Engineering Design Portfolio

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Engineering Portfolio

This document supplements my resume with additional information about the design and work experiences I have had while pursuing my Bachelors of Science degree in Mechanical Engineering with a minor in Robotics Engineering and a concentration in Mechanical Design at Worcester Polytechnic Institute.

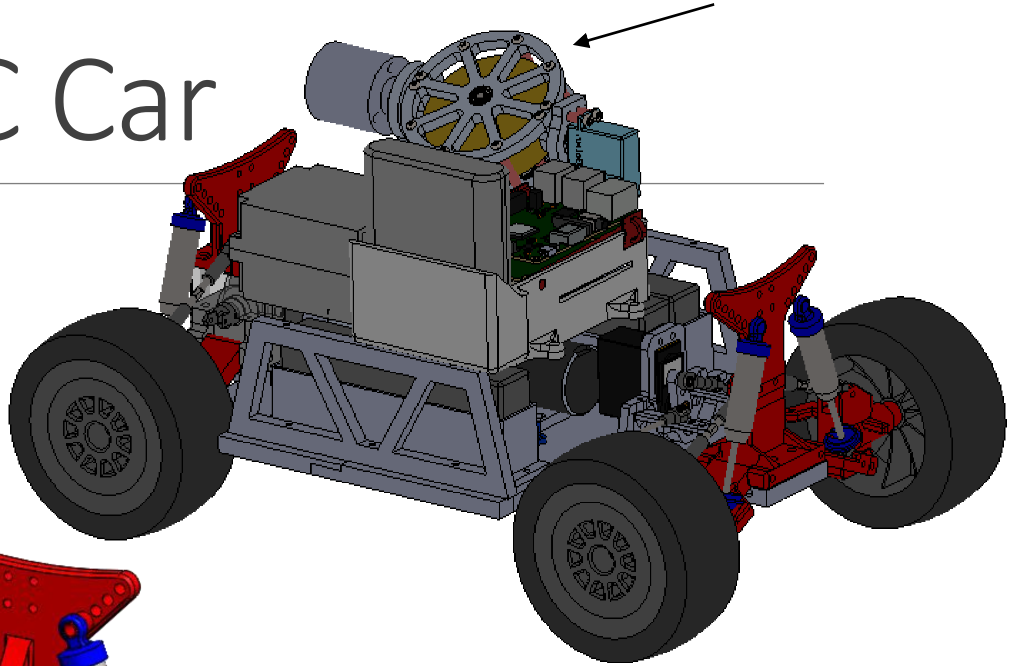
I am pursuing a full-time position in engineering to work on the cutting edge of science while solving both human and technical problems. The examples shown in my portfolio represent that desire.

If you have any questions about my application or hesitations about my qualifications, I would be pleased to address them. I can be reached by email at aboggess@wpi.edu or by phone at (803) 804-8127.

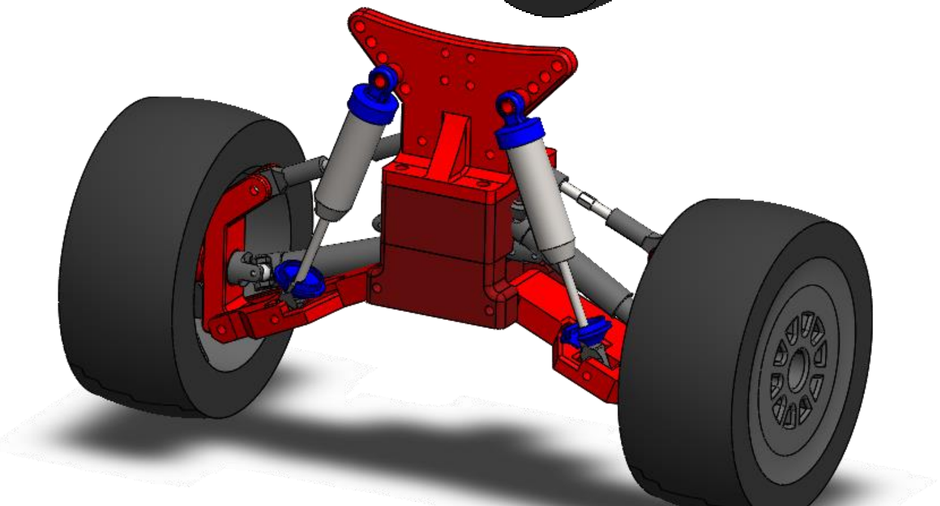
3D Printed Self-Driving RC Car

Key Take-Aways

- **Challenge:** Create a modular 3D printed RC car that incorporates a front/rear suspension, differential, and steering linkage
- Front and rear suspension was designed with a parallelogram steering linkage to maintain proper angle of wheel as suspension articulates
- Differential was used to allow the rear wheels to rotate at different speeds in order to maintain traction around turns
- CMG (Control Moment Gyroscope) was incorporated to allow roll-over recovery



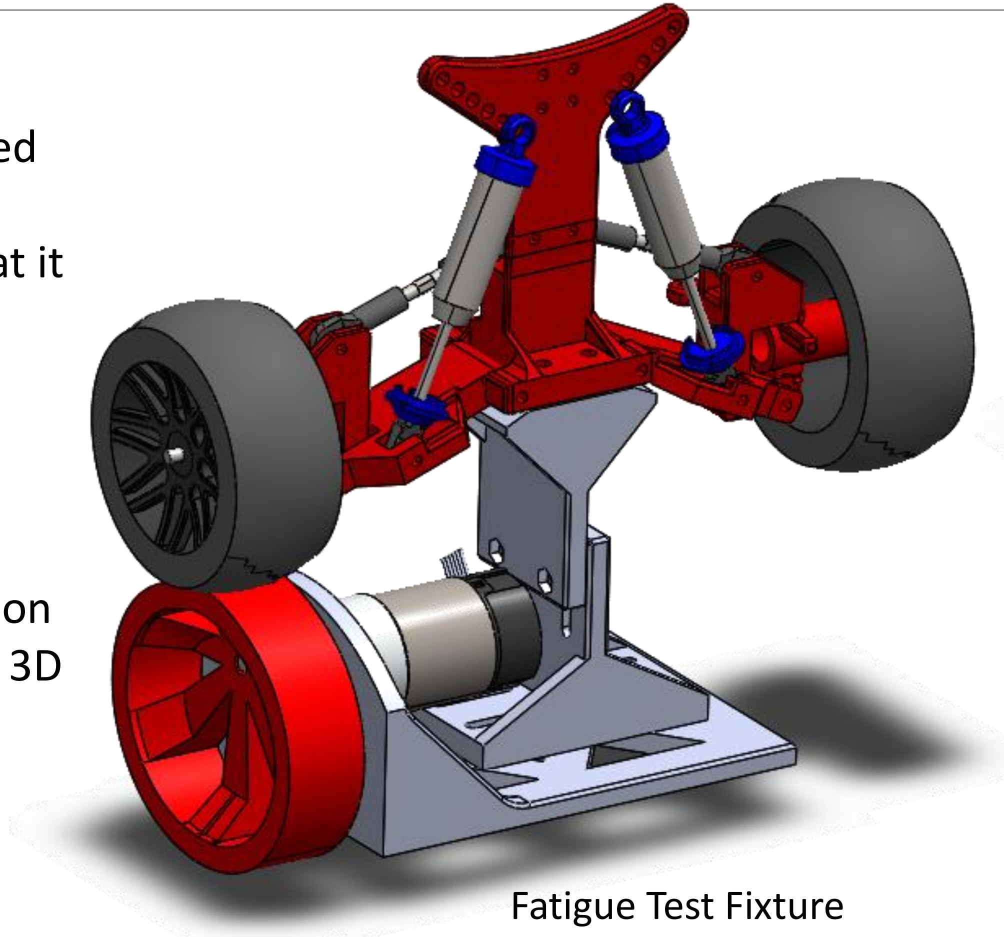
Full Car Assembly


Rear Suspension / Differential Assembly

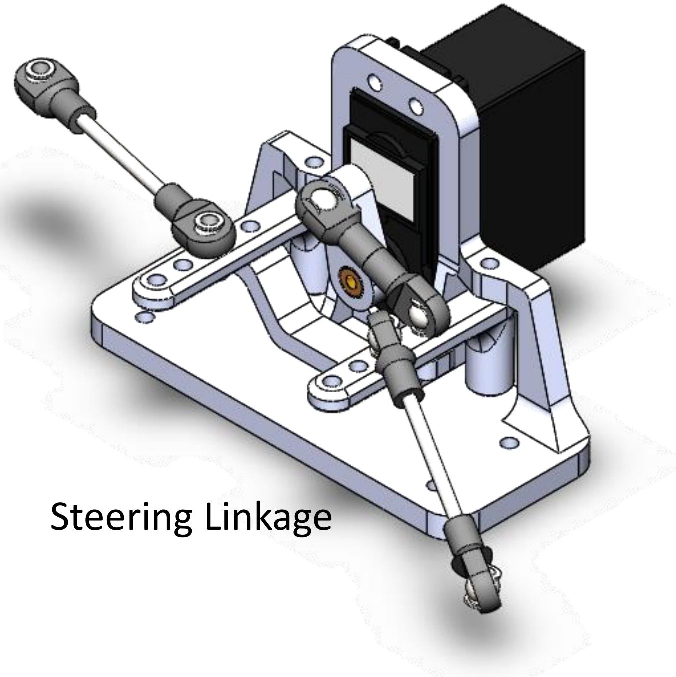
3D Printed Self-Driving RC Car (Cont.)

Key Take-Aways

- Steering linkage was designed as an 8-bar linkage and is placed in a position such that it does not interfere with the suspension articulation
- Front suspension fatigue testing fixture was designed using a cam in order to articulate the front suspension to determine lifetime of the 3D printed suspension



Fatigue Test Fixture



Steering Linkage

David Clark Internship

Board Testing Inserts (Figure 1)

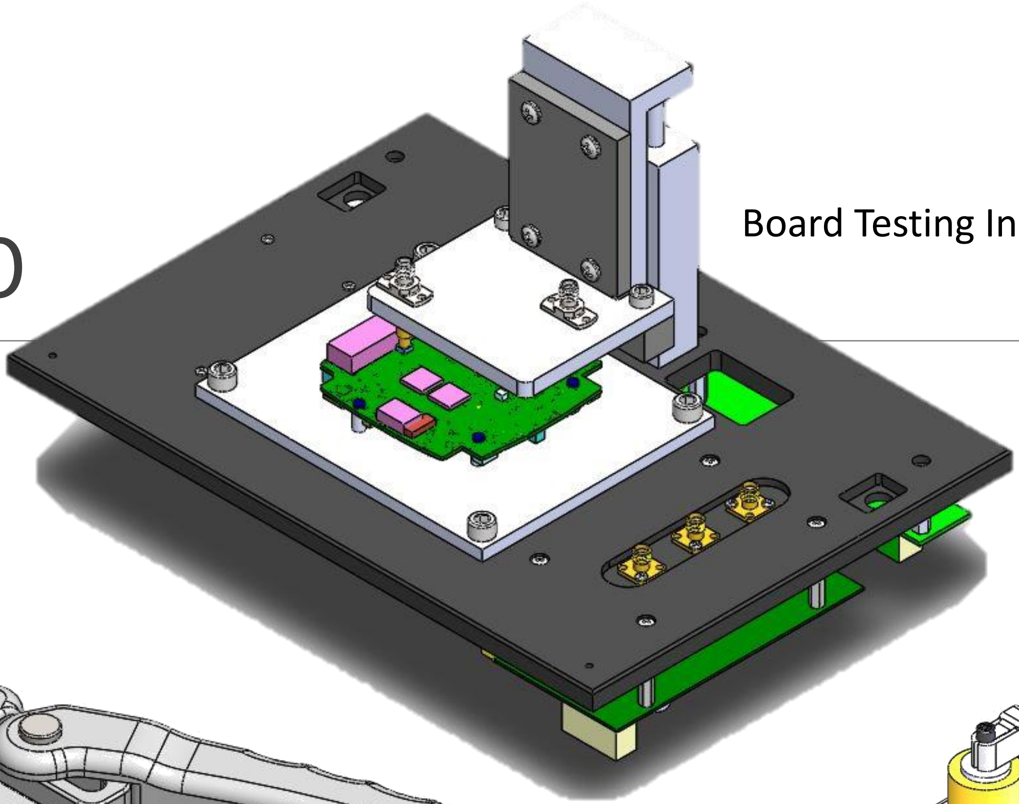
- Designed five modular circuit board testing inserts for Quality Assurance

Conxall Removal Pliers (Figure 2)

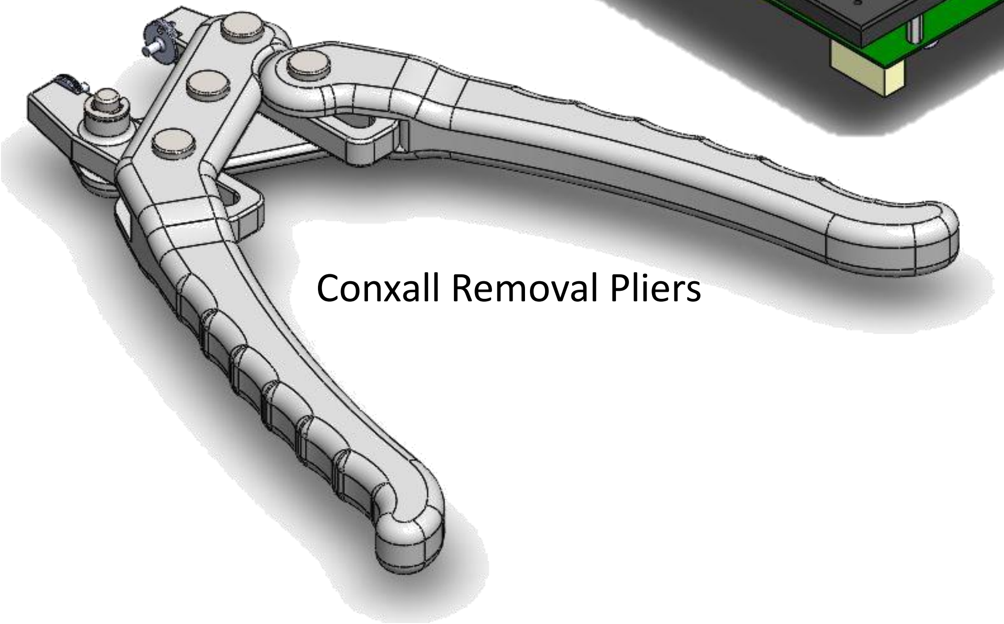
- Designed parallel action 3D printed pliers for a 7-pin Conxall connector using a FormLabs Form 2 with Rigid Resin (SLA Printer)

Speaker Test Station (Figure 3)

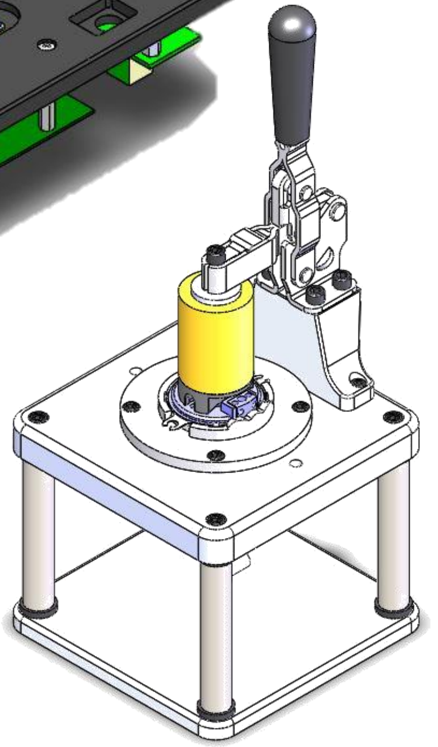
- Designed a speaker testing station to accommodate two different speaker housings



Board Testing Inserts



Conxall Removal Pliers

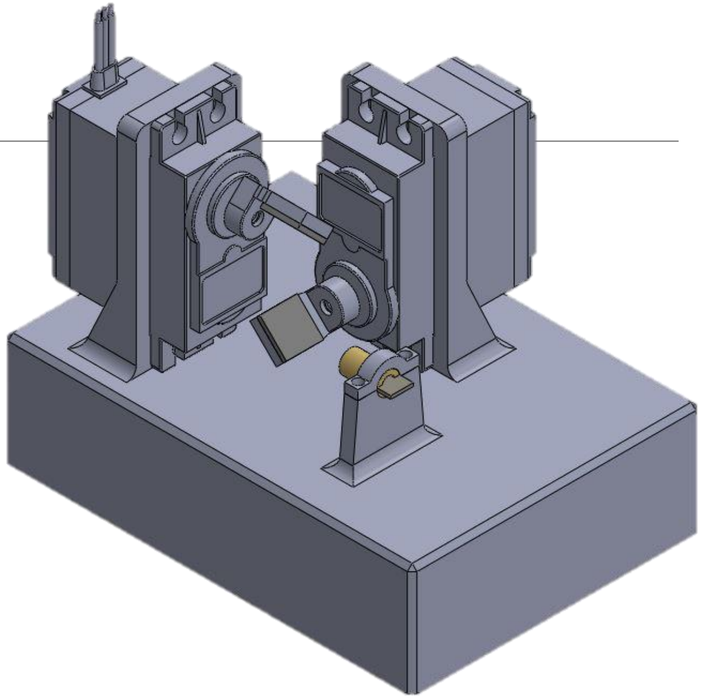


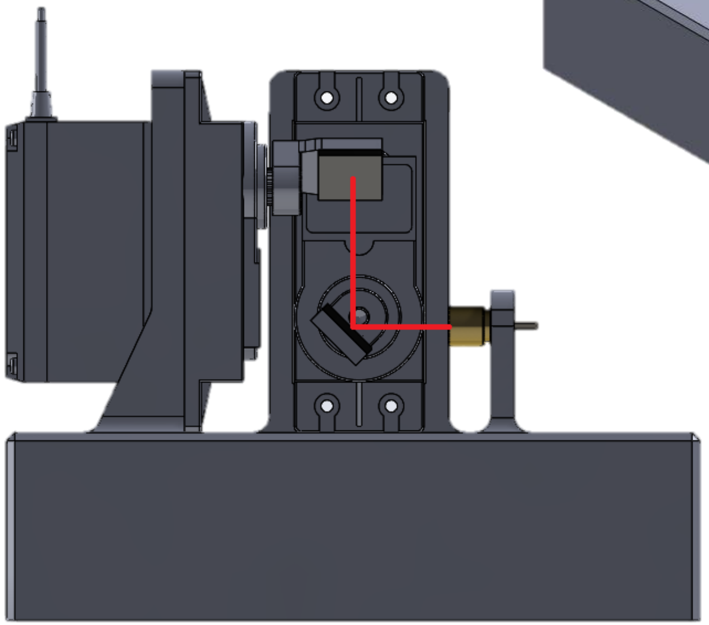
Speaker Test Station

Laser Etch-a-sketch

Key Take-Aways

- **Challenge:** Create art with light for my art practicum
- Designed a laser etch-a-sketch using SolidWorks where the user draws using two potentiometers controlling the XY coordinates of the laser point
- After the user has finished drawing, the Arduino will quickly replicate what the user has drawn, creating a persistence of vision effect

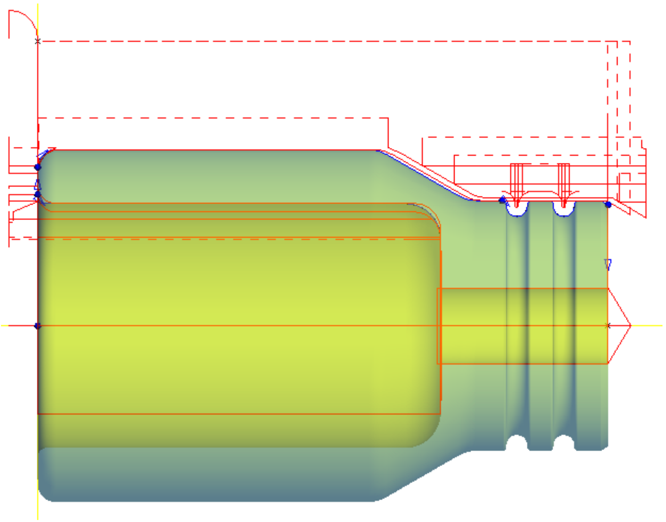




Stirling Engine

Key Take-Aways

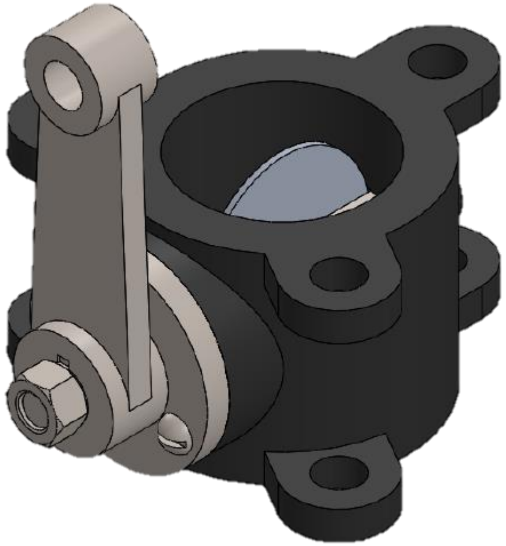
- **Challenge:** CAM and machine a stirling engine while learning safe practices for the HAAS MiniMill/Lathe
- Learned computer aided manufacturing (CAM) using ESPRIT in order to properly create g-code for HAAS MiniMill/Lathe
- Used ESPRIT to simulate operations and show crashes that may occur. Fixed any crashes before they occurred and followed safe operations procedures. I machined the stirling engine without any failures

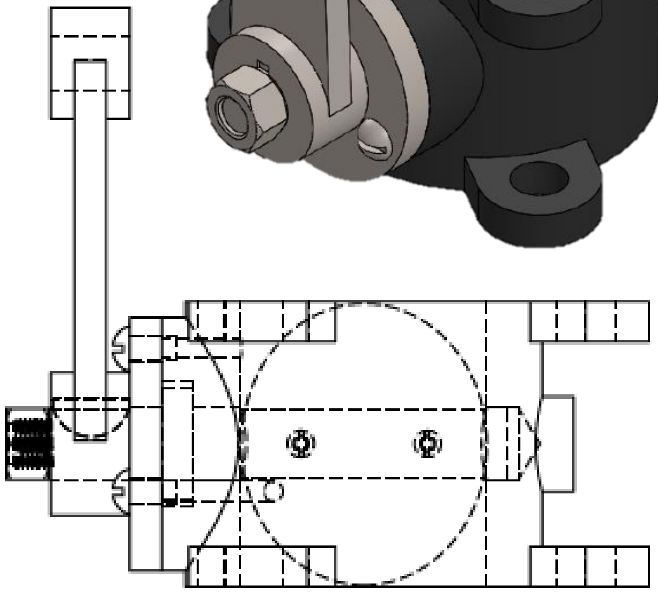


Butterfly Valve

Key Take-Aways

- **Challenge:** Design a butterfly valve using SolidWorks.
- Modeled each individual part, which included a SolidWorks Drawing and an auto-updating Bill Of Materials
- After completing the butterfly valve, I found that using a CAD program allows for rapid prototyping. This makes it easy to test the clearance or fit of the mechanical part. SolidWorks can also test the stress and strains on the model with various applied forces. The CAD model can easily be turned into a 3D part by 3D printing or machined once we are satisfied with the part

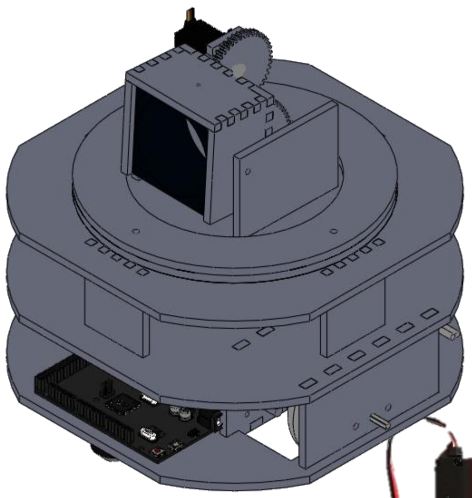


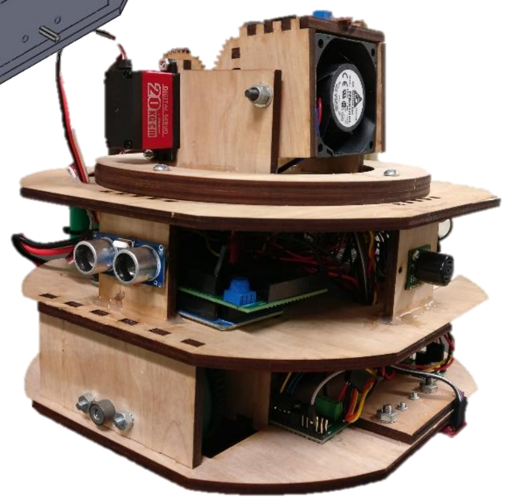


Autonomous Mobile Robot: Firefighting

Key Take-Aways

- **RBE 2002 Challenge:** Create a robot t0 autonomously navigate a maze, find and extinguish a flame, and then report the cartesian coordinates of the flame once it was found.
- Learned the importance of testing the fit regularly to find potential errors quickly. After ensuring that all parts were correct, I exported the part files to the laser cutter to be cut out of ¼” plywood
- Sensors used: Three ultrasonic sensors for wall following, a line sensor for detecting the edge of the table, an IMU for tracking the location of the robot and accurate turning using PID, two quadrature encoders for precise wheel rotations, and a flame sensor.
- Learned to use an Arduino Mega that is coded in C using the Arduino IDE and GitHub.





Autonomous Mobile Robot: Payload Manipulation

Key Take-Aways

- **RBE 2001 Challenge:** Create a robot to autonomously line follow in order to precisely pick up a small rod in a vertical storage container and place it in a horizontal storage container. The robot must also communicate with a smartphone via Bluetooth to tell the robot which storage containers were occupied.
- Demonstrated my design skills using SolidWorks while also testing the alignment of the robotic gripper without the need to manufacture each piece which saved time and money.
- Sensors used: An array of line sensors for line following navigation, bump switches for wall sensing, and a potentiometer for measuring four-bar crank angle.
- YouTube Video of Robot
  - https://www.youtube.com/watch?v=At7_rs0EWPs