A machine with wheels and a metal pole

AI-generated content may be incorrect.

**PART A**

I would propose a tracking belt mechanism. Each side of the robot is equipped with an independently powered track, allowing differential steering and robust ground contact.

**Justification**

We’ve chosen a tracked robot that runs on a flexible rubber track powered by wheels of different size — the larger ones positioned toward the centre and the smaller ones at the edges.(As shown in figure) This configuration allows the track to naturally form a "peak" or gentle curve, which helps it better traversing the profile of stairs, providing both grip and mechanical advantage(Stability) when transitioning from one step to another. The chain joining the wheels is of much importance, as in other types of mechanism there is chance of tyres getting stuck at sharp edges. This mechanism also allows smooth turning on curved stairs which is difficult in legged mechanism and other also.

**Stability Mechanics**

The robot will be designed with a wide, low-slung base to maximize its ground contact and lower the risk of tipping over.

All heavy components like motors, battery packs, and controllers would be placed close to the chassis bottom.

We would require High Torque to overcome the Weight of components of the robot to move up. Hence I would prefer DC Motor to power the tracks.

**Control Strategy:**

Ultrasonic Sensors (Front):  
To stair height before climbing each step and thereby adjusting the angle the front tracking system should make with respect to chassis.

IR Sensors (Back):  
To check if the current step is climbed completely.

Motor Encoder  
To control speed of both the sides.

IMU (Inertial Measurement Unit):  
To monitor the robot’s tilt and detect sudden shifts in pitch or roll while climbing.

PID Controller Logic

A PID controller can be used to distribute motor power between the left and right tracks. Using data from the IMU and ultrasonic sensors, it can adapt the motor speed and torque dynamically to avoid slipping or tipping. Like if the bot is tipping towards right , then it may command the right motor to move quick in right direction

**Stair Detection**

The ultrasonic sensor detects depth of upcoming stairs. When the rise is too sharp for normal movement, the control logic increases the motor power briefly.

The IMU checks for sudden tilts — if the robot leans back too much, it signals to reduce speed or pause, ensuring that the robot doesn’t topple.

A notebook with writing on it

AI-generated content may be incorrect.

**PART-B:**

If one side of the tracked system stops working — say due to a motor failure or gear/chain jam — the robot will begin to rotate or veer toward the side that’s still functioning.

**Path Deviation:** It may go to a spiral path into the stair edge rather than climbing straight.

**Toppling:** If the path deviation occurs to a significant extent then the robot may even topple due to difference in weight distribution over the stairs.

In worst case, if the bot could not move at all, then it may end up burning the components.

**Fault Detection:**

If one motor shows **zero rotation** while a control signal is being sent, unusual or sudden change yaw/pitch values.

**Prevention & Recovery**

Alert the operator about the fault through buzzer or LED, if such conditions arise.

On detecting a jam, pause both motors to avoid tipping.