University of Texas at Arlington

Final Project: Stair Climbing Robot Project Report

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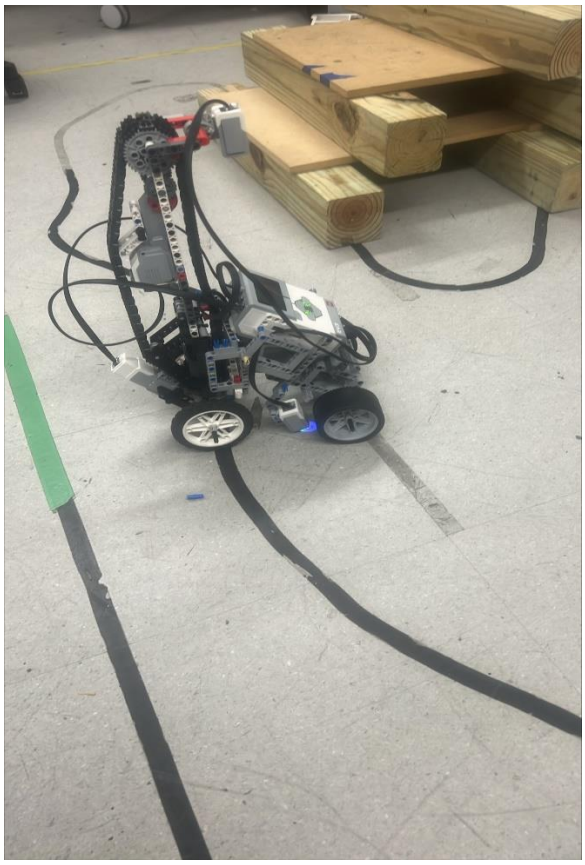
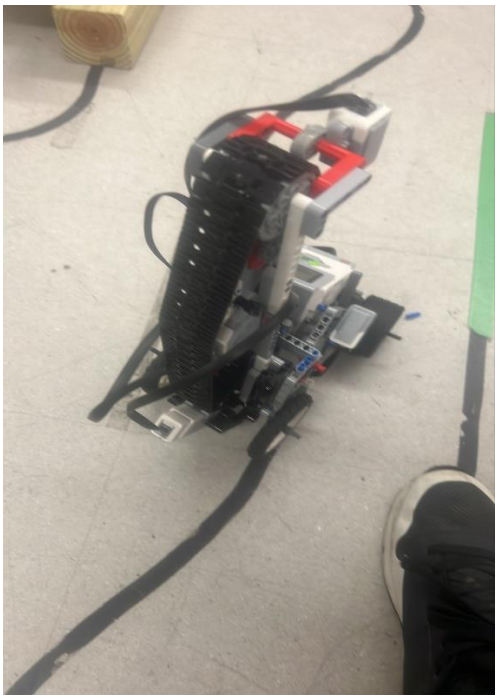
Robot Specification

The robot has a collection of motors and sensors to climb up and down the stairs. Two large motors are used to control the front wheels and the lifting mechanism while a medium motor is used to control the back wheels. The robot uses a color sensor to identify the blue mark at the top of the stairs which will signify that the robot has reached the top of the stairs. Secondly, the robot uses a gyroscope to determine when the robot is beginning to tilt while climbing up or down the stairs which determines the launch of the lifting mechanism. Finally, the robot has a touch sensor which would indicate the maximum length that the lifting mechanism can rotate to. This is to ensure that the rear end doesn't overshoot the lifting mechanism which could cause some damage to the robot.





Behavior Implementation

Our robot begins by driving towards the stairs where the robot will begin to tilt as it is dragging along the first set of stairs. Once the robot reaches a desired angle, the lifting mechanism at the back will start to lift the robot up the stair platform and begin to move for a short period of time until it has reached an angle close to 0. After the robot has reached the desired orientation, the robot will begin to move forward to reach the next stair and lift itself back to its original position. Throughout the movement procedure, the speeds for the front and back wheels would change to better perform the action of tilting itself onto the stair platform. In addition, the robot keeps track of each step it has performed while climbing up to be used during the climbing down procedure. Climbing up the stairs will end once the color sensor detects a blue color underneath the platform which indicates that the robot has reached the top of the stairs and is ready to start climbing down the stairs.

The strategy for climbing down the stairs is almost identical to climbing up the stairs as it begins to drive in reverse but slower. The same logic is applied for climbing down the stairs as the tilt angle of the robot remains the same once it starts to almost fall off the stairs. To compensate for possible slippage and falling, the desired tilt angle is decreased so that the robot has enough time to pull itself down using the lifting mechanism.

Challenges

Throughout the process of the project, we faced several challenges that proved to be challenging. Firstly, the robot would fall off while trying to climb up the stairs using the lifting mechanism.

This event would be minimized by experimenting and finding the ideal speeds for both motors controlling the front and back wheels that will produce the least amount of slippage. However, the robot would still fall off during certain scenarios and different sets of stairs, especially when trying to climb down the stairs. Additionally, the robot would sometimes overshoot the amount of rotation for lifting the robot which would cause damage at the rear end of the robot. To avoid this, a touch sensor was added so that the motor in charge of the lifting mechanism would stop rotating and begin movement again. Finally, several gears and wheels were used and tested to find out which sets of gears and wheels would produce enough torque to lift the robot without breaking critical parts in the robot.

Code

The code for the robot is attached separately to this compressed project folder.