Group: Hotel
Group Members: Aarush Maddula
School Year / Term: 2024 - 2025

LEGO Sumo Project Report

Introduction

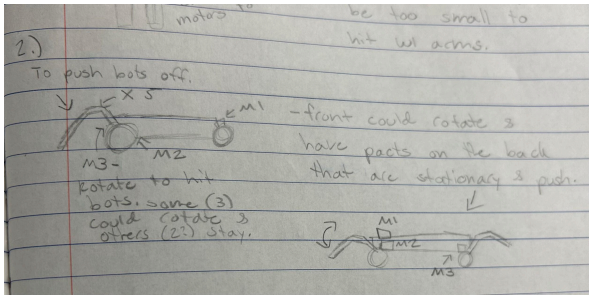
In this project, we were asked to make a Lego sumo robot that used up to three motors and could fit a 12 in by 12 in box. This robot is going to compete against other robots in our class for two rounds of competition in the ring where 2 robots have to fight to push each other off the table edge.

Project Report

Engineering Notebook

Autumn's idea:

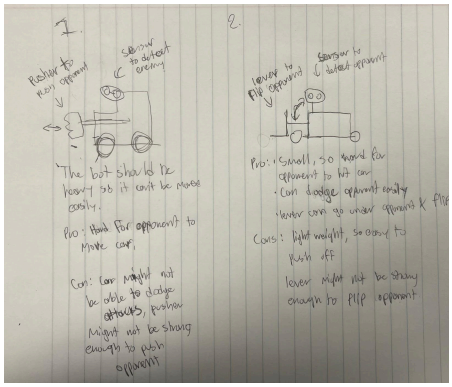
My idea was to have a rotating piece on the front of a robot which is on wheels, that could push or hit another robot. This would use three motors, one for each set of wheels and one to rotate the front piece.



Aarush's idea:

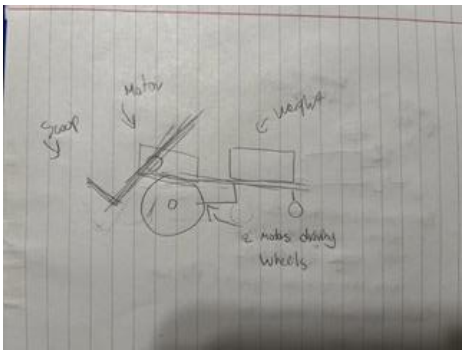
One of my ideas (left) was to have a mechanism that goes in and out of the robot that "punches" the opponent off the table, which would be activated by a distance sensor that detects if the robot is close.

Another idea (right) I had was to keep the sensor mechanism but replace the pusher with a scoop that would grab the car from below and lift it, essentially disabling the opponent and allowing us to move it off the edge

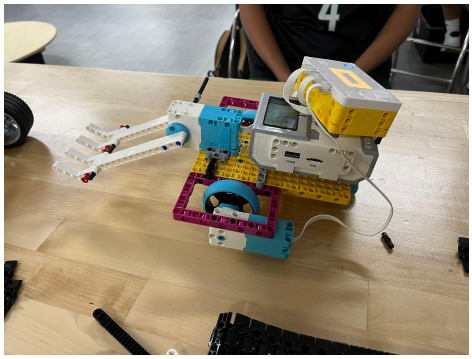
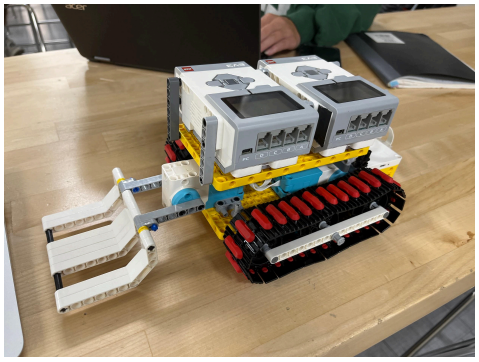


Compromise:

We worked together to come up with a compromise. We decided to incorporate the scoop idea into our final design since we thought it would be the most effective at pushing against the opponent, along with 2 big wheels on the front with a rolling ball on the back to ensure maneuverability. We decided not to use sensors since we thought it would be more effective if we manually activated the scoop ourselves.



Task 1 - Initial Robot Design and Competition

Initial Design	Revised Design
 This design uses two wheels in the front and a rolling ball in the back. We placed an old EV3 on the back to prevent it from tipping over when flipping a robot, but we found this was not enough weight during testing. The front piece used to pick up other robots in battle used four spaced-out bars to flip the robot from underneath. After testing, this piece was not able to pick up much weight. Also, the wheels kept slipping when grabbing something, reducing traction.	 The revised design used three wheels on each side connected to tracks to replace the slipping wheels. These were attached using stable bars so they couldn't be knocked out of place like our original design. The top includes two old Ev3s to add more weight so the newly designed front piece could pick up robots and be hard to be pushed by opponents. We made the front piece more stable by placing it closer to the ground and adding supports next to each other.

Competition

After finishing our revised design, we competed with other sudo robots other groups made in the class in a competition. Our sumo-robot did decently well, with us placing in 3rd place. During the competition, we encountered many issues with our design:

- During one round, both tracks came off the sumo robot since it wasn't properly secured. This made the robot unable to move.
- The controller that we were using was often glitchy and slow to respond to inputs. This resulted in the robot falling off the table on its own as it unexpectedly moved backward.

- The treads were too loose, which compromised our speed and allowed the opponent to rip of one of our treads.

Task 2 - Robot Redesign and Competition

Redesign Process

For our redesign process, we sought to address and fix the numerous issues we encountered during the 1st competition.

Problem: Tracks assembly kept falling off & was too loose

One of the issues we encountered was that the track assembly of our robot would detach from the main body of the vehicle and cause the connection between the motor and track to break, ultimately preventing the robot from moving. Also, the track was too loose as it was too long to securely wrap around the track assembly. We couldn't remove an individual track piece as it made the track too short to wrap around the track without bending the assembly.

To address the track assembly coming off, we focused on adding more Lego pieces that connect the track and the main body to prevent the assembly from coming off the body. Also, to address the loose tracks, we made the assembly longer so that the track properly wrapped around the assembly without any problems.

Problem: The controller was buggy

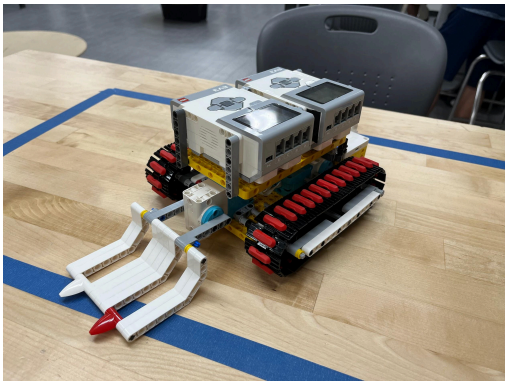
During our competition, the controller for the sumo robot we created on the Lego Mindstorms app could have been better as it would often make unpredictable movements. We diagnosed the issue with the joystick module we used for our controller as when we tried to position the joystick to a diagonal, it would glitch between the actions for the 2 adjacent axis.

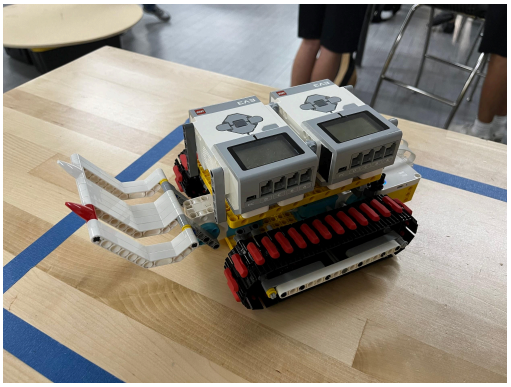
To fix this, we switched out the joystick for a d-pad, which only allowed for inputs in the 4 directions we wanted the robot to go in. After reprogramming it, we tested it and found it more reliable.

Other changes

We decided to add some spike pieces to our robot's scoop. We thought the sharpness of the spikes would allow the scoop to more likely go under the opponent's robot and scoop it up.

Final Design





Competition

After finishing our final design, we competed for a second time with the other cars in our class. We unexpectedly did worse than our first time, with us placing in 4th place. We think this is mostly due to the major improvements our opponents made since the first competition. The major problem we had was how the opponent's scoops were bigger, sharper, and lower to the ground than ours, with 1 opponent using a 3d printed part to achieve this. This caused our robot to get caught on the scoop and get easily pushed off the edge.

Conclusion

In the end, we successfully created a Lego Sumo Robot that met the requirements of using 3 motors and fitting in a 12 in by 12 in box. After compromising with an initial design composed of a scoop with 2 front wheels and a rolling ball on the back, we did some testing with the robot and realized a few issues with the design, like a lack of weight and slipping wheels. We fixed that with our redesign, which switched the wheels for tracks, made it more structurally stable, and added more weight. Shortly after, we competed with other robots our class made. We placed 3rd in the competition and realized there were some issues with track stability, connection to the motors, as well as controller responsiveness. We redesigned the robot by switching the setup of the controller with a d-pad and making the tracks more structurally stable, as well as adding spikes to the scoop to increase its ability to go under robots. We competed again to place 4th place as our opponents had better scoop designs that went lower to the ground, were bigger, and were sharper.

I think we could've 3d printed some parts to create a more effective, lower, and bigger scoop that could've helped in defeating our opponent. Otherwise, I am proud of our design process since throughout the design process, I and Autumn successfully collaborated and compromised to create this robot and I had plenty of fun throughout it. I learned more about how to program Lego Mindstorm robots and gained experience with communication and teamwork skills.