ESP32 Robot Control Lab 1: Joystick & Dual-Speed Control

Course: Robotics / Embedded Systems

Topic: 4-Wheel Robot Control using Joystick and Buttons

Submission Type: Group

Marks: 100

1. Objective

The objective of this lab is to design and implement a control system for a 4-wheel robot using a joystick and push buttons. Students will apply a flowchart-based approach to separate forward/backward speed control from rotation speed control, similar to real mobile robot systems.

2. Background

Real robots do not use a single speed for all motions. Linear motion (forward/backward) and rotational motion (turning) are controlled independently. In this lab, students will use a joystick to select movement direction and buttons to adjust two different speeds.

3. Hardware Setup

Joystick:
- X-axis → GPIO 34
- Y-axis → GPIO 35

Buttons:
- UP → GPIO 16 (Increase forward speed)
- DOWN → GPIO 15 (Decrease forward speed)
- RIGHT → GPIO 4 (Increase rotation speed)
- LEFT → GPIO 2 (Decrease rotation speed)

4. Single Task: Dual-Speed Robot Control

Design and implement a program that controls a 4-wheel robot using the following concept:

• The joystick determines the robot movement direction.
• Two independent speed variables must be used:
 - forwardSpeed: controls forward and backward motion
 - rotationSpeed: controls turning motion

• Button presses adjust the speeds:
 - UP / DOWN → adjust forwardSpeed by ±5%

- LEFT / RIGHT → adjust rotationSpeed by ±5%

• Initial value of both speeds must be 50%.
• Speed values must be limited between 0% and 100%.
• A dead zone must be applied to the joystick center position.
• The robot must support forward, backward, left turn, right turn, and stop.

5. Flowchart Requirement

Before writing code, students must design a flowchart that represents the control logic.

The flowchart must include:
1. Start
2. Read joystick X and Y values
3. Read button states
4. Update forwardSpeed or rotationSpeed based on button input
5. Apply speed limits (0–100%)
6. Check joystick dead zone
7. Decide robot motion (forward, backward, rotate left, rotate right, stop)
8. Apply calculated motor speeds to the 4-wheel robot
9. Loop back to read inputs again

Students must submit the flowchart as a clear diagram.

6. Demonstration

During the demonstration, students must show:

• Adjustment of forward/backward speed using UP/DOWN buttons
• Adjustment of rotation speed using LEFT/RIGHT buttons
• Correct robot response to joystick movement
• Smooth and stable robot behavior

7. Submission Requirements

Students must submit:

1. Arduino (.ino) source code
2. Flowchart diagram and Video Testing from (6. Demonstration)
3. Short explanation (½ page) describing:
- The purpose of using two different speeds
- How the flowchart helped in designing the program