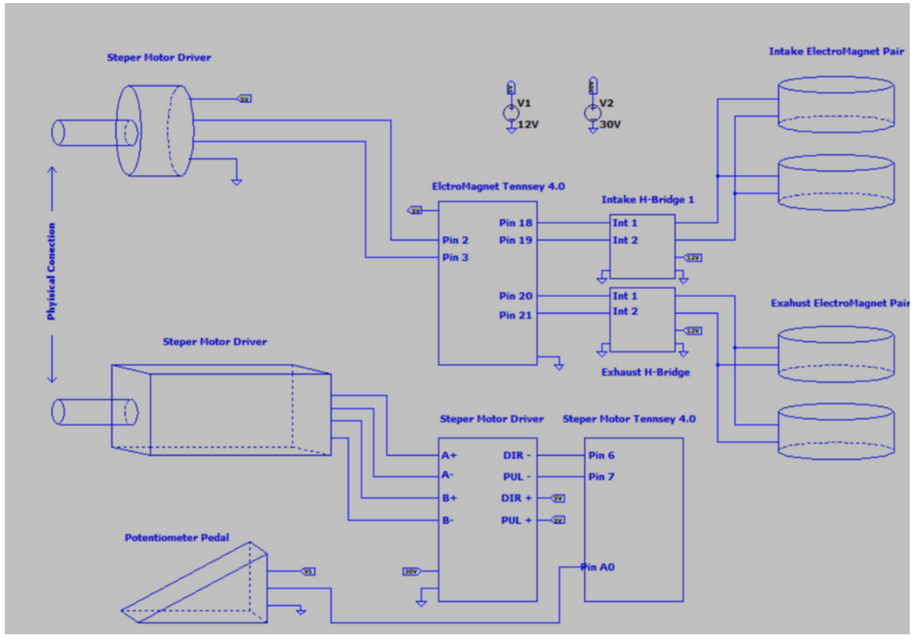
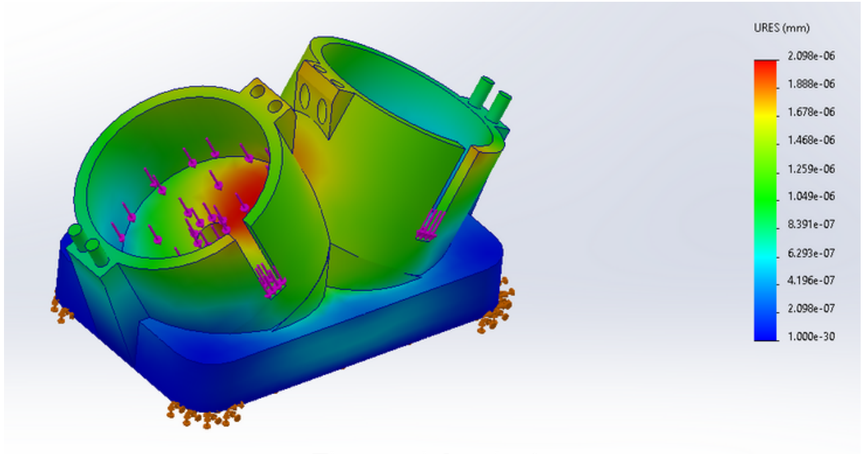
Project 1 - Electromagnetic Valve Actuation System

This was the capstone project for my engineering degree and was completed along with 3 other students. The goal of the system was to create a proof of concept for an electromagnetic valve actuation system. In standard I.C.E. vehicles, valves are actuated inside the cylinder using a mechanical system called the camshaft. This system generally works very well; however, the camshaft is prone to mechanical losses due to friction and other factors. Additionally, electromagnetic systems can operate more quickly and be controlled more precisely than the mechanical version can. This project was successful in proving that there is merit to the initial concepts that inspired the idea and deserve further research and development.

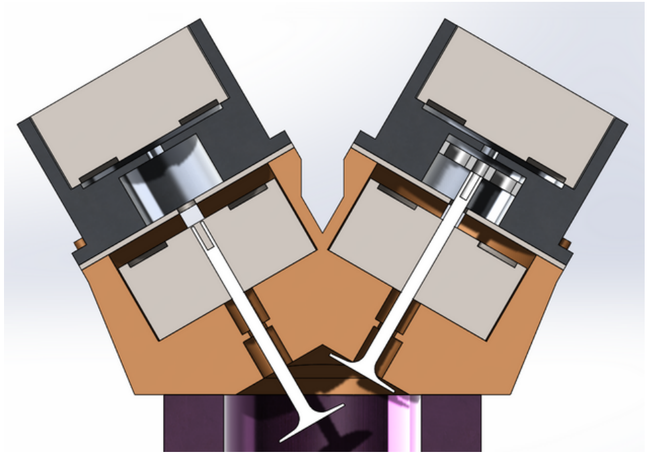
Video of operation: https://youtu.be/TBy_gREQdK0



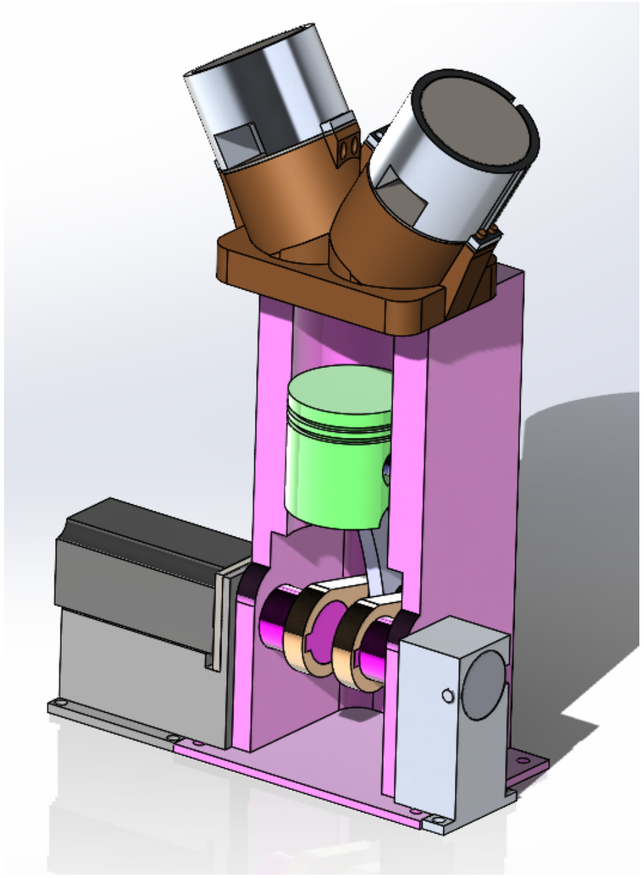
Wiring Diagram



Thermal Analysis

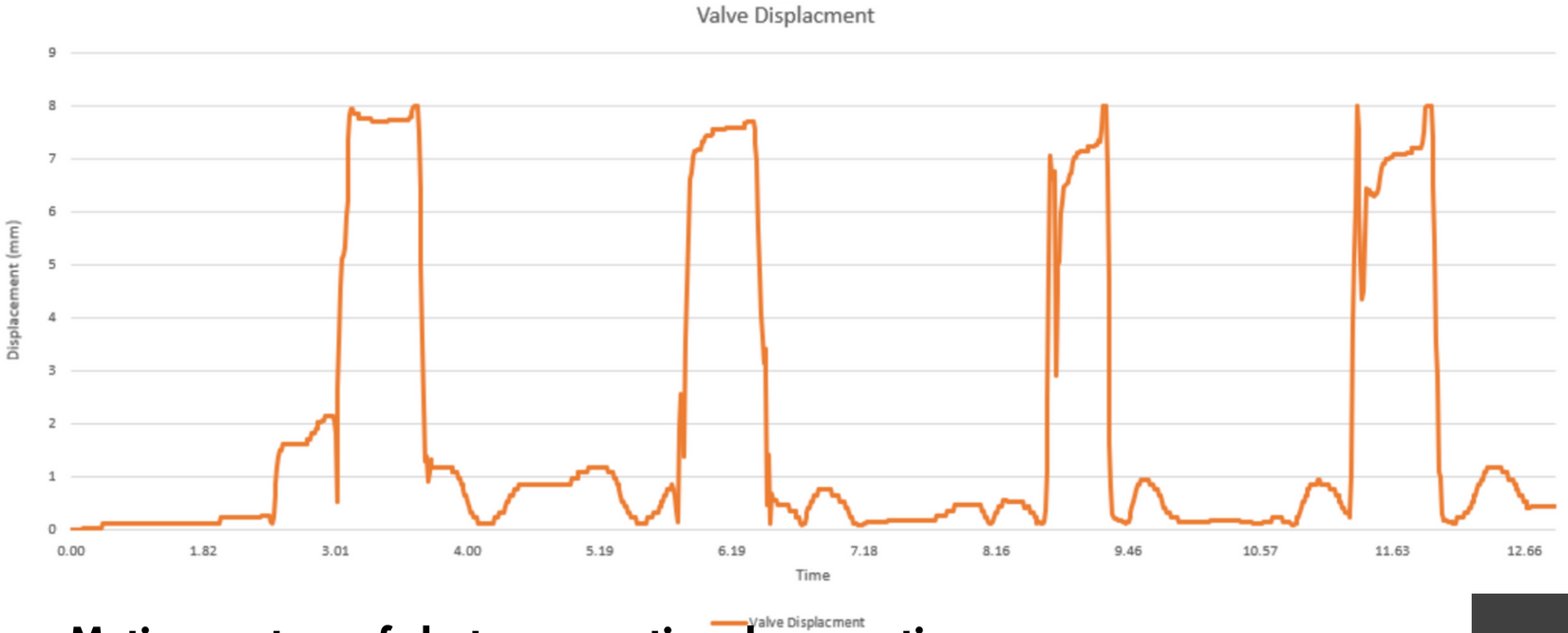


Cross Section



Final Assembly

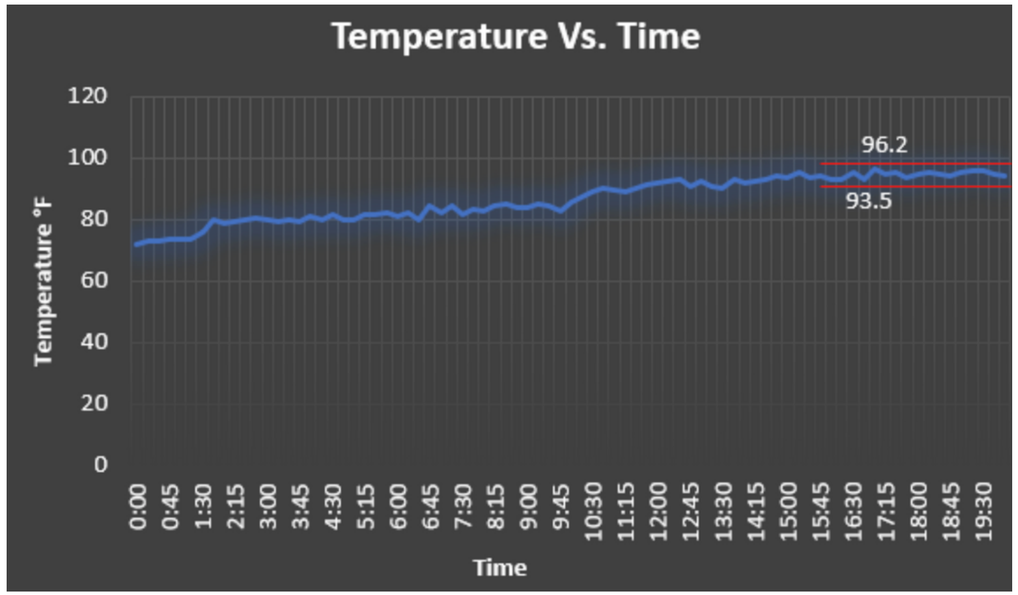
Project 1 – Electromagnetic Valve Actuation System: Results



Motion capture of electromagnetic valve over time

- **Average valve travel time is 0.07 seconds**
- **Can maintain speed equivalent to 1600 rpm**

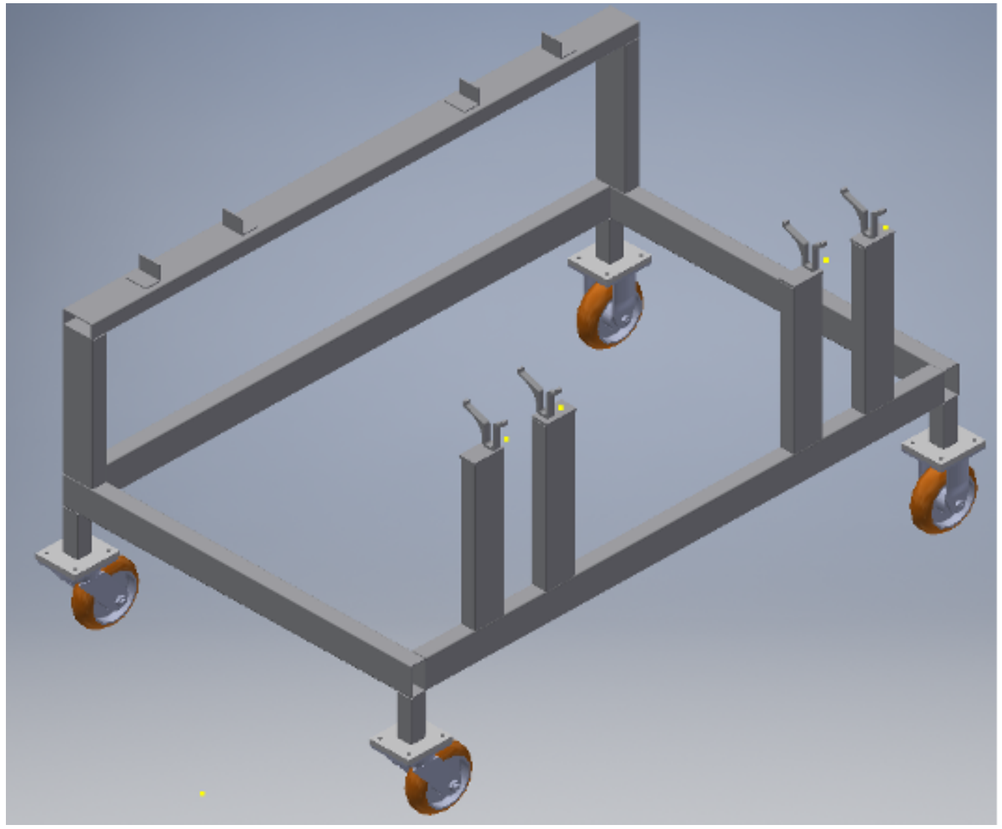
The magnets increased in temperature with operation, but the magnetic strength was not noticably diminished



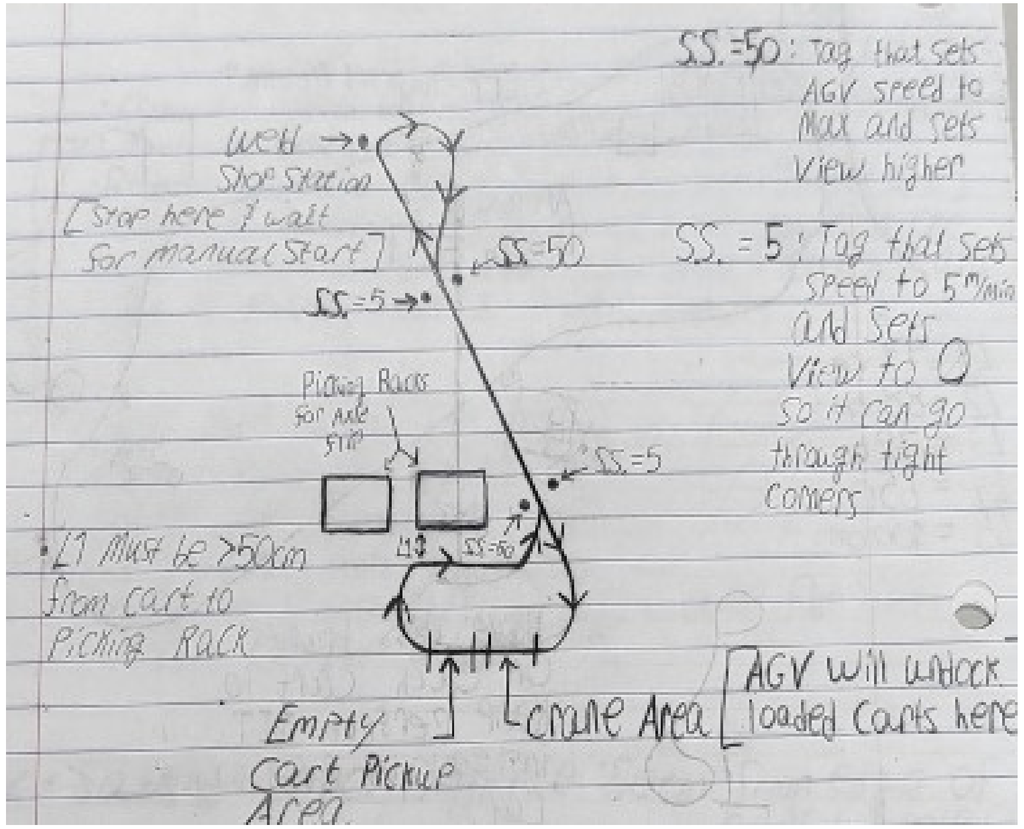
Project 2 - Autonomous Guided Vehicle Route & Custom Cart [Kubota]

Over the summer of 2022, I redesigned an entire AGV route at one of Kubota Industrial Equipment's locations. To do this, I first studied the original route and figured out where it was inefficient. Next, I drew several new variations of routes that would be more efficient and used the guidance of other manufacturing engineers to decide on the best one. After this, I designed a new cart in Inventor that would dock with the Creform AGV. Finally, with the help of the manufacturing engineering shop I built 3 of the carts in real life and implemented them onto the route.

Results: Increased average speed of AGV by 3 miles per hour which reduced the number of AGVs on the route from 2 to 1. Reducing the number of AGVs on the route frees up an AGV to be used elsewhere which effectively saves the company the cost of buying a new one ($25,000 - $30,000).



Custom Cart Deisgned in Inventor



Optimized AGV Path

Project 3 - Electric Bicycle

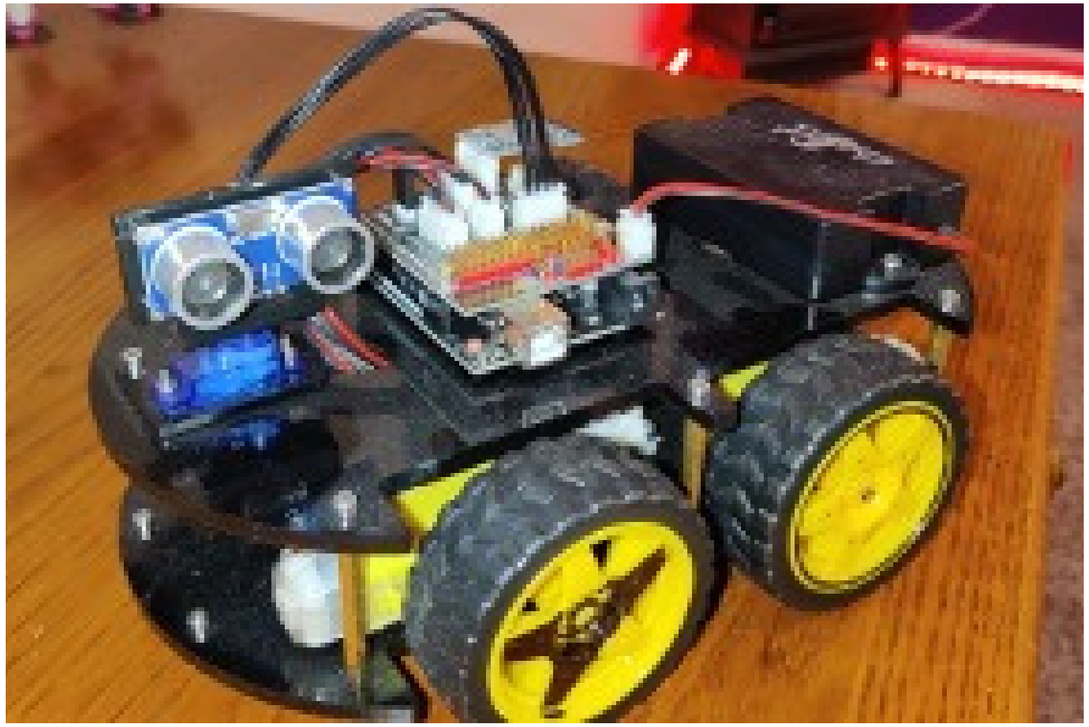
During the Spring 2022 semester, I built an electric bicycle from start to finish. The bike is theoretically capable of a brisk 28mph top speed (unmeasured) and long-range trips (relative to a bike). The biggest challenge for this project was the assembly of the battery. This battery is 12 tabbed cells wired in series and then connected to a battery management system. I had to disassemble and reassemble this battery 2 two times because of faulty wiring connections. However, my final battery design has held up extensive testing for both off-road and top-speed runs.

Additionally, I used a 1KW hub motor overclocked to 3KW for extra torque. The battery is set up to handle this kind of power. However, the extra power draw reduces the range. All of this is controlled through my motor controller which is mounted above the battery as seen in the pictures on the next page. Many aftermarket parts were used to create this bike. Even though I did not create any new parts from scratch, the important part of this project was the assembly of the bike and the thought process for selecting parts. This project taught me many practical concepts such as the inner machinations of a battery, weight distribution, and many others.

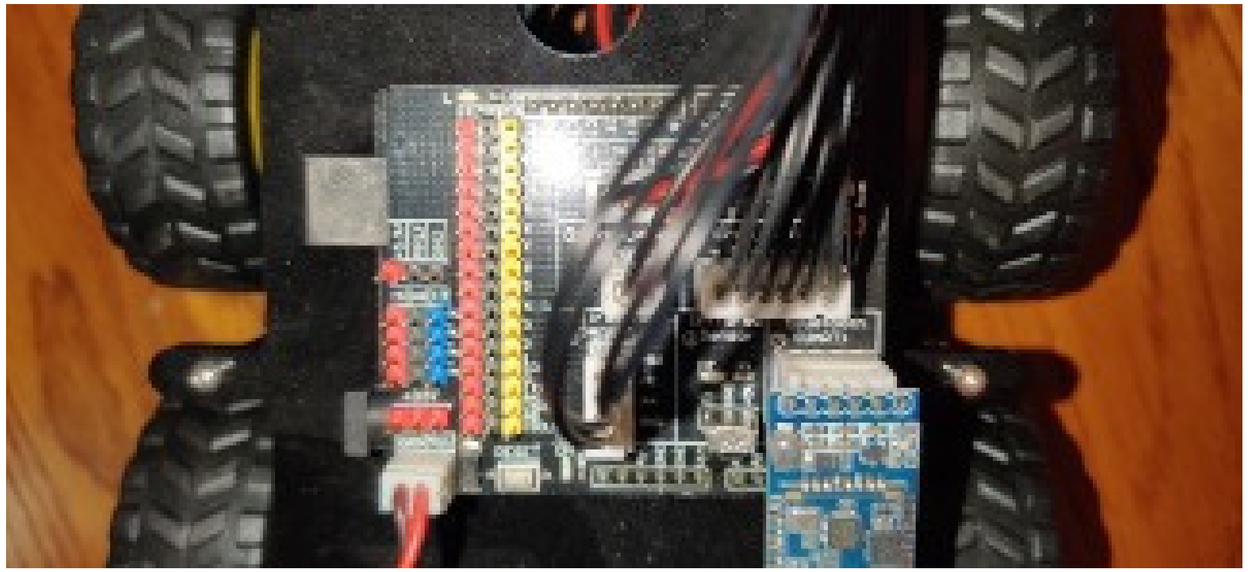
Project 4 - Autonomous Path Seeking Robot

I completed this project for my Sophmore level Mechatronics class. For this project, we ordered a kit robot from Amazon. Even though this robot had all the necessary parts included, the build process was still somewhat involved. However, the coding of the robot was our focus. For the coding, we used the Arduino IDE with the Python programming language. We created and troubleshot the code for this robot over the course of several lab exercises. At the end of our class, the robot had full autonomous driving capability.

Videos of robot operating:
https://youtu.be/PPMuoGXKc8A
https://youtu.be/ygK8RUeh_oQ



Fully Assembled Robot



Motherboard with Bluetooth Chip