**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 the wheel axle to differentiate between stairs and obstacles |
| Servo Motors  Encoders  IMU Sensors | 2  6  1 | For measuring the tilt angle of the L arms  Feedback system.  For detecting any unexpected disturbance. |

**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.

**Steering and Control:**

This will be an **autonomously** moving robot and the steering or drive mechanism is **Differential Drive** where all the three wheels are treated as left wheel and all three right wheel are treated as the left wheel and the three right ones are treated as the right wheel.





