Mobility Management Discussion:

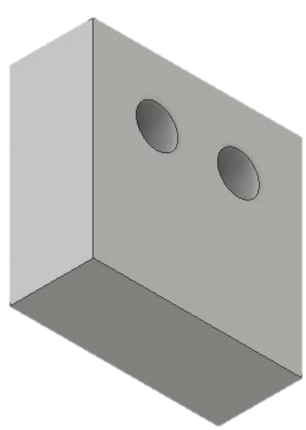
1- Motor Selection and Implementation

- DC Geared Motor for Movement:

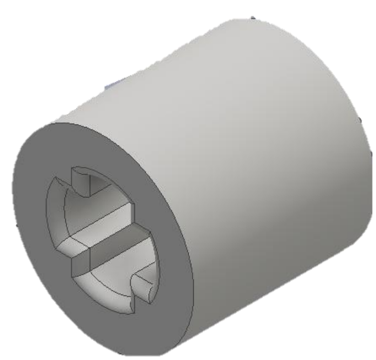
- **Selection: The DC geared motor is selected for its high speed and efficiency, ideal for moving the vehicle forward and backward. Its built-in gearbox allows for effective speed regulation.**

- **Implementation: The motor's built-in gearbox connects directly to a differential mechanism, facilitating smooth power distribution to the wheels and enabling independent wheel speeds during turns. To help fix the motor in place and ensure proper alignment with the differential mechanism, we printed a spacer using 3D printing technology. Additionally, we printed a cabler that acts as a connector between the motor and the differential mechanism shaft, ensuring the motion of gears when the motor rotates.**

3D Printed Models :

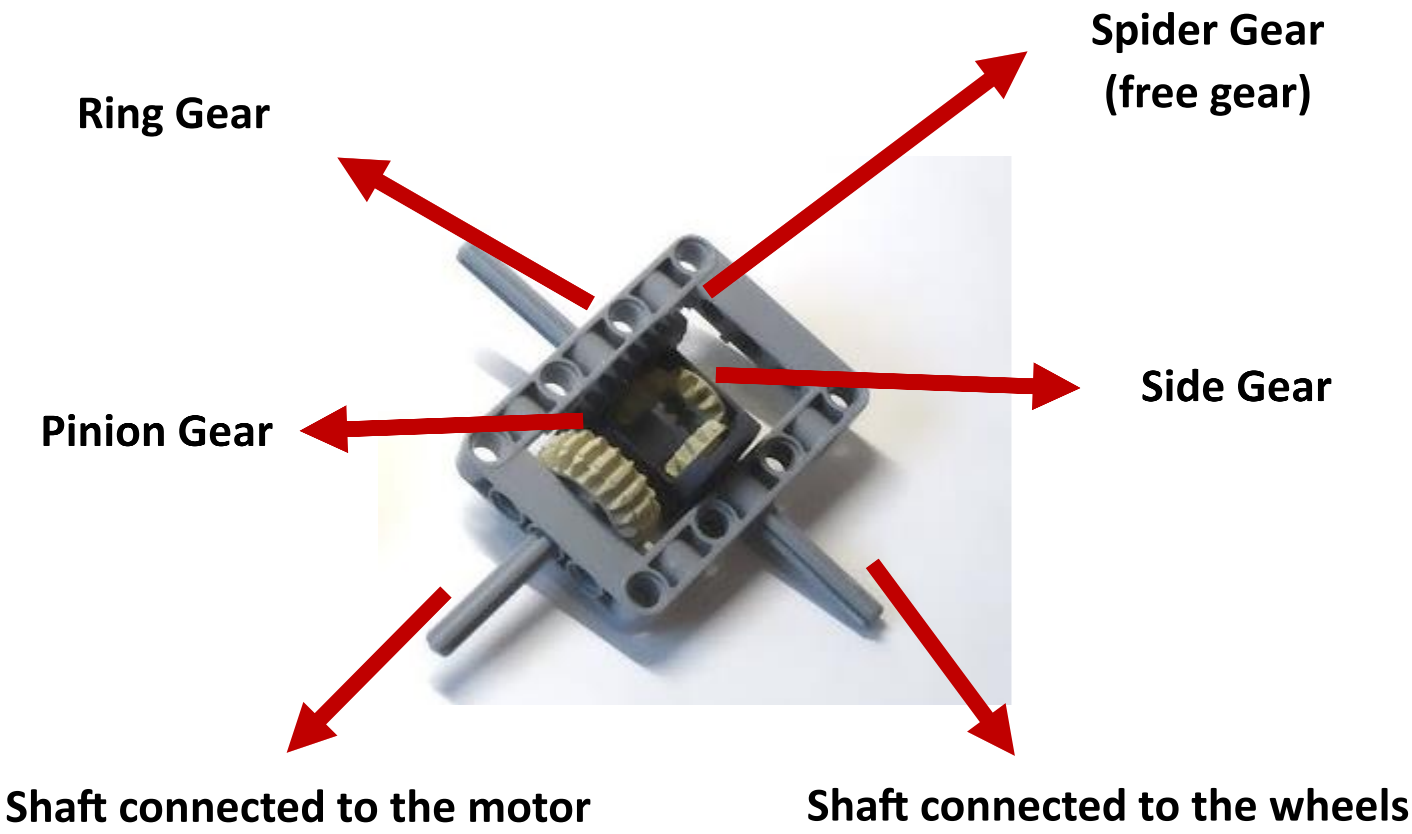


Spacer



Cabler

Differential mechanism (Built from LEGO EV3):

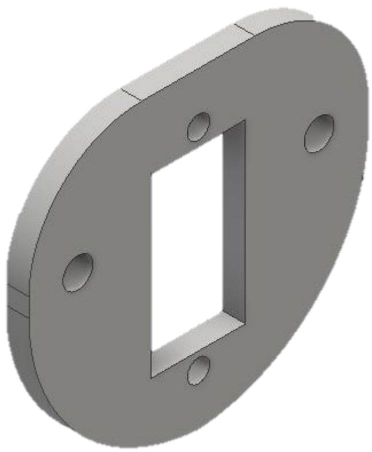


- **The differential mechanism enables the wheels to rotate at different speeds, providing smooth turns and enhancing overall stability.**

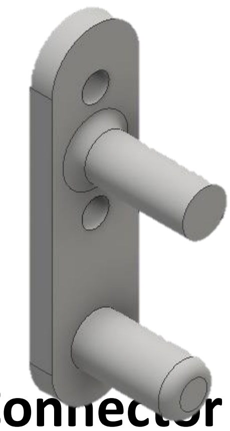
- **Servo Motor for Steering:**
    - **Selection: A 180° servo motor is utilized for steering, providing precise control necessary for effective navigation.**
    - **Implementation: The servo is mounted at the front of the vehicle and connected to the steering mechanism, which is constructed using LEGO EV3 beams and shafts. To securely hold the servo in the chassis, we used a 3D printed model, ensuring stability during operation. Additionally, we designed a 3D printed connector that links the servo to the LEGO beams, allowing for effective rotation of the wheels when the servo rotates. This**

configuration enhances the vehicle’s maneuverability and responsiveness.

3D Printed Models :



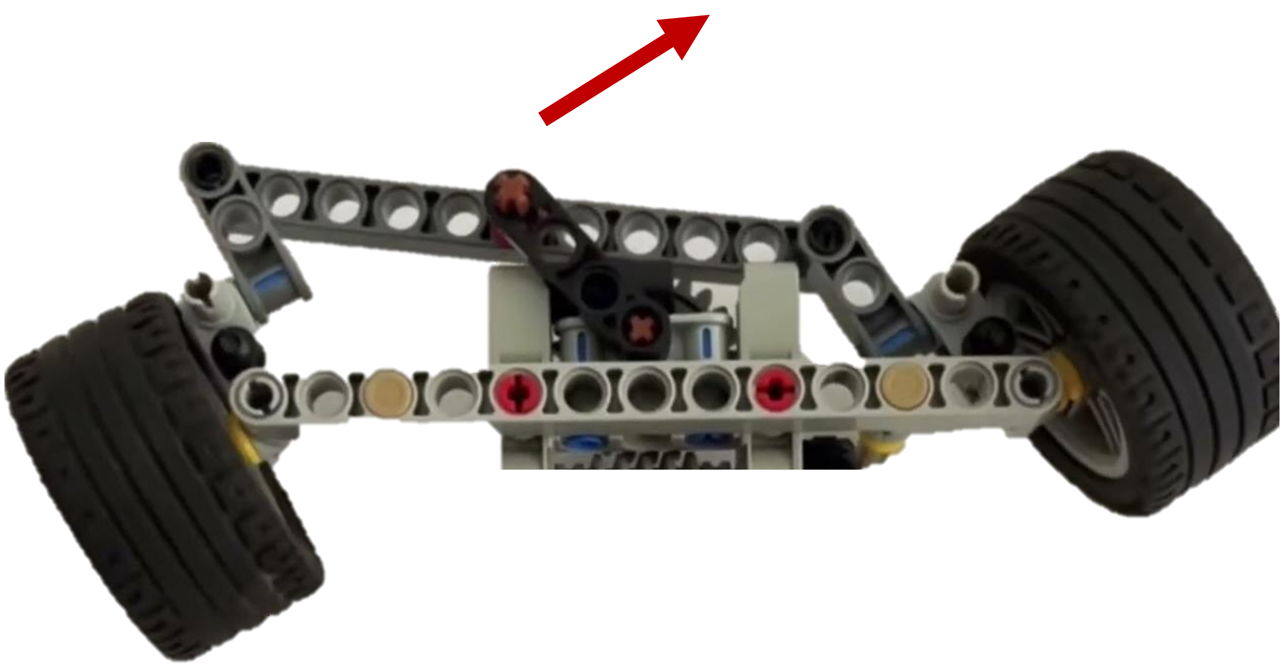
Servo holder



Connector

Steering mechanism:

Connector



Vehicle Chassis Design and Selection

- For our vehicle, we opted for a handmade wooden chassis due to its low weight, which contributes to improved maneuverability and efficiency. The wooden structure provides a sturdy base while remaining lightweight, allowing for easier handling and faster speeds.
- To build the movement mechanism, we utilized LEGO components. This modular approach not only simplifies assembly but also allows for easy modifications and repairs as needed.

Motors Mounting:

- The yellow DC geared motor is securely mounted at the rear of the chassis. This position is chosen for ease of access, making it straightforward to replace or maintain the motor if needed.
- The built-in gearbox of the motor connects directly to the differential, which then distributes power to the wheel axles, allowing for independent movement during turns.
- The servo motor is mounted at the front and directly linked to the steering assembly for precise wheel control.

Used Wheels (4x):

- We selected tank LEGO wheels for the vehicle, as they offer high friction and a larger diameter (8 CM). The increased friction enhances traction, which is essential for navigating various surfaces. Additionally, the larger diameter of the wheels contributes to a higher speed, enabling the vehicle to traverse obstacles more effectively while maintaining stability.

In the qualifying challenge, our strategy involves the following steps to ensure effective navigation:

1. **Forward Movement:**
    - **The vehicle will continuously move forward until the front ultrasonic sensor detects a wall.**
2. **Distance Comparison:**
    - **Upon detecting an obstacle, the vehicle will compare the distances measured by the right and left ultrasonic sensors to determine which side has more space available.**
3. **Turning Decision:**
    - **The vehicle will turn towards the side with the larger distance, allowing it to navigate around the obstacle efficiently.**
4. **Centering algorithm:**
    - **While moving, the robot will utilize four ultrasonic sensors (two on the right and two on the left) to help maintain its central position on the course. This ensures balanced navigation and helps avoid straying from the intended path.**

In the final challenge, our strategy involves the following steps to ensure effective navigation:

1- Forward Movement:

- **The vehicle will continuously move forward until the color sensor detects either a red or green obstacle.**

2- Color Detection:

- **Upon detecting a color, the vehicle will determine its position relative to the obstacle.**

3- Turning Decision:

- **Based on the position of the detected color (left or right), the vehicle will make a decision to turn right or left to avoid the obstacle.**

4- Continuing Forward:

- **After successfully navigating around the obstacle, the vehicle will continue moving forward while monitoring for additional obstacles.**

Pseudo Code

```
DEFINE pin constants for ultrasonic sensors and motors

INITIALIZE global variables for distances and speeds

FUNCTION setup:
    SET pin modes for ultrasonic sensors and motors
    ATTACH servo to the designated pin
    INITIALIZE serial communication
    WAIT until button is pressed

FUNCTION loop:
    CALL ultra to get distances from sensors

    IF right rasper sensor is triggered:
        RECORD start time
        WHILE right rasper sensor is still triggered:
            CALL Move to move the robot left
        RECORD end time
        CALL Move to stop and adjust speed
        CALL Move to continue in the original direction

    ELSE IF left rasper sensor is triggered:
        RECORD start time
        WHILE left rasper sensor is still triggered:
            CALL Move to move the robot right
        RECORD end time
        CALL Move to stop and adjust speed
        CALL Move to continue in the original direction

    ELSE IF center front distance is less than threshold:
        CALL Move to stop the robot
        CALL ultra to update distances
        IF right front distance is greater than left front distance:
            CALL Move to turn left
```

```
    ELSE:
        SET speed to a default value
        CALL ultra to update distances
        IF right front distance is less than threshol
            CALL Move to steer left
        ELSE IF left front distance is less than thres
            CALL Move to steer right
        ELSE:
            CALL Move to continue straight

FUNCTION ultra(front, back):
    IF front sensors are active:
        FOR each front sensor:
            TRIGGER sensor
            WAIT for echo response
            CALCULATE distance using response time

    IF back sensors are active:
        FOR each back sensor:
            TRIGGER sensor
            WAIT for echo response
            CALCULATE distance using response time

    REPLACE zero distances with a large value

FUNCTION Move(speed, direction, duration):
    IF speed is positive:
        SET motor direction to forward
        SET motor speed based on speed
    ELSE IF speed is negative:
        SET motor direction to backward
        SET motor speed based on speed
    ELSE:
        STOP motors

    CALCULATE steering based on direction
    MOVE servo to the calculated position
    WAIT for the specified duration
```

```
FUNCTION center(duration):
    RECORD start time
    WHILE the elapsed time is less than duration:
        CALL ultra to update distances
        IF right front distance is less than threshold:
            CALL Move to steer left
        ELSE IF left front distance is less than threshold:
            CALL Move to steer right
        ELSE:
            CALL Move to go straight
```