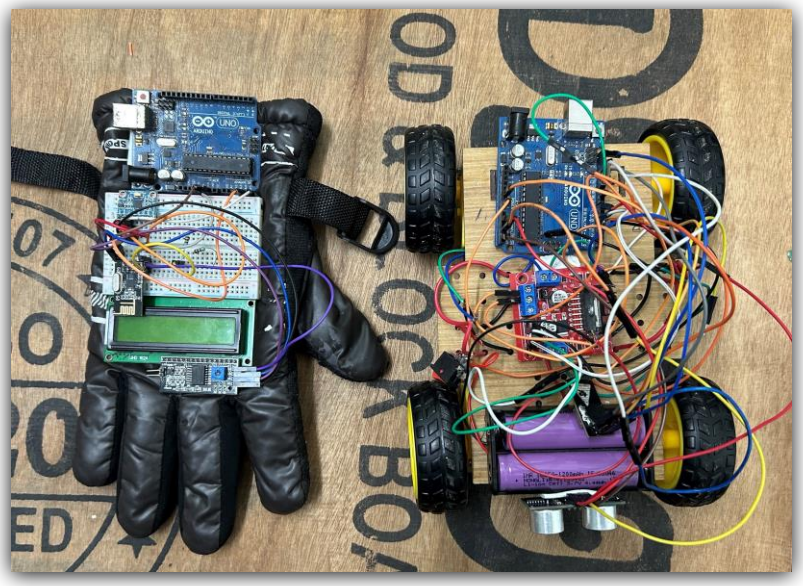
INDIAN INSTITUTE OF TECHNOLOGY, ROPAR
RUPNAGAR - 140001, INDIA

GE107 - TINKERING LAB

PROJECT TITLE - SMART GESTURE CONTROLLED CAR



Introduction

- In the era of automation and smart robotics, our project on a smart gesture-controlled robotic car, integrates several technologies to create an efficient, responsive, and intelligent system.
- We are using an accelerometer for gesture input, RF transceiver modules for wireless communication, a motor driver circuit for movement, an ultrasonic sensor for obstacle detection, and an LCD to display the car speed.
- Our project serves as a base model for potential real-world applications such as remote surveillance and contactless deliveries.
- Gesture control replaces traditional input mechanisms like buttons or joysticks with more natural, intuitive movements.
- Using an accelerometer embedded in a wearable glove, hand motions are translated into directional commands, which are wirelessly transmitted to the car. The robot interprets these commands and acts accordingly.
- To enhance its usability of our project, we integrated real-time proximity-based decision making using ultrasonic sensors and speed monitoring.

Components Used

Given below is the list of components used in our project -

1. Control and Motion -

- **Arduino UNO (x2) -** Acts as the main processing unit both on the transmitter and the receiver side.
- **Accelerometer (MPU6050) -** Senses motion gestures from the user's hand.
- **RF Transceiver Module (nRF24L01) -** For wireless data transmission between the gesture controller and the robotic car.
- **Motor Driver (L298N) -** Controls the movement of the DC motors based on input from Arduino.
- **DC Motors (x4) -** Provide motion to the wheels.
- **Chassis & Wheels -** Acts as the mechanical frame of the robotic car.

2. Obstacle Detection and Display -

- **Ultrasonic Sensor -** Measures the distance between the car and nearby objects to prevent collisions.
- **Buzzer -** Used for alerting the user if there is an obstacle.
- **LCD Display (16x2) -** Displays the speed of the robotic car in real time.

3. Power Supply and Miscellaneous -

- **9V Battery -** Powers the car and electronic modules.
- **Resistors, Capacitors, Breadboard and Jumper wires** - For electronic connections.
- **Glove -** For mounting the accelerometer on the user's hand.

Working Principle

The working of our robotic car is explained below -

1. Gesture Sensing and Transmission -

- The accelerometer mounted on the glove detects tilt in X and Y axes.
- Then, the Arduino processes the data to identify gesture directions: forward, backward, left, and right.
- Based on the directions, the Arduino sends command signals via the **nRF24L01 transceiver**.

2. Command Reception and Motor Control -

- The receiver module on the car receives the commands via its own **nRF24L01 module**.
- The Arduino interprets the signals and switches the **L298N motor driver** to move the car in the desired direction.

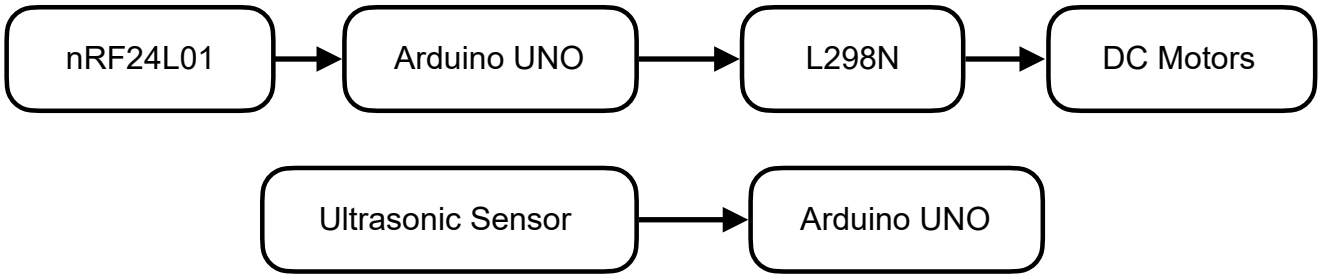
3. Speed Monitoring and Obstacle Detection -

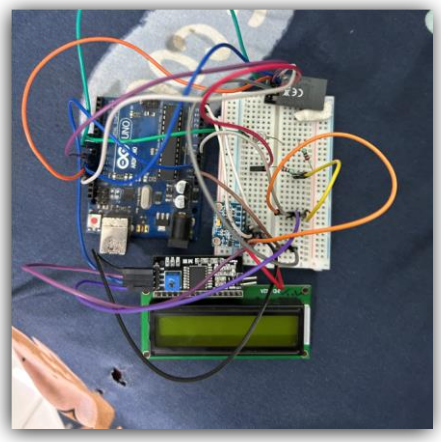
- This speed is displayed on a **16x2 LCD**.
- The **ultrasonic sensor** continuously checks for obstacles in front of the car. If an obstacle is detected within a threshold range. the car stops and buzzer starts ringing.

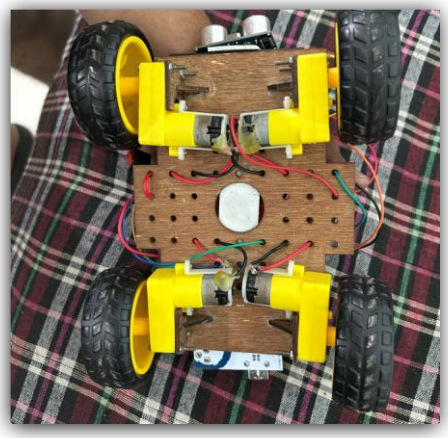
System Architecture

A. Transmitter Block -

B. Receiver Block -

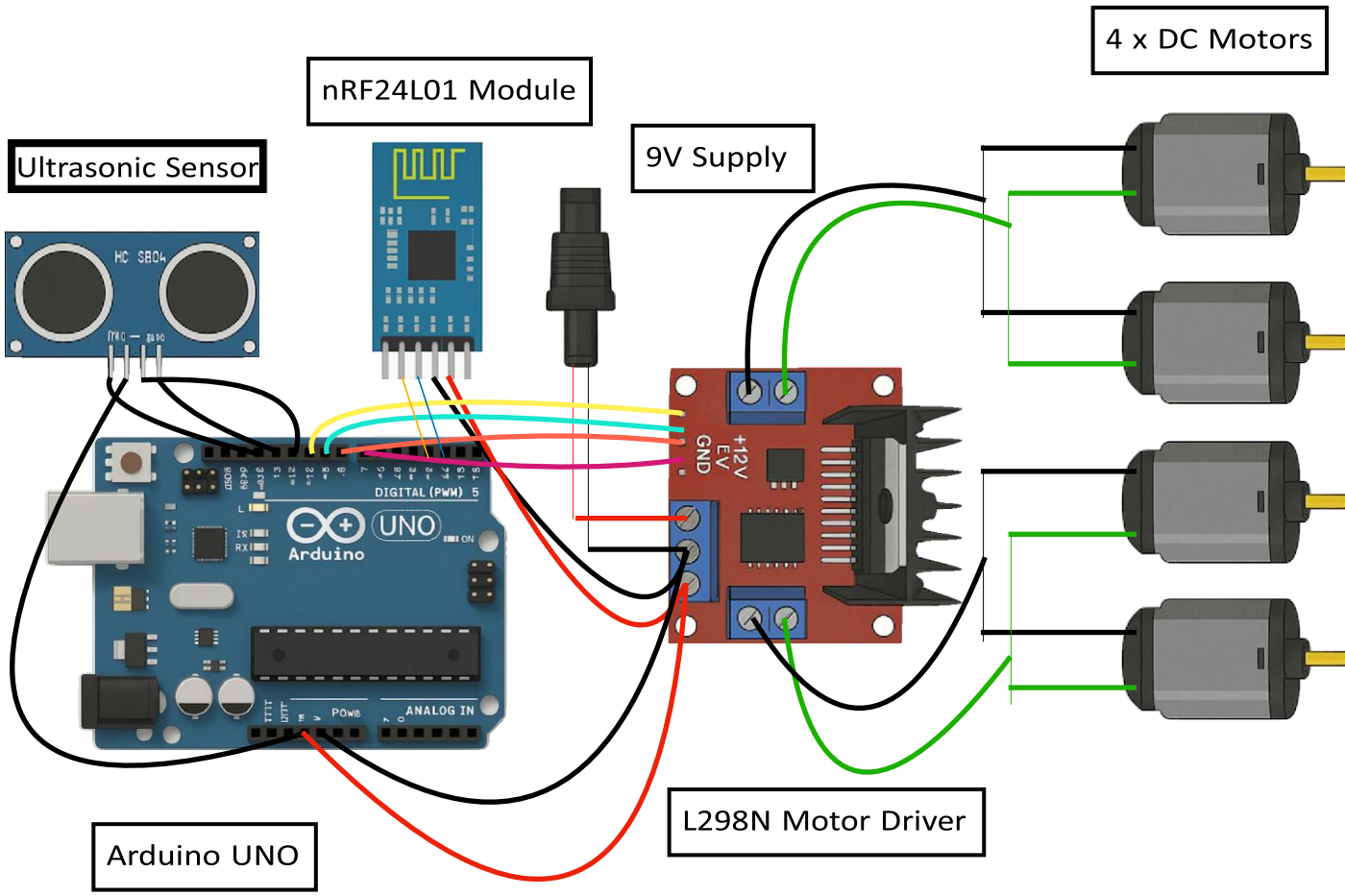




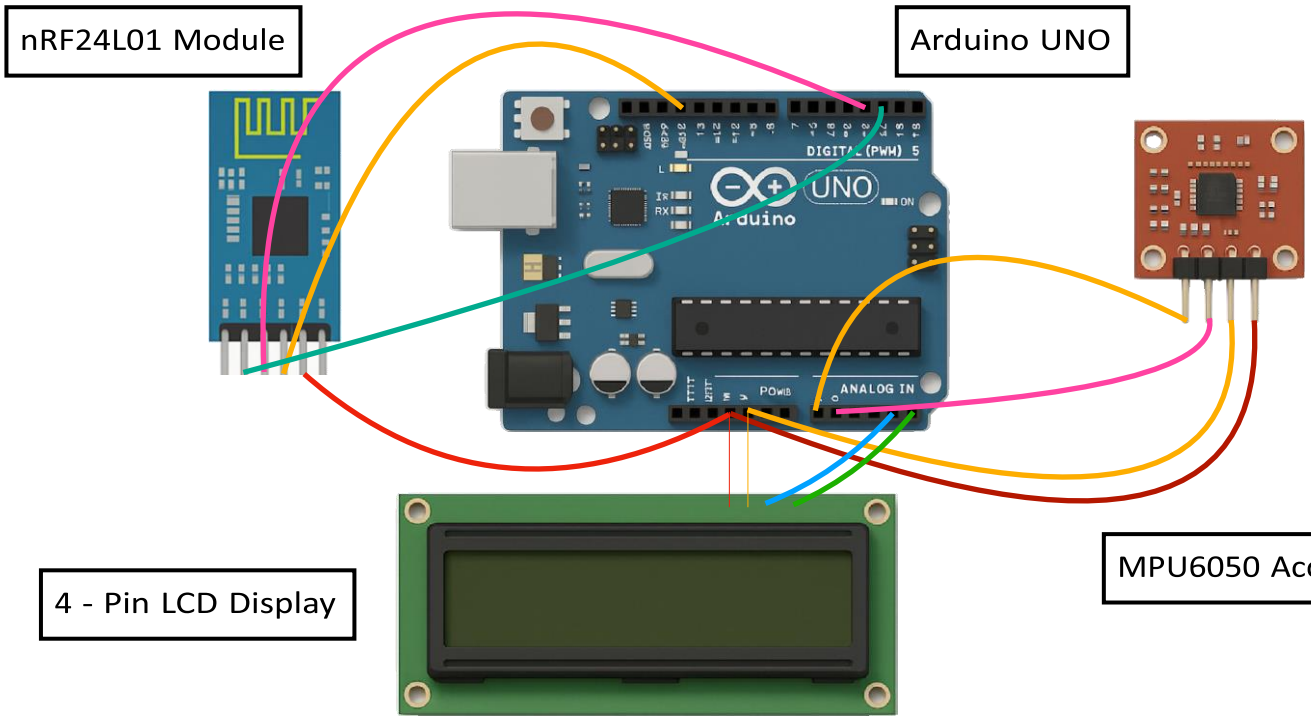


Circuit Diagram

1. Receiver Module Circuit Diagram



2. Transmitter Module Circuit Diagram



Challenges Faced and Their Solutions

1. The accelerometer produced fluctuating readings, causing incorrect gesture detection.

- **Solution -** Implemented the moving average filtering and set threshold bands to classify the gestures reliably.

2. Data transmission via nRF24L01 sometimes got delayed due to interference.

- **Solution -** We switched to lower data rate for more stable transmission (250kbps) and used unique communication addresses.

3. The car took time to stop after detecting an obstacle due to sensor latency.

- **Solution -** Reduced the polling interval and introduced non-blocking ultrasonic reading using timers.

4. Also, we received some faulty components, but we tried to replace them as soon as possible. Hopefully, they got replaced and we completed our project successfully.

Conclusion

- This gesture-controlled robotic car project demonstrates the power of embedded systems, sensor integration and wireless communication.
- It provides an efficient, user-friendly interface for controlling robotic movement through natural hand gestures.
- By integrating speed display and obstacle detection, the car not only becomes more interactive but also safer and more intelligent.
- Throughout the development, we encountered numerous technical challenges, each serving as a learning opportunity.
- This project lays a foundation for more complex gesture-based systems and illustrates how relatively simple components can come together to build advanced robotics applications.

THANK YOU!