# Group 5
# Section : E

## Memeber List

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# Automatic Garbage Collector with Live Image Detection using ESP32 and Laptop

## Introduction:

The project aims to build an automatic garbage collector system that can search for trash, move toward detected objects, and collect them using a robotic arm. The system will use a **laptop with a webcam** for object detection and an **ESP32** microcontroller for motor control, arm operation, and handling motion sensors. The setup will allow the garbage collector to move autonomously in search of trash, stop when an object is detected, and collect it using an attached arm.

## System Overview:

1. **Object Detection:**

   - The object detection system will be handled by the **laptop** using a **webcam** for live image capture. Object detection will be performed using a **pre-trained YOLOv10 model** running on the laptop. When the webcam detects garbage, the laptop sends movement commands to the ESP32 to approach the detected object.

2. **Movement and Control:**

   - The **ESP32** controls the DC motors of the robot using an **L298N motor driver**. Based on the commands received from the laptop over **serial communication**, the ESP32 drives the motors to either move forward or rotate in search mode.

3. **Motion Sensor:**

   - An **ultrasonic sensor** or **IR motion sensor** is placed at the front of the robot to detect proximity. When the motion sensor detects an object within a certain range, the ESP32 stops the robot and triggers the robotic arm to collect the object.

4. **Robotic Arm:**

   - The robotic arm is controlled using a **servo motor** connected to the ESP32. Once the robot is near the garbage, the arm lowers, grabs the object, and then returns to its original position.

# Components Used:

- **Laptop**: The laptop will handle image processing using the webcam. It will run a Python script that processes the camera feed in real-time using the YOLOv10 object detection model.
- **Webcam**: Attached to the laptop for capturing live video feed.
- **ESP32**: A microcontroller used to control the movement of the robot and the servo motor for the arm.
- **DC Motors**: Used for the movement of the robot.
- **L298N Motor Driver**: To control the DC motors.
- **Servo Motor**: To control the robotic arm that picks up the garbage.
- **Ultrasonic or IR Motion Sensor**: Detects proximity to the object and helps the robot stop before using the arm.
- **USB to Serial Connection**: Used to connect the laptop to the ESP32 for communication.

## System Workflow:

1. **Object Detection on Laptop**:

   - The laptop's webcam captures live video, and the YOLO model detects garbage in the frame.
   - If garbage is detected, the laptop sends a signal to the ESP32 via serial communication to move forward toward the detected object.
   - If no garbage is detected, the laptop sends a signal to the ESP32 to rotate the robot and search for garbage.

2. **Robot Movement via ESP32**:

   - The ESP32 receives commands from the laptop and controls the robot's movement accordingly.
   - When the laptop sends a **forward movement** signal, the ESP32 drives the DC motors to move the robot forward.
   - When the laptop sends a **search command**, the ESP32 rotates the robot to look for garbage.

3. **Stopping and Garbage Collection**:

   - Once the motion sensor detects an object close to the robot, the ESP32 stops the robot.
   - The ESP32 activates the servo motor to lower the arm, collect the object, and return the arm to its original position.

4. **Continued Search**:

   - After collecting the object, the robot resumes searching for more garbage by receiving instructions from the laptop based on the webcam feed.

## Advantages of Using a Laptop:

- **Increased Processing Power**: Using a laptop for object detection allows for better processing power and faster detection than an embedded system like a Raspberry Pi.
- **Ease of Use**: The laptop can easily interface with the ESP32 via serial communication, making debugging and development more convenient.
- **Webcam Integration**: Most laptops come with a built-in webcam, which simplifies the hardware setup and reduces costs.

## Project Skeleton:
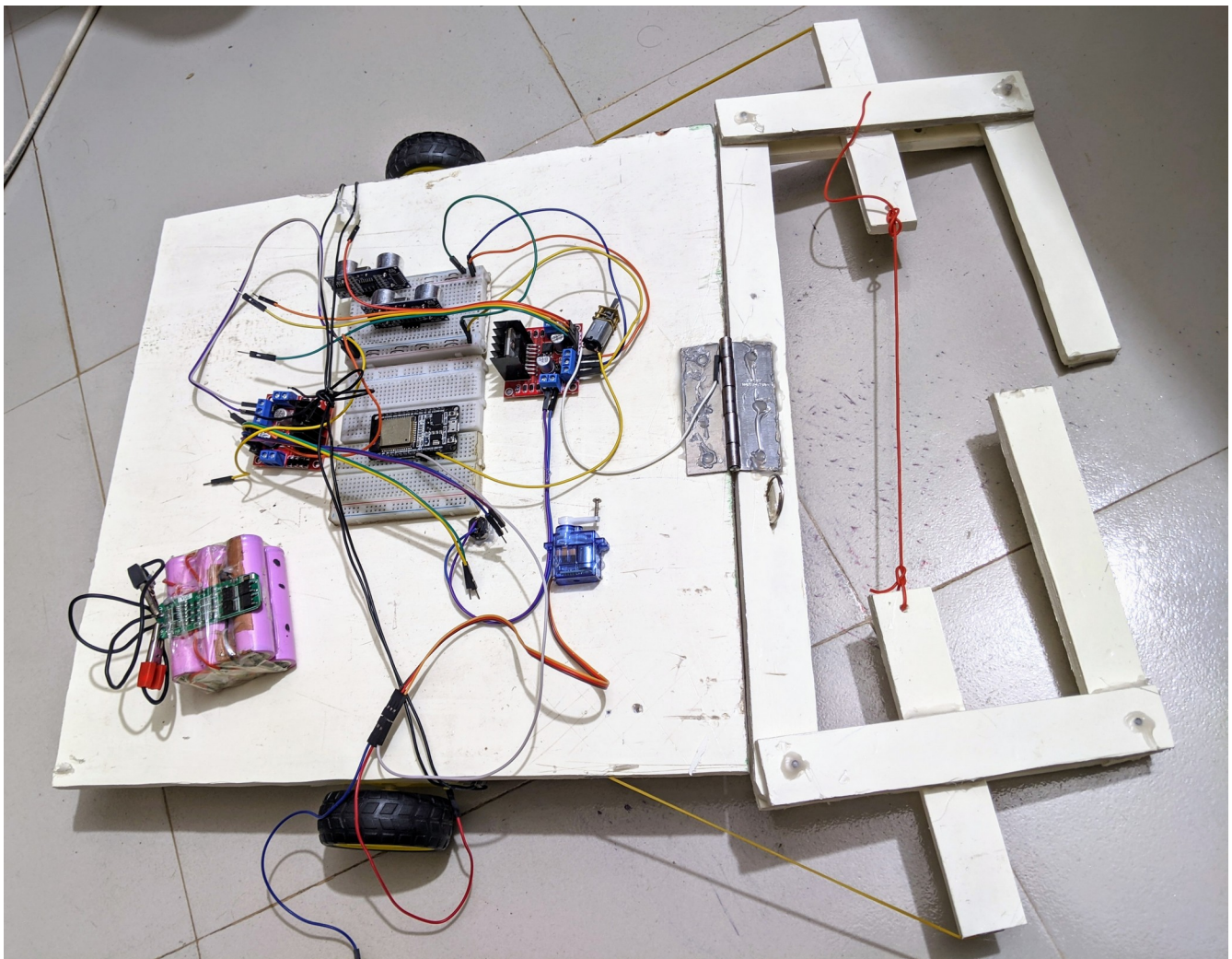
## Conclusion:

This modified system integrates the laptop for object detection using a webcam, replacing the originally intended Raspberry Pi. The ESP32 still handles all motor and servo controls, making the robot's movements and garbage collection autonomous once an object is detected. This system provides a cost-effective and efficient solution for automatic garbage collection with live image detection.