

PORTFOLIO

NEMISHTEJASWI



About



ahoy!

I am Neemish, a masters student studying mechanical engineering at Stanford. I am interested in being at the intersection of design and manufacturing. Passionate about utilizing technology to positively impact people's lives as I strive to create meaningful experiences. This portfolio is a collection of my personal projects.

My expertise lies in product engineering, with a strong background in mechanical and thermal systems design, manufacturing, computational simulations, and materials. I have extensive experience in design and manufacturing, and excel at hands-on building, testing, and troubleshooting hardware. Throughout my career, I have worked with a range of teams, including tightly knit research teams, multi-disciplinary research and project teams, large teams with over 20 members, and global design teams spanning multiple time zones.

Happiest in a fast paced, collaborative, and driven environment tackling complex problems.

Want to chat? Connect with me through
LinkedIn or email:

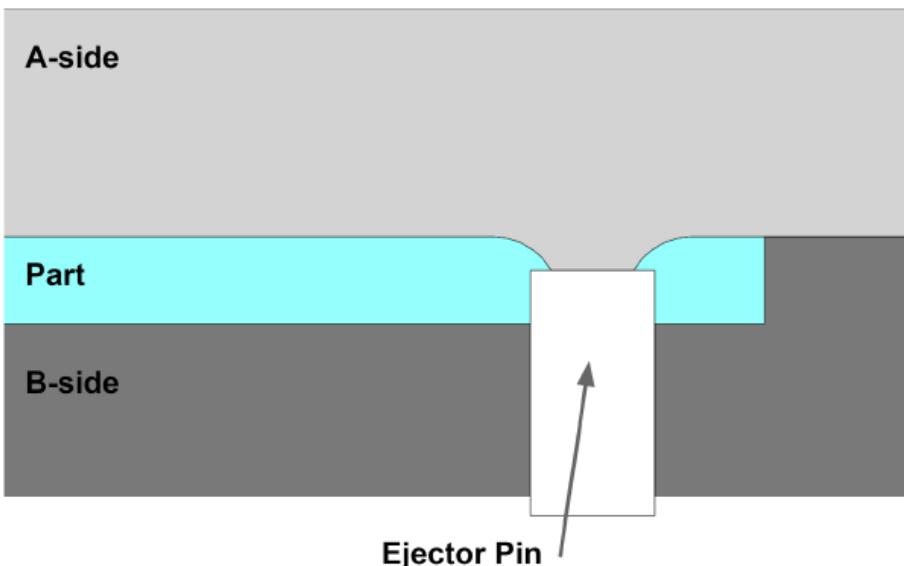
LinkedIn: linkedin.com/in/neemish
Email: neemish@stanford.edu

BREAKFAST OF CHAMPIONS

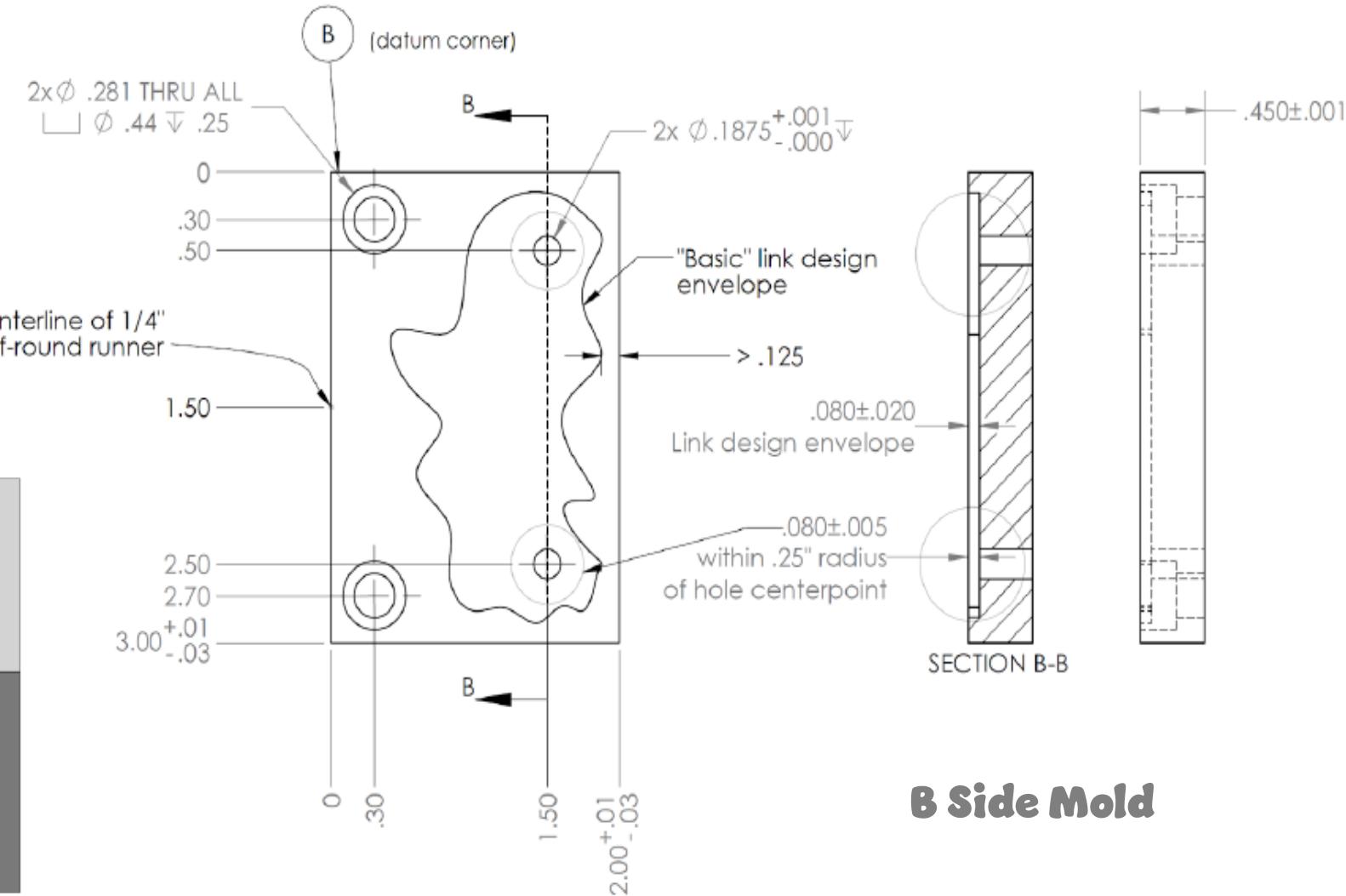
OVERVIEW

The goal of this project was to build up my familiarity and get more comfortable with injection molding by making some polypropylene parts.

I was tasked to design a part that would fit inside the envelope described on the right.



PROCESS: Injection Molding, CNC Machining, Vinyl Cutting
MATERIALS: Polypropylene, Aluminum, Sticker Vinyl



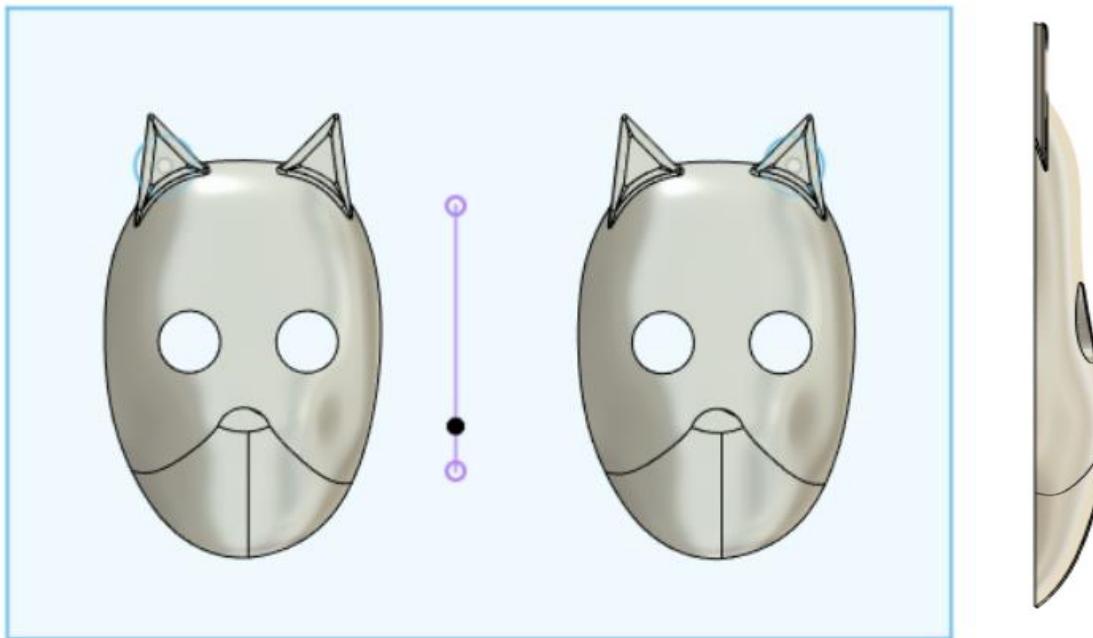
B Side Mold

For this project, I created my B side mold that would mate with a standard A side mold(not designed by me) in the machine.

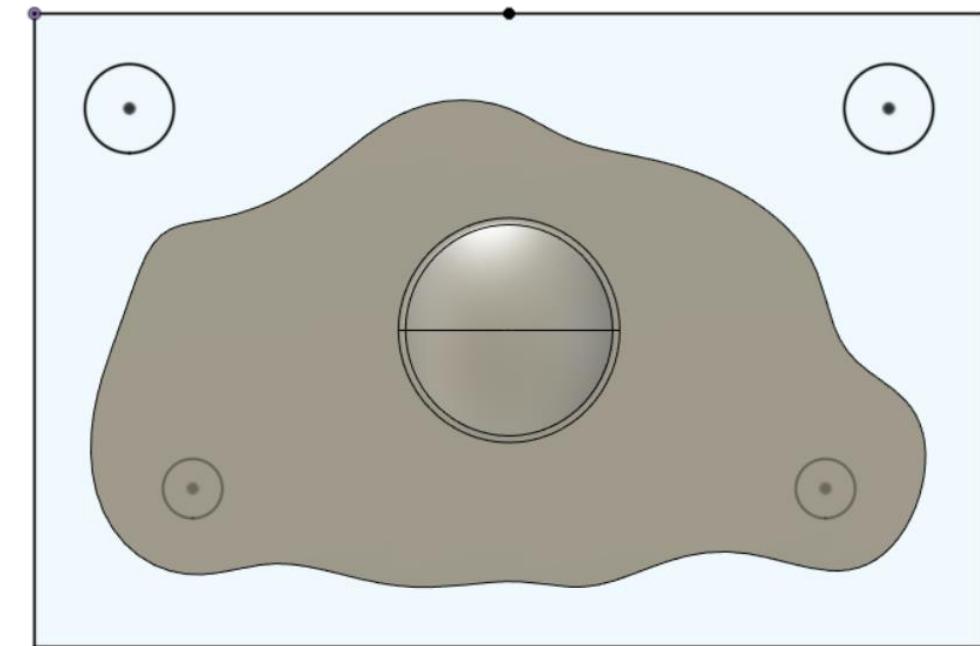
DESIGN IDEATION

BREAKFAST OF CHAMPIONS

After some quick napkin sketches, I quickly converged towards a cat and a fried egg. I decided to CAD both designs to see how the end results might look like given that my sketches were both low resolution and fidelity.



I generally struggled with contextualizing my cat face in the mini-mold as the aspect ratio of the mold and part envelope did not make a lot of sense. I tried playing around with having two faces in a mini-mold with ejector-pin-holes through the ears, but the vision never really came together.



My next design was fired egg, one of my favorite breakfast food (at least when I have the time to eat it). I felt the design was more suitable for the project given the 2D-ish nature of a fired egg. I also felt it had the right amount of surface modeling involved for the scope of this project as opposed to my cat face. I decided to prototype it next.

PROTOTYPING

For prototyping, I chose 3D printing as my main tool. It allowed me to quickly make a realistic looking prototype of my to be injection molded part.

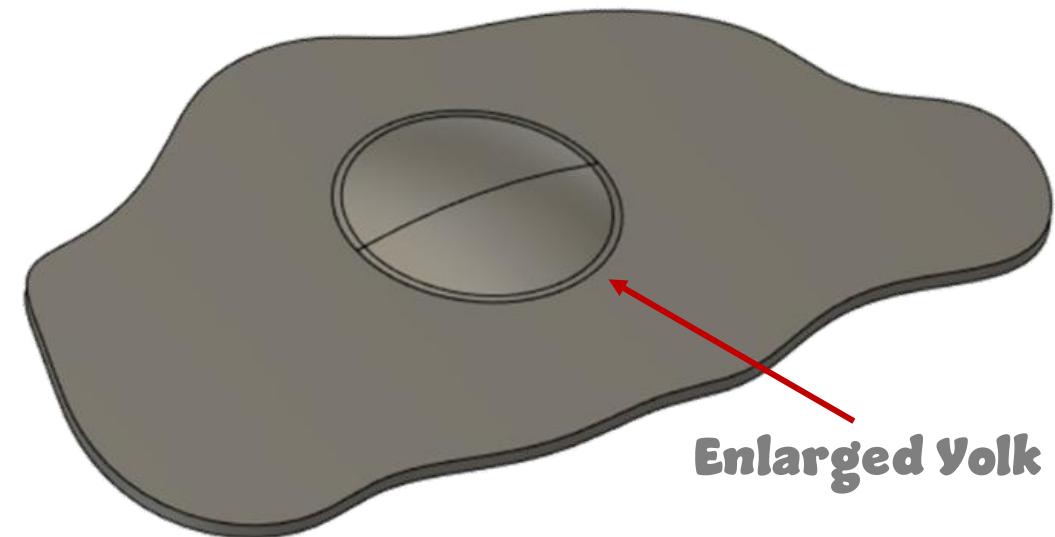


3D Printed Egg

I felt the cost to results trade off for 3D printing really made it worth for my part. My print took about 15 mins, had high fidelity and low resolution. This exercise allowed me visualize my part and I could identify potential design changes.

BREAKFAST OF CHAMPIONS

Based on my printed part, I decided that I needed to make my egg yolk bigger. While modeling it in CAD I felt that it was adequate, the use of guided lofts to make it the perfect shape made the yolk appear a little bit smaller than desired.



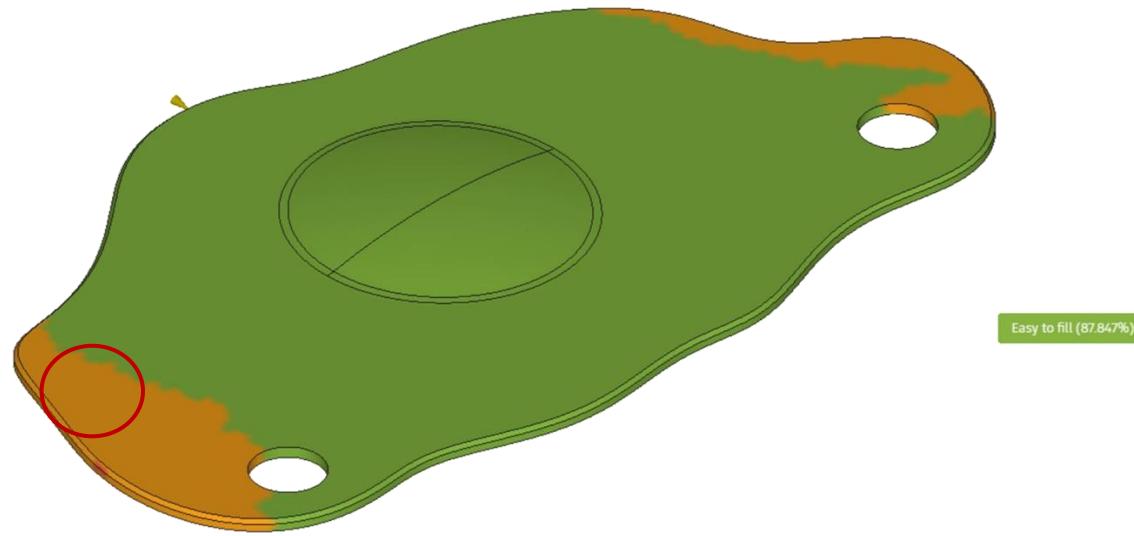
Once I was satisfied with the design and form of egg, I then turned to simulations to get injection molding insights about my part. So, I set up a study in Fusion 360.

SIMULATION

BREAKFAST OF CHAMPIONS

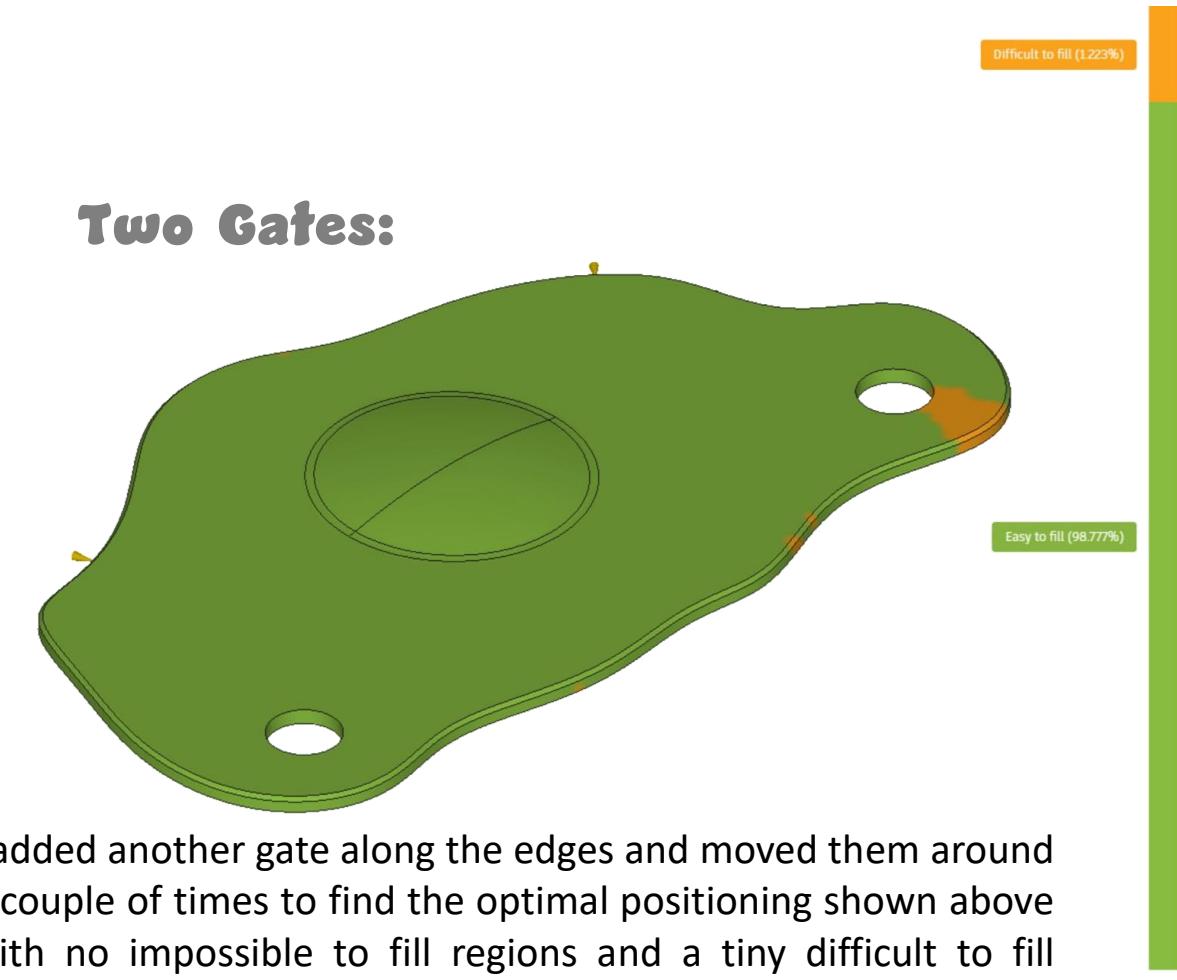
Typically, an injection molding study is comprehensive with lot different considerations involved in it. However, for this simple mini-mold project my main considerations were part gating, visualizing the fill and identifying defects like knit lines

Single Gate:



I started out by placing a single gate right down the middle. However, my simulations predicted a tiny impossible to fill region along with a large difficult to fill region.

Two Gates:



I added another gate along the edges and moved them around a couple of times to find the optimal positioning shown above with no impossible to fill regions and a tiny difficult to fill region.

SIMULATION

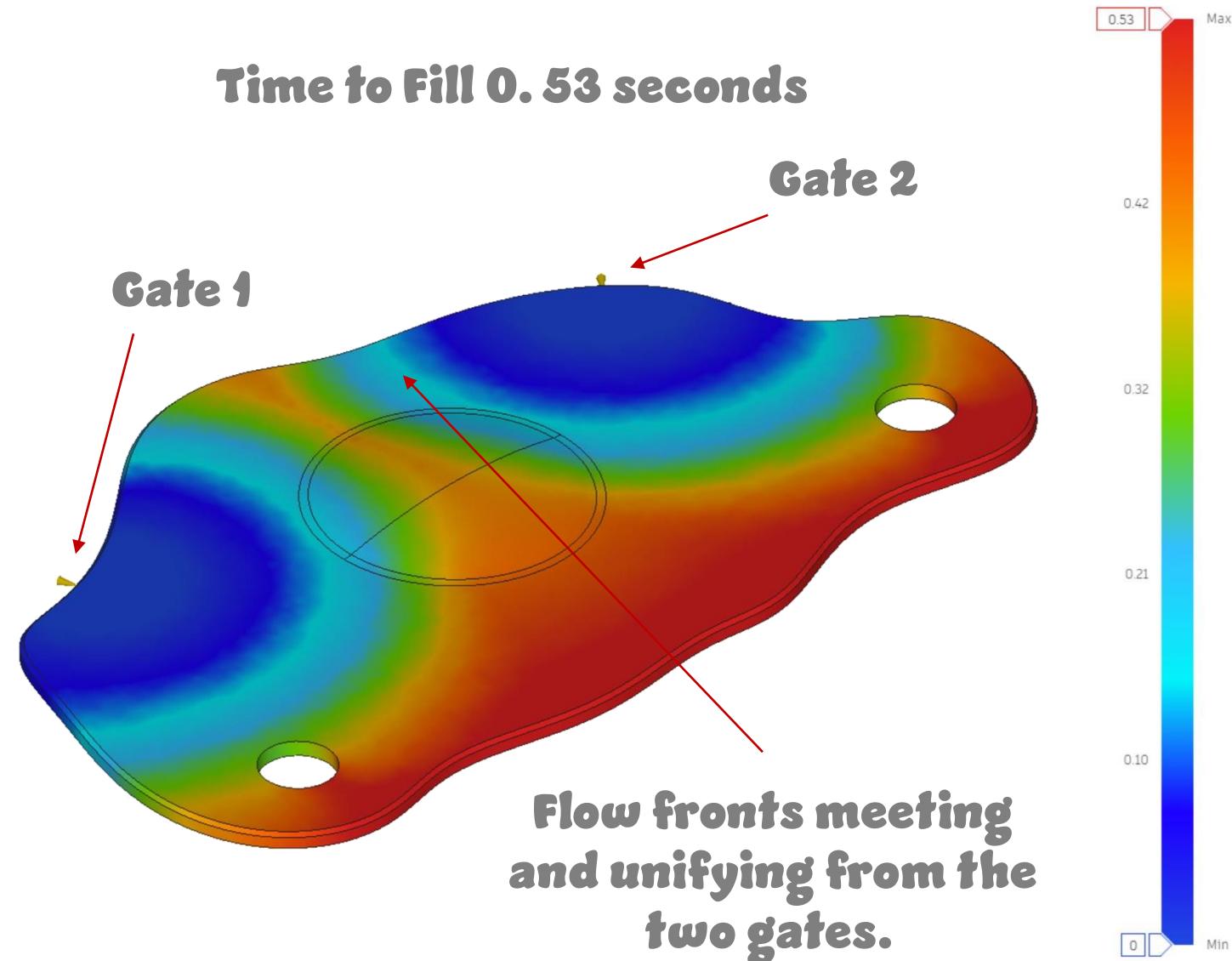
BREAKFAST OF CHAMPIONS

I looked at the fill animation generated by Fusion 360 study to visualize my mold filling.

This helped me set some expectations of what to expect once I would have machined my mold and done some short shots at the Arburg machine.

Lastly, I looked at possible defects that might arise in my part. Given, that I was using two gates to fill my mold I was naturally concerned about a big weld line in the middle where the flow front from the two gates would meet. I also expected small knit lines near the hole in my part due to local flow front separation.

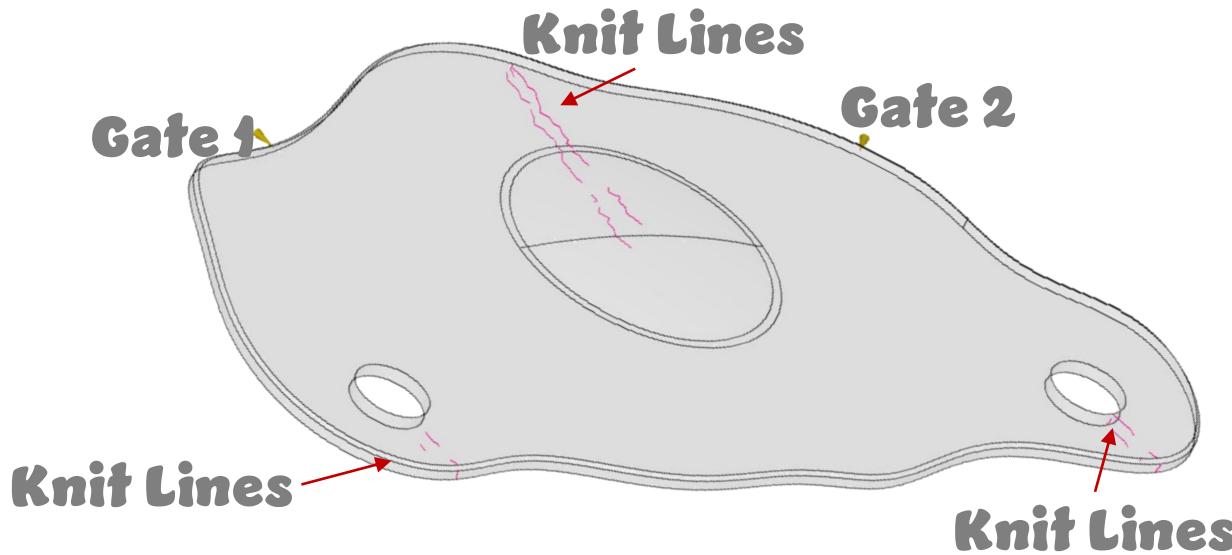
I looked at defect predictions made by Fusion next.



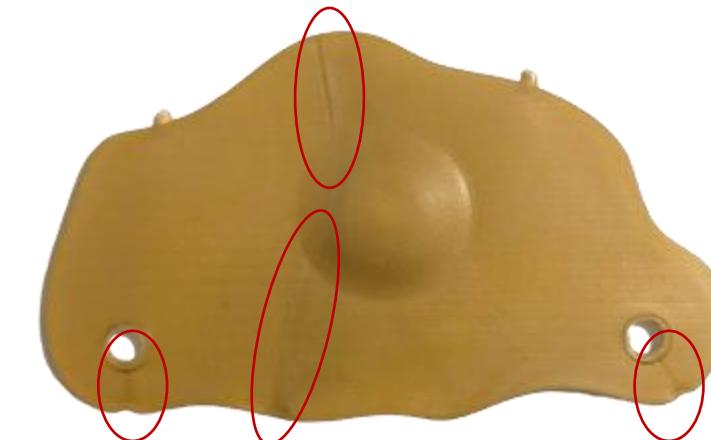
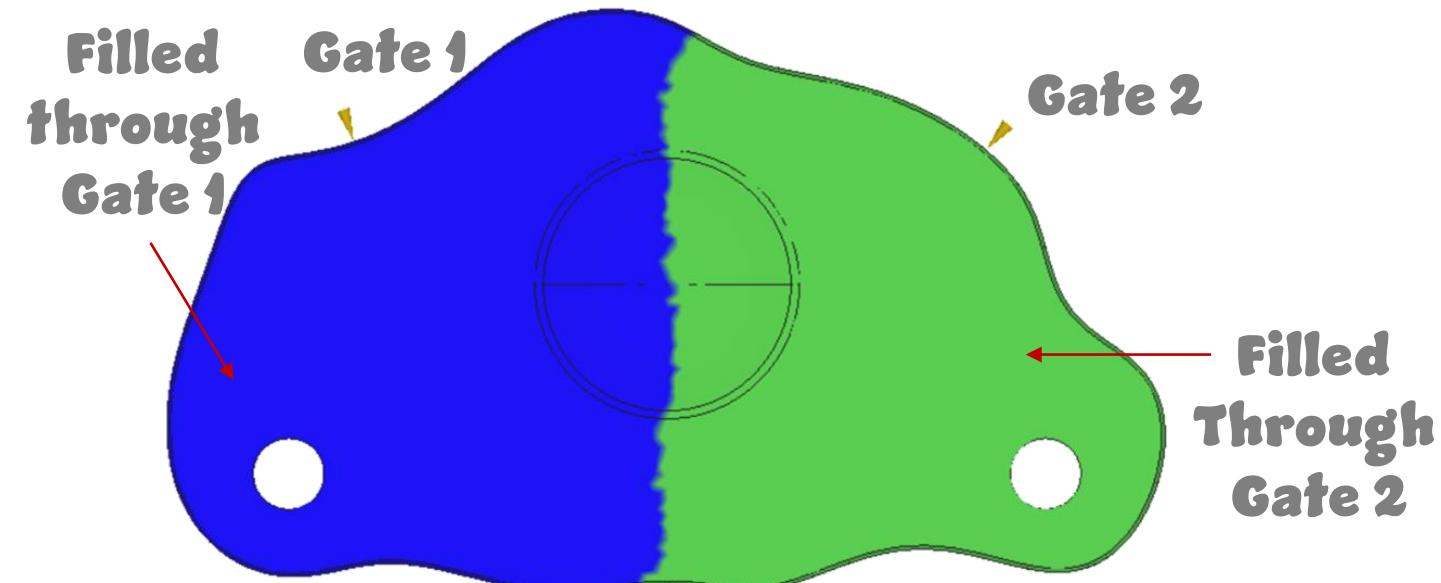
SIMULATION

As expected, Fusion predicted a large knit line where the two flow fronts met and small knit lines around features like holes.

In addition to the flow fronts meeting these knit lines were a function of the part thickness and resulting cooling of material as the mold fills. The part most of my fried egg was about 0.050" thick which played into it.



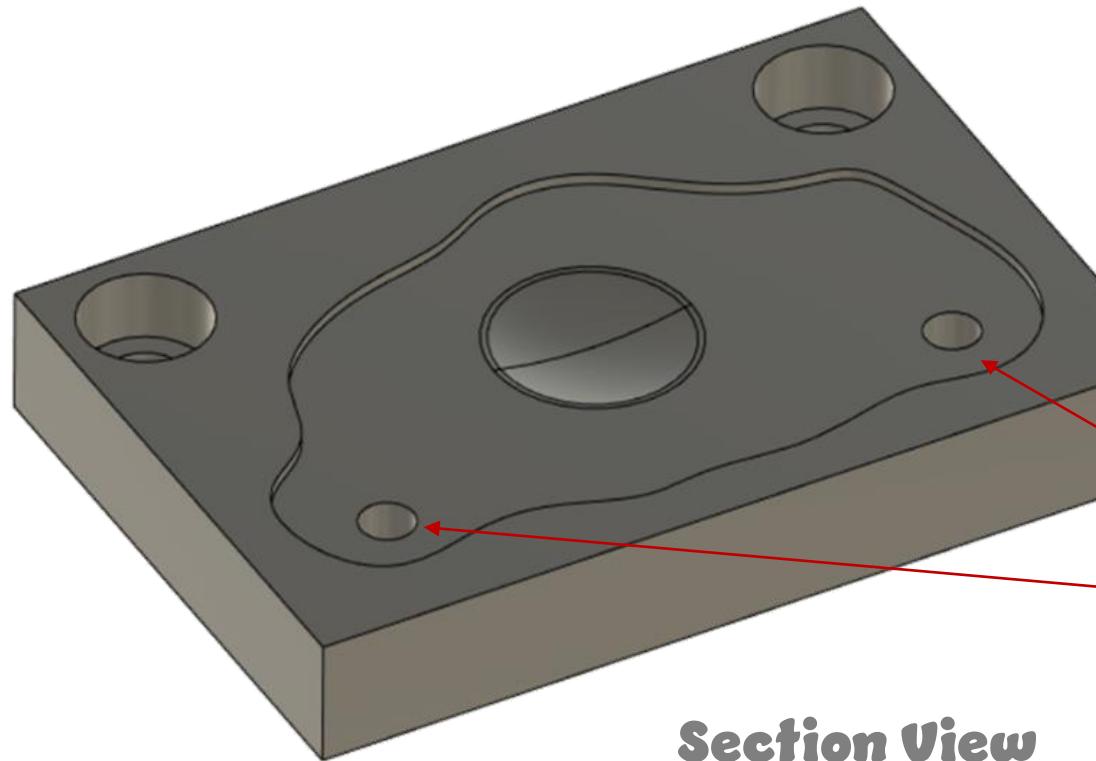
BREAKFAST OF CHAMPIONS



Knit lines tend to show up more in metallic colors. Luckily, for me my ideal part was white, and I did not have to worry about this too much.

MOLD DESIGN

BREAKFAST OF CHAMPIONS

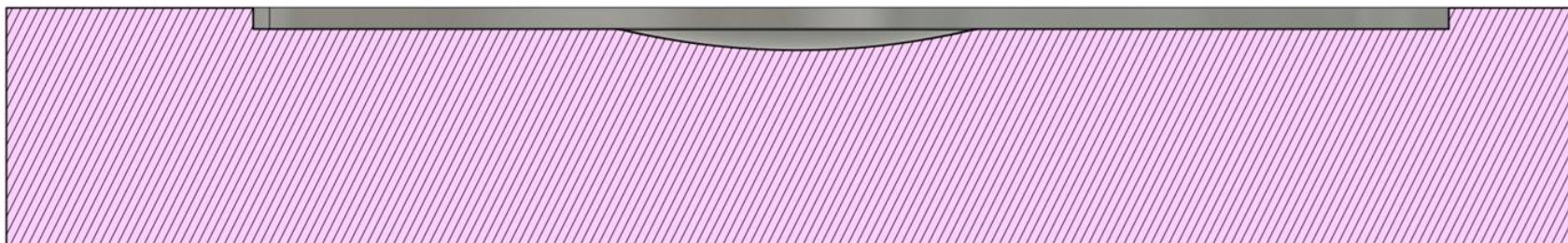


Section View

With all these considerations I went on to create a CAD model of my mold which would be made from square aluminum stock.

The mold apart from being a negative of my part had two counter bores for $\frac{1}{4}$ - 20 TPI socket head screws and holes for ejector pins that together with A side would form the hole in my part.

**Through holes where
ejectors pins would sit flush
with the mold.**



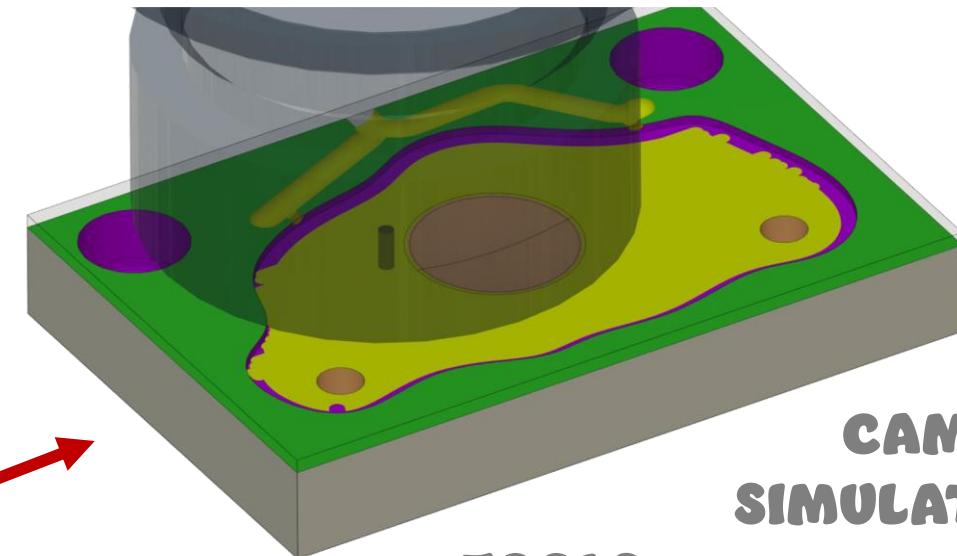
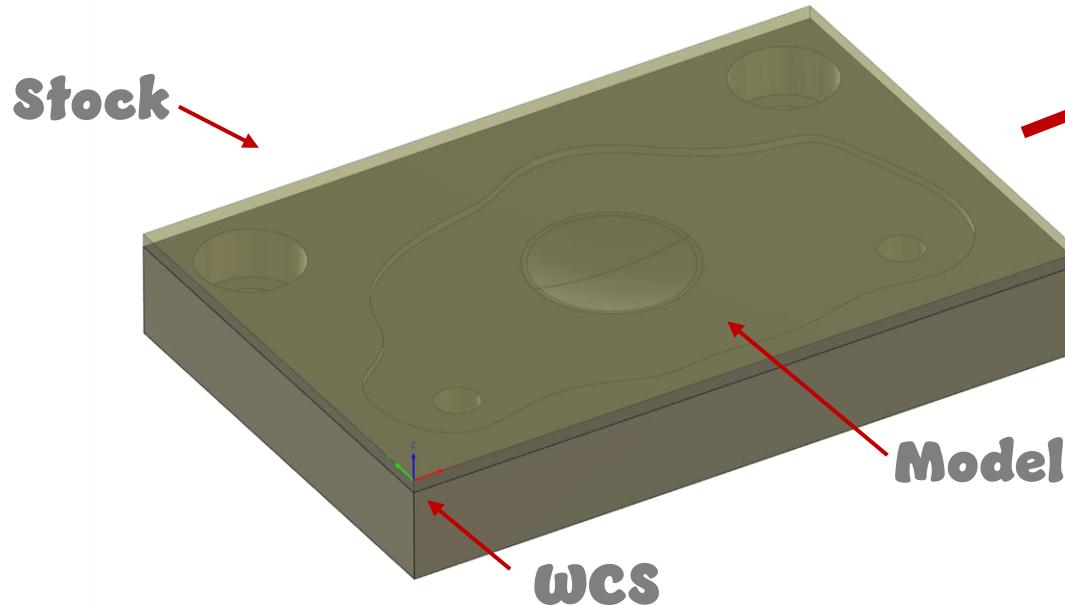
For this project, I was designing only the B-side of the mold that would mate with a standard already in-place A side mold.

MOLD MACHINING

BREAKFAST OF CHAMPIONS

With my design locked the next step was make the mold. The mold was machined from aluminum stock on a Hass VF2 CNC.

The work setup was standard and straightforward as the stock was already squared and all the machining was going to happen on the inside. I set up my operations in Fusion 360 to generate tool paths and G code.



CAM
SIMULATION

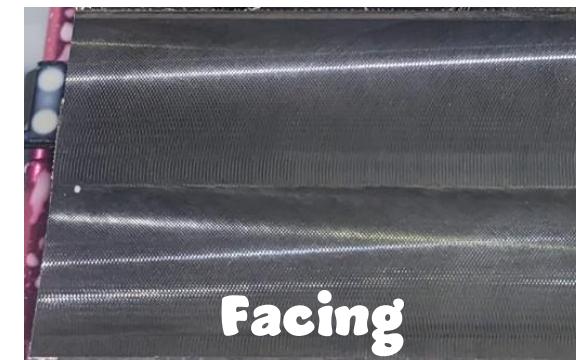
TOOLS

1. **2" FACE MILL**
2. **#2 SPOT DRILL**
3. **3/16 TWIST DRILL**
4. **1/8 BALL END MILL**
5. **1/16 BALL END MILL**
6. **1/4 FLAT END MILL**
7. **1/16 FLAT END MILL**

CNC MACHINING

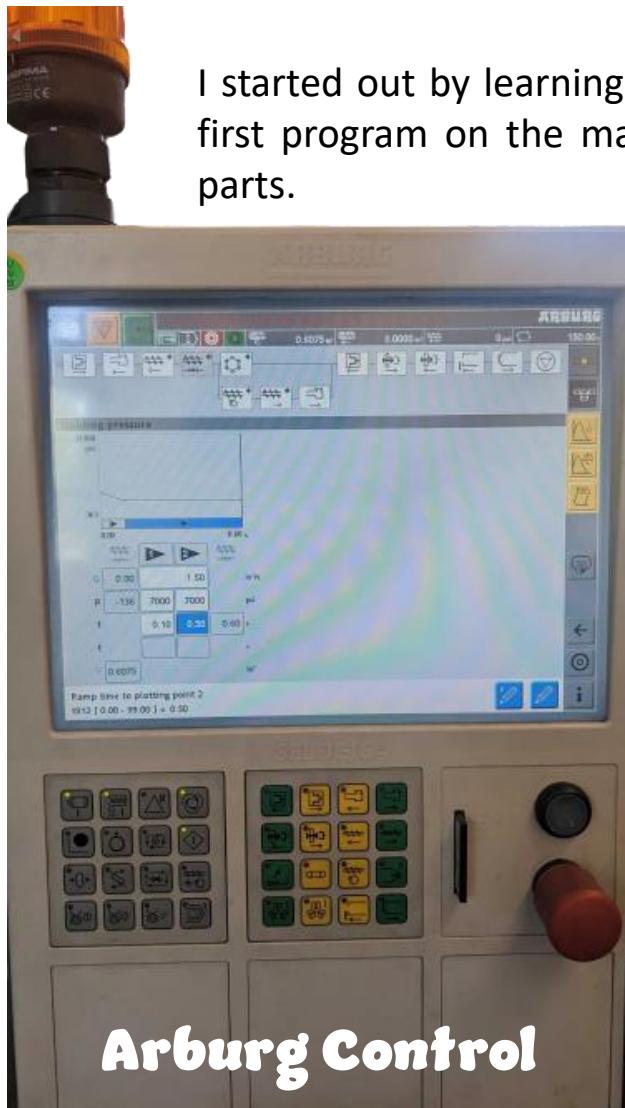
1 Hour 5mins
11 Operations

BREAKFAST OF CHAMPIONS



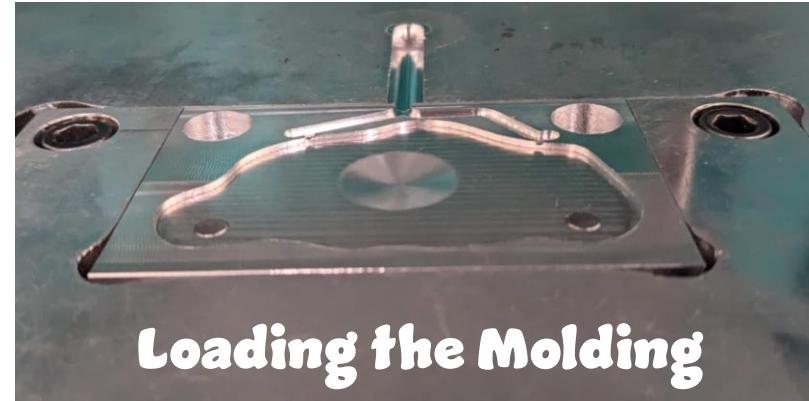
INJECTION MOLDING

BREAKFAST OF CHAMPIONS



Arburg Control

I started out by learning how to navigate the Arburg control and how to create my first program on the machine followed by process tuning to churn out successful parts.



Loading the Molding

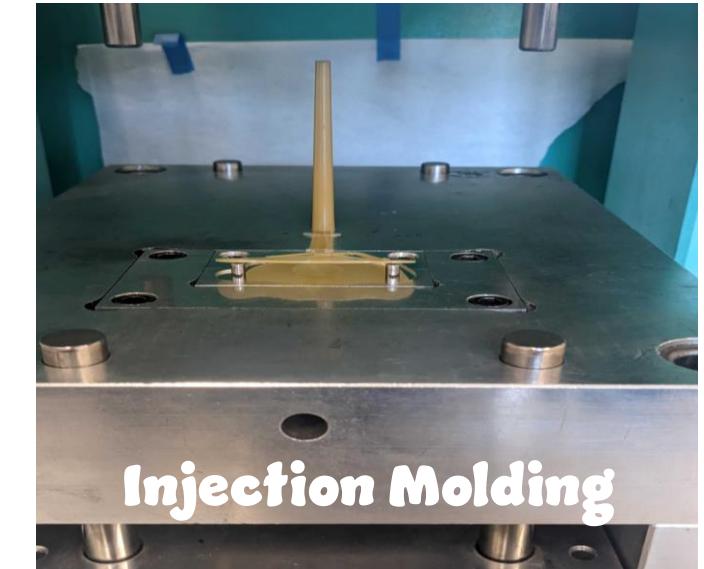
Process Tuning Flow:

Started with an estimated volume and recommended parameters for PP

Increased Volume till the mold would fill.

Fine tuned volume for both stages till the part came out without any flash.

Created a two stage switch over & played w/ injection rates.



Injection Molding

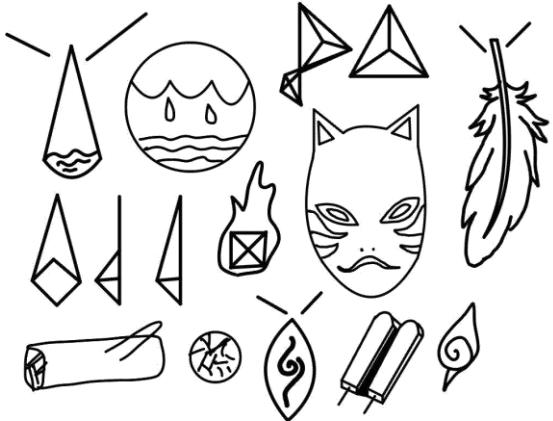


RESULTS

SILVER SMITHING

PROCESS: Investment Casting, Wax Printing, Finishing

MATERIALS: Sterling Silver, Castable Resin Wax, Jewelry Plaster



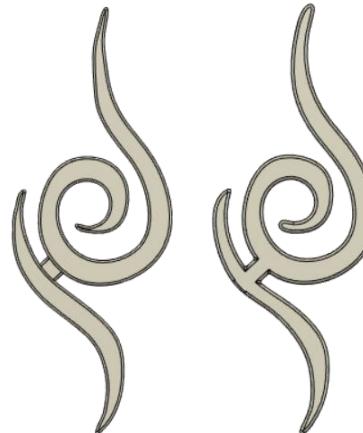
Ideation



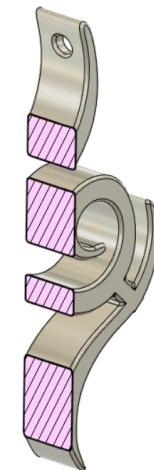
CAD



Prototyping



Design for
Manufacturing



Final Design Changes



Pattern Making



Plaster Mix in Vacuum



Investing



Vacuum Casting



Resulting Part

BIRTHDAY TAGS

PROCESS: Injection Molding, CNC Machining
MATERIALS: Polypropylene, Aluminum



CAD



CAM



Machined Insert



Molded Part



CNC Machining



Injection Molding

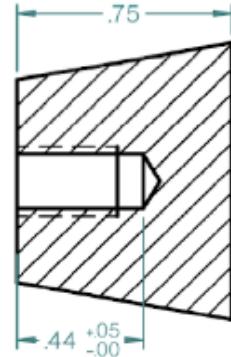


Stacked Parts

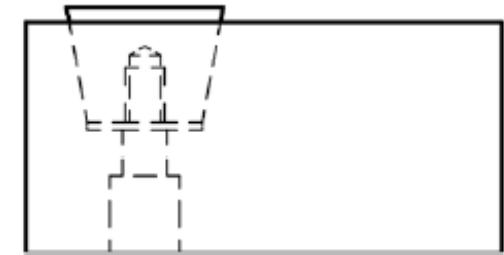
I designed and machined my own Aluminum mold inserts to create injection molded tags that I can hand out to my friends and family on their birthdays. The tags can be stacked together and carry the perfect birthday message for everyone, a statement of fact that is. I molded the tags on a single shot vertical injection molding machine out of polypropylene in different colors.

BIRTHDAY TAGS

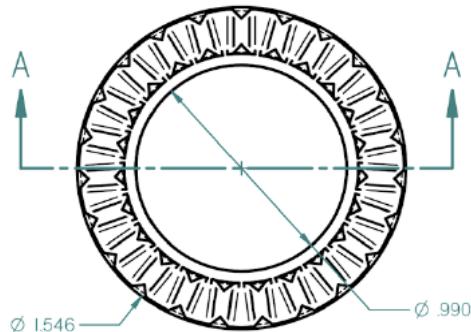
PROCESS: Injection Molding, CNC Machining
MATERIALS: Polypropylene, Aluminum



Tapered Insert
on Lathe



CNC Machining
Mold Features



Injection Molding
Tags



Short Shot
Parts



When tolerances
do not stack up as
expected !



Final Part



Making Multiples

BAJA SAE

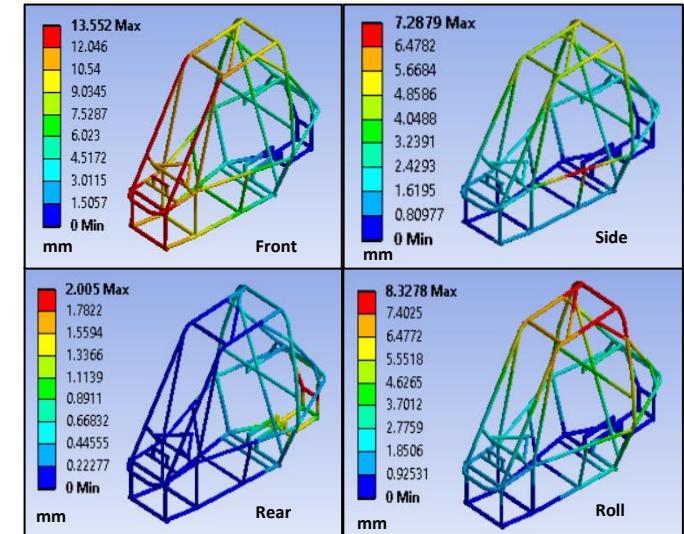
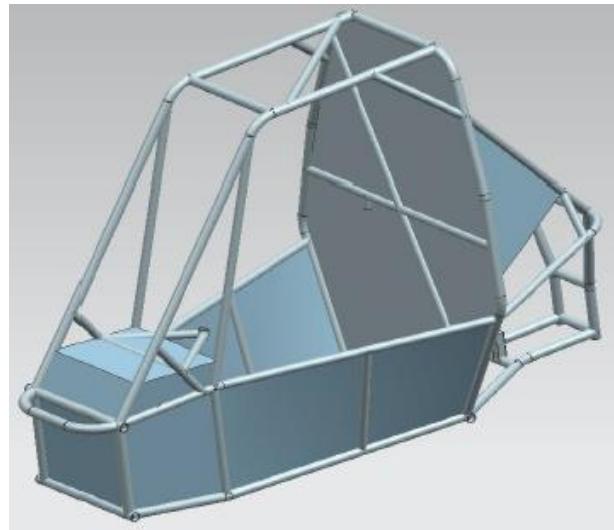
I designed, built and raced off-road race vehicles for over two years to take part in Baja SAE, an inter collegiate design series competition.



During my time with the team, I worked on finite element analysis, CAD modelling, ideating and evaluating new designs, generating concepts for DfM, data acquisition in addition to being a chassis welder for the team.

BAJA SAE

As the lead frame designer, I owned all aspects related to structural performance, material selection, tubing & sizing. I carried out static and modal analysis of the frame and explored analysis techniques like Explicit dynamics for structural design.



CAE Team
Structural
Performance

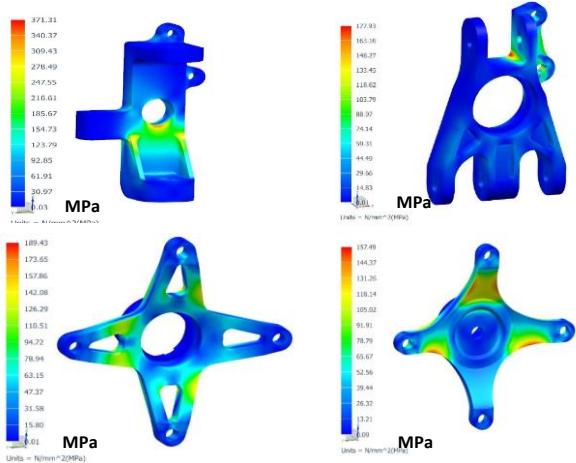
- Positioning of key bracing members
- Design trade offs between Performance, Clearances, and Mounting decisions
- Sizing for Primary and Secondary Tubing
- Incorporate Mountings into Structural Members

**Design Integration
Team**
Subsystem Mounting

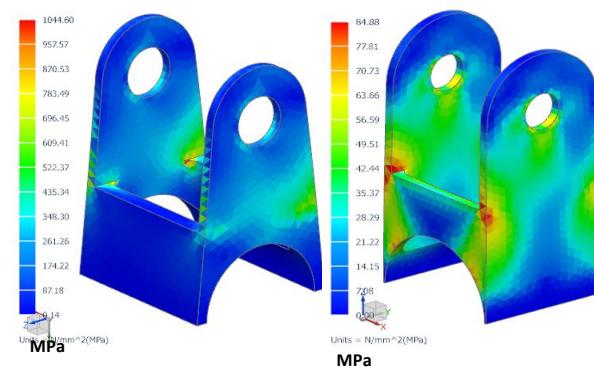
Material	AISI 4130
Tube OD	29.2mm / 25.4mm
Tube Thickness	1.65mm / 1mm
Primary Flexure	2787.6 Nm ²

BAJA SAE

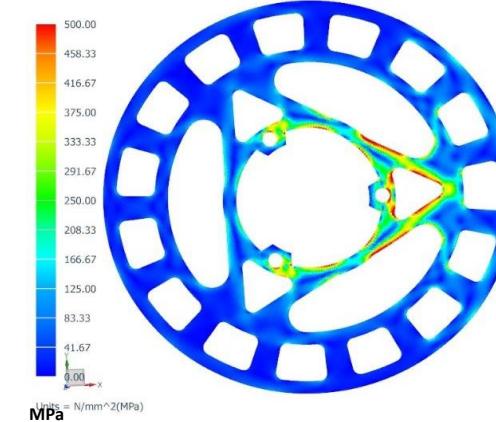
I carried out structural analysis for different wheel assembly components, developed design concepts, assisted in full vehicle assembly and worked on introducing a data acquisition initiative which was our first foray as a team to gain insights via sensors.



Upright and Hubs



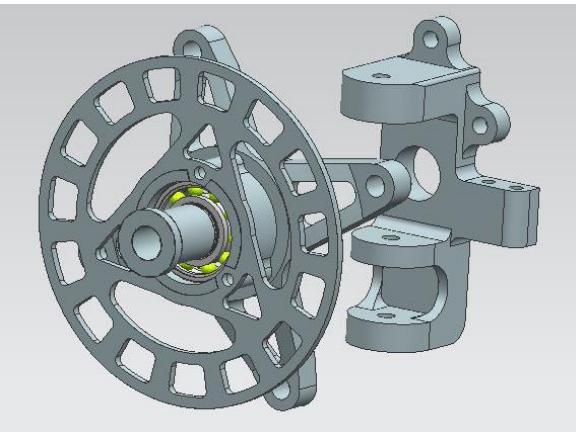
Control Arm and Suspension Mounts



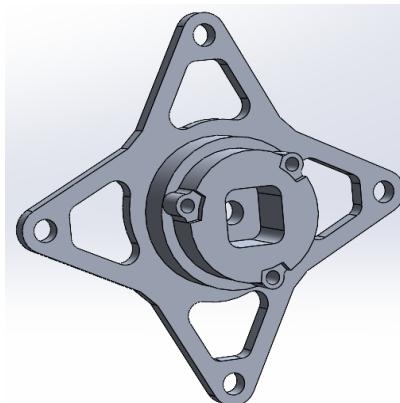
Brake Rotor



Front Upright Joint



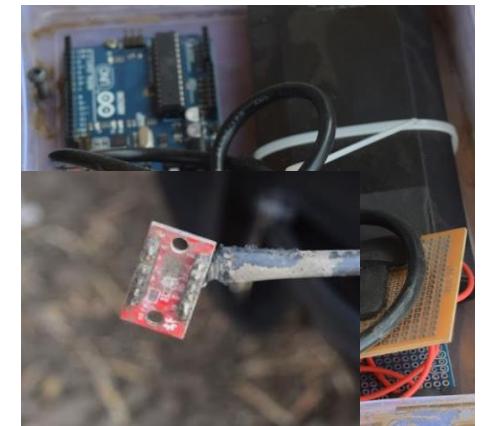
Front Wheel Assembly



DFM Concept



Testing



Data Acquisition

BAJA SAE

During the manufacturing phase of the vehicle, I was a chassis welder for the team where I utilized TIG with ER 70S2 as the filler material to weld AISI 4130 chromoly with a 2% Thorium Tungsten electrode under DCEN configuration.

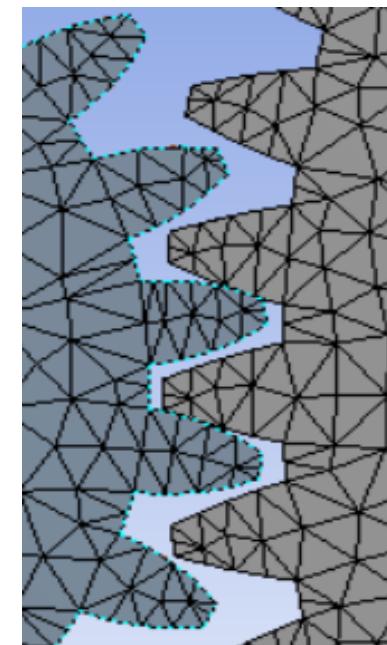
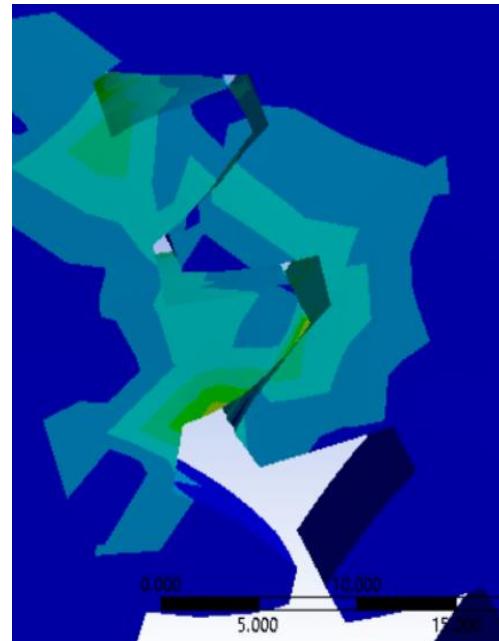


Apart from being a chassis welder for the team, I worked on finishing the chassis and control arms via air gun spraying. I took lead on installing bearings and wheel sub assemblies, I made fixtures for welding and notched tubes to prep for welding.

BAJA SAE

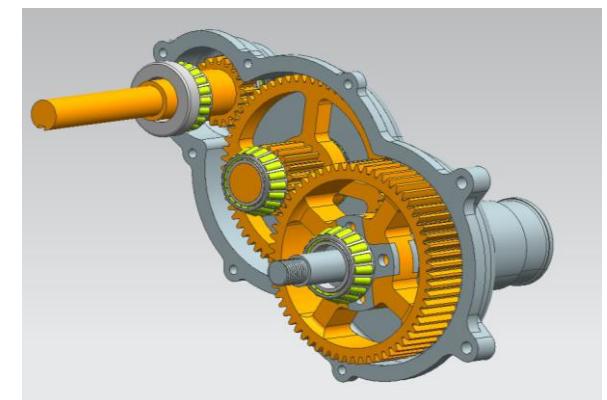
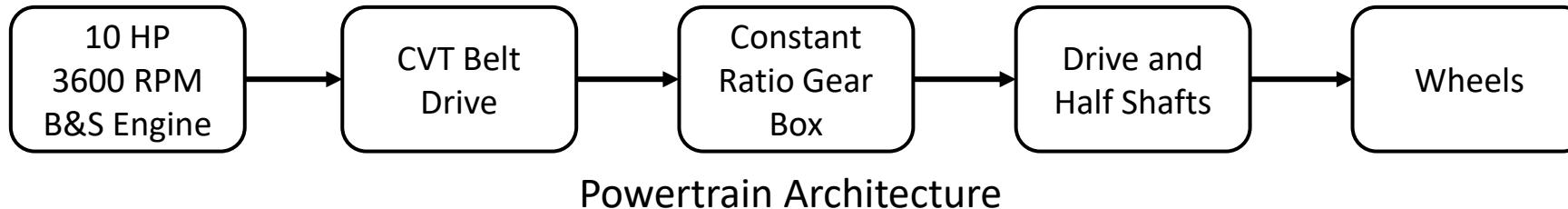
I carried out the kinematic design for a two-stage constant transmission ratio compound gearbox with an overall targeted reduction of 9.35.

Overall Ratio	9.35
kW	7.5
Stages	2
Reduction per Stage	3.058
Input RPM	8372
Output RPM	881
Zg	74
Zp	24



I also performed FEA (static and dynamic) on the gears, shaft and carried out hand calculations for verification.

For gear, the hand calculations were carried out based on the Lewis bending strength of the gear teeth.



BAJA SAE

Leadership, Collaborative Culture, and Inclusion are important to me as person, and I strived to create a good working environment for my team and lead by example whenever possible.



People Led in CAE Team



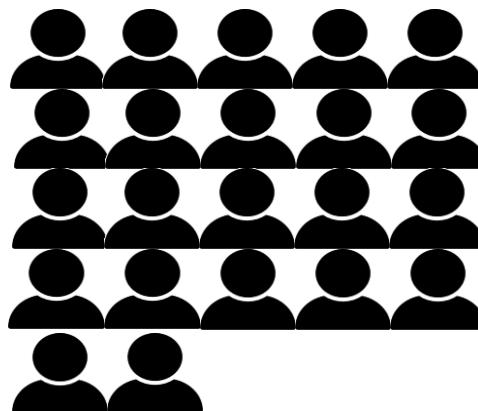
Managed people in Welding Group



Cross-functional Collaborators



People Led in DAQ Team



2019 TEAM



Main Collaborators

Established a data acquisition team, which went on to become a standalone sub team in the future.

Gave an overview of what we do and how we design, workspace tour to all new team members; familiarize them with the vehicle and different subsystems.

Spearheaded the efforts to organize an intro-meet with a goal to attract diverse people. Over 100 people expressed intent to join the team in the next year.

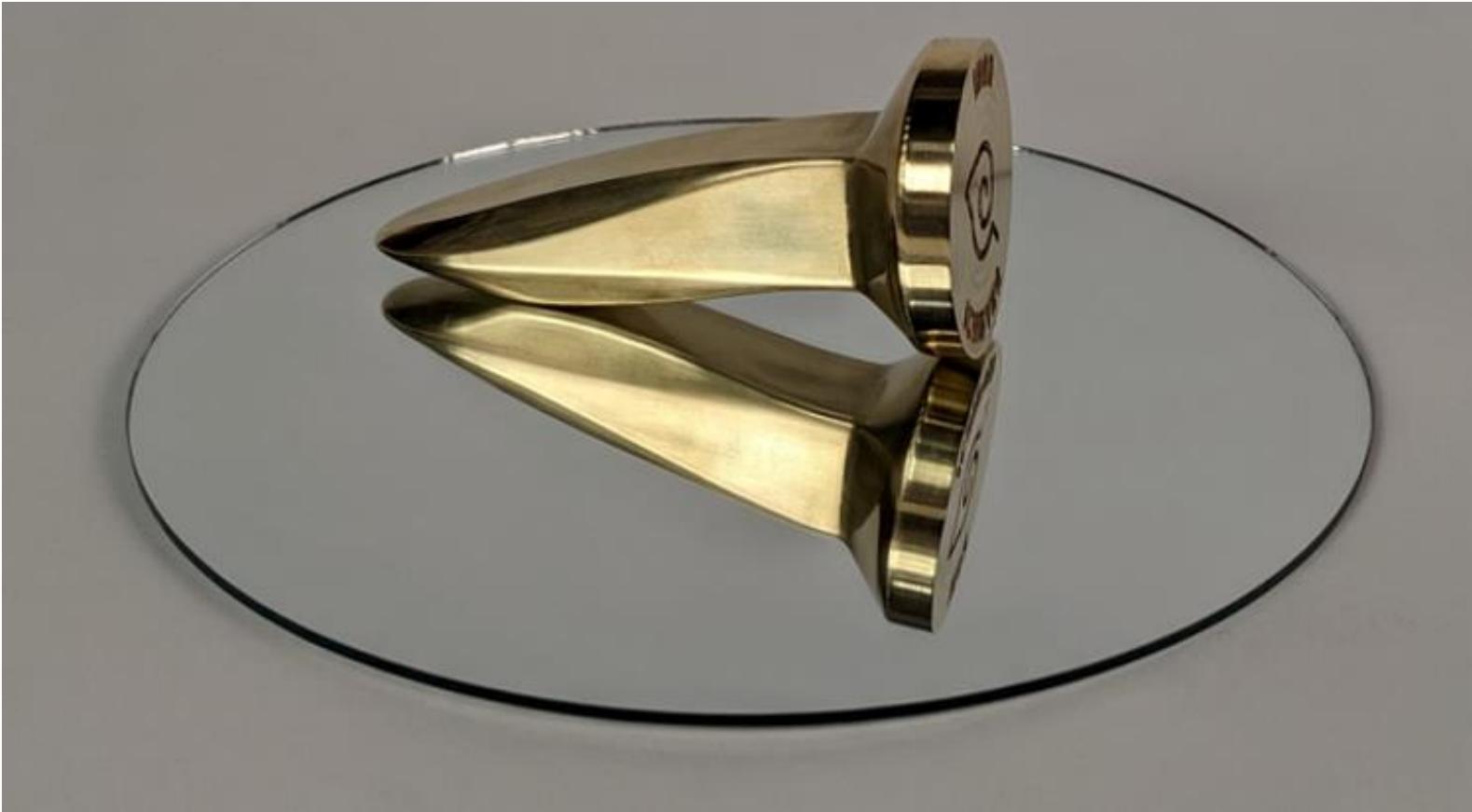


Convinced few teammates to come together and teardown an old engine instead of enjoying a day off

FW31

PROCESS: CNC Machining

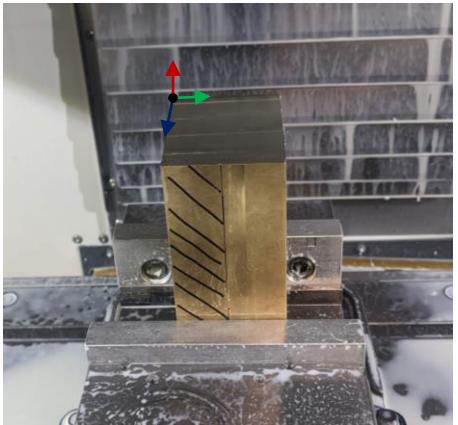
MATERIALS: C360 Free Machining Brass



Formula One Inspired Espresso Tamper



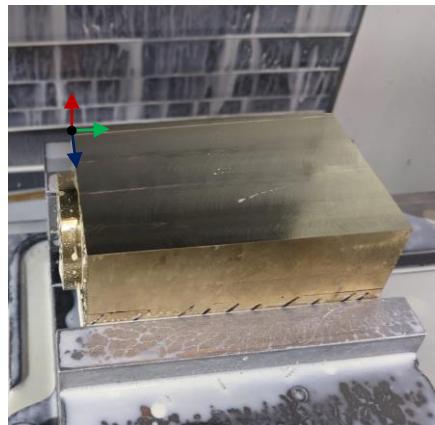
FW31



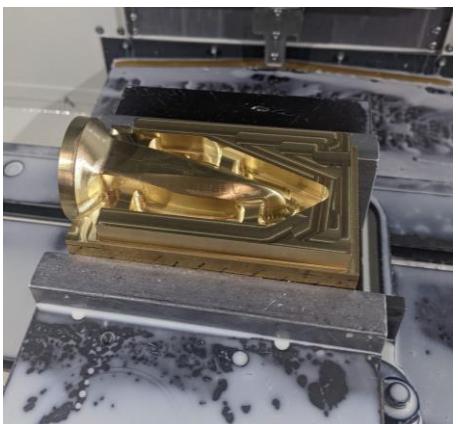
Initial Setup



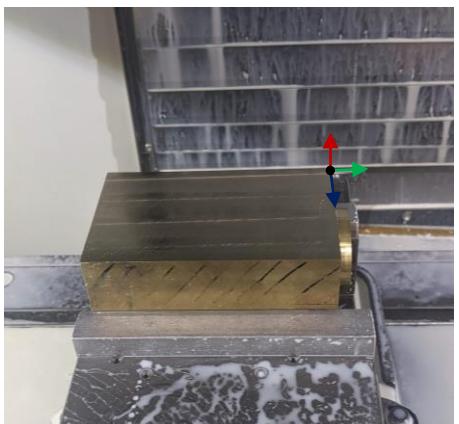
Result: First Operation



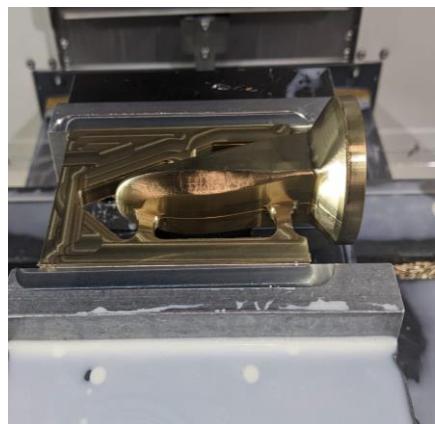
First Part Flip



Result: Second Operation



Second Part Flip



Result: Third Operation



FW31 was machined on a Haas VF2 CNC mill and then finished by hand. The part is made from free machining brass(C360) and work holding was accomplished using tabs.

The main design is inspired by the nose of the Formula One car FW31. The bottom has engravings that convey my love and passion for coffee.

HOOXI

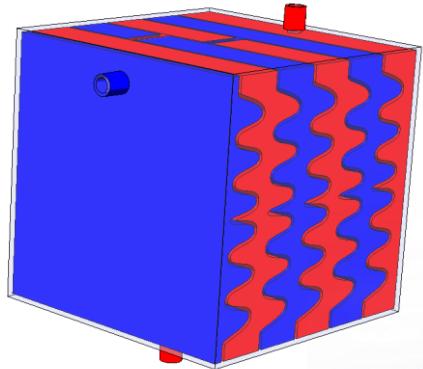
A topologically optimized bottle opener made by my team of 3 for my class ME 349.

The design was optimized using Fusion 360, the results were further verified using Ansys by creating a FEA study in addition to hand calculations. The opener was realized using SLA and tested successfully on multiple bottles and demonstrated to the whole class.

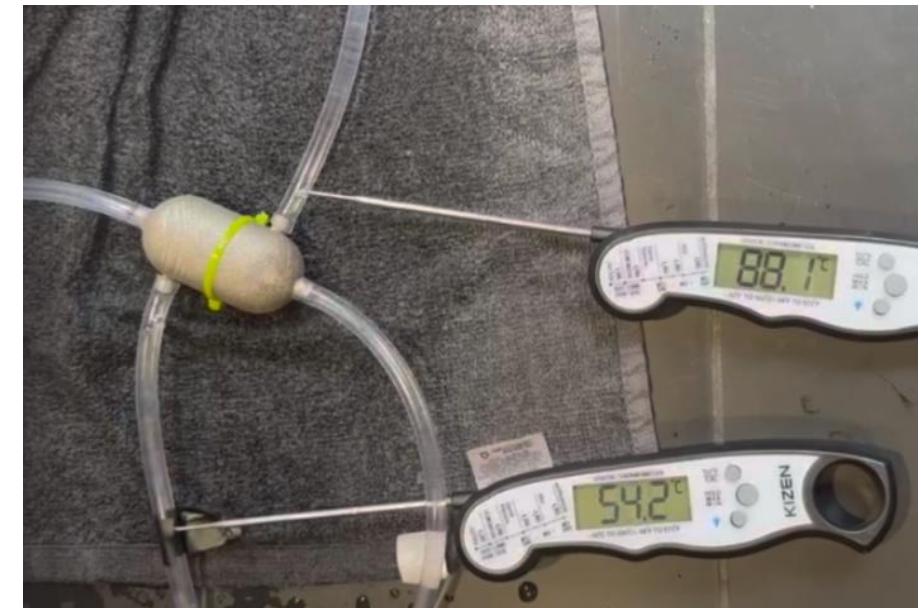
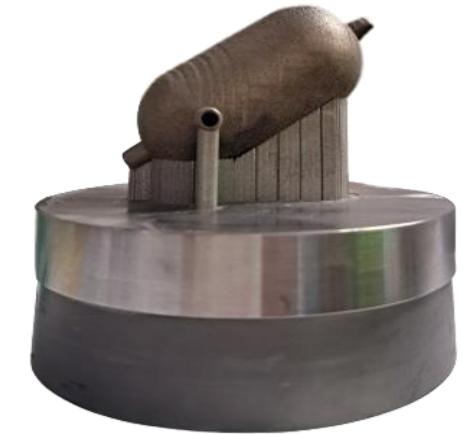
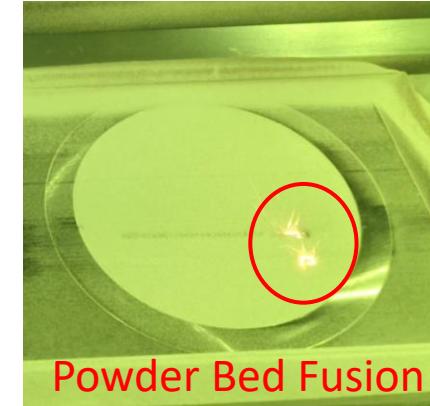
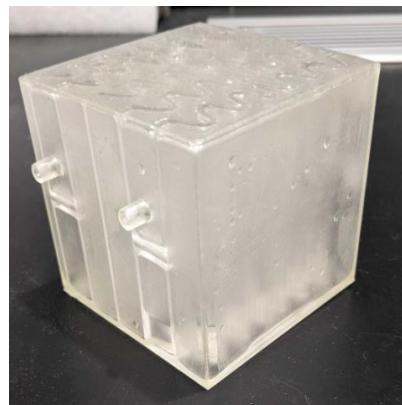
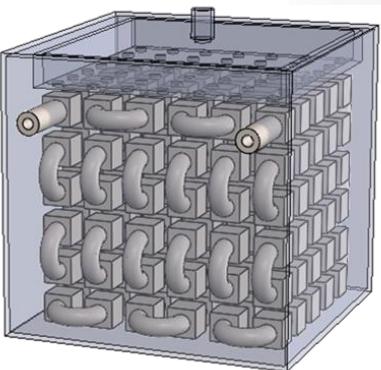
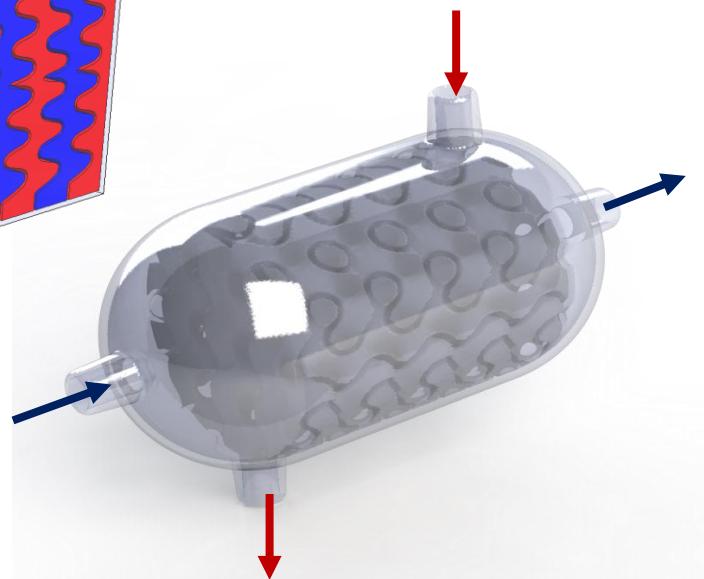
It was judged as the best opener in the class by the teaching team.



METAL ADDITIVE HEAT EXCHANGER



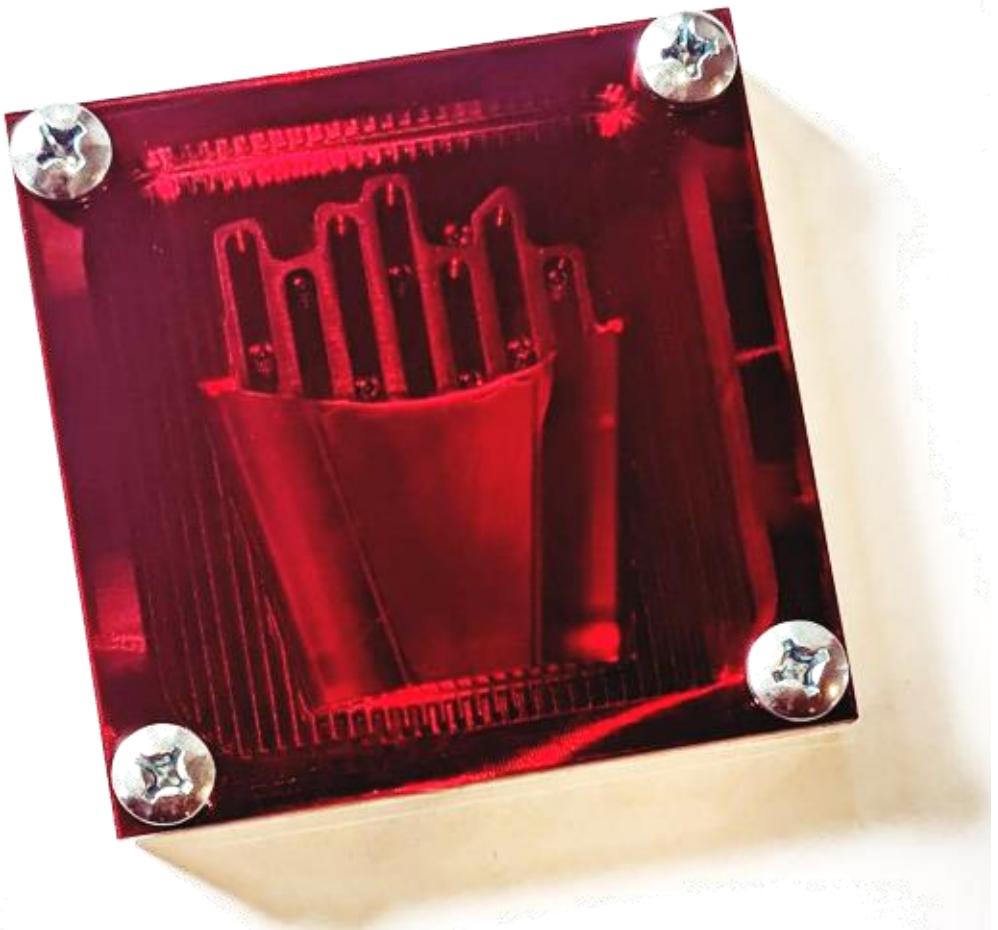
Length Scale
~60 mm



The goal was to design a compact heat exchanger that could achieve a temperature drop of 20 deg-C without leaking. Created a TPMS based gyroid lattice design which provided additional surface area along with maximizing the AM advantage.

PROCESS: LPBF (Laser Powder Bed Fusion) **MATERIAL:** SS316L

FRITES ROUGES



MATERIALS: Aluminum 6061 , Acrylic
PROCESSES: CNC Machining, Laser Cutting, 3D Printing (FFF), Assembly

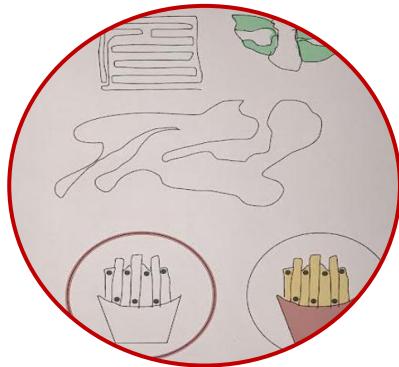
Frites Rouges is my manifestation of a surrealistic maze. The maze is a box of french fries inside with several marbles embedded throughout. This design breaks the notion of “what’s a maze” in different ways. The steel marbles inside the slots of the fries are “trapped” as there is no way to get them out and it’s not possible to get the satisfaction of completing a maze. The steel marble on the outside periphery can be moved around but there is no well-defined start or end point in the maze which again peals away the satisfaction of successfully finishing something like a maze. However, it makes for an interesting desk toy.

The design process involved leaning heavily on lateral thinking for ideation, Fusion for CAM to generate toolpaths for adaptive clearing, pocketing, tapping, scalloping, and finishing operations before machining the part on a Haas VF2. Hand sanding was done to accentuate some surfaces before assembling the maze with steel marbles what are held in place by a red acrylic lid which was laser cut from an acrylic sheet. The assembly is held together by $\frac{1}{4}$ -20 UNC screws.

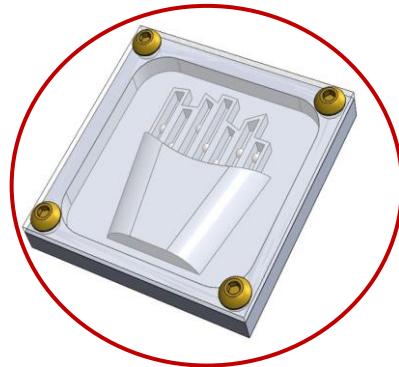
FRITES ROUGES

MATERIALS: Aluminum 6061 , Acrylic

PROCESSES: CNC Machining, Laser Cutting, 3D Printing (FFF), Assembly



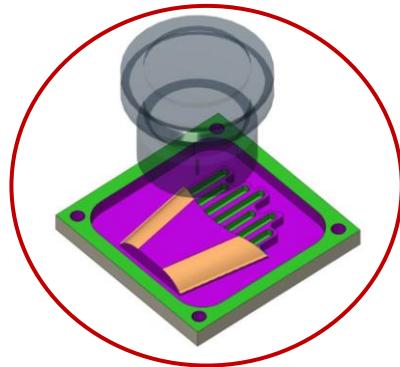
Ideation



CAD



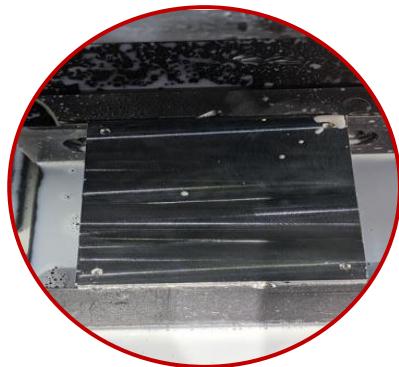
Prototyping



CAM



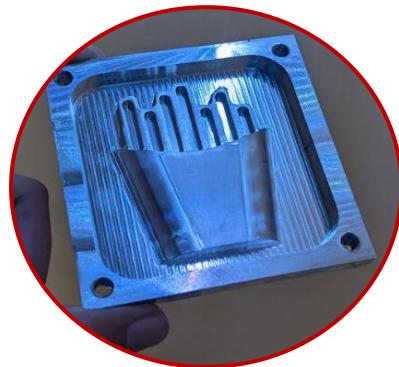
Tooling



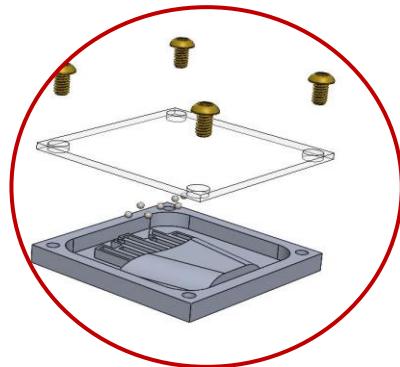
Work holding



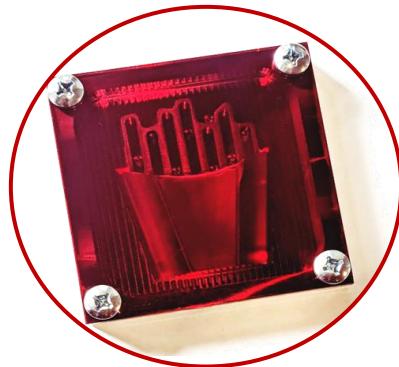
Machining



Finishing



Assembly

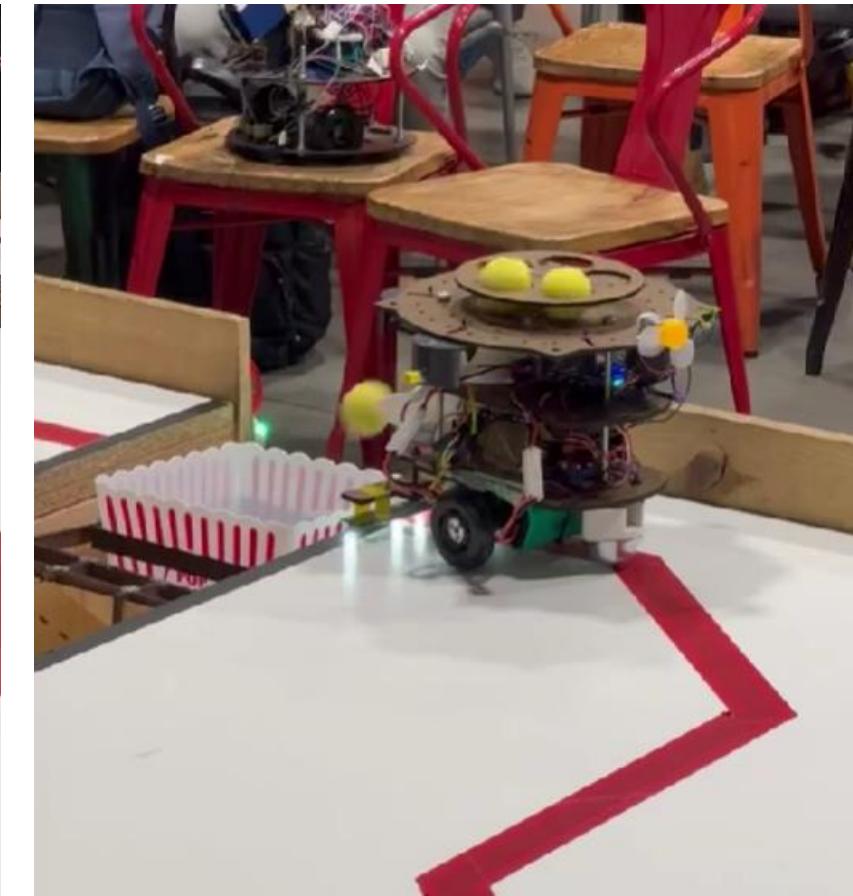
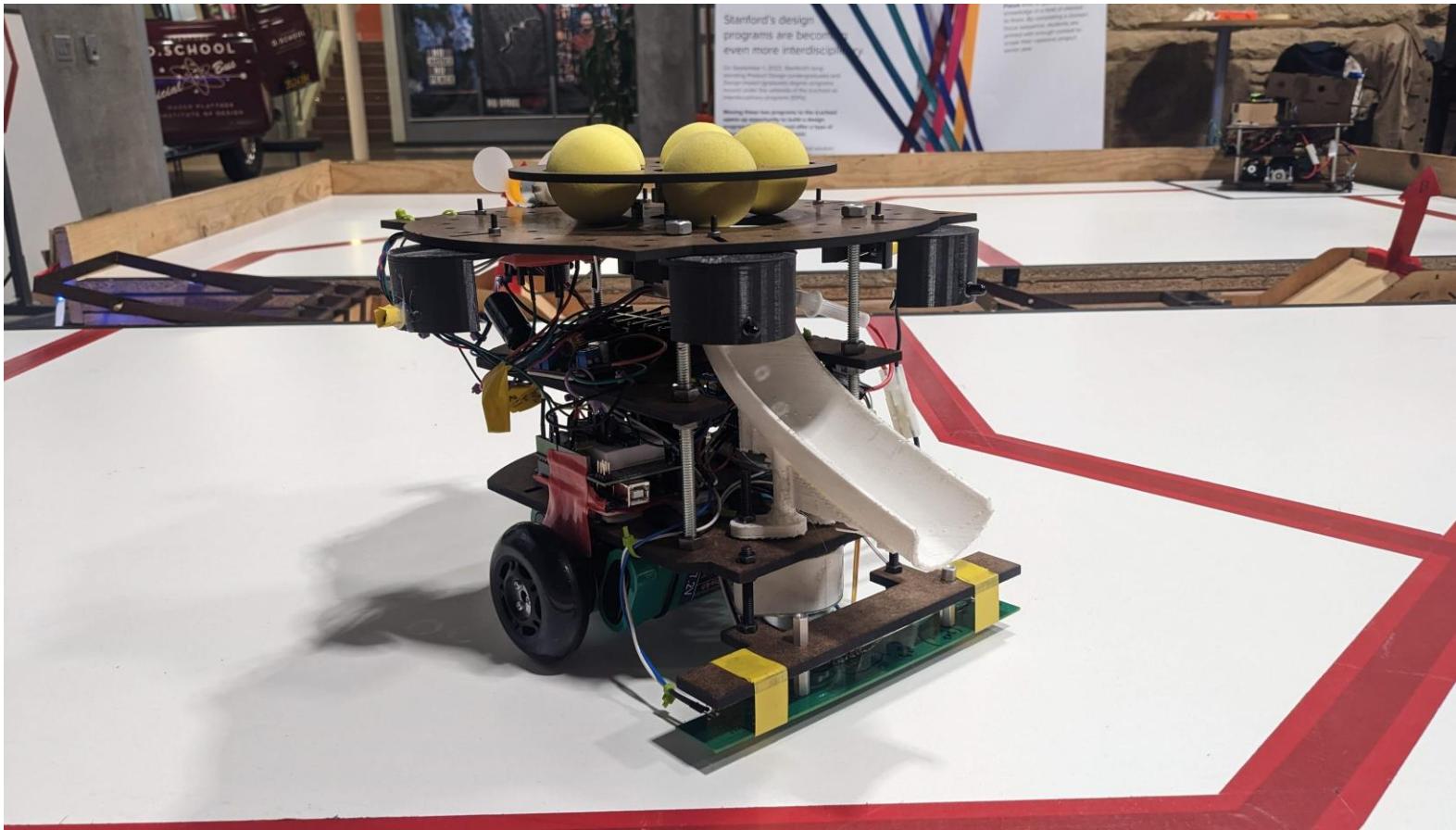


Result

WOODPECKER



My team of 4 created an autonomous robot to compete in the annual me210 mechatronics competition at Stanford, our goal was to navigate a simulated high profile Oscars red carpet event and deliver press (balls) for our film to the attendees (bins) in order to win an award.

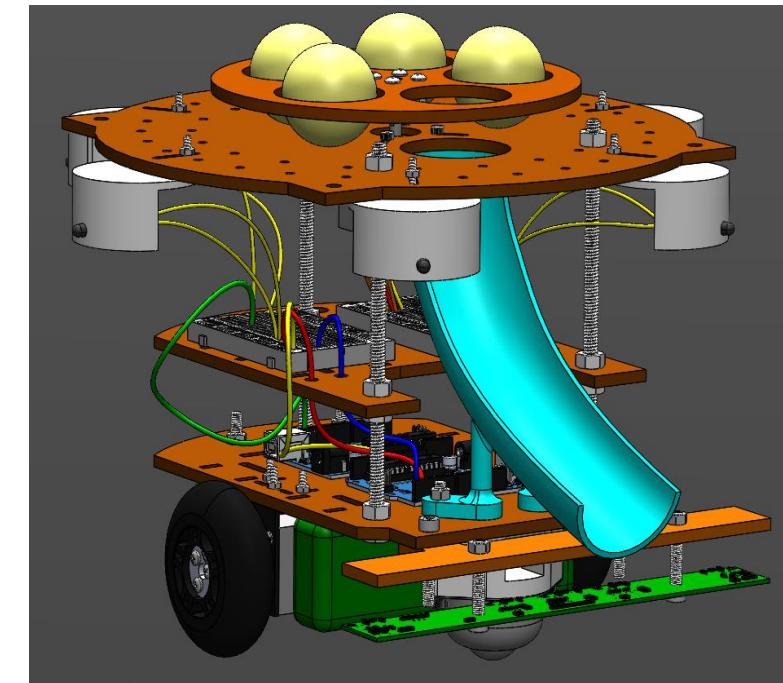
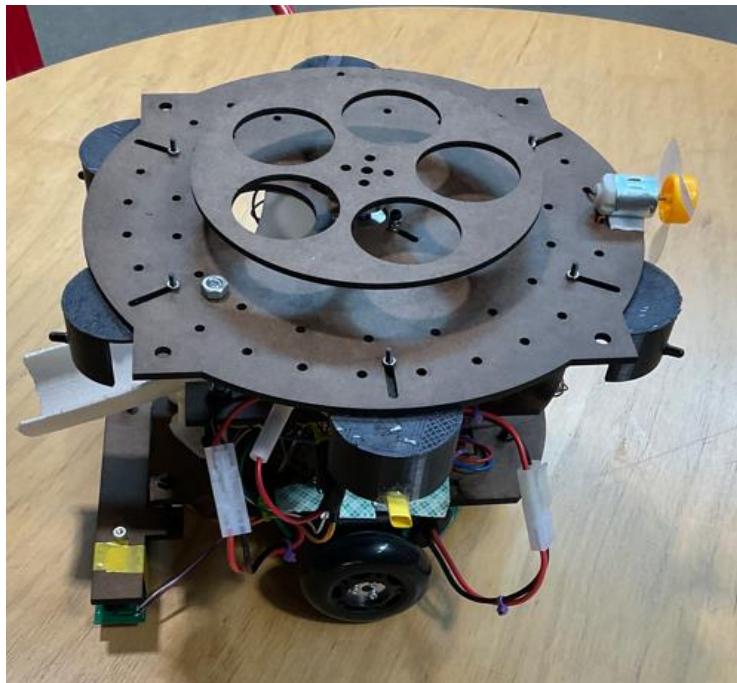
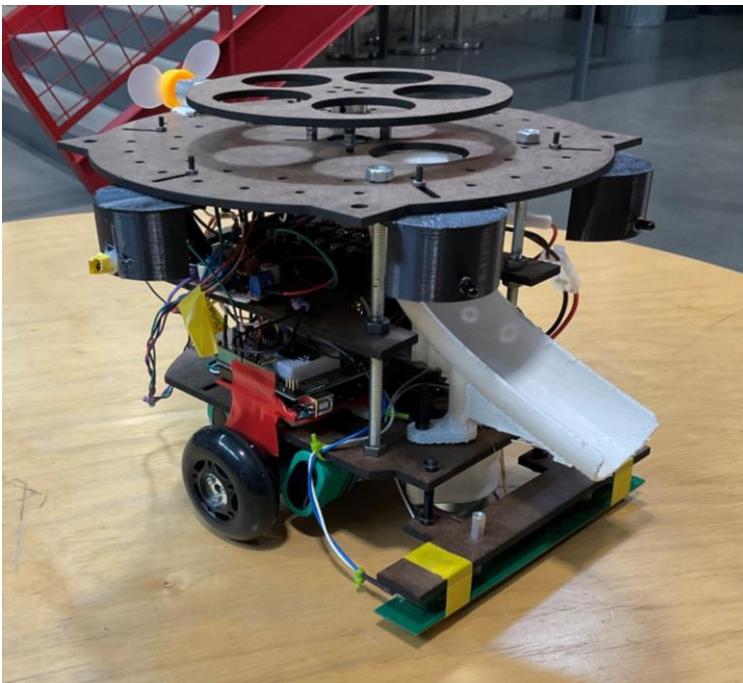


WOODPECKER

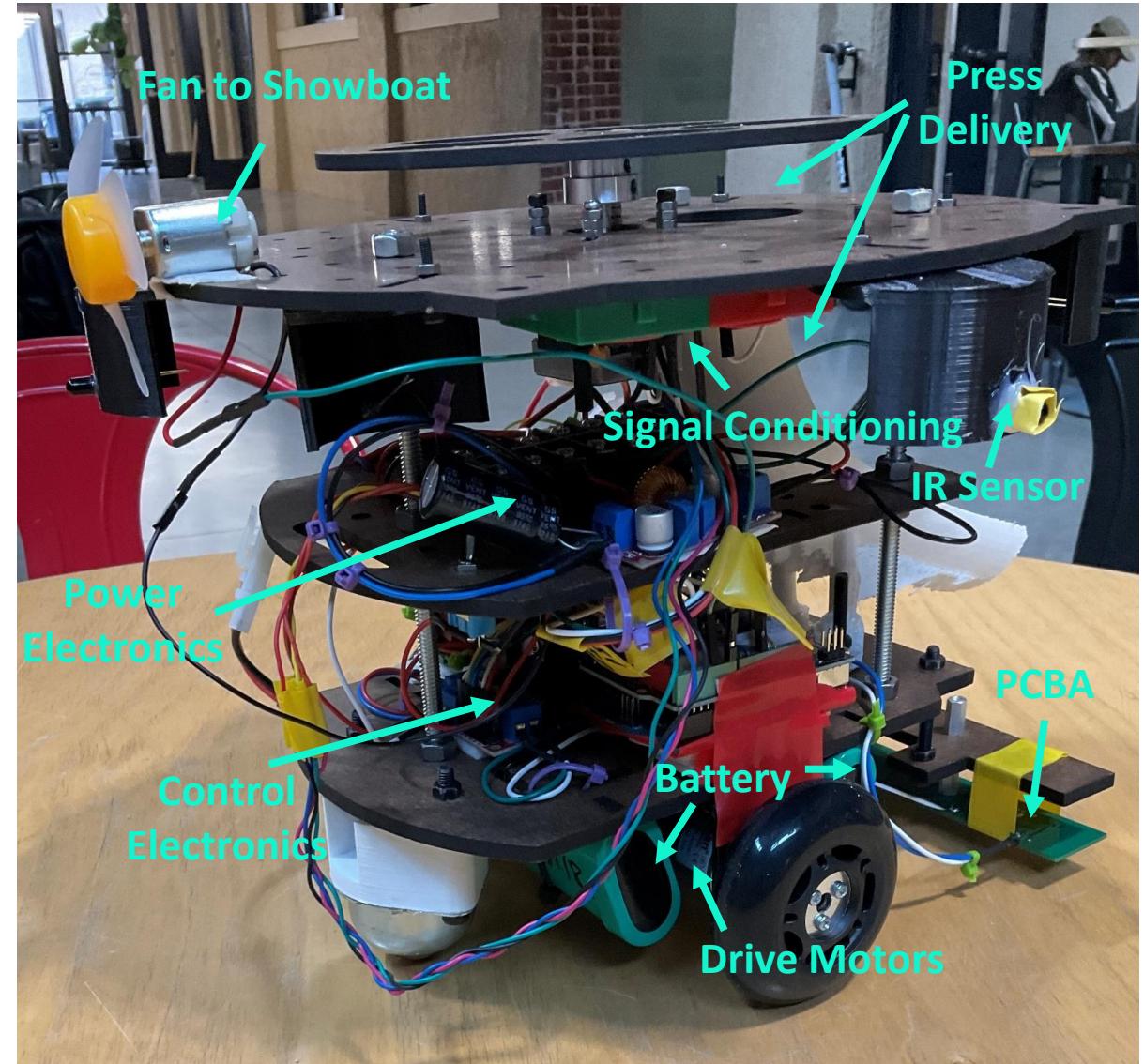
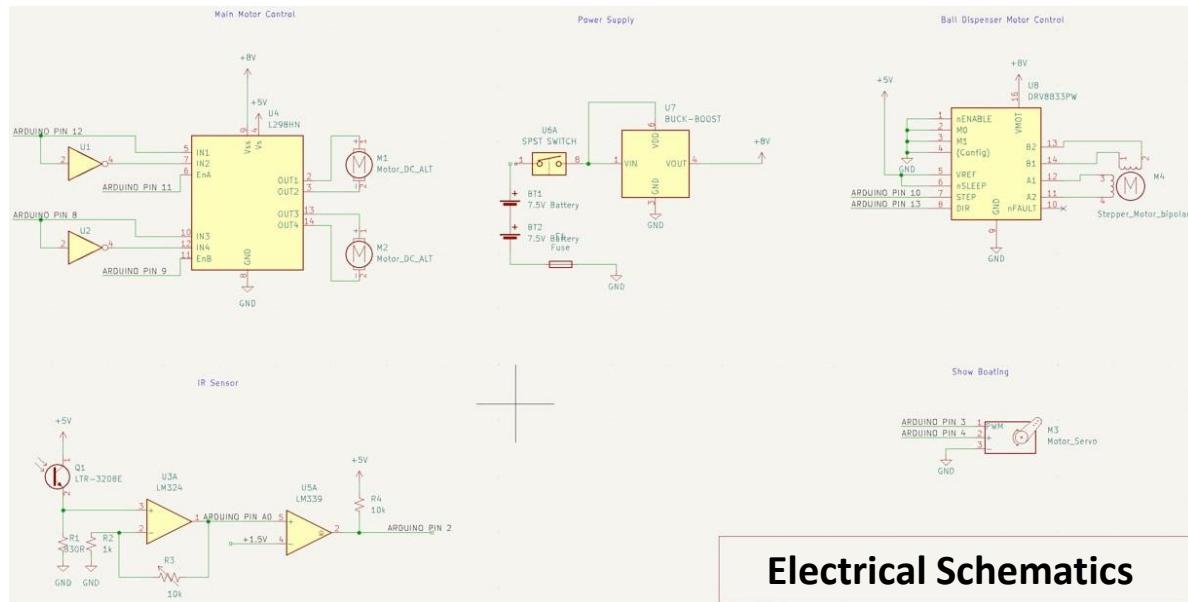
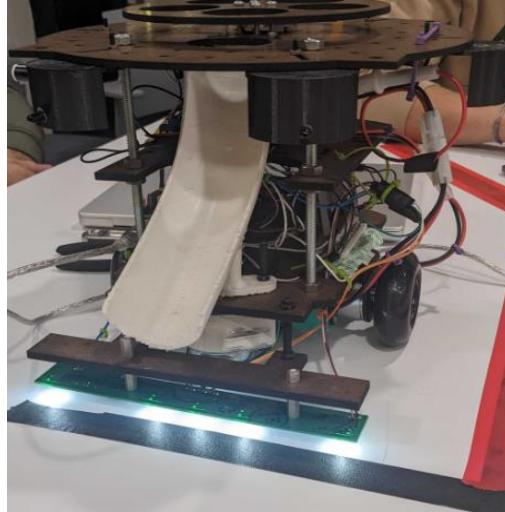
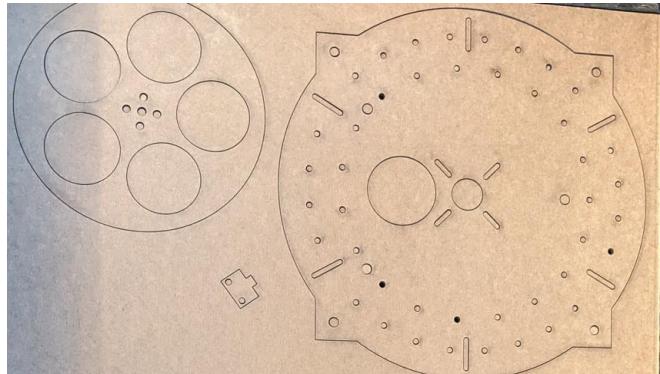


I designed and realized a revolver style PRESS delivery mechanism including its full electro-mechanical design using a stepper motor, was responsible for integration of all other electrical and mechanical sub systems into the robot which included designing the robot chassis, adjustable sensor mounts including one for PCB assembly. I created the complete CAD model (pictured below) of our bot and made sure that all the integration happens without any hiatus. I fabricated all the mechanical parts, procured COTS parts before assembling.

PROCESSES: Electro-mechanical Design, Motor Control, Soldering, 3D Printing, Laser Cutting



WOODPECKER



WOODPECKER



All of design, fabrication and debugging for this project took place in less than 3 weeks which was a tight timeline to realize a bot that is autonomous, had multiple subsystems that needed to work together in addition to designing, fabricating, and assembling lot of parts including a custom PCB assembly. This naturally created a lot of stress in team, and I assumed the role of Yoda where I maintained morale, mediated team conflicts and supported different subsystems as needed. I did project management for the team, created, tracked and updated timelines.



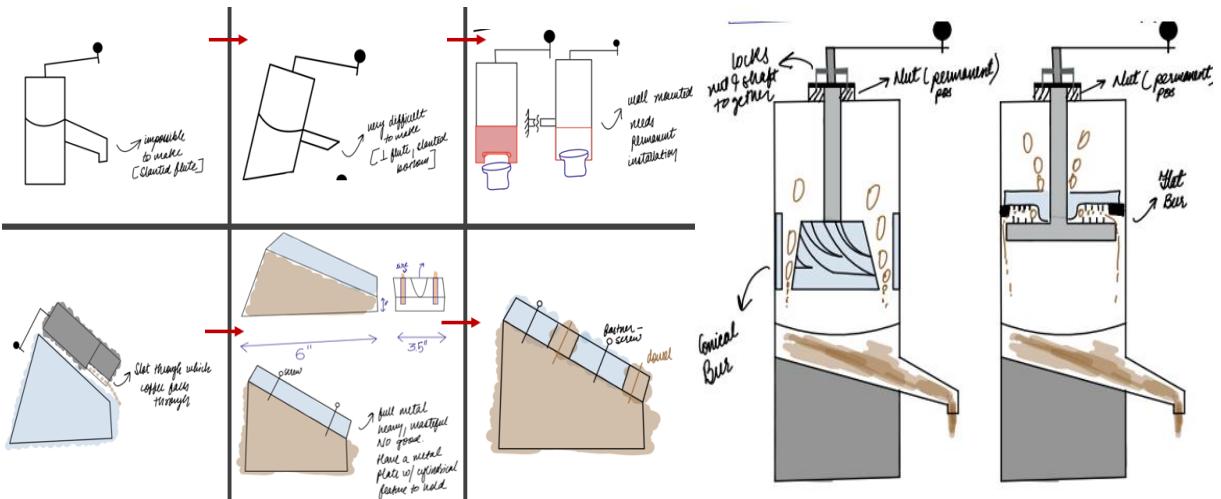
MILAANA



PROCESS: Manual Machining – Mill, Lathe; Woodworking
MATERIALS: Aluminum, Hard Wood, Steel Fasteners

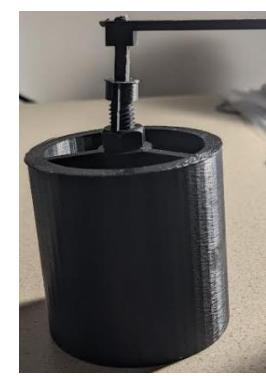
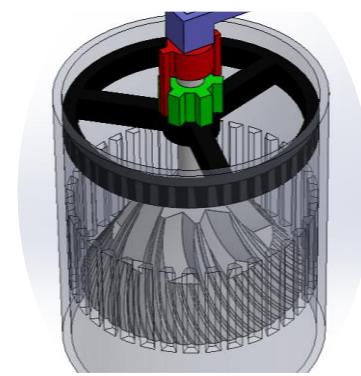
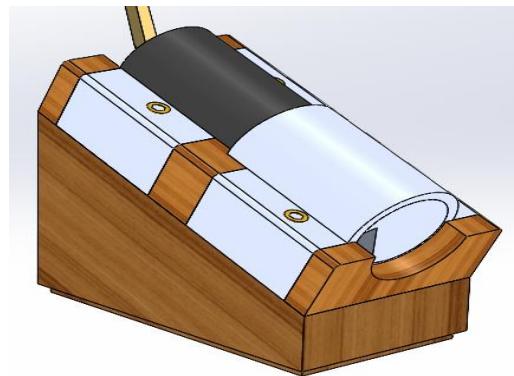
Milaana is the coffee bean grinder I created during my course on design and manufacturing. Motivated by my never dying thirst for coffee, this project took lot of machining and some woodworking to realize it.

The design process started with napkin sketches, experience & functional prototypes, to shape design directions and evaluate function. Involved revising the design numerous times as I iterated before finally spending time to machine and assemble it.

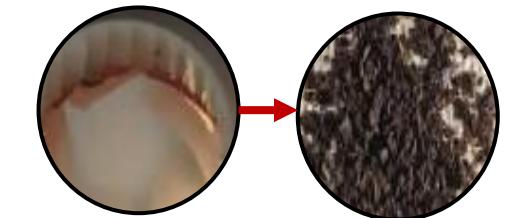
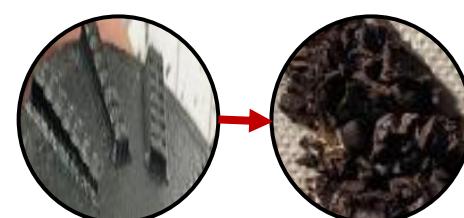
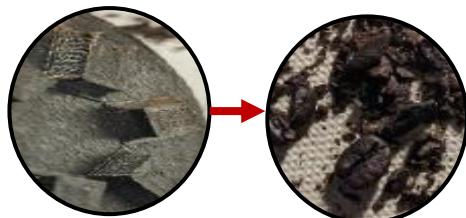


MILAANA

PROCESS: Manual Machining – Mill, Lathe; Woodworking
MATERIALS: Aluminum, Hard Wood, Steel Fasteners

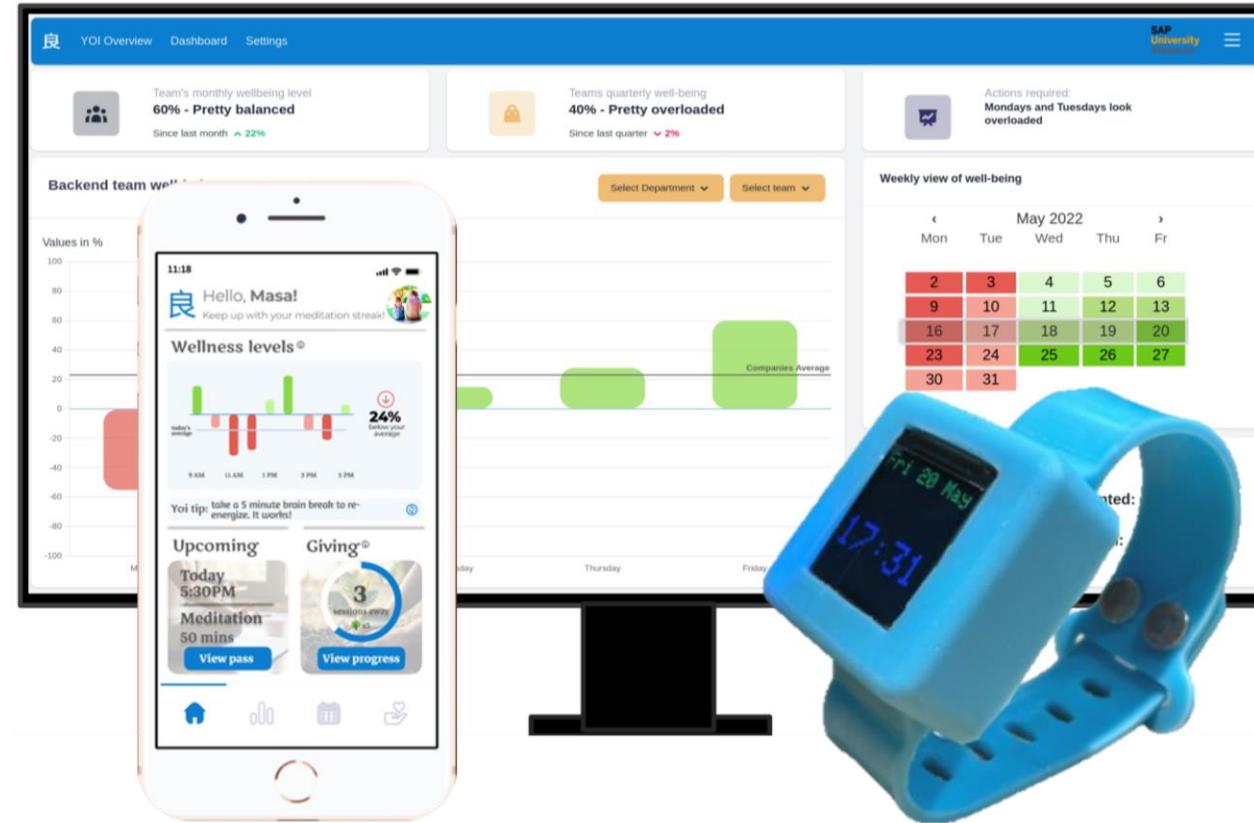


Prototyped Burr Geometries:



YOI ECOSYSTEM

Spread across 5 time zones, Future Talents was a Stanford ME310 global design innovation project between 5 universities and corporate partners. As a part of this project, our team developed and prototyped a solution to support employee wellness in the tech. industry. This included developing a wearable device that tracks stress levels in employees through their skin response and developing intervention tools and mechanisms for both the employee and the employer. We ran multiple user experience and testing studies and carried out ethnographic need finding to understand the problem space.

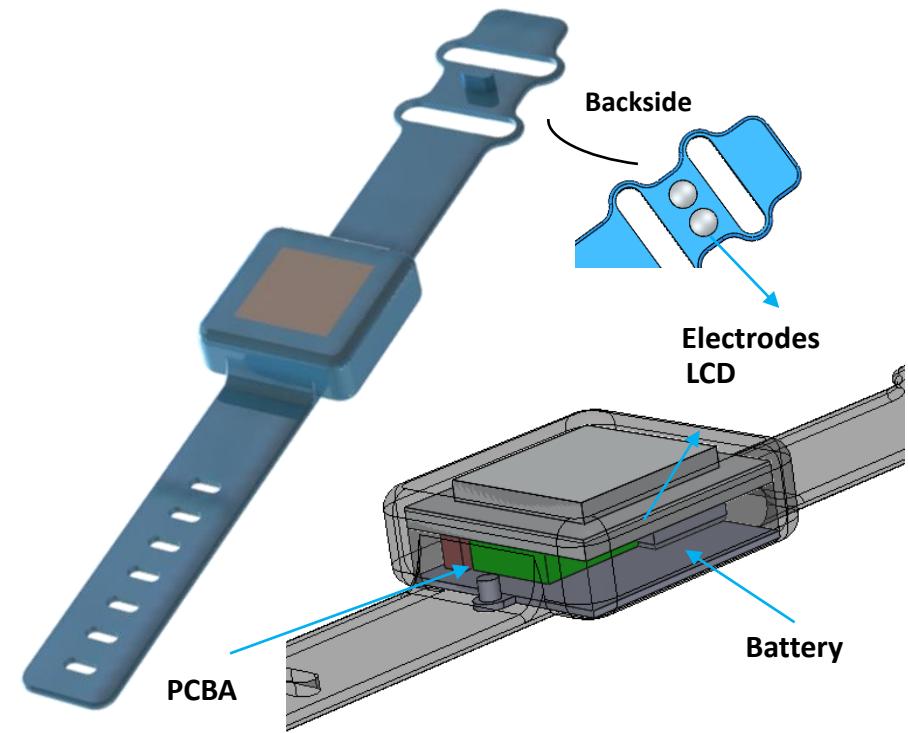
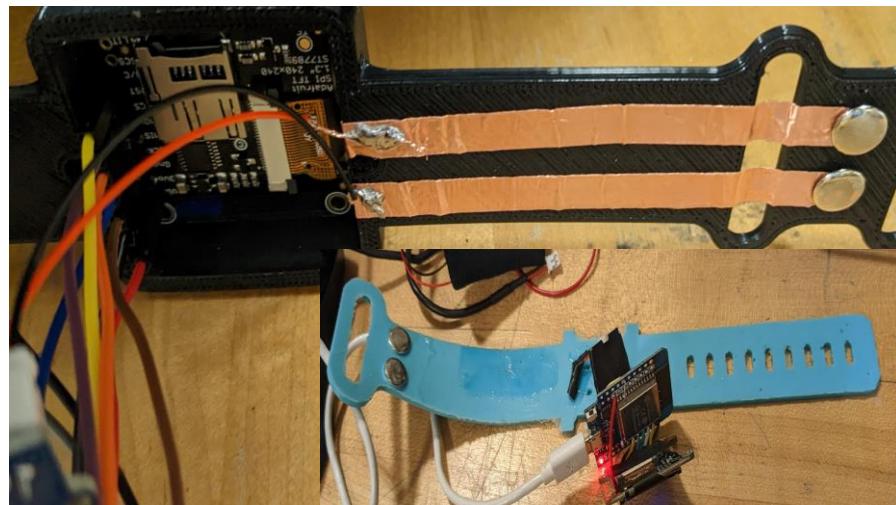


YOI ECOSYSTEM

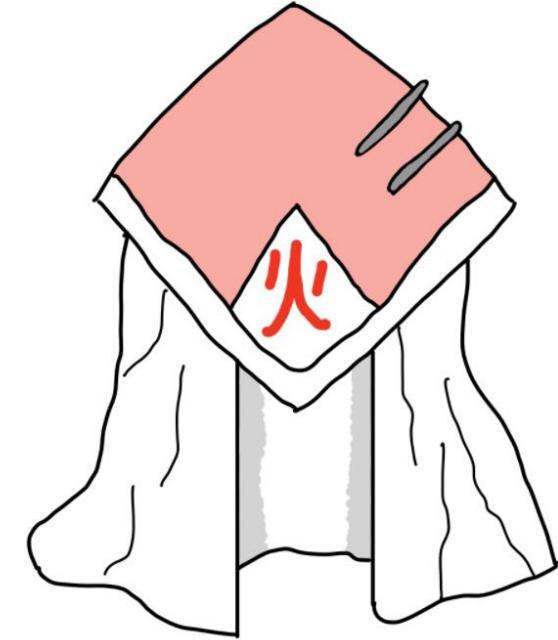
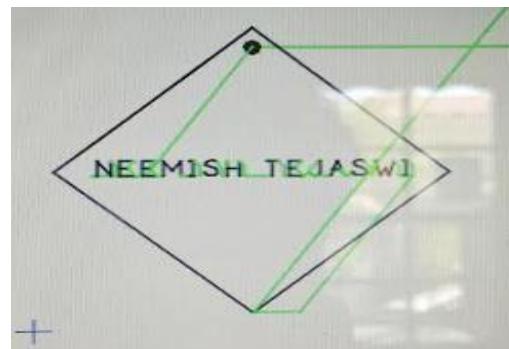
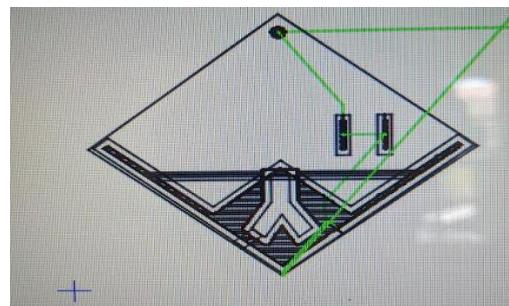
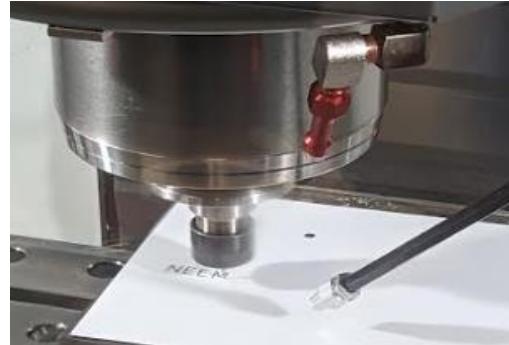
I designed and manufactured the wearable device for the team.

In the final product the wearable had skin response electrodes embedded in its strap which was electrically connected to the main housing without being visible from the outside.

PROCESS: Silicone Molding, Electronics Soldering



火影 WILL OF FIRE

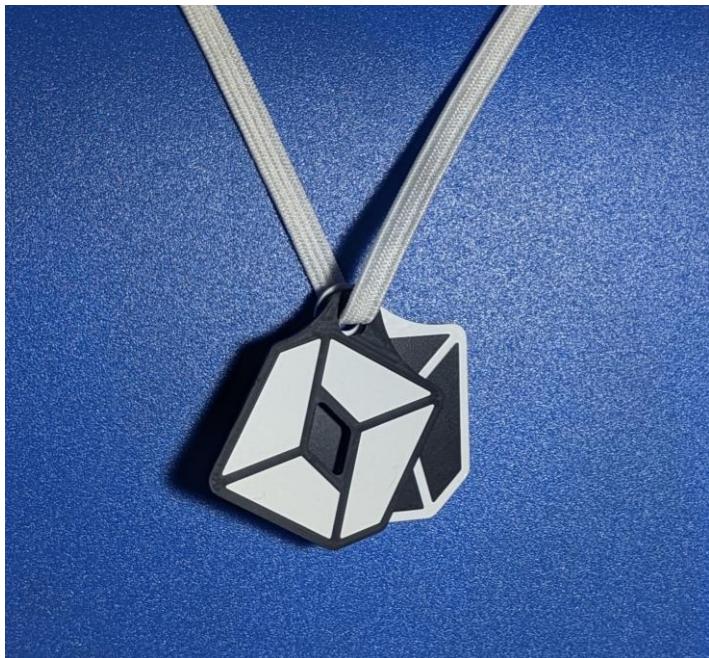


I designed and machined a two-sided luggage tag for my bag pack. The tag is the Hokage hat from my favorite anime Naruto.

I programmed the part by hand without relying on a CAM system and used a 1/32nd inch end mill for the job. The stock was secured using VHB tape to a HDPE fixture plate.

MACHINE SHOP EXPLORATIONS

Pendant



MATERIAL: Sign Stock

PROCESS: 1/16th inch end mill on a CNC mill; Used VHB tape to secure the sign stock on to a HDPE block

Magnifying Glass



MATERIALS: Brass, Delrin, Acrylic

PROCESSES: Milling, Silver Brazing, Turning, Spherical Turning, Facing, Threading

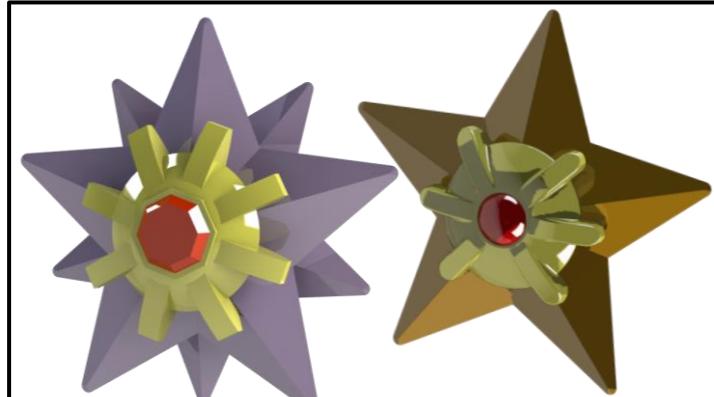
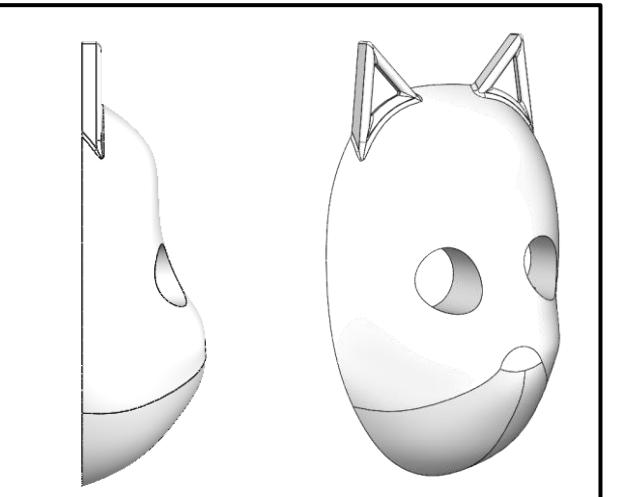
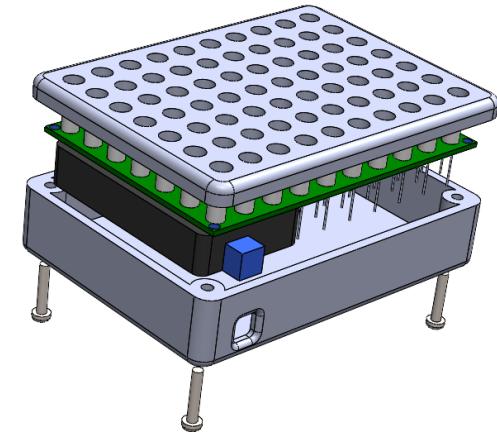
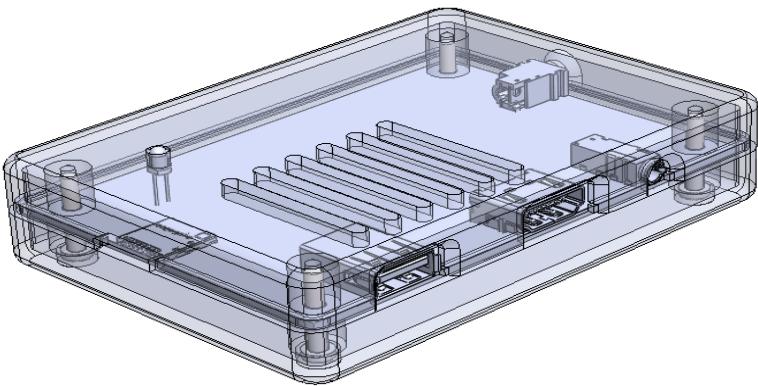
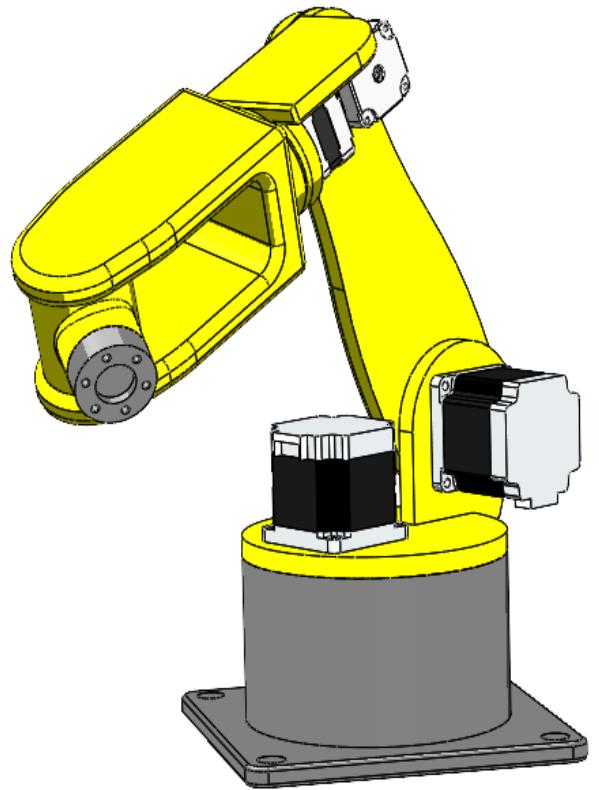
Plaque



MATERIALS: Bronze, Sheet Metal

PROCESSES: Sand Casting, Sheet Metal Forming, Gas Welding, Bead Blasting

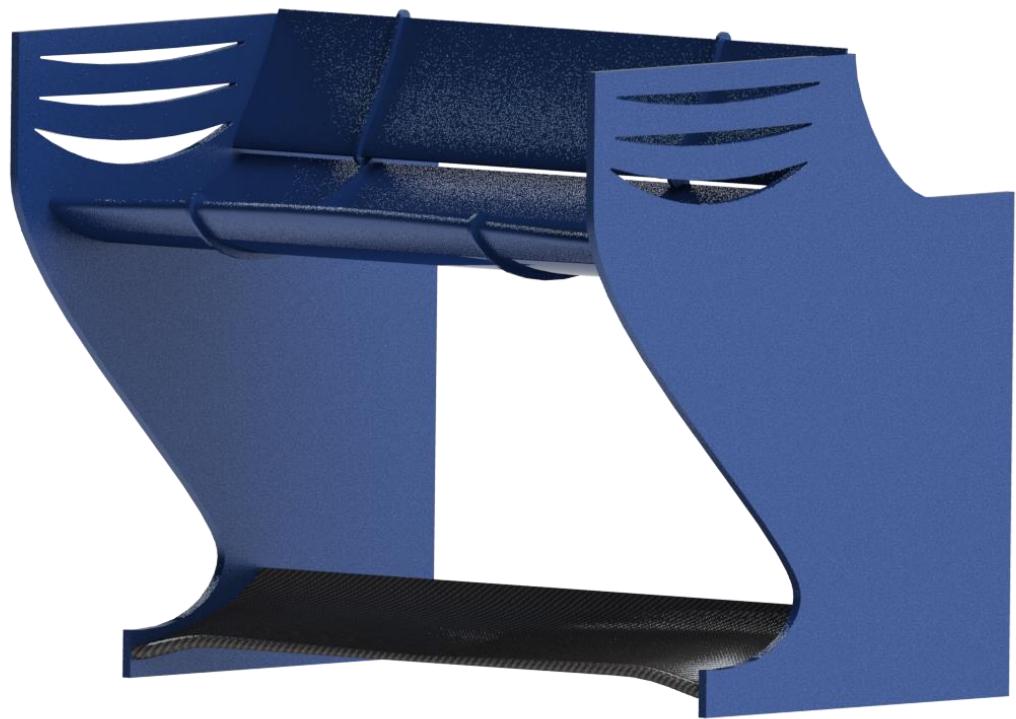
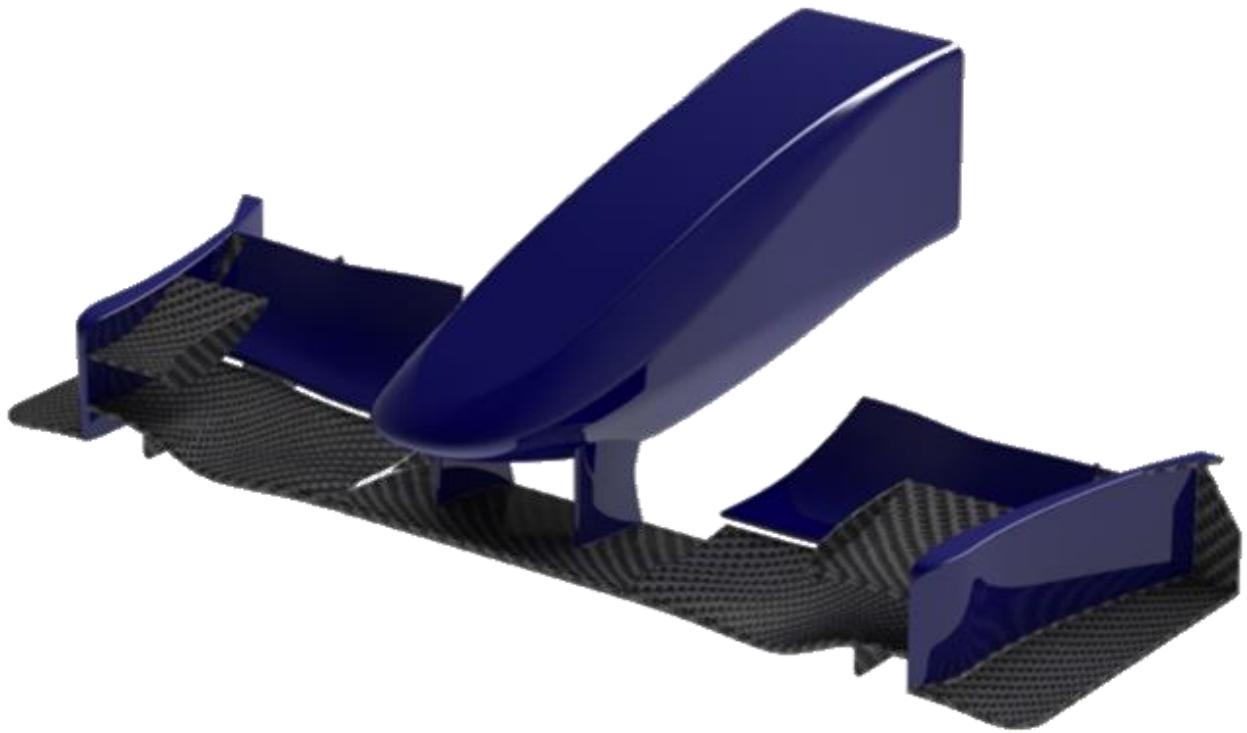
CAD DESIGNS



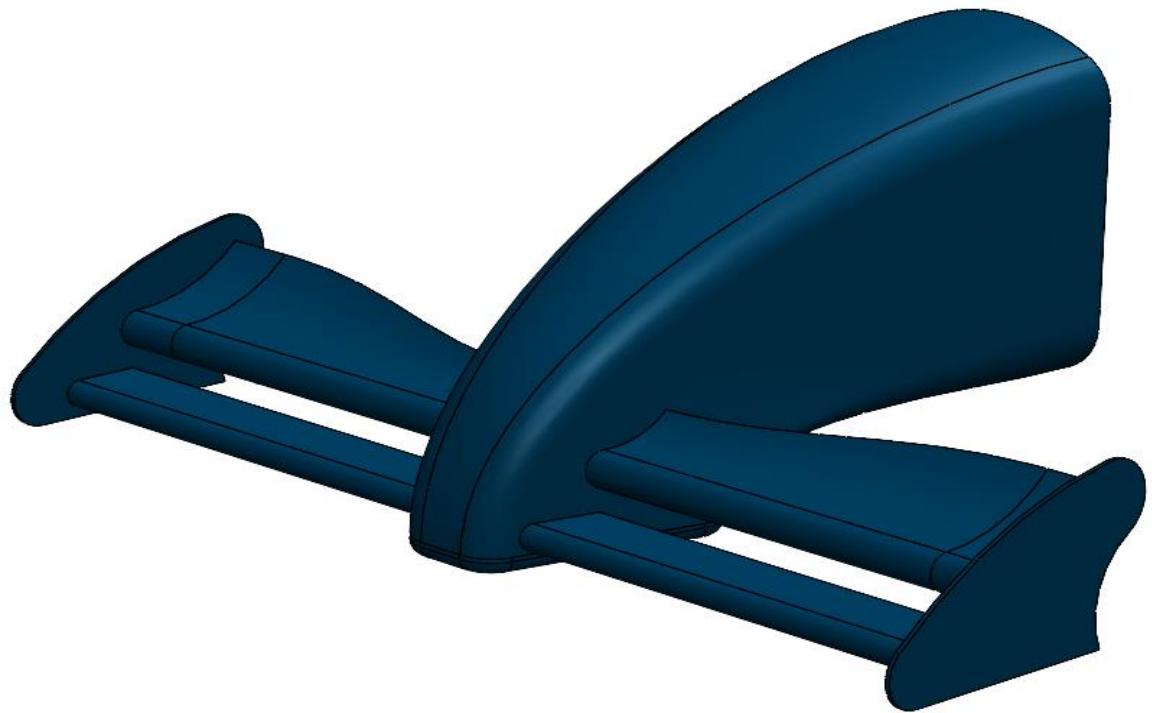
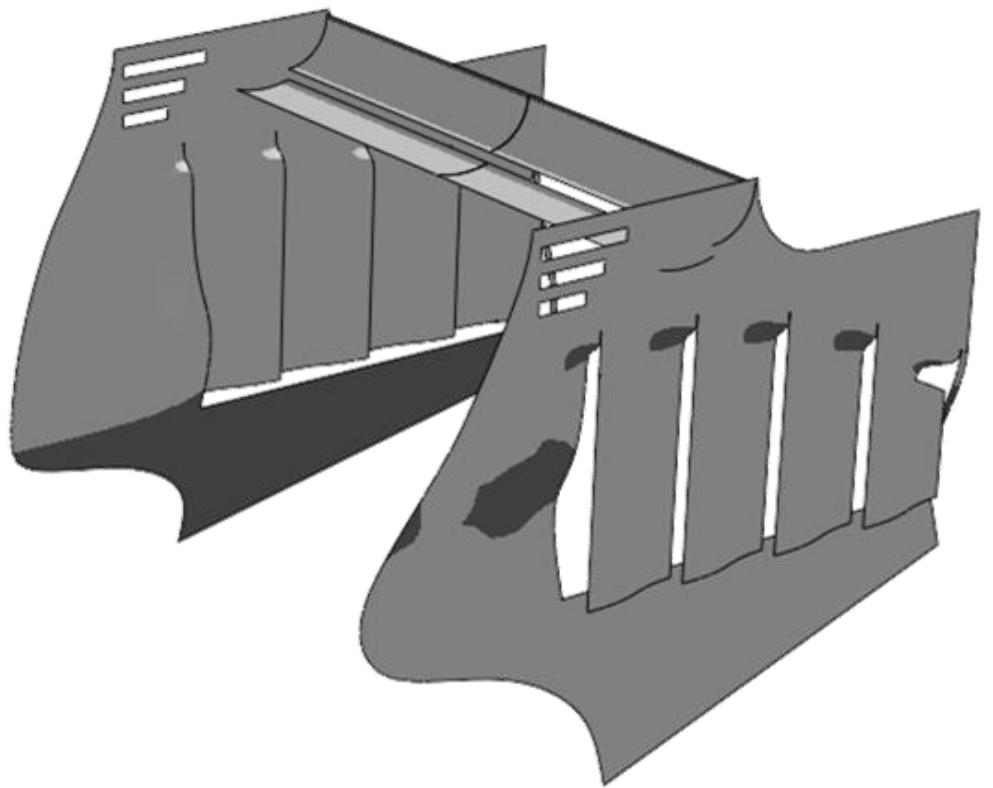
CAD DESIGNS



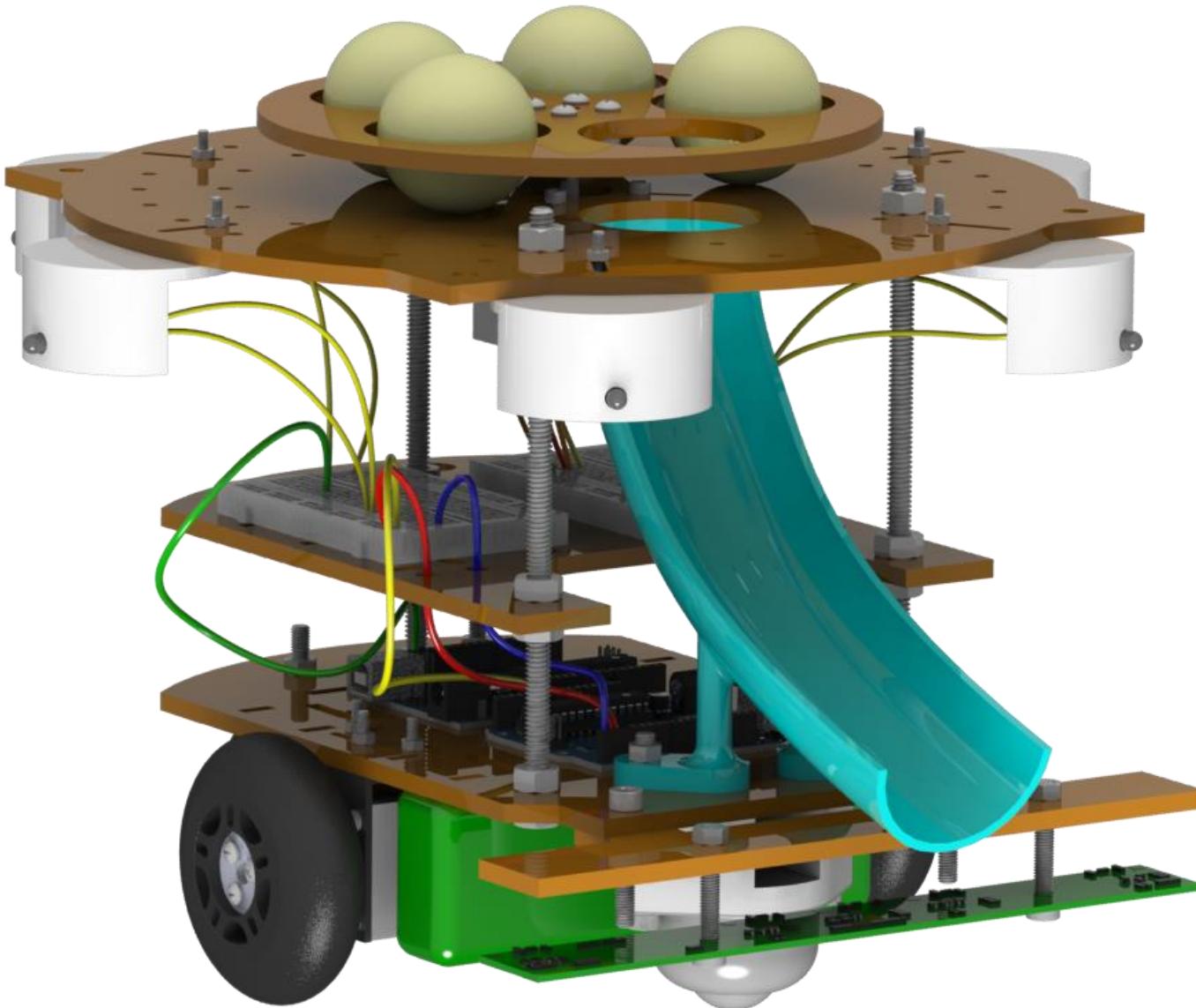
CAD DESIGNS



CAD DESIGNS



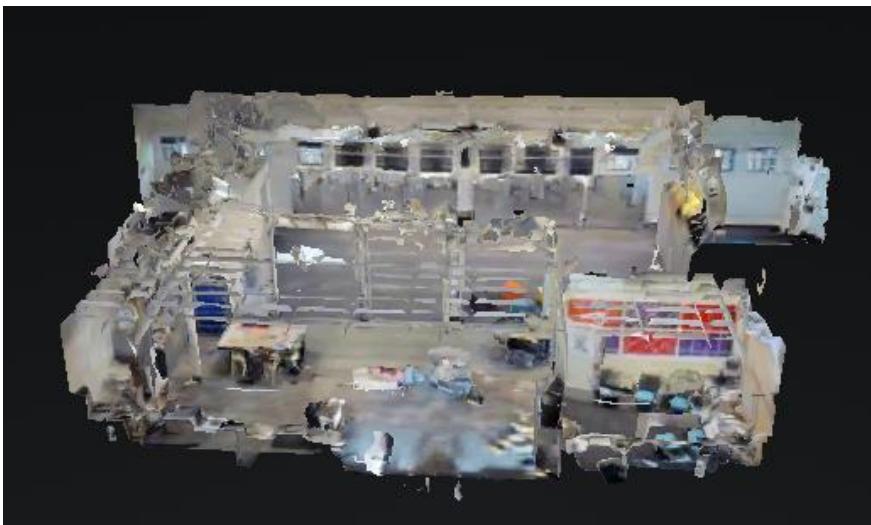
CAD DESIGNS



VIRTUAL FIELD TRIPS



Product Realization Lab @ Stanford
<https://ixd.su.domains/vft/>



Roble Arts Gym @ Stanford:
<https://my.matterport.com/show/?m=77rKLLUk1j1>



Mechanical Engineering
Virtual Personal Visits to Stanford Maker Spaces

Stanford provides a variety of well-equipped maker spaces and a world-class program in how to use them, yet students with no prior experience in making can be intimidated by the machinery or the complexity of skill involved in learning to use it. We are creating a virtual experience of Stanford's maker spaces that will invite students to explore, learn about equipment and activities, and hear from fellow students who have developed making skills using these spaces and the resources they offer. Our project aims to encourage many more students to feel welcome and confident in their ability to learn to use these spaces.

Rebecca Currano, Veronika Domova, David Sirkin, Mark Cutkosky