 2 / 4
Ground	GND	GND	Pin 6 / 14 / 39

6 Raspberry Pi 5 GPIO Pinout Diagram

The following diagram illustrates the Raspberry Pi 5 GPIO header layout, showing both the physical pin numbers (1–40) and the corresponding BCM GPIO numbers. This diagram serves as a reference for understanding the pin assignments used in the wiring tables below.