Mechanism Used

I have chosen to use a **hybrid mechanism** for the stair-climbing robot, as it offers better adaptability for steps of varying heights. The design combines both **wheels and articulated (armed) legs** to climb stairs more effectively.

The overall structure resembles an **RC car**, but with a unique twist: the **front wheels are flexibly movable** through an arm mechanism to help with stair climbing.

Design Explanation

The robot has a total of **6 wheels**, and the main climbing is done using the **front four wheels**. For clarity, I'll describe the mechanism for **one side** of the robot:

- The **first two wheels** on one side are connected by an **L-shaped arm**.
- The **length of the L-arm** defines the **maximum step height** the robot can climb.

Climbing Process (One Side):

1. **Approach the Step:**
   The first wheel comes in contact with the stair and starts climbing.
   The **middle and rear wheels push** the robot forward during this.
2. **Middle Wheel Climb:**
   Once the first wheel has climbed, the **middle wheel starts to ascend**.

The front wheels **pull**, while the back wheel **pushes**.

3.**Top Pull:**
With both the front wheels on top of the stair, they **pull the entire robot forward**, completing the climb.

A PDF named Climbmech.pdf has been attached in the repository to depict the climbing mechanism.

Weight Distribution

- The **major weight contributors** are the **structural frame and battery**.
- Other components (sensors, controllers, wiring) are relatively light and don't significantly affect the center of mass.
- The **battery is placed toward the front** to:
- Keep the center of mass forward.
- Prevent the robot from **toppling backward** during stair climbing.

Components List

Component	Quantity	Reason for Selection
3D Printed Frame		Lightweight and customizable

Johnson Motors (100 RPM)	6	High torque, suitable for climbing, speed is not a priority
Arduino Uno/Mega	1	Easy programming and integration, enough I/O for sensors and drivers
IBT-2 Motor Drivers	2	Capable of handling high currents (~15A)
Li-Po Battery (3S 12V)	1	Lightweight and provides high discharge current for motors
Ultrasonic Sensors	2	One at the top and one at wheel axle to differentiate between stairs and obstacles
Servo Motors	2	For operating any flexible or assistive mechanisms as needed

Control Strategy

- **Ultrasonic Sensor Placement:**
  One sensor is placed **on top**, and the other near the **axle of the front wheels**.
- If both sensors detect a **significant difference in distance**, it likely indicates a stair.
- The bot then proceeds to **initiate the climbing sequence**.

Battery & Power Calculation

➤ **Motor Requirements:**

Each **Johnson 100 RPM motor** (under load):

- **Voltage:** 12V
- **Current (max):** 1.5A
- **Stall Current:** ~2.5A

For **6 motors**:

- **Normal Operation:** 6 × 1.5A = **9A**
- **Stall Condition:** 6 × 2.5A = **15**

➤ **Battery Specifications:**

- **Type:** LiPo
- **Rating:** 3S, 2200mAh, 25C
- **Current Capacity:** 2.2Ah × 25C = **55A max output**

Why L298N Is Not Used(The most popular one in the club :))

- The **L298N motor driver** cannot handle high current (limited to ~2A per channel).
- With total current peaking at **15A**, the **IBT-2** is chosen as it's more suitable for high-torque applications like stair climbing.