Lab 5: IoT Robot Control using MIT App Inventor and Web Radar

Course: Robotics / Embedded Systems

Submission: Group Work

Total Marks: 100

1. Introduction

In this lab, students will build a WiFi-based robot control system using MIT App Inventor and an ESP32 web server. The robot must support two operating modes: Manual Mode and Automatic Mode. In Manual Mode the robot is controlled from a mobile application using buttons and sliders. In Automatic Mode the robot navigates automatically using an ultrasonic sensor to detect obstacles. In addition, students will visualize ultrasonic data using a radar interface on a web server.

2. Learning Outcomes

- Create a mobile interface using MIT App Inventor.
- Send HTTP requests from a smartphone to an ESP32.
- Control robot movement using mobile app buttons.
- Adjust motor speed and servo angle using sliders.
- Implement automatic obstacle avoidance using an ultrasonic sensor.
- Switch safely between Manual Mode and Automatic Mode.
- Visualize ultrasonic sensor data using a web-based radar interface.

3. Mobile App Requirements (MIT App Inventor)

Students must design a mobile application with the following components:

Movement Buttons (5):

- Forward – move the robot forward
- Backward – move the robot backward
- Left – rotate the robot left
- Right – rotate the robot right
- Stop – stop the robot

Speed Slider:

Slider 1 must control the motor speed. The slider value should be sent to the ESP32 as:

/speed?value=XX

Servo Slider:

Slider 2 must control the servo angle between 0 and 180 degrees.

Mode Selection Buttons:

- Manual Mode – robot responds to button commands from the mobile app
- Automatic Mode – robot moves autonomously using ultrasonic sensor

4. Manual Mode Requirements

When Manual Mode is selected, the robot must respond to movement buttons from the mobile application. The speed slider adjusts the motor speed, and the servo slider controls the servo position.

5. Automatic Mode Requirements

When Automatic Mode is selected, the robot ignores manual movement commands and navigates automatically.

- The robot moves forward continuously.
- The ultrasonic sensor measures the distance to objects in front of the robot.
- If an obstacle is detected closer than 20 cm, the robot must stop.
- The robot then rotates right by approximately 90 degrees.
- After turning, the robot continues moving forward.

6. Web Radar Visualization

Students will be provided with radar visualization code for the ESP32 web server. The radar interface displays ultrasonic distance measurements and obstacle locations. The radar updates continuously as the servo scans the environment.

7. Flowchart Requirement

- System initialization
- WiFi connection
- Waiting for mode selection
- Manual control logic
- Automatic obstacle avoidance logic

- Radar update
- Continuous looping

8. Demonstration

- Robot responds to five movement buttons
- Motor speed changes using slider
- Servo position changes using slider
- Manual Mode operation
- Automatic Mode obstacle avoidance
- Web radar visualization working

9. Submission Requirements

- ESP32 source code (.ino file)
- MIT App Inventor project (.aia file)
- Flowchart diagram
- Short written explanation (approximately one page)
- Video demonstration of the robot working