Future Engineers 2024 design documentation

Part 1 Design Process

When the competition began, we were given two options: build a bot using Lego parts or design one from scratch. The challenge of creating a bot from the ground up intrigued me as the team's builder, so I decided to take it on. My goal was to build a bot that was manoeuvrable, precise, and reliable.

To kickstart the process, I began by gathering inspiration and references online. Platforms like Reddit and GitHub, with their vast communities of creators, provided a wealth of open-source models and ideas. The resources I found on these sites were invaluable in helping me develop and refine my design.

With prior experience using CAD software like Fusion 360, I applied several techniques that helped streamline the design process. One key technique was utilizing the parameters function to make critical dimensions, such as the overall length of the car, adjustable. This allowed for quick scaling of the car in various iterations, as shown in the photos, enabling efficient adjustments without having to revisit the entire design timeline. Additionally, I standardized certain components, such as the shaft, by setting a consistent 5mm outer diameter for screws, bearings, and shafts throughout the car. This approach not only simplified the assembly process but also reduced the number of different parts needed, effectively lowering costs.

Part 2 Prototyping

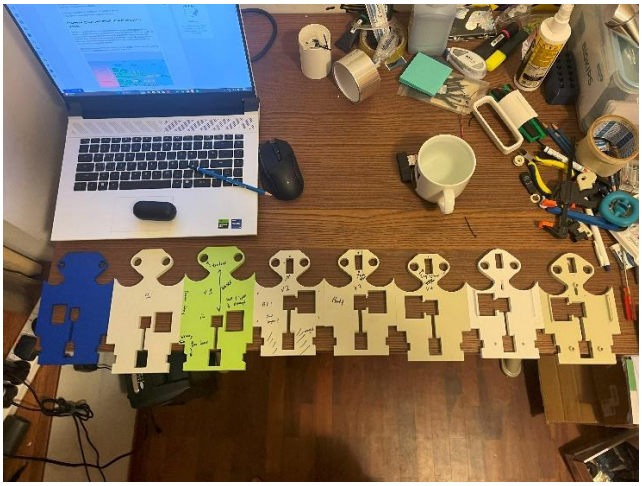
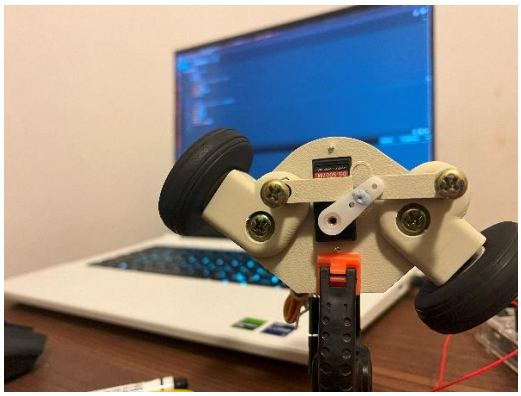


*Photo of iterations lined up

*Comparing versions height

During the design phase, prototyping was crucial, especially in ensuring that the car's components—whether the base or the steering system—were dependable. We employed various techniques to guarantee the reliability of each part, ensuring the car's performance wouldn't falter during the competition. By conducting rigorous tests, including stress testing and load testing, we identified and quickly addressed any flaws in the design, ensuring the car was optimized and ready for the challenge.

The competition made me realize the importance of prototyping. Many design flaws were uncovered during this process. One such instance involved the steering mechanism, where the initial part attached to the horn was made from PLA. During stress testing, I noticed the part cracked, revealing a weakness along the Z-axis. This discovery led me to switch the material to TPU, known for its strength in that direction. After reassembly, the part successfully endured around 6,000 cycles. Without the prototyping phase, it would not have lasted nearly as long.



*Stress testing

*steering portion of car

Part 3 Final Assembly

Concluding this write-up is the final step: assembling the car. I was pleased to see that the effort put into testing individual components had paid off, as it prevented more than two reprints of the final car model. This approach saved us a significant amount of material. The prototype car models were printed with only 1-2% infill and reduced top and bottom layers, whereas the final car was printed with 5-8% infill and increased top and bottom layers. This strategy helped reduce the cost of printing prototypes. The only reason we needed to reprint the final model was due to a small oversight in mounting the sensors.

Final Product: