

# SUMMARY-Team Techno Dynamics

(220247J, 220064U, 220106D, 220380J, 220334A)

## Overall Strategy

### White Line Following

We plan to use an array of 8 IR sensors for line following. The speed of the motors is controlled by implementing a PID algorithm in the microcontroller.

### Wall Following

Two VL53L5x ToF sensors mounted on the robot's sides will measure obstacle distance to avoid obstacles.

### Color Line Following

To identify the line's color, we will employ a TCS34725 color sensor alongside the existing array of IR sensors, adjusting the threshold values for red and blue. A PD algorithm will be used for this task.

### Portal Navigation

An ultrasonic sensor will be used to detect the presence or absence of an obstacle, which will help identify whether the portal is closed or opened.

### Box Height Measurement

We will use the VL53L5x TOF sensor attached to the lifting mechanism to measure the height of objects.

### Coin-Dropping Mechanism

A coin holder attached to a servo motor, allowing precise control of its angle is used here. This enables accurate coin placement at designated locations, ensuring smooth and consistent drops.

### Lifting and Grabbing Mechanism

The rack and pinion mechanism, driven by a servo motor, controls the up-and-down movement of the grabber, enabling precise gripping and releasing for versatile tasks.

## Mechanical Design

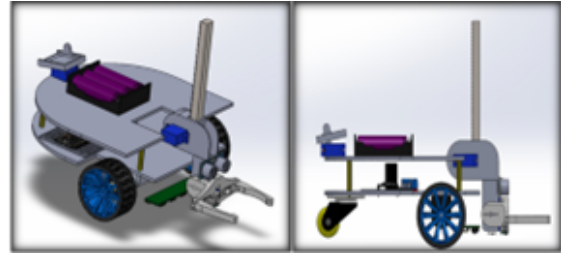


Figure 1: Mechanical design

## SENSORS

### TASK 1 (Barcode Reading and Line Navigation)

For barcode reading, we will use the Raykha module, which features eight TCRT5000 IR sensors, combined with the motors' magnetic encoders. Reasons for selection: Provides detailed detection along the line, Greater detection range, Quick response to changes and it Offers both analog and digital output options.

### TASK 2 (Maze Navigation and Box Manipulation)

We plan to utilize the 8-channel IR sensor array and quadrature magnetic encoders to navigate the maze and manipulate the virtual box.

### TASK 3 (Color Line Following)

We selected the TCS34725 color sensor for its integrated IR filter, I<sup>2</sup>C interface, 3.3V operation, high dynamic range, and accurate color detection across a broad spectrum, alongside 8 IR sensors for line following.

### TASK 4 (Dashed Line Navigation)

To follow the dashed line, we will employ the IR sensor array.

### TASK 5 (Portal Navigation)

We chose the ultrasonic sensor for this task due to its reliability, low cost, energy effi-

ciency, and effective short-range obstacle detection.

### **TASK 6 (Box Arrangement)**

Using VL53L5x TOF sensor for measuring the heights of boxes with high accuracy and fast response times.

### **TASK 8 (Coin Drop and Task Completion)**

We plan to use the Magnetometer sensor to detect the magnetic field while using the TOF sensors integrated at the robot's sides to avoid collisions.

## **Actuators**

### **Motors**

JGB37-520 motors drive the robot's movement. They provide high torque, effective low-speed control, and voltage flexibility, making them efficient and suitable.

### **Servos**

The servo motors control the movement of the grabber arm, lifting mechanism, and coin holder. It provides high torque with an accurate control in a relatively small size enough for positioning applications.

## **Battery**

Three 3.7V lithium-ion batteries power the robot, totalling 11.1V. This allows sufficient voltage to be supplied to the robot, hence allowing it to run for a longer a compact, rechargeable design for effective power delivery.

## **Algorithms**

### **Line following:**

- Read the values from each of the 8 IR sensors.
- Determine the line's position using the IR sensor array
- Apply PID for correction.
- Set an appropriate speed.

### **Wall Following**

- Get the input from the side-mounted VL53L5x ToF sensors.
- Calculate the distance.
- Adjust motor speed based on the distance to the obstacle to avoid them.

### **Color line following:**

- Get the input from the TCS34725 color sensor and the array of IR sensors
- Use PD control to maintain the correct line-following behavior based on the color.
- Adjust motor speeds accordingly.

### **Portal Navigation**

- Initialize a timer variable
- Read Ultrasonic Sensor Values to detect if the Portal is closed while monitoring the timer for Confirmation
- Confirm Portal is closed for the required Duration-Reset Timer if Portal Closes Prematurely
- Start moving forward when the portal is open after being closed for the expected period.

### **Lifting and grabbing mechanism**

- Control the upward/downward movement of the grabber using servo motors.
- Adjust the grip and release to handle objects flexibly by using the servo motor attached to the grabber.

### **Coin dropping mechanism.**

- Read Magnetometer Values
- When the field is detected, control the servo motor to drop the coin precisely at the designated spot.

## **Task Delegation**

- Jayakody J.A.K.(Tech Lead)
  - Maze navigation + Box manipulation
- Kulasinghe H.P.G.N.A.(Electrical Lead)
  - Barcode reading + White line following
- Bandara M.A.G.S.(Algorithms and Programming Lead)
  - Color line, Dashed line following, Portal Navigation
- De Zoysa A.S.I.(Mechanical Systems Lead)
  - Uneven terrain + Coin-Dropping Mechanism
- Manawadu D.N. (Systems Integration Lead)
  - Box Height Measurement + Chamber insertion