VICTORIA VASTIS

Creative Portfolio

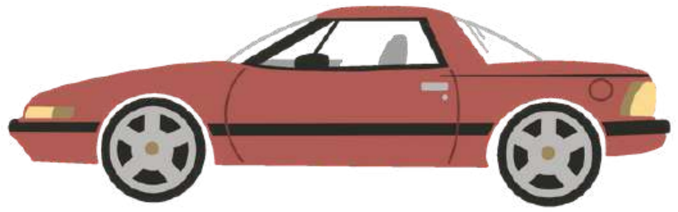
Hey, I'm Victoria.

On the surface, I'm a mechatronics engineer with a passion for creating beautiful vehicles that move people both physically and emotionally. User experience and my desire for adventure are at the heart of everything I create.

But I am so much more than that.

I'm a mechanic, a product designer, a surfer, and a musician. My love for automotive engineering and product design was ignited after I fixed my mom's old 1989 Buick Reatta back in 2020. This portfolio showcases the complexity and depth of my creativity through a variety of independent, professional, and academic design projects. You'll find everything from aluminum guitars with sound-reactive LEDs to electric vehicle system testing and design.

And I'm just getting started.



All images, sketches, graphics, and, 3D models are my own unless otherwise stated.

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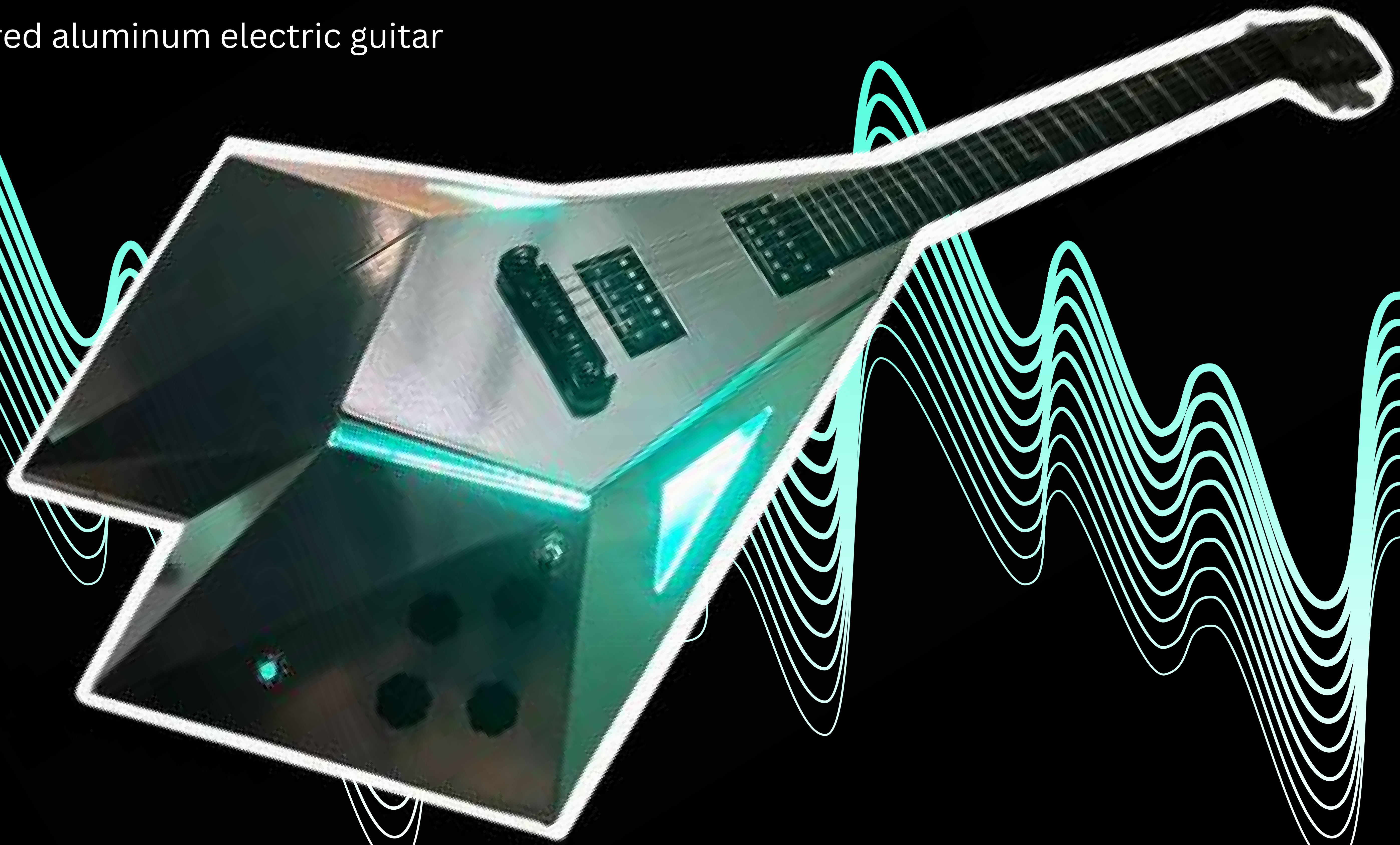
CYBER SHREDDER

Cybertruck-inspired aluminum electric guitar



CYBER SHREDDER

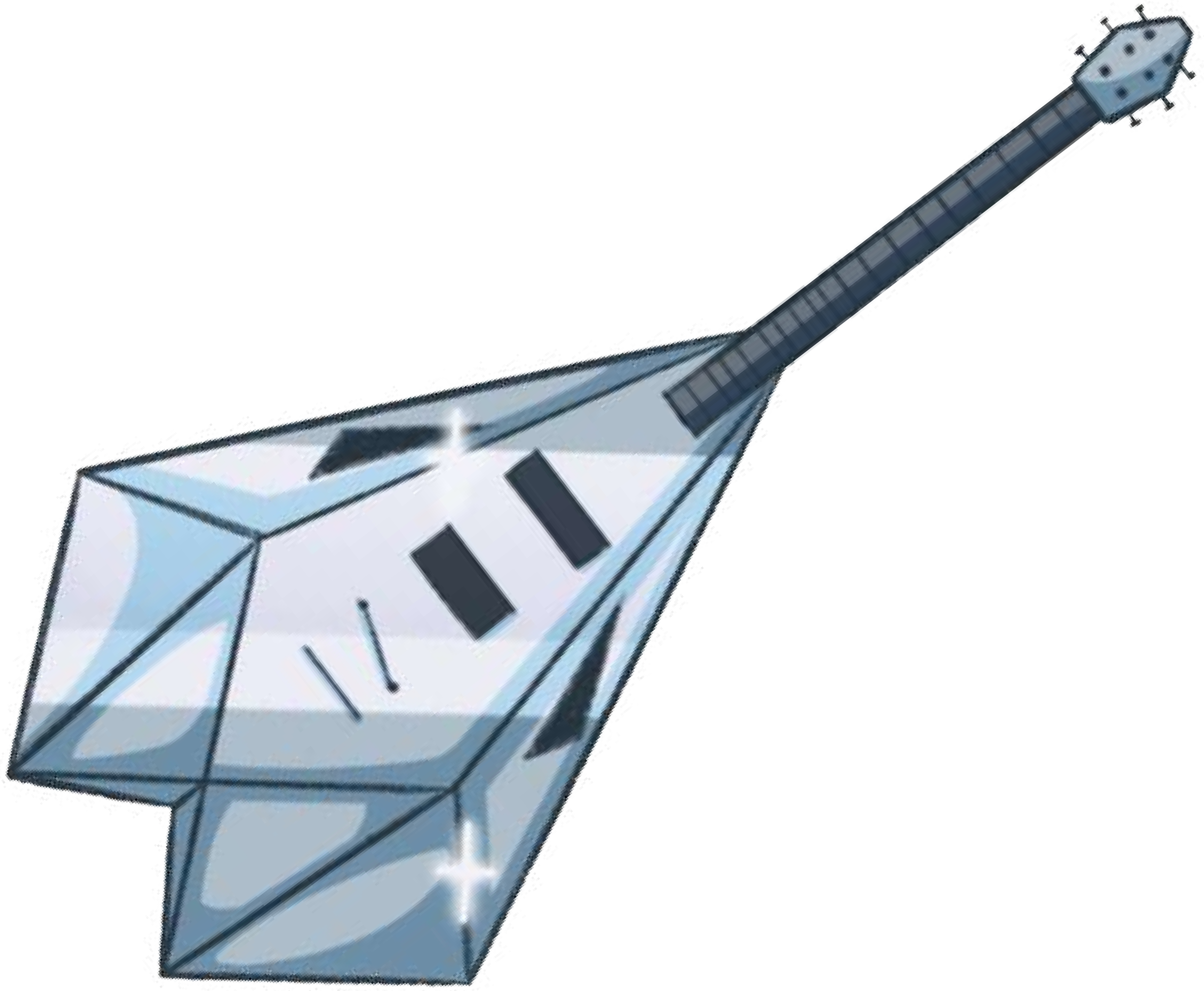
Cybertruck-inspired aluminum electric guitar

The Cyber Shredder is an experiment.
Its purpose is to push the boundaries of modern guitar design through the use of unconventional body geometries, uncommon materials, and external LED electronics to create a unique sonic and playing experience. I wanted a guitar that was dynamic and reacted to the user's music. It needed to embody the aesthetic of the Cybertruck and stay true to its metal exterior without compromising ergonomics.

This instrument was not designed for a course or an employer, but purely for the joy of creating something that excited me. I wanted to disrupt the world of traditional guitar design while growing my hardware and user-facing product design skills.

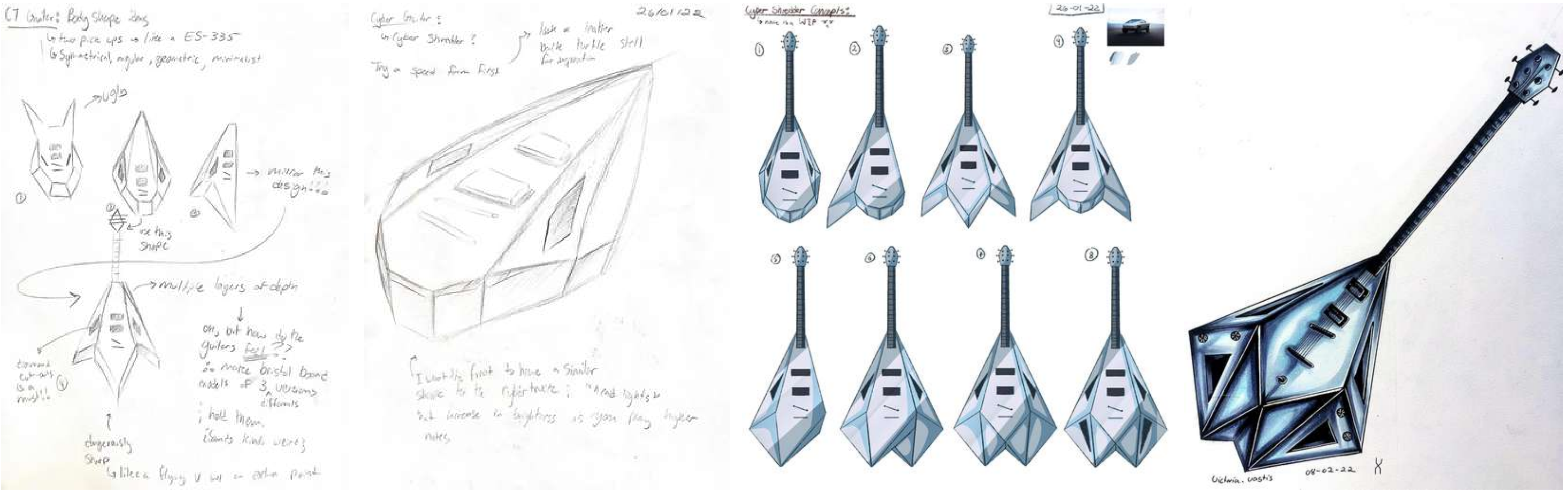
Design Objectives

- Unique resonance and sound
- Ergonomic body design
- Sound-reactive LEDs
- Easy-access yet hidden LED controls and buttons
- Removable back panel to modify electronics



Solo Project - Feb 2022 to Oct 2022 | Arduino | Acoustic Design | Sheet Metal Fabrication

SKETCHES + PROTOTYPES



I wanted this guitar to have a minimalistic, metallic exterior while still maintaining depth as it reflected light. To do this, I created several sketches using pencil, digital media, and alcohol-based markers to perfect the exterior design

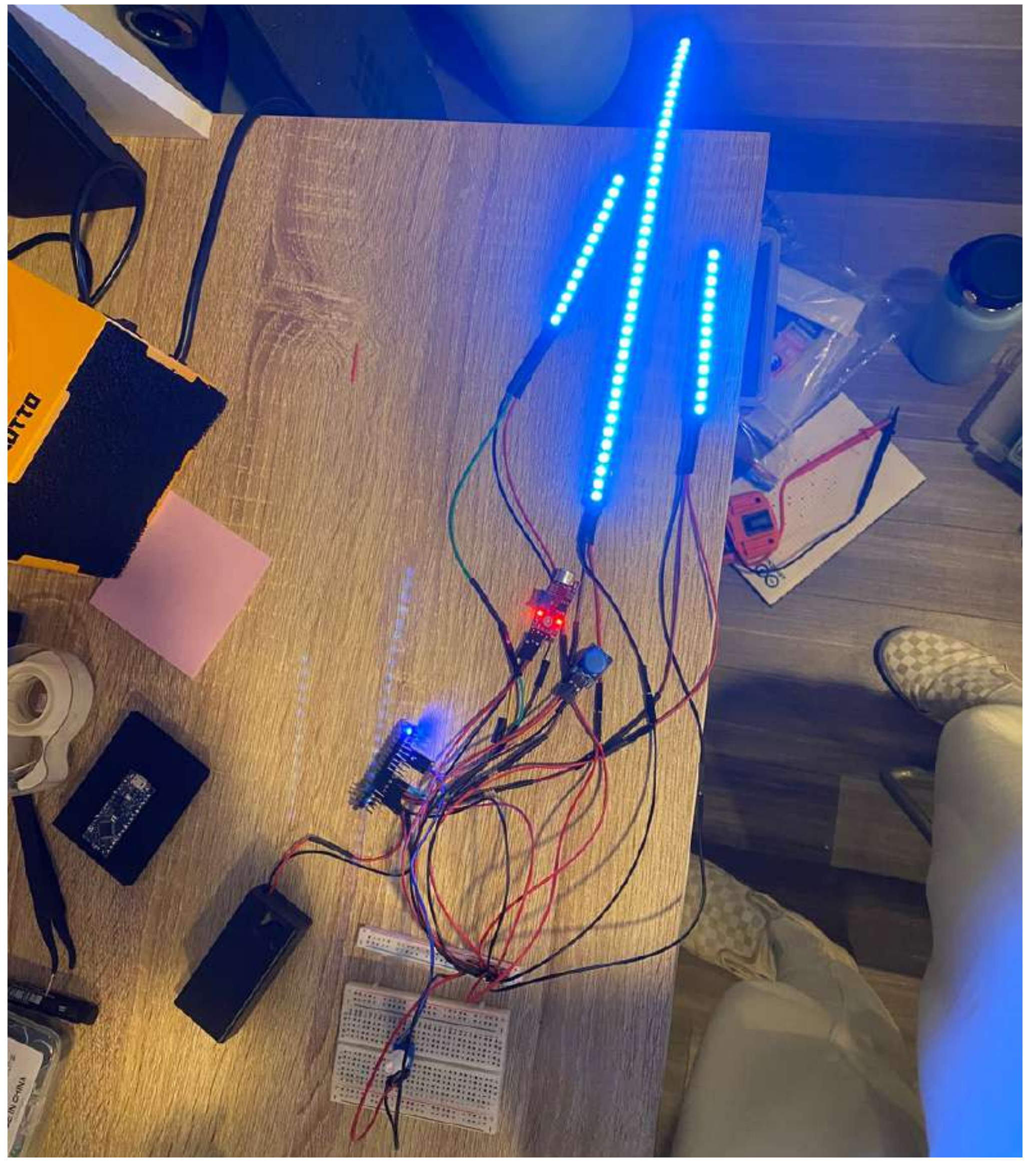
Before modeling the Cyber Shredder, I created a 1:1 scaled prototype using bristol board to verify its ergonomics and aesthetics.

Next, I created renders based on the bristol board prototype before producing a 3D-printed prototype. This prototype was created to test the assembly process and verify all electronics fit correctly.

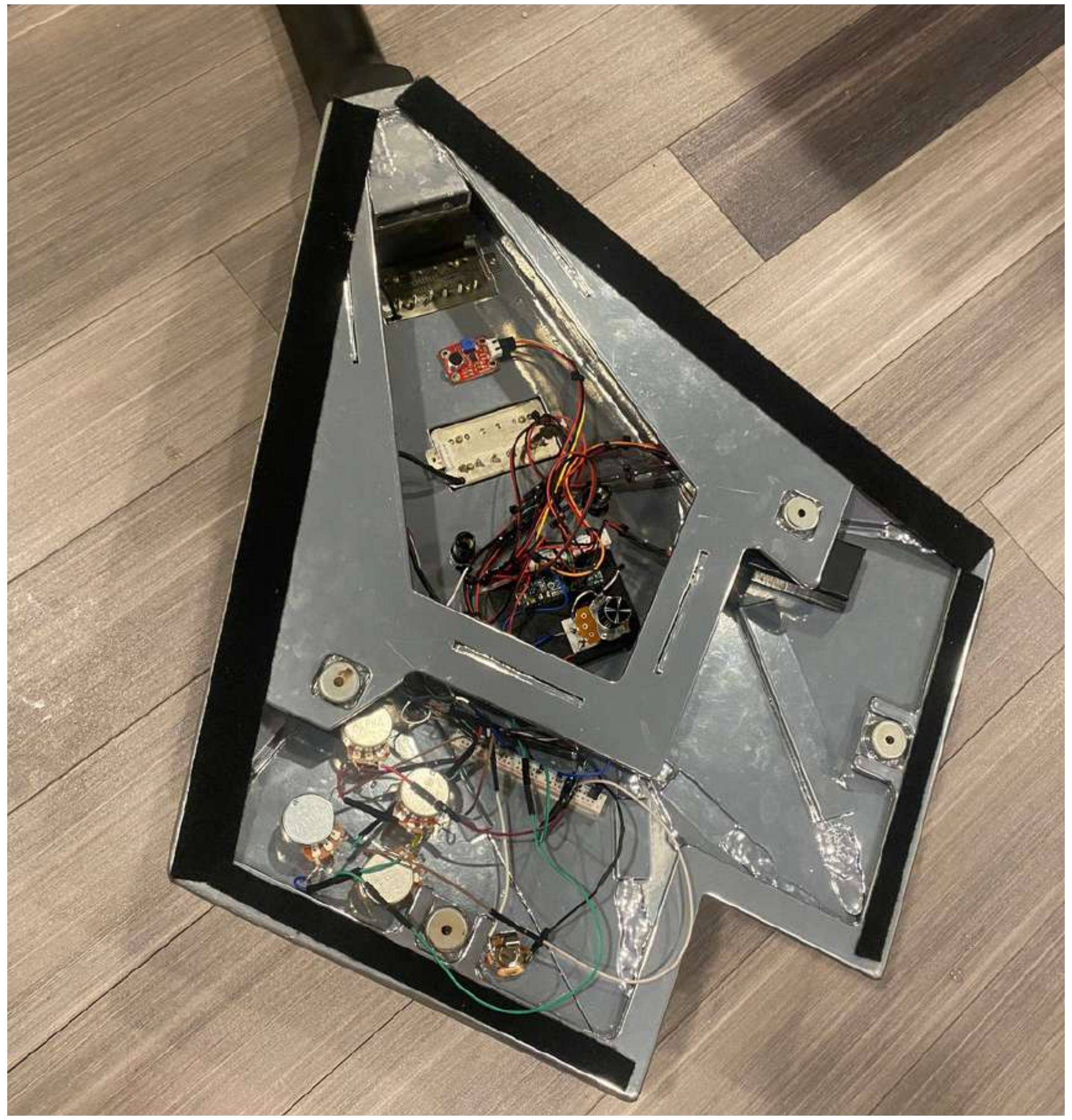
The body was made from several aluminum sheet metal components assembled with high-strength steel epoxy. The exterior was chrome-dipped.

SOUND-REACTIVE LEDS

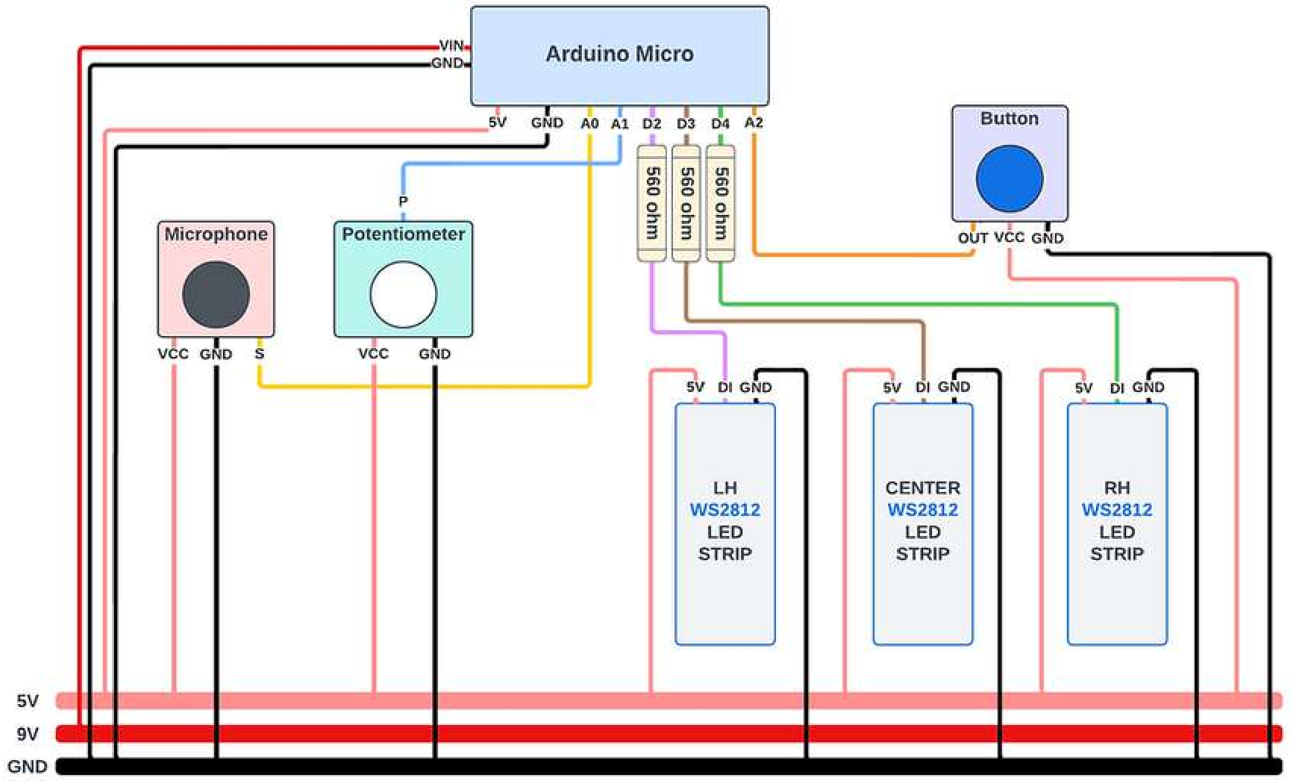
I wanted the Cyber Shredder to have sound-reactive LEDs that would pulse and sparkle when the user is playing or singing. I also wanted to add an element of customization to allow the user to change the color of the LED strips with a potentiometer and switch between 5 different LED display settings with a button. To do this, I used an Arduino micro to take input from a potentiometer to get the position on the color wheel, a tuned microphone to detect guitar and vocals, and a hidden button to switch between one of five different LED display settings.



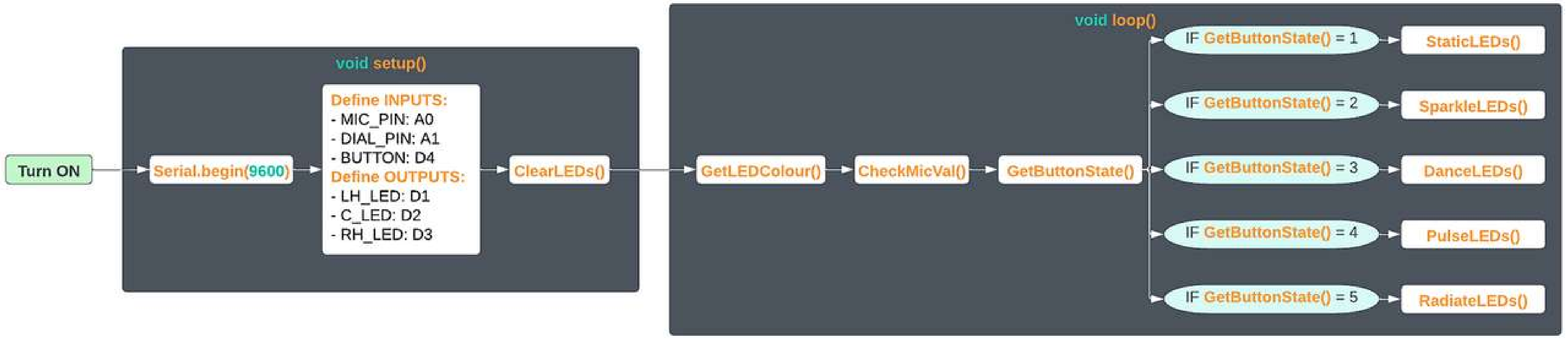
LED System prototype testing



LED System assembly and installation



LED System electrical architecture



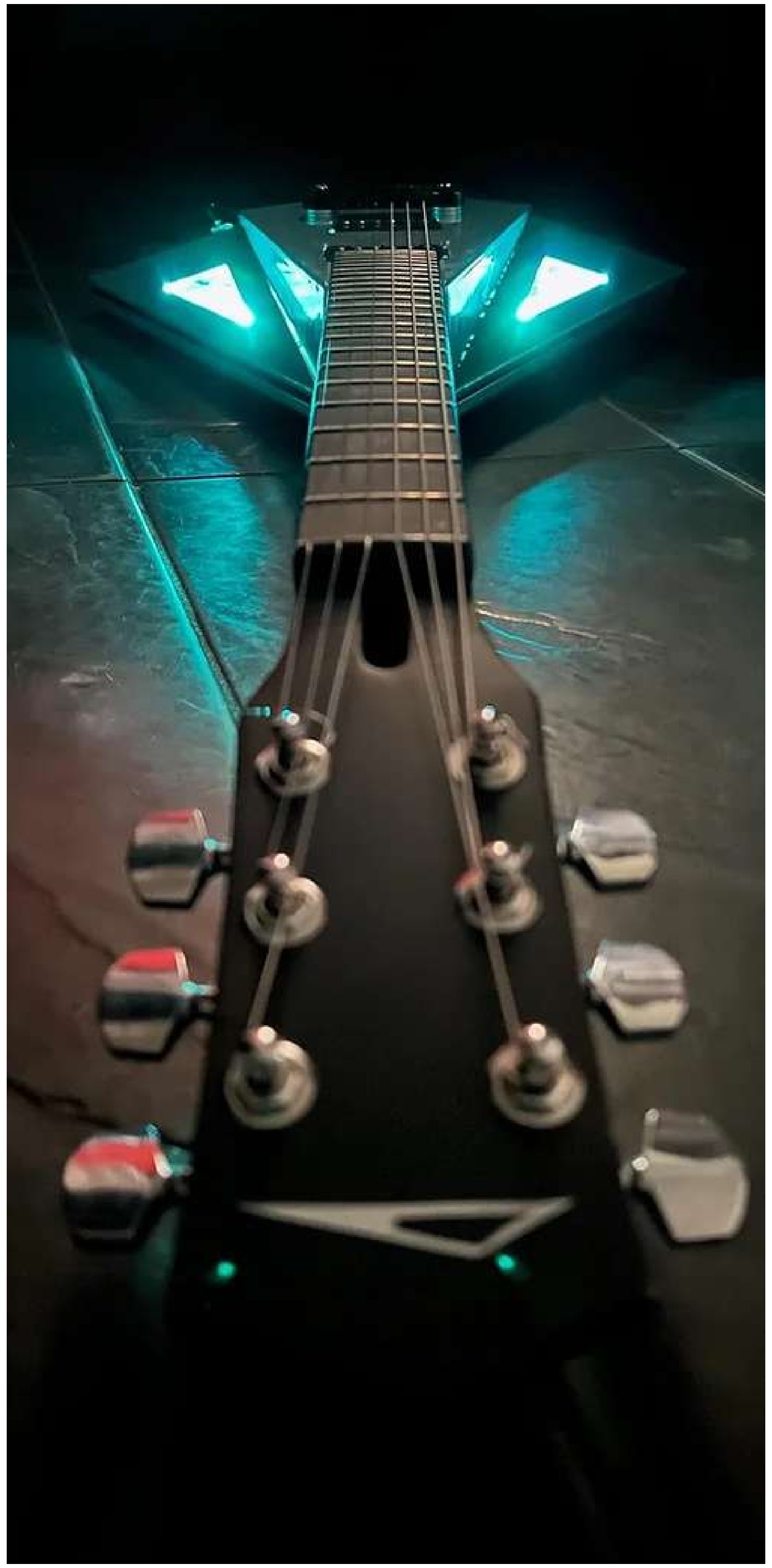
LED System high level process flow diagram

FINAL DESIGN

FEATURES

Cyber Shredder with Active LEDs

Me and the Cyber Shredder



Cyber Shredder Headstock

Here it is! The Cyber Shredder. The world's first hollow-body, chrome-dipped aluminum electric guitar. With its unique metallic sound and customizable LEDs, the Cyber Shredder offers a one-of-a-kind look and playing experience to any musician.

The Natural Chorus Effect

Aluminum resonates differently than any standard tonewood used for guitars. This causes the Cyber Shredder to vibrate in a way that's similar to applying a chorus pedal to get that signature 80s pop sound. The "Chorus Effect" is usually achieved through analog signal modulation, but the Cyber Shredder does this in a purely mechanical way!

Sound-reactive LEDs

The Cyber Shredder lights up as you play with 5 different LED display modes! You can swap between modes with an easy-access, hidden button. You can also change the color of the LEDs with the color dial on the back of the guitar.

LED Modes:

- Static Colour
- Ambre
- Pulse
- Strobe Lights
- Radiate

See the video attached to my application for a demonstration!

LIVE USER TESTING

Inspiring the next generation of innovative guitar designs.

After a few solo jam sessions, I hosted "Demo Week" and invited my fellow University of Toronto students and friends to play the Cyber Shredder (CS) and give some constructive feedback that will influence my next guitar project. I even got the Dean of Engineering to give it a try! The majority of musicians were mechanical and hardware design specialists with a lifelong background in guitar and performance.

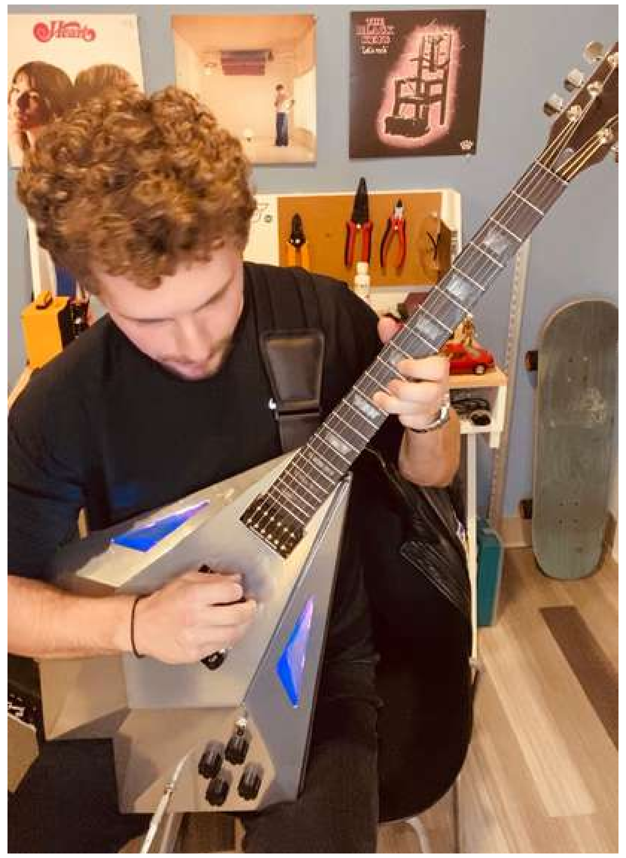
As a guitarist, vocalist, and pianist, I've played my fair share of unique instruments. My main goal with the CS was to "bring the sound to life" with visuals via sound-reactive LEDs. I tried several hidden button placements to insure they were user-friendly.

Sebastian is a robotics engineer, product designer, and rock musician. With a collection of his own guitars, he provided feedback on what attributes are important to instrument design. Playability and quality of sound are two factors that the CS excelled in.

As the Dean of Engineering at the University of Toronto, Chris has an incredibly diverse design background. He loved the aesthetic of the CS and how the light reflects on its body in contrast with the LEDs. Our engineering department even wrote an article about it!

As a metal musician and long-term guitar hardware designer, Padraig has played every type of guitar out there and stated he "never played a guitar quite like the Cyber Shredder." He loved how the natural chorus effect added a subtle, brassy vibrato to his rock songs.

Sunny is a guitar pedal designer, electrical engineer, and an old bandmate of mine. He customizes his own guitars and provided insight on guitar materials and ergonomics. He enjoyed testing the various LED display settings and playing around with colors.



As a physics major and lead guitarist of a local Toronto band, Yianni loved the uniqueness and sound of the CS and suggested implementing a mechanism to adjust "action height" as the guitar's wooden neck will slowly deform with age.

SO-89

Retro touchscreen-controlled electric guitar

SO-89

Retro touchscreen-controlled electric guitar

What if a guitar had user-selected digital filter presets that could be accessed with the push of a button?
SO-89 stands for the "Summer of '89."Its design embodies the transition of late 70s surf culture to a new technological era of the 80s in a hollow-body, beach-rock, electric guitar. It’s a physical manifestation of the energy that represents the 1989 Buick Reatta - my first project car and the catalyst of my creative career that got me into the automotive and product world. The Reatta was ahead of its time; complete with a CTR touch screen where the user could pre-program different buttons and pop-ups. ***What if a guitar could do the same?***

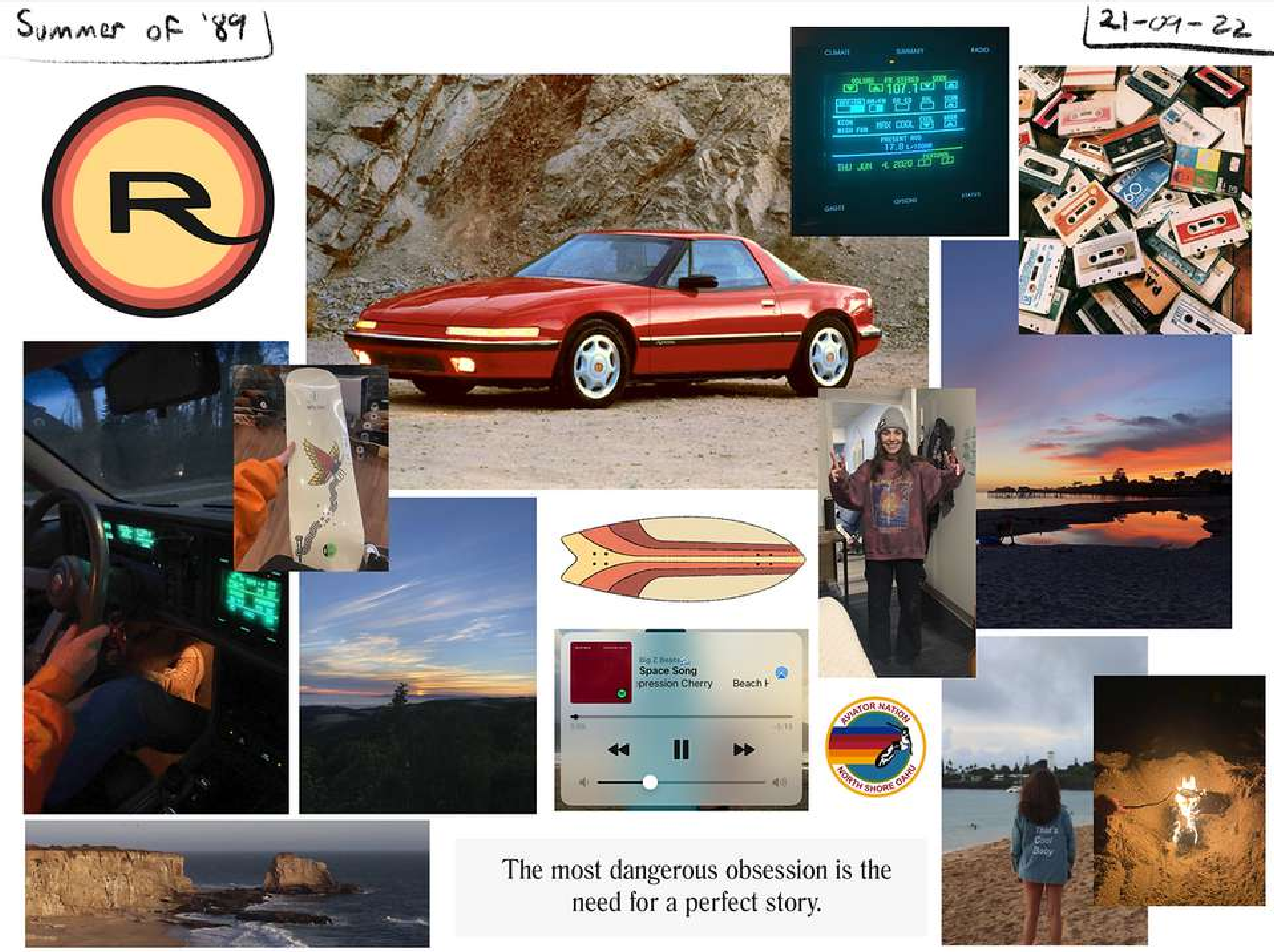
Design Objectives

- Achieve "chorus resonance" in a purely mechanical way
- Touchscreen controls 6 built-in digital guitar pedals (filters)
- Touchscreen controls LED attributes (Hue, saturation, value)
- Users can save various LED and guitar pedal presets to a settings library
- Users can assign LED and pedal presets to programmable buttons

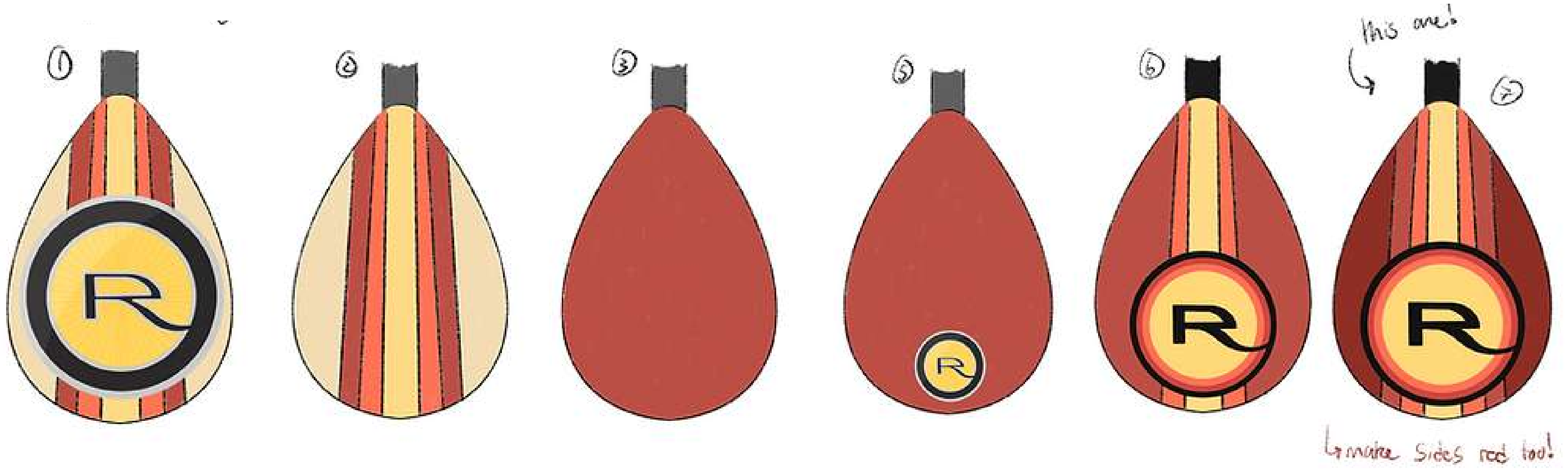
Solo Project - Oct 2022 to Present | Digital Signal Processing | UX/UI Design | Raspberry Pi

CONCEPT GENERATION

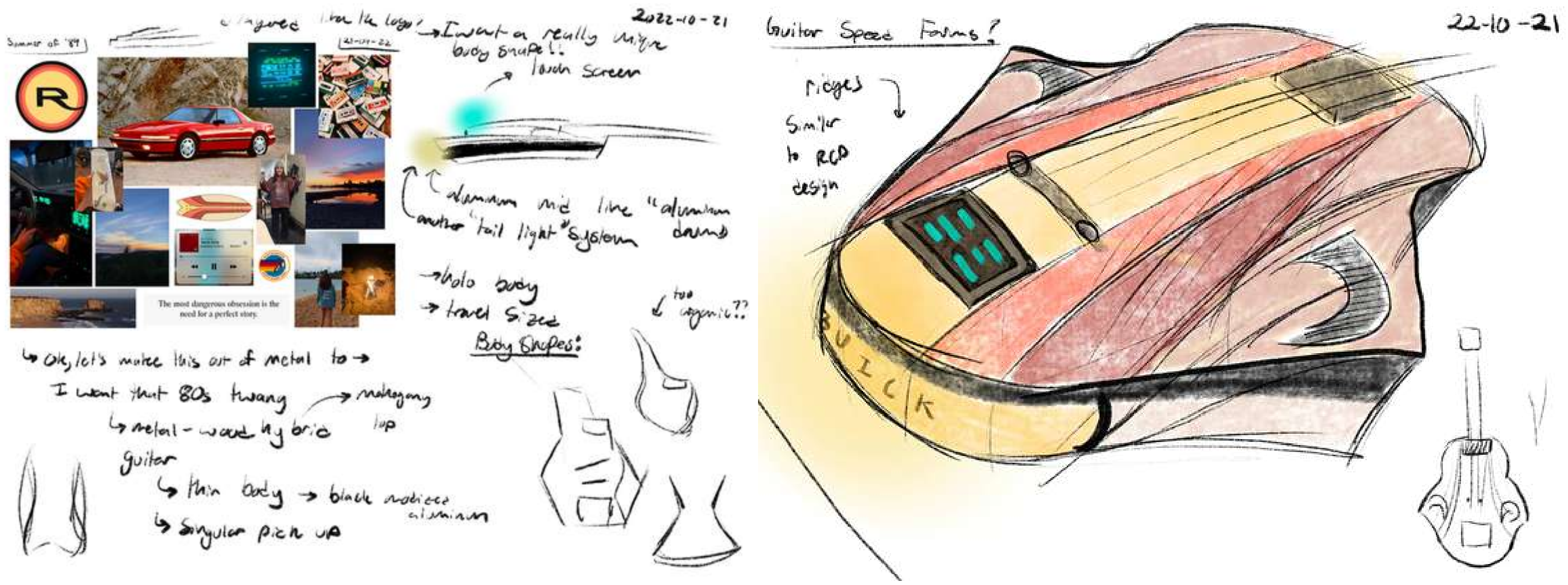
The mood board below captures the "energy" I wanted the product to have. It includes various moments of mine surrounding my experience with surf culture and sunsets through what I call “the Tesla era.” For most of September 2021 to August 2022, I predominately lived in Northern California working on cars, hitting the waves, and playing guitar on the beach.



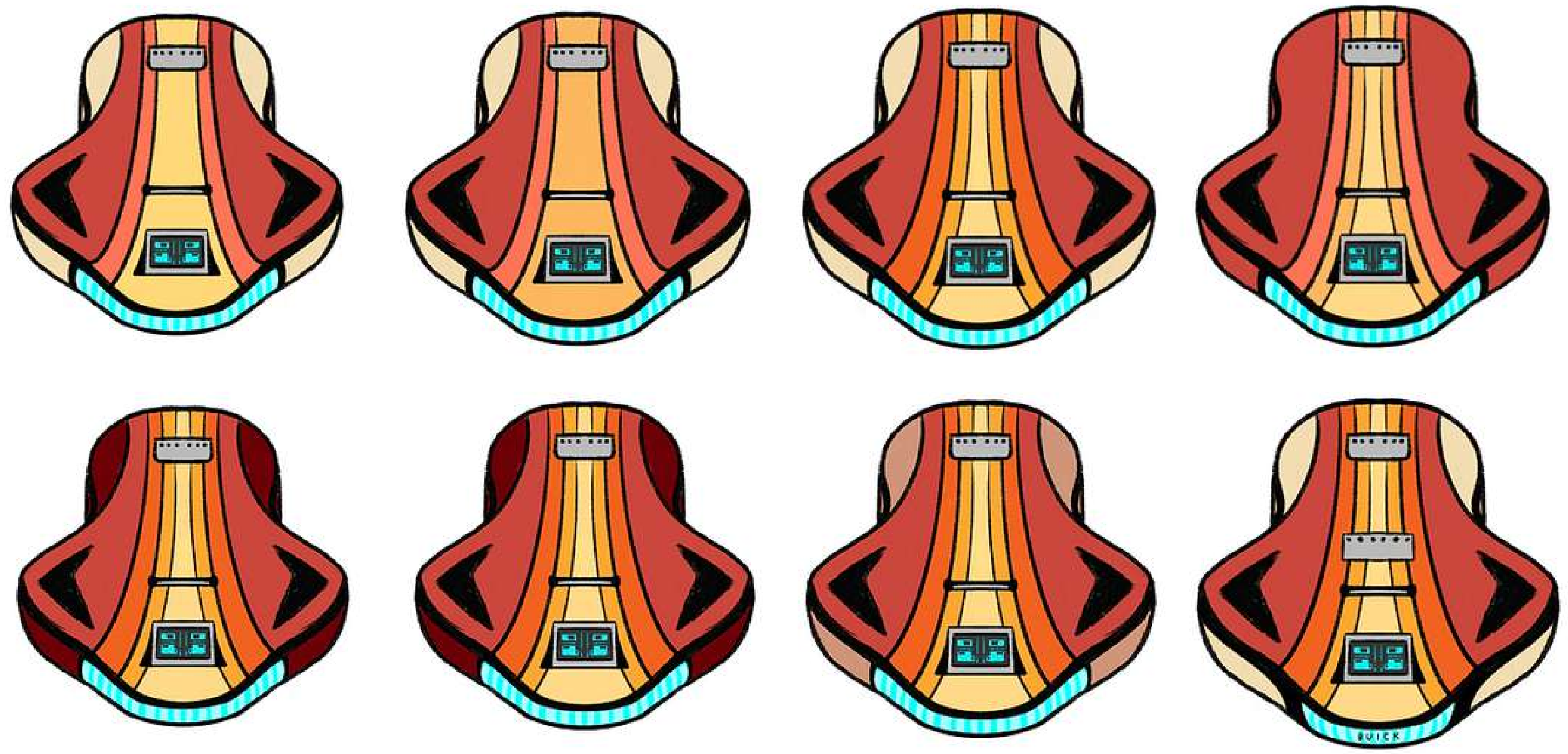
Originally, I designed the SO-89 to be a smaller, travel-sized guitar with a simpler body shape inspired by the bouzouki and mandolin.



SKETCHES + PROTOTYPES



Eventually, I scrapped the travel guitar idea and rescoped the project. Starting from scratch, I used a technique automotive designers use to brainstorm vehicle shapes and sketched several guitar "speed forms" to capture the shape of the Buick Reatta.



Iterative Guitar Body Sketches

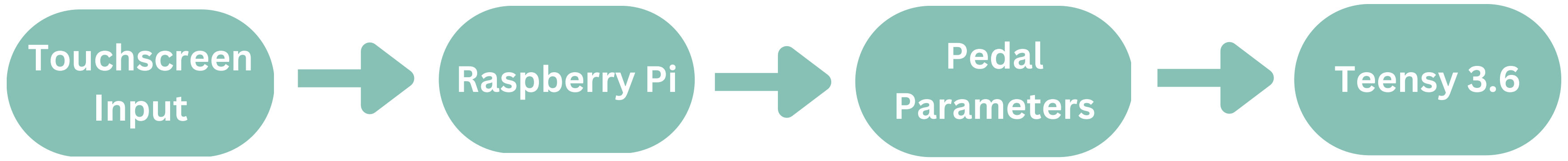


Once again, I built a 1:1 scaled prototype of the SO-89 using bristol board to see how the guitar would actually feel in my hands. I needed to make sure the "wings" that come out the sides were comfortable to hold and naturally guided the user's hand away from the centered touchscreen.

Final SO-89 Concept Design

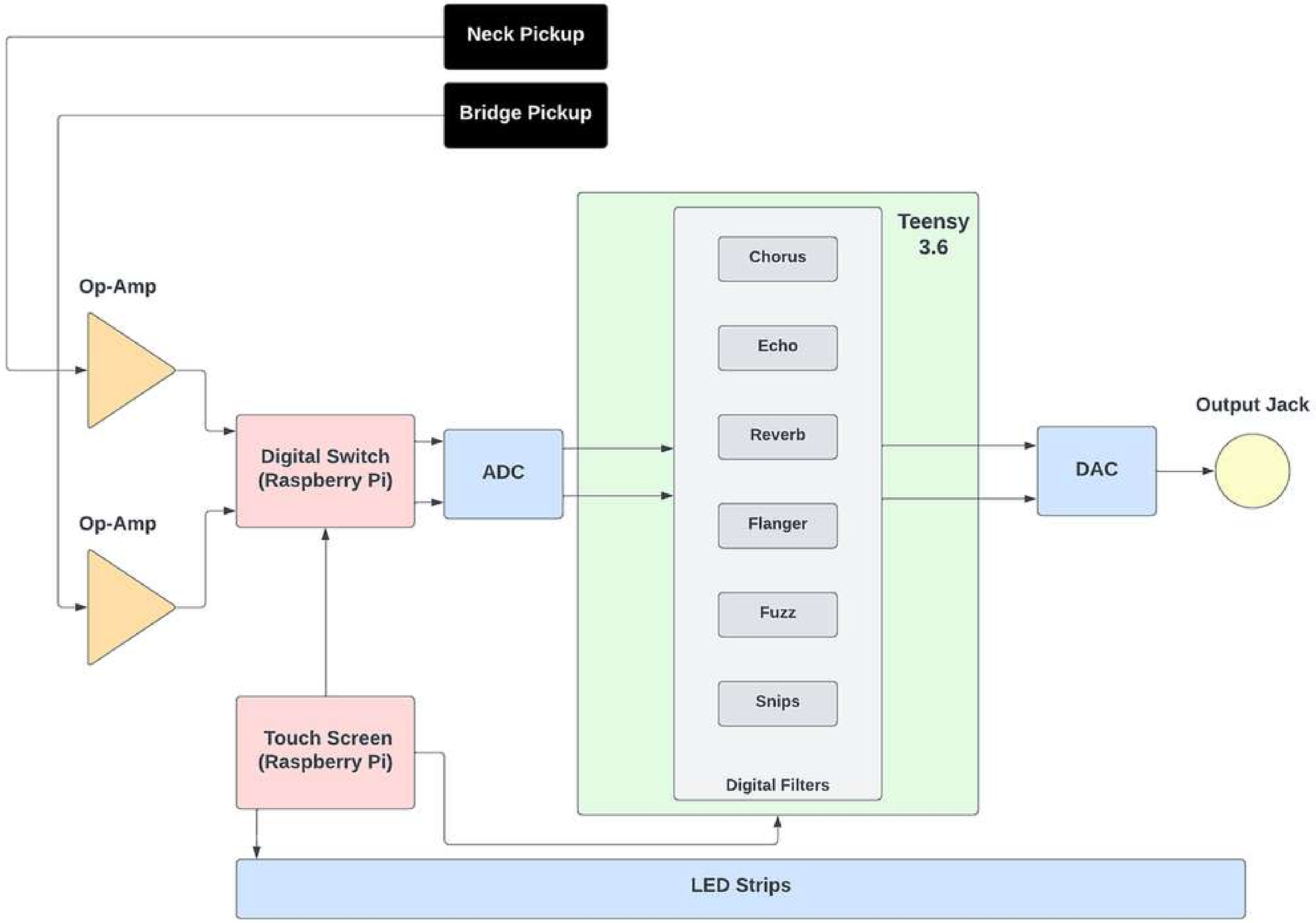
ELECTRONICS + UI

The SO-89 will be entirely digitally controlled - from its standard tone and volume nobs to the complexities of its internal reverb filter. A Teensy 3.6 will be used as a digital signal processor to alter various digital guitar pedal (filter) parameters based on inputs from a Raspberry Pi that takes user input from an LCD touchscreen. The Teensy will receive digitally converted signals from the guitar's pickups which transform vibrational energy into electrical energy.



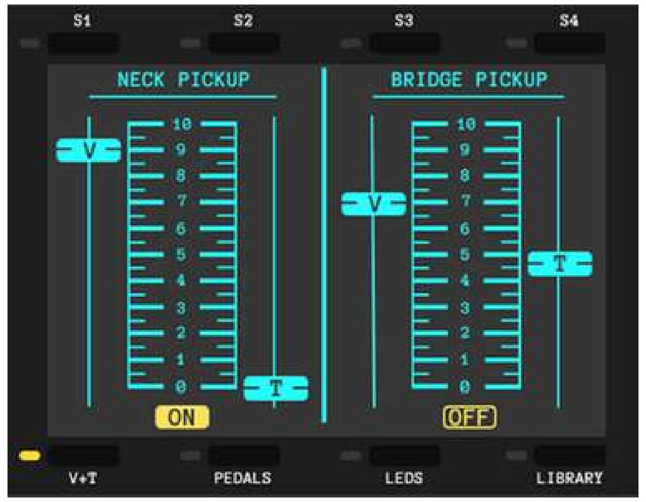
1989 Buick Reata CTR Touch Screen

There's a reason guitars haven't been digitized yet - Analog components like dials and switches are often easier to interact with! How can I design a user interface that provides comparable sensory feedback to analog components while still usingthe CTR screen aesthetic of the '89 Buick Reatta?

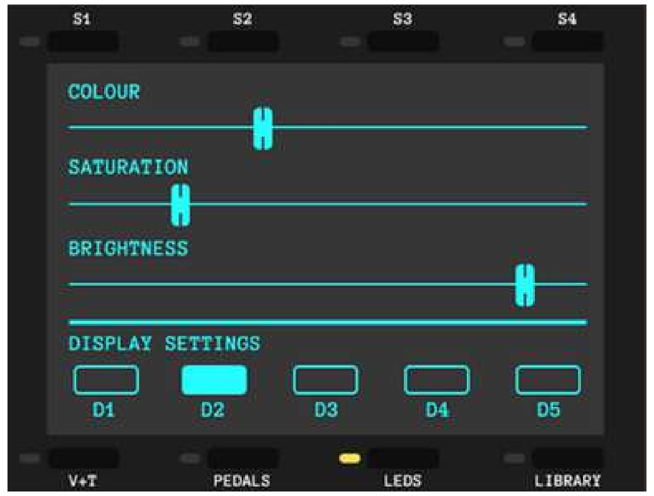


High-level SO-89 Electrical Architecture

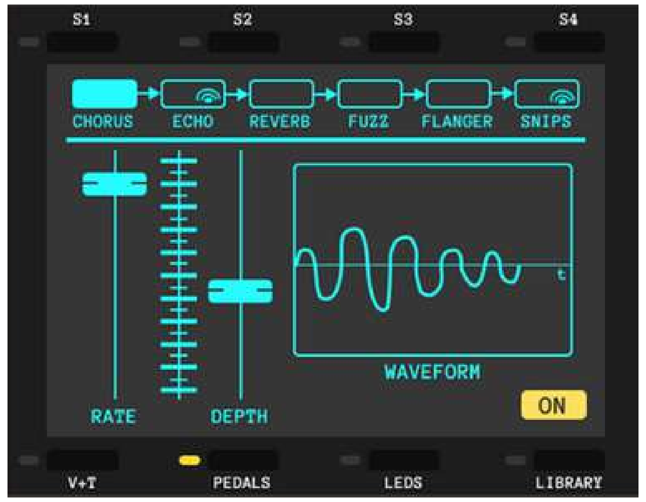
Touchscreen UI designed in Figma



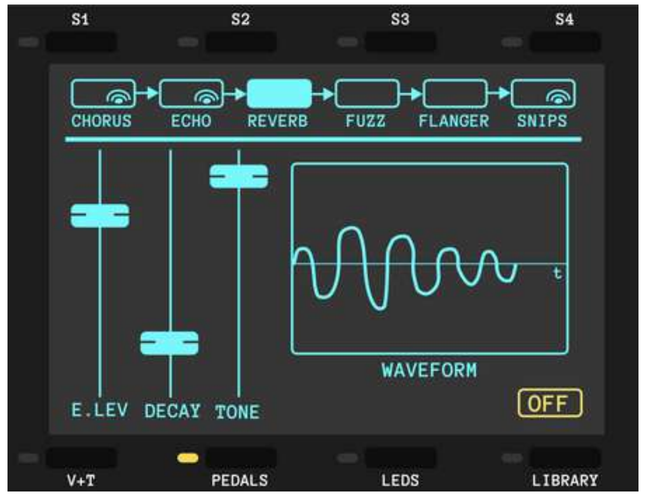
Volume and Tone Screen



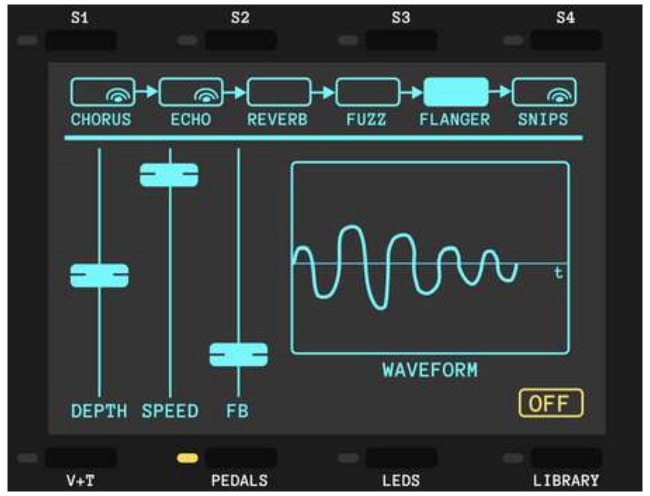
LED Display Settings Screen



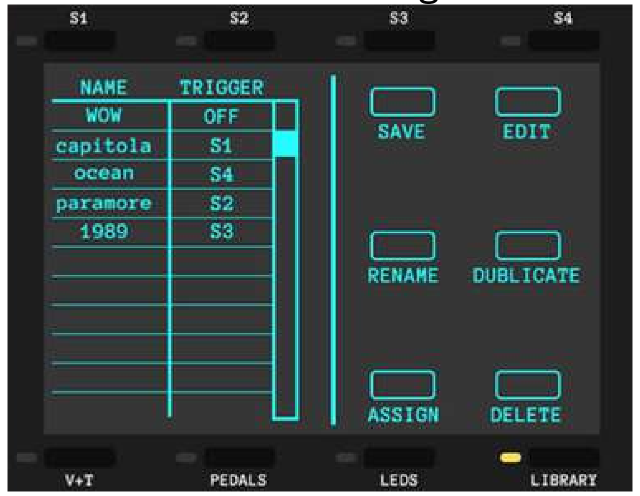
Chorus Pedal Settings Screen



Reverb Pedal Settings Screen



Flanger Pedal Settings Screen



Settings Library Screen

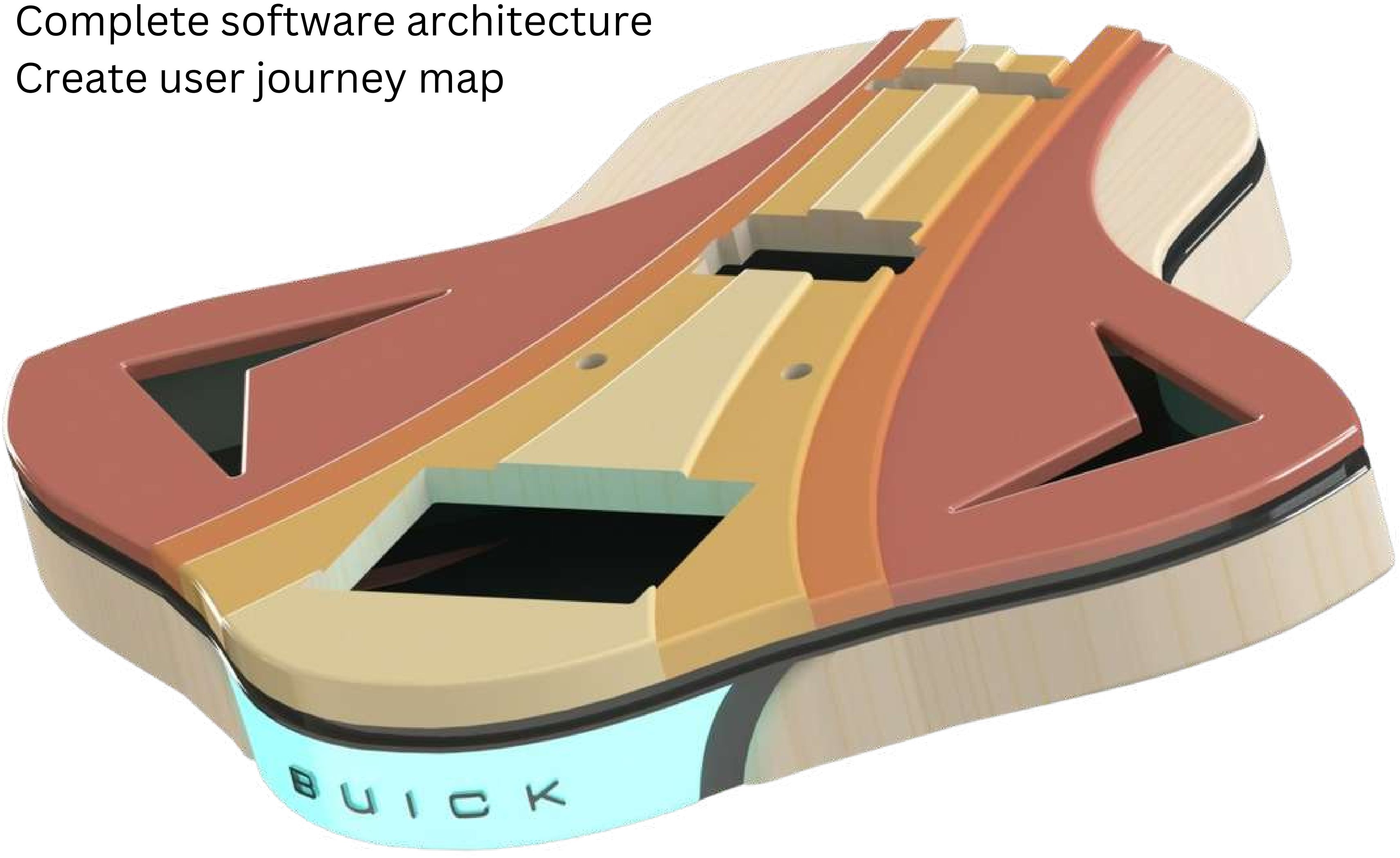
RENDERS + NEXT STEPS

As I've decided to make the SO-89 my final project for my Microcontrollers and Embedded Microprossers course, I will be continuing this project under academic supervision starting January 2023.

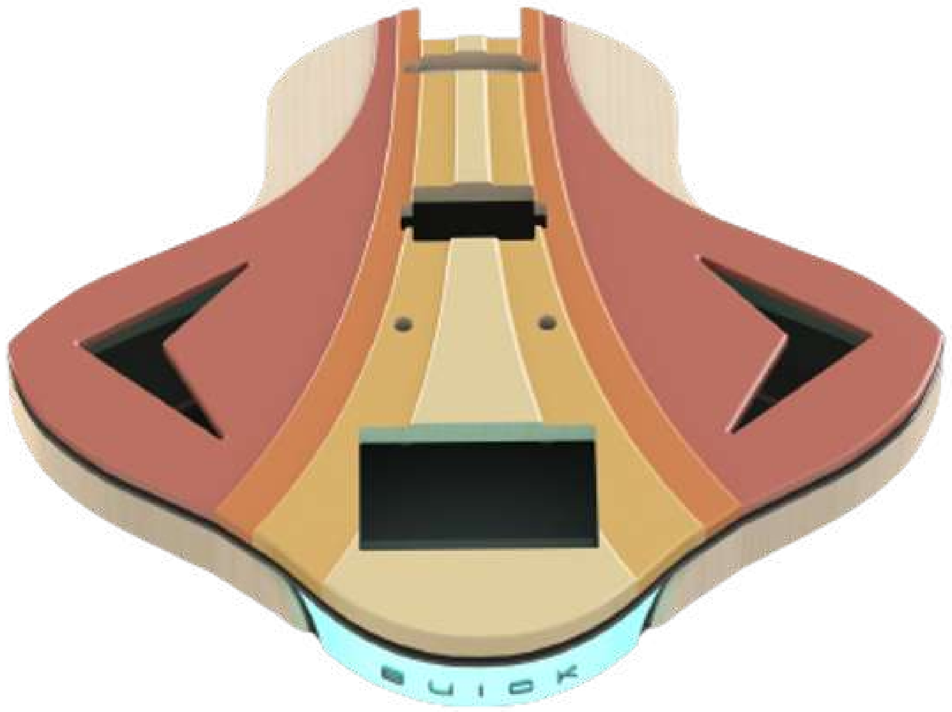
Next Steps:

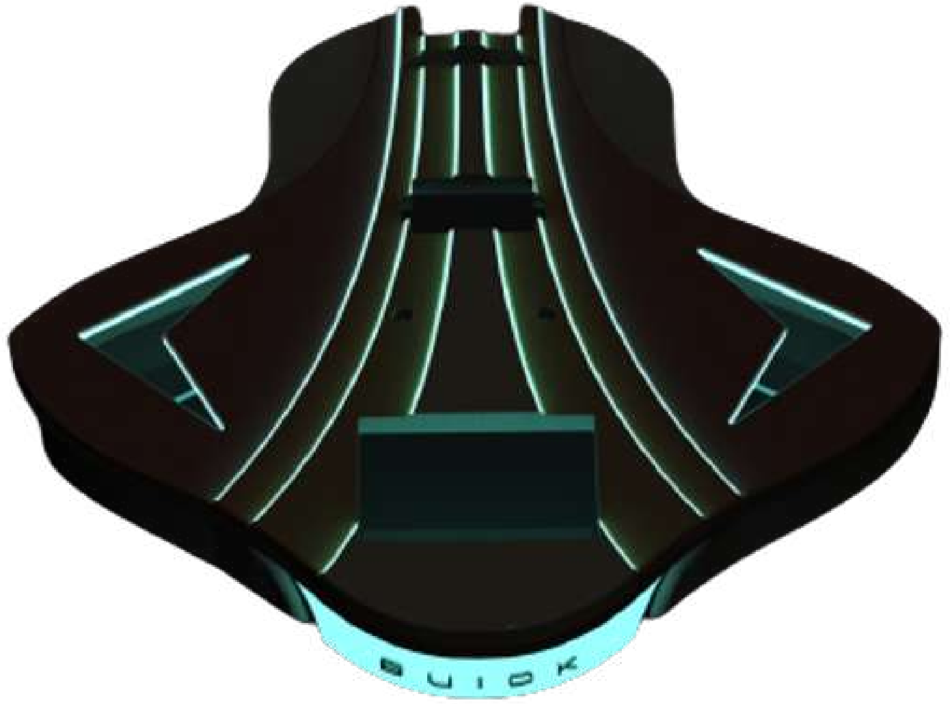
- Design all 6 filters in MatLab and get waveforms
- Complete a digital signal processing course and learn the basics of Teensy 3.6
- Design the interior aluminum diaphragm and graph the guitar body's frequency response
- Complete software architecture
- Create user journey map

SO-89's Buick Reatta-inspired Retro "Tail Light" Feature



SO-89 Isometric Exterior Render





SO-89 with a Fully Lit LED Display

PROJECT AURA

Foundation of CleanSlate UV's first consumer product

PhoneSoap Go by PhoneSoap

PROJECT AURA

Foundation of CleanSlate UV's first consumer product

"This project is a startup within a startup."
That's what one of my old co-workers at *CleanSlate UV* said to me. During the last six weeks of my internship, he tasked me to build a foundation for CleanSlate's consumer product and thoroughly understand if it is feasible for our company to enter the business-to-consumer market. Project Aura aims to analyze the unmet needs and pain points of the current UV-C consumer market to ultimately design a product that adds value to the user's life without compromising our company values such as sanitization efficacy, industrial design aesthetic, and sanitization cycle time duration.

Project Objectives

- Map the competitive landscape for user-facing UV-C sanitizers
- Validate consumer profiles
- Study and verify the product/market fit for business-to-consumer UV-C sanitizers
- Present product proposal document to sales team

Employer:	**Role:**
CleanSlate UV	Product Manager

Collaborative Project (Team Size: 2) - Jul 2020 to Aug 2020 | Competitive Analysis | R + D

Current State → **Gap** → **Final State**

Current State: Smartphones and other personal products are infected

Gap: ?

Final State: All personal product surfaces are sanitized using UV-C light

UV-C Sterilizer by Samsung

UV-C Sanitizer by HoMedics

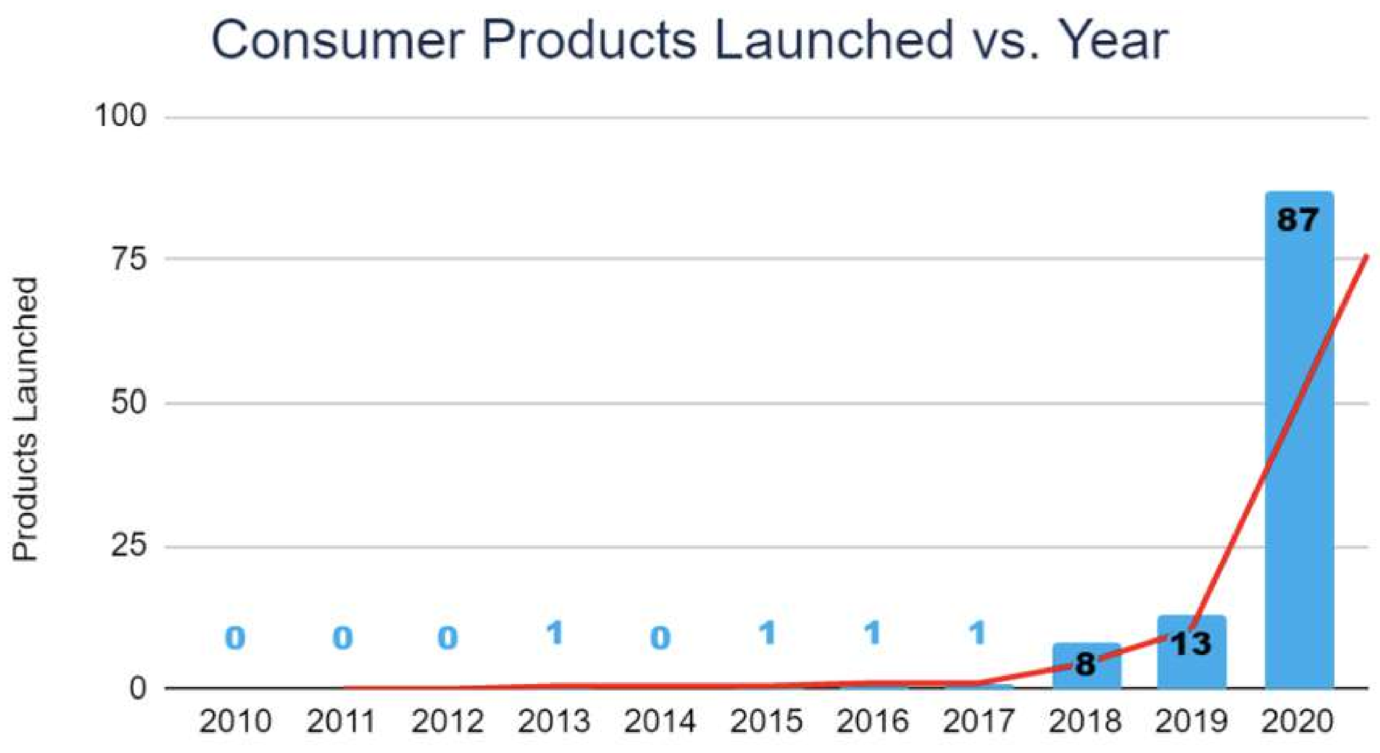
Rock Box byRock UV

PhoneSoap 3 by PhoneSoap

cleanslate UV

PRODUCT/MARKET FIT

The portable UV-C sanitizer market in new, growing, and relevant. Prior to the height of the COVID-19 crisis in March 2020, there were 25 products on the market and 8 individual companies specializing in UV-C sanitization technology. As of July 2020, there are over 115 UV-C products available for purchase and total of roughly 80 different companies – and this number will only continue to grow.



% Growth 2019-2020
569%

Incoming Products
10+

Total # of Products
115+

Most Active Month for Product Release
April 2020

Market Favoured Product Type
Box-style

Market Favoured Price Range (USD)
$50-$100

Products Launched in 2020
85+

Amid the large and growing consumer market, there are only a handful of companies and products that could compete with CleanSlate UV when it comes to making an impact as a global leader in UV-C sanitization technology space. We can better understand our competition by mapping them out across a Competition Landscape. This landscape schematic consistsof 3 metrics: **Product price**, **sanitization efficacy**, and **company size**.

CASE STUDIES + SURVEYS

Who are our consumers?

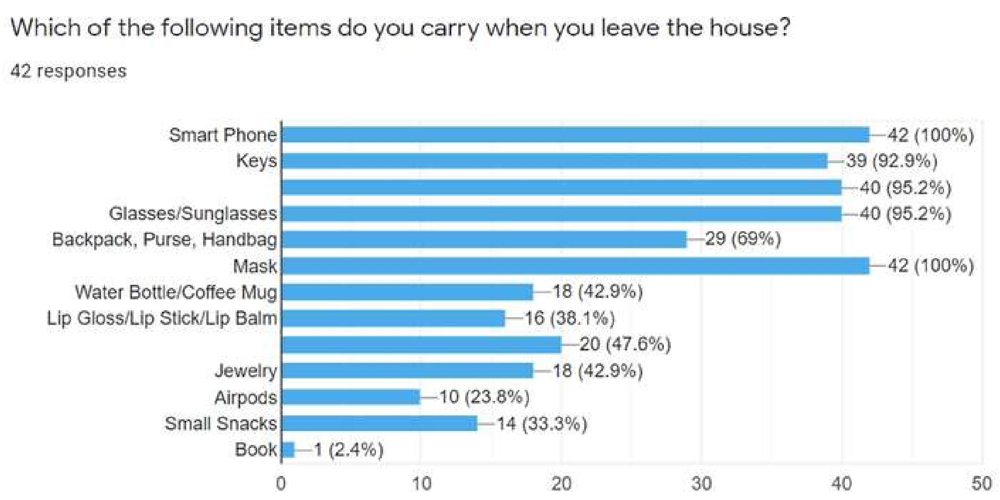
The goal of the following consumer case studies is to iteratively pinpoint the primary consumers and discover answers that will influence and drive inspiration for new features and high-level design decisions. The case study begins by imagining potential consumers through the use of consumer profiles. They explain who the average consumer is and how they behave. Their thoughts, senses, and, feelings are all explained. You can run through their typical day to see their patterns and where there might be a need for a sanitization device. People purchase products or services for three reasons: to satisfy basic needs, to solve problems, or to make themselves feel good; it will be crucial in determining where the solution lies so it can be marketed accordingly. The second step is to begin validating the consumer profiles through surveys and interviews.

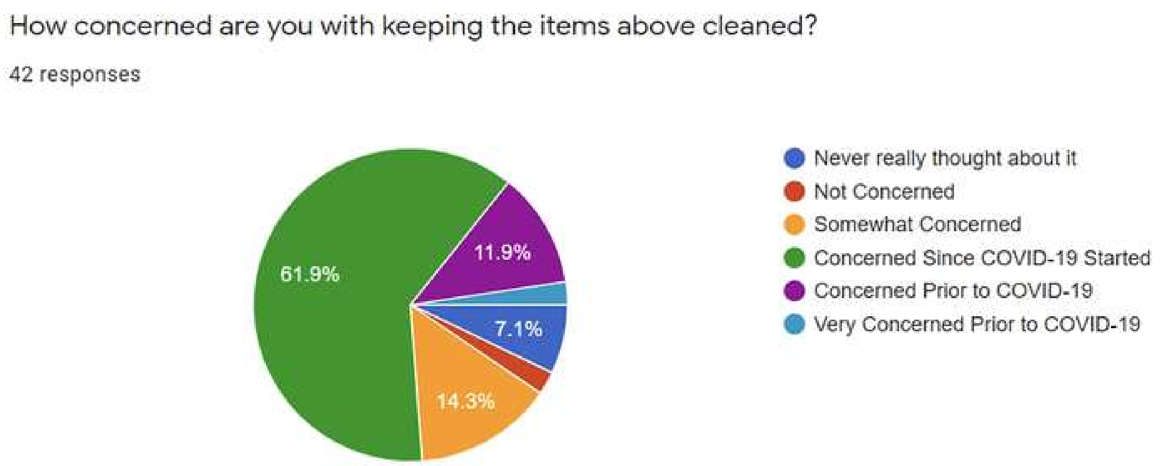
Profile Example: Kathy

Stock Image of a Suburban Mom

- Mother of young children
- Lives in a suburban home
- Cares about children's health, hygiene, and safety
- Values higher-quality products and lifestyle
- Owns a Dyson vacuum, a Roomba, and similar products
- A typical day includes lots of driving to different locations: Store, school, kids' extracurriculars, gym, friends' houses

In total, we got 42 "Kathys" to answer our survey in two days! Here are some samples from the results.





Survey Results Summary

- New consumer profile should be investigated – Women over 65
- Most people are satisfied with their current cleaning methods Different methods may not be needed
- Users favor portable cleaning products
- Users purchase sanitizers to protect their own personal health and their families

cleanslate UV

FINAL PRESENATION

The UV-C market is unique.
Until the COVID-19 pandemic, UV-C technologies were mainly reserved for medical applications. Now, the consumer market is being educated about the benefits and use cases of UV-C light at an exponential rate. However, it is still a relatively new technology and its continuous demand in the consumer space is still uncertain. During my last week at CleanSlate UV, I presented my findings in regard to the competitive landscape and product/market fit as well as survey results and proposed product features. Finally, I showcased a roadmap to illustrate the next steps for Project Aura.

My Coworker and I Presenting Project Aura

Proposed Product Features

- **Contactless Sanitization**
  - *Limiting or removing any contact points during the sanitization process eliminates the risk of cross-contamination.*
- **Sanitization Process Feedback**
  - *The product must stimulate the user's senses in a way that builds trust between the user and the device via LEDs, sound effects, etc.*
- **Less Than 3 Minute Sanitization Cycle Time**
  - *Not only will this make product use more efficient, it also gives our device a competitive edge. All portable UVC sanitizers have a cycle time of 10 minutes or more.*

Project Aura Roadmap

TESLA PROJECTS

Pneumatic suspension vibration and strength testing

Cybertruck by Tesla Inc.

Semi by Tesla Inc.

PNEUMATICS BRACKET

Air suspension support bracket design and modal analysis

Let's shake it up.

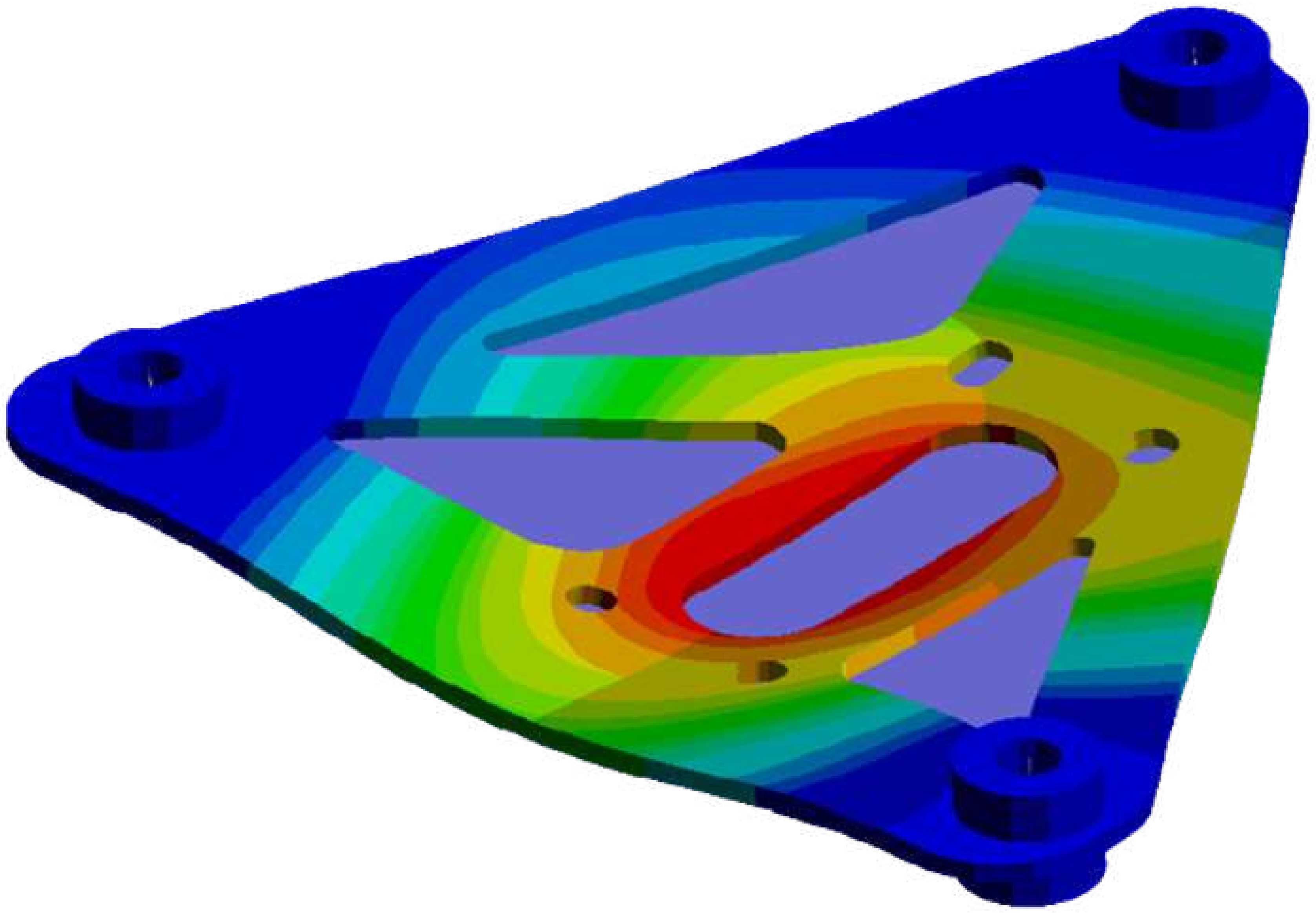
One of my tasks at Tesla was to design a vibration test fixture for large vehicle pneumatic system subassemblies to troubleshoot current fatigue failures seen in road testing. During the test, I offered to redesign a couple of structural brackets based on the failure analysis of vibration tests. To design these new brackets, I taught myself modal analysis within a week to ensure all my designs were properly tested before installing them on the fixture.

Fixture Design Objectives

- Resist bending
- High weight capacity
- Cheap to fabricate

Bracket Design Objectives

- Increased stiffness
- Simple geometry (Cheap + quick to mass produce)
- Easy-to-install

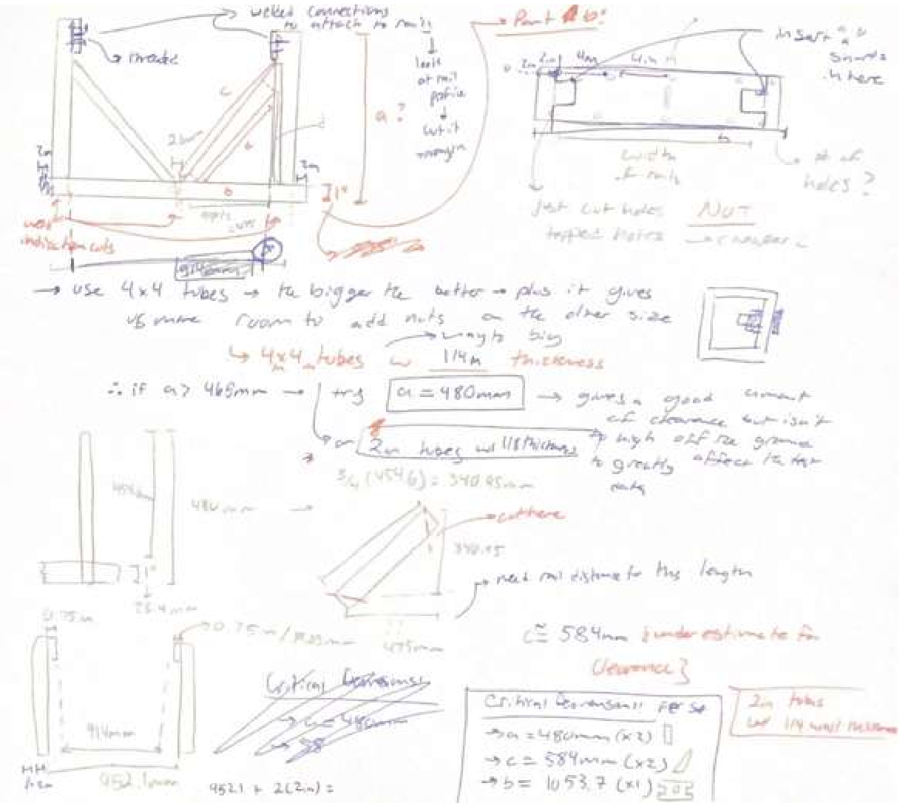


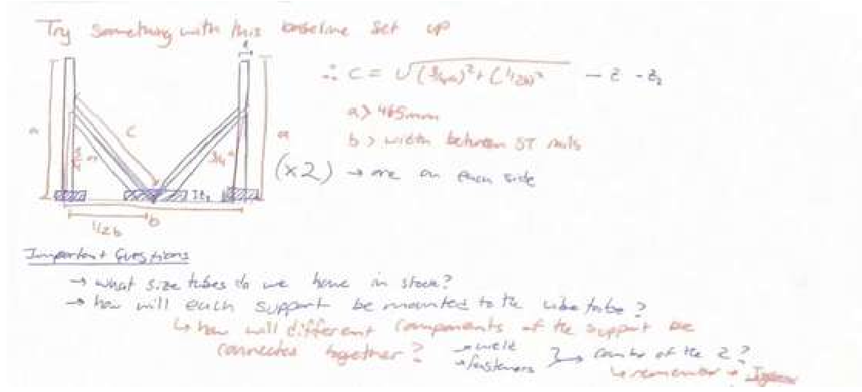
Collaborative Project - Sep 2021 to Dec 2021 | Modal Analysis | CAD | Vibration Testing

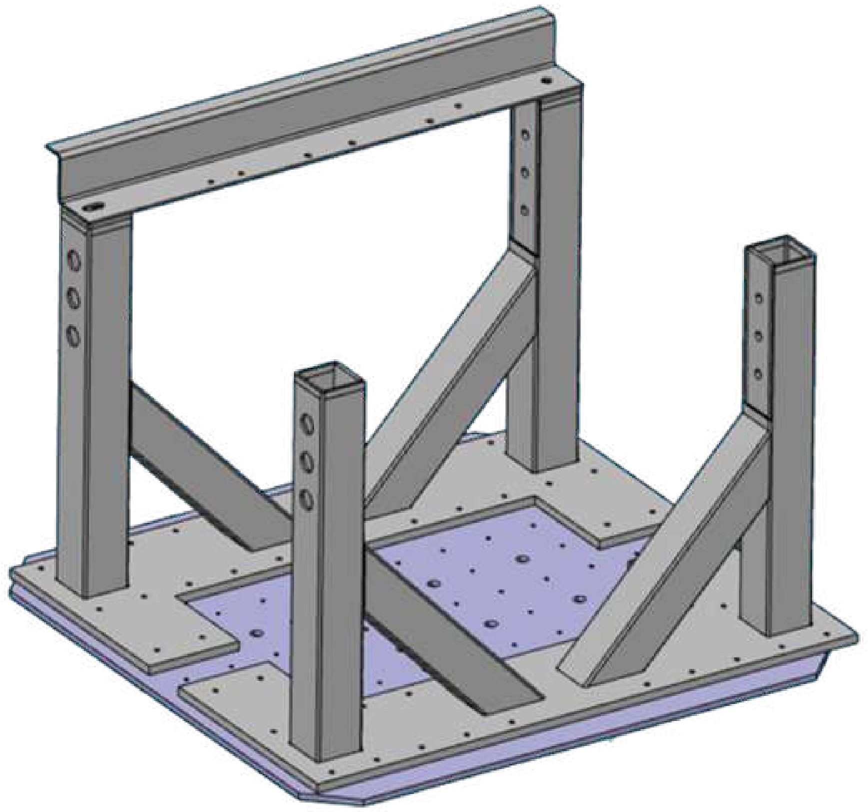
Employer:
Tesla Inc.

Role:
Chassis Engineering Intern

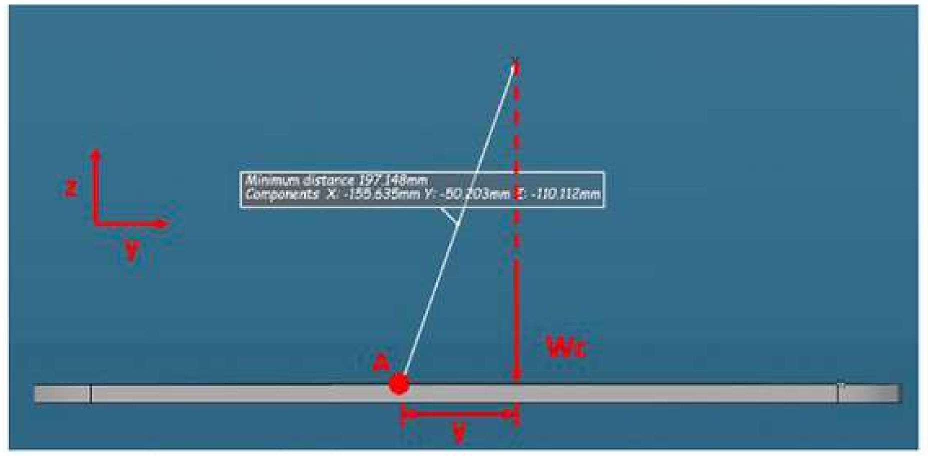
TESLA







To the left are various preliminary conceptual sketches for the vibration and shock test fixture made with low-carbon steel tubes to save cost. Above, is the final CAD model of the same test fixture.



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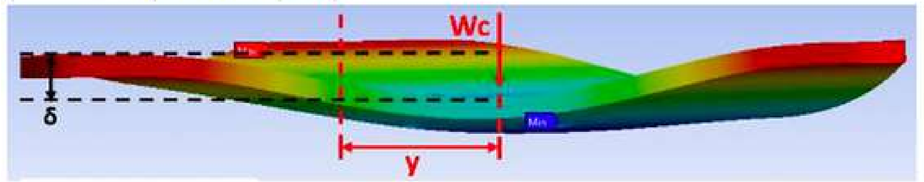
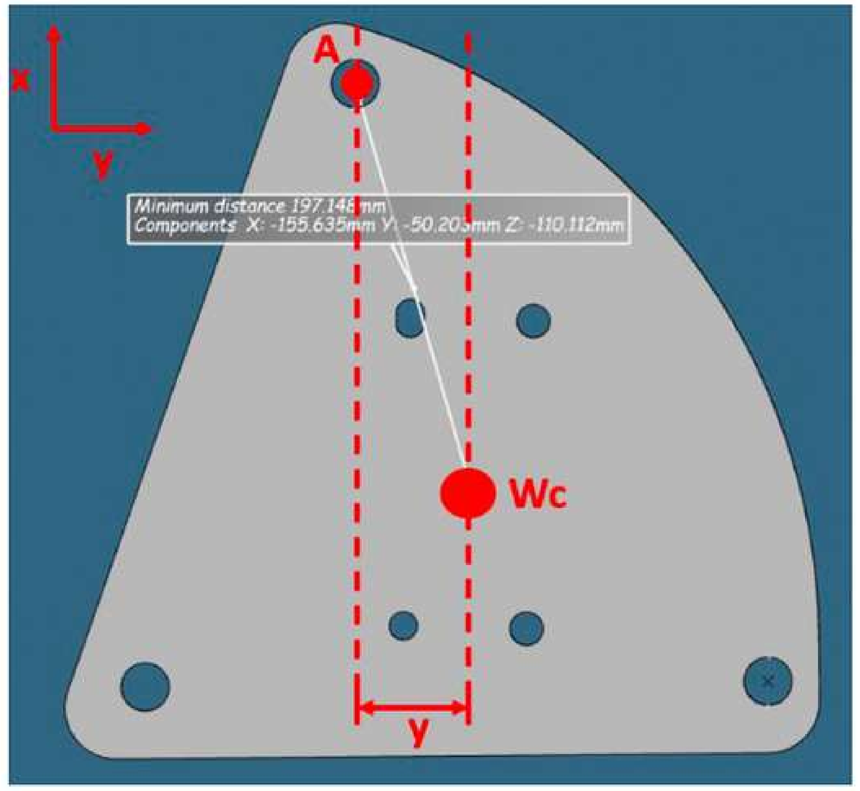
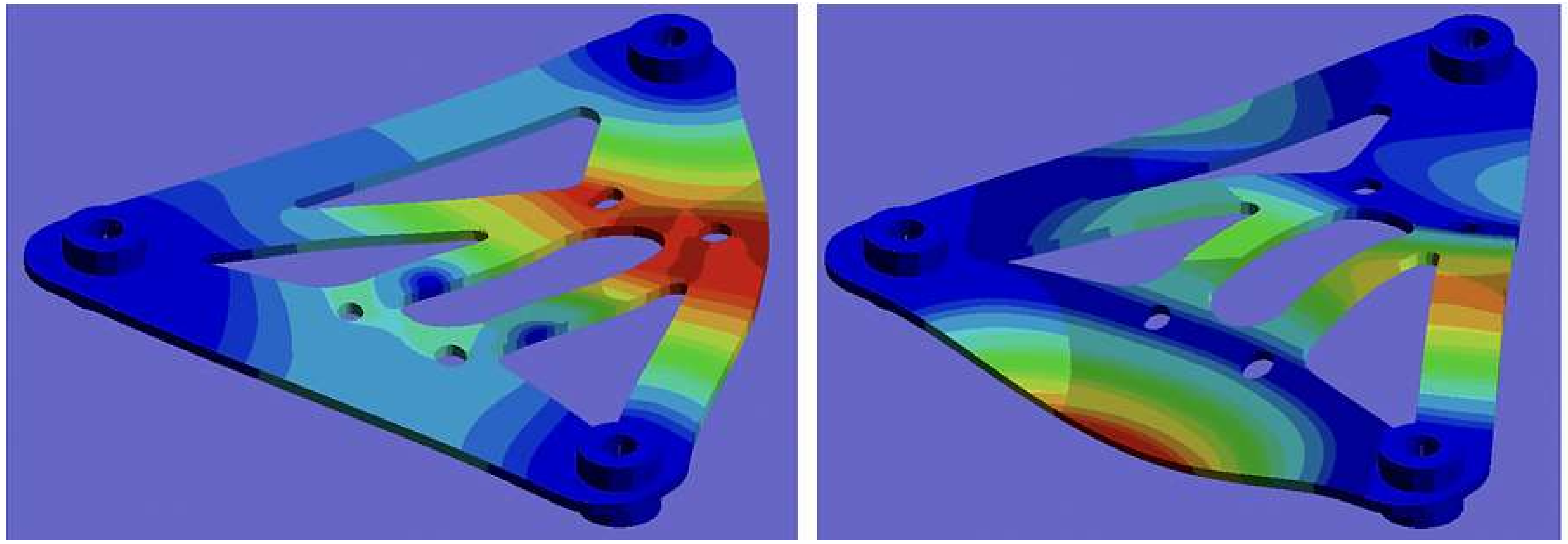


$$k_r = \frac{M_A}{\theta} \qquad \theta = \tan^{-1}\left(\frac{\delta}{y}\right)$$



The brackets that were failing during the vibration test had a natural frequency similar to the frequencies that the system was excited to during the test, causing resonance. Therefore, I needed to increase the stiffness of the original bracket. As I started to develop new bracket designs, I developed a way to approximate bending stiffness to see how the stiffness would change with each new geometry.



Mode shape examples for the final bracket design

Fixture Design Highlights:

- Designed a stiff and durable test fixture that could withstand intense vibration testing while supporting heavy assemblies without bending or deforming
- Assembled and installed large pneumatic systems by hand
- Worked tireless hours to rework the failing sub-assemblies to keep the whole test running

Bracket Design Highlights:

- Created a modal analysis simulation that accurately reflects the boundary conditions of the vibration test
- Developed 7 versions of this bracket and fabricated the final design for further vibration testing
- Presented final designs and simulation results to the reliability and testing team

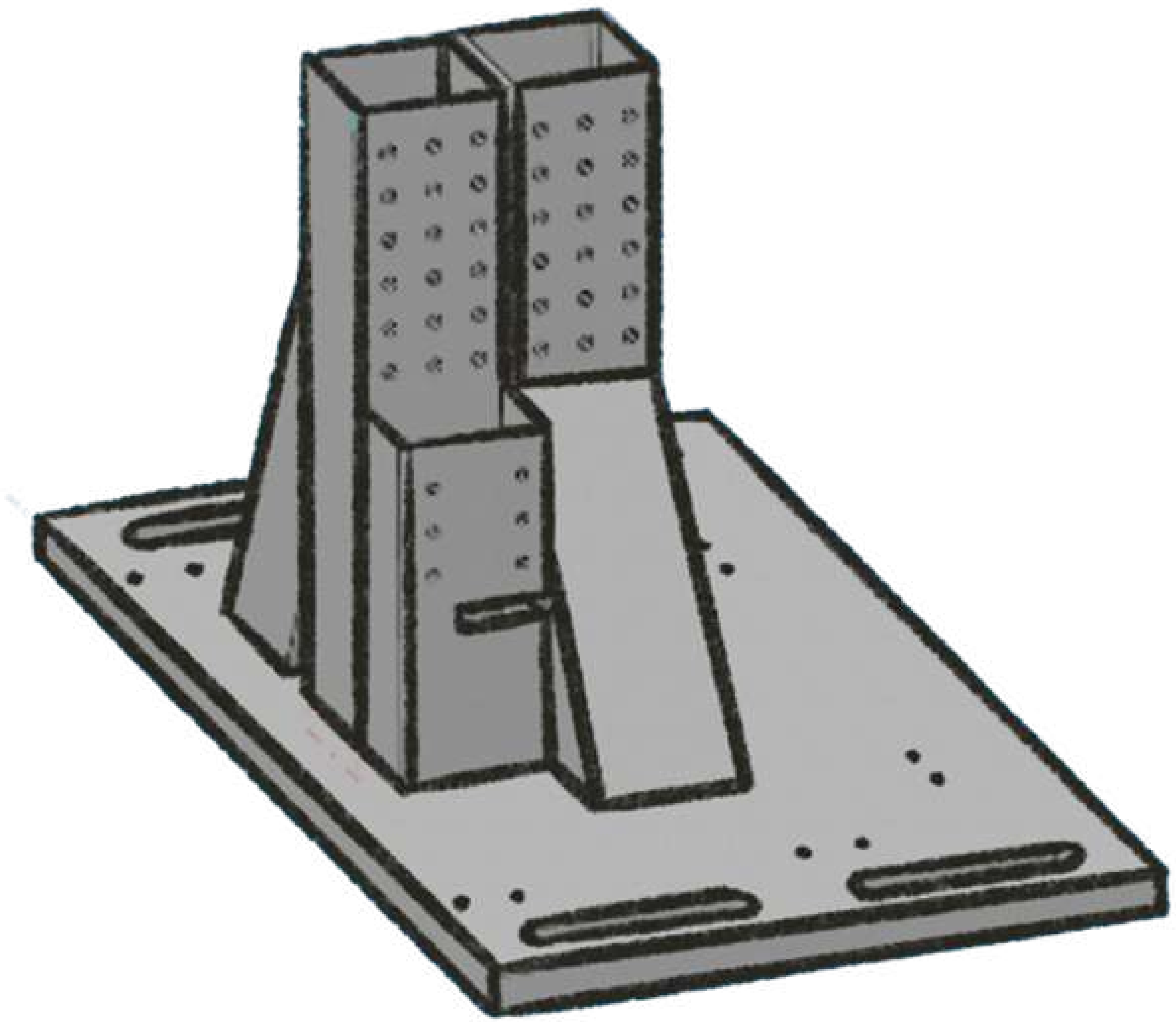
PRESSURIZED BEND TEST

Quantifying air reservoir structural endurance

Bend it till it breaks.
My first task at Tesla was to design an air reservoir bend test for one of their vehicles. This particular air reservoir needed to support very high bending loads and our current finite element analysis (FEA) models were unable to predict the load at which the reservoir would burst. Therefore, I needed to find the reservoir's ultimate failure load in which the reservoir bursts. To do this, I developed a bending test fixture and procedure to push the reservoir to its breaking point. With the data from this test, we could validate our current FEA models of the reservoir.

Design Objectives

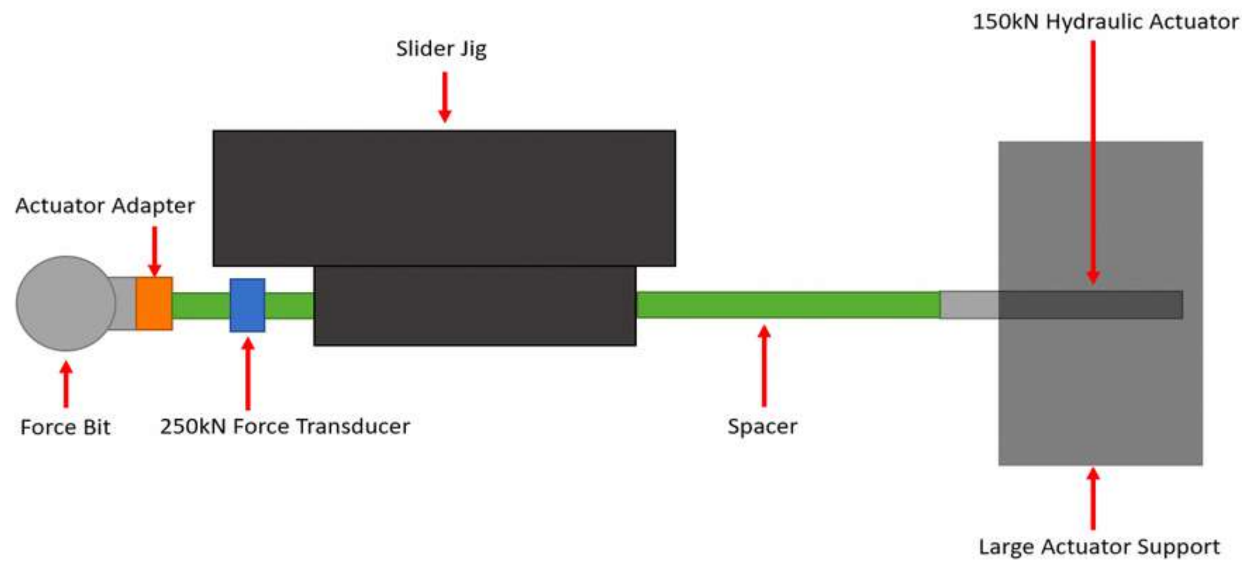
- Robust and stiff
    - Does not deform under high bending loads
- Adaptable
    - Can retrofit current and future air reservoir designs to fixture
- Easy-to-install



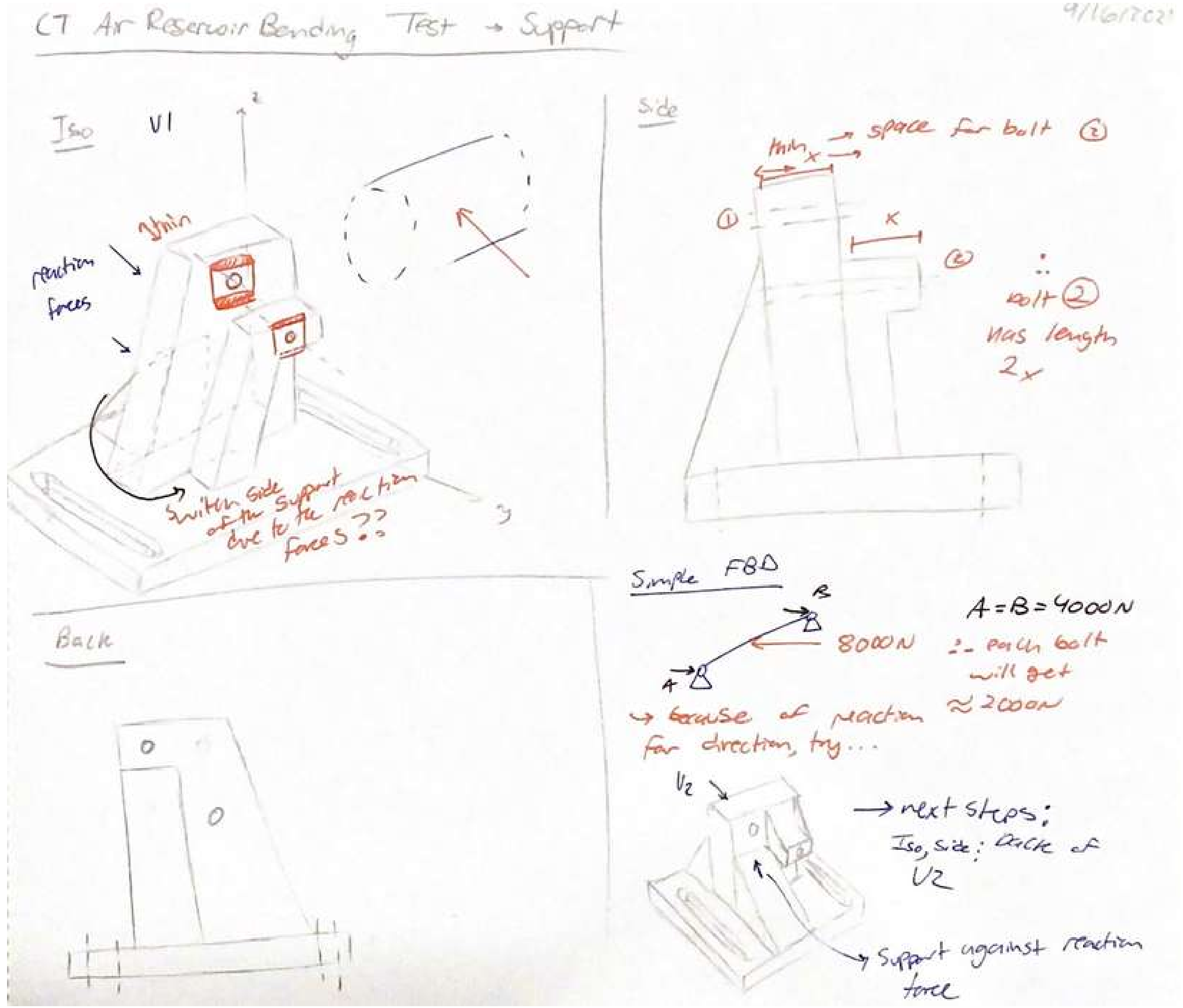
Employer:
Tesla Inc.

Role:
Chassis Engineering Intern

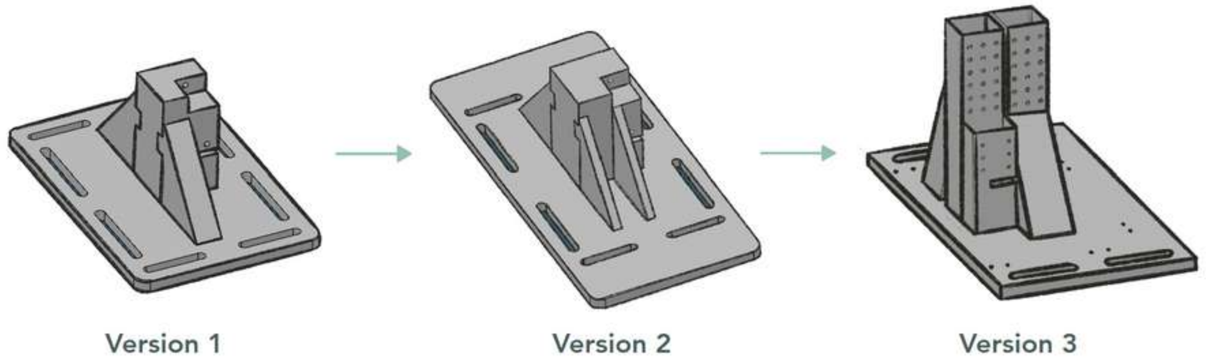
Collaborative Project - Sep 2021 to Dec 2021 | Reliability | CAE Validation | Test Fixture Design



Working closely with the vehicle testing team, I developed a test layout that worked for them and their means of installation. We wanted this test done well and for it to be set up efficiently. I also implemented their slider jig as a safety measure in case the fixture failed before the reservoir.

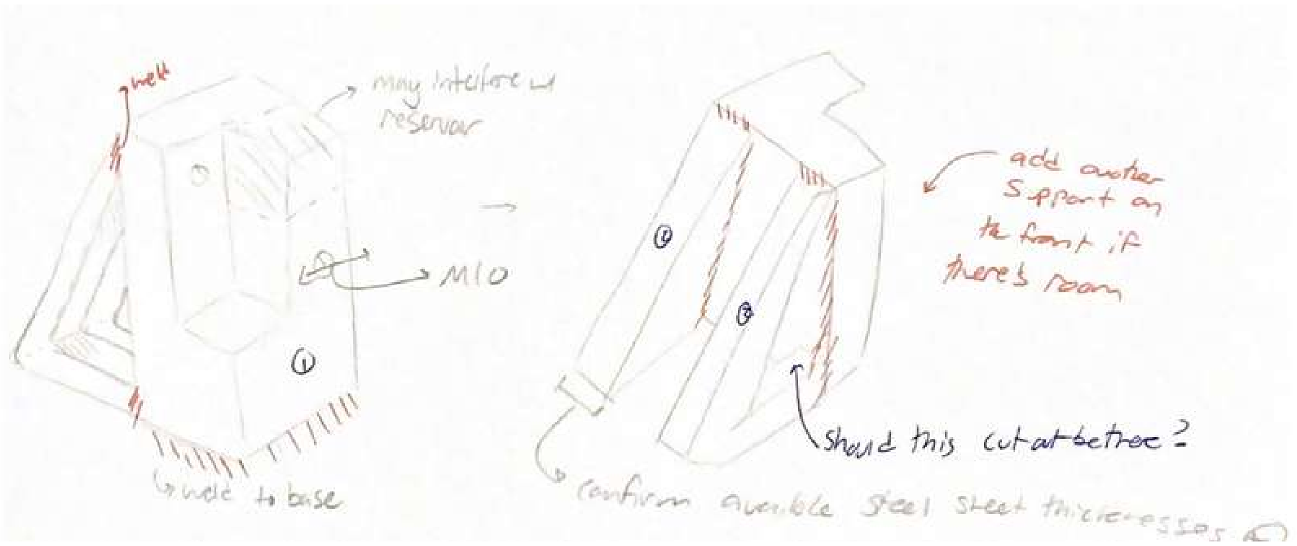


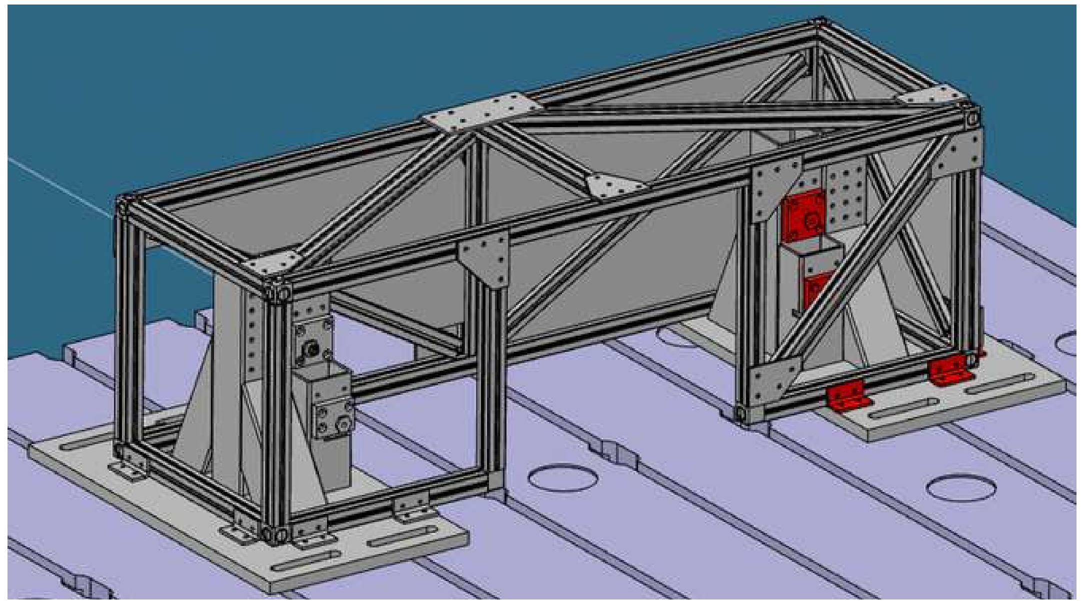
This fixture had two main parts - supports to mount the reservoir and a high-velocity projectile shield to protect the technician when the reservoir bursts. All components needed to be easy-to-fabricate, cheap, and incredibly stiff in the event of the pressurized reservoir rupturing.



Reservoir support iterations

High-velocity projectile shield assembled by hand





Final Fixture Assembly in CATIA V6

Design Highlights

- Designed versatile and robust universal bending test supports which can be adapted to test future iterations of the reservoir
- Fabricated and assembled an 80/20 aluminum x polycarbonate shield to protect the technicians while the test was running
- Worked with reliability and test team to create a bend test layout that utilized high-force hydraulic actuators to apply the load
- Reservoir endured up to 425% of the predicted ultimate force (Much higher than we though!)

TESLA

VEHICLE PROJECTS

Formula SAE and aerial rescue vehicles

2021 Combustion Student FSAE Vehicle - University of Toronto Formula SAE

Buick Reatta by General Motors

WHEEL CENTRE

Reiteration and mass reduction of unsprung suspension mass

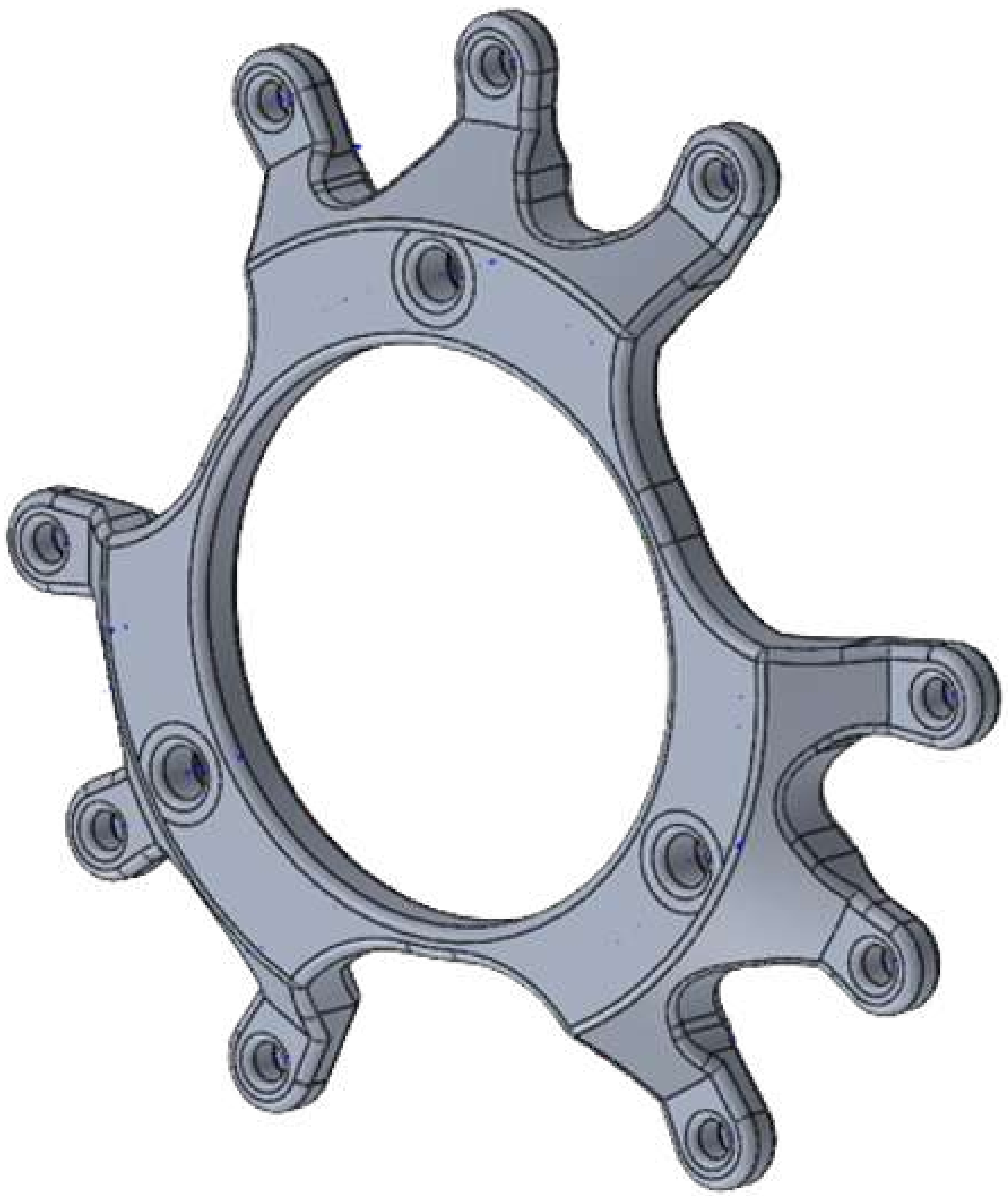
My first step into the world of chassis design.
This was my first project as a suspension engineer for the University of Toronto Formula Racing Team (UTFR). My goal was to radically change the design of the existing wheel centre and reduce its overall mass without compromising the strength or stiffness of the part. The wheel centre is a structural component of the suspension assembly that connects the wheel hub to the rim. Once completed, I installed it on our car and tested its strength. Since 2020, we've been using it on our car in every competition!

Design Objectives

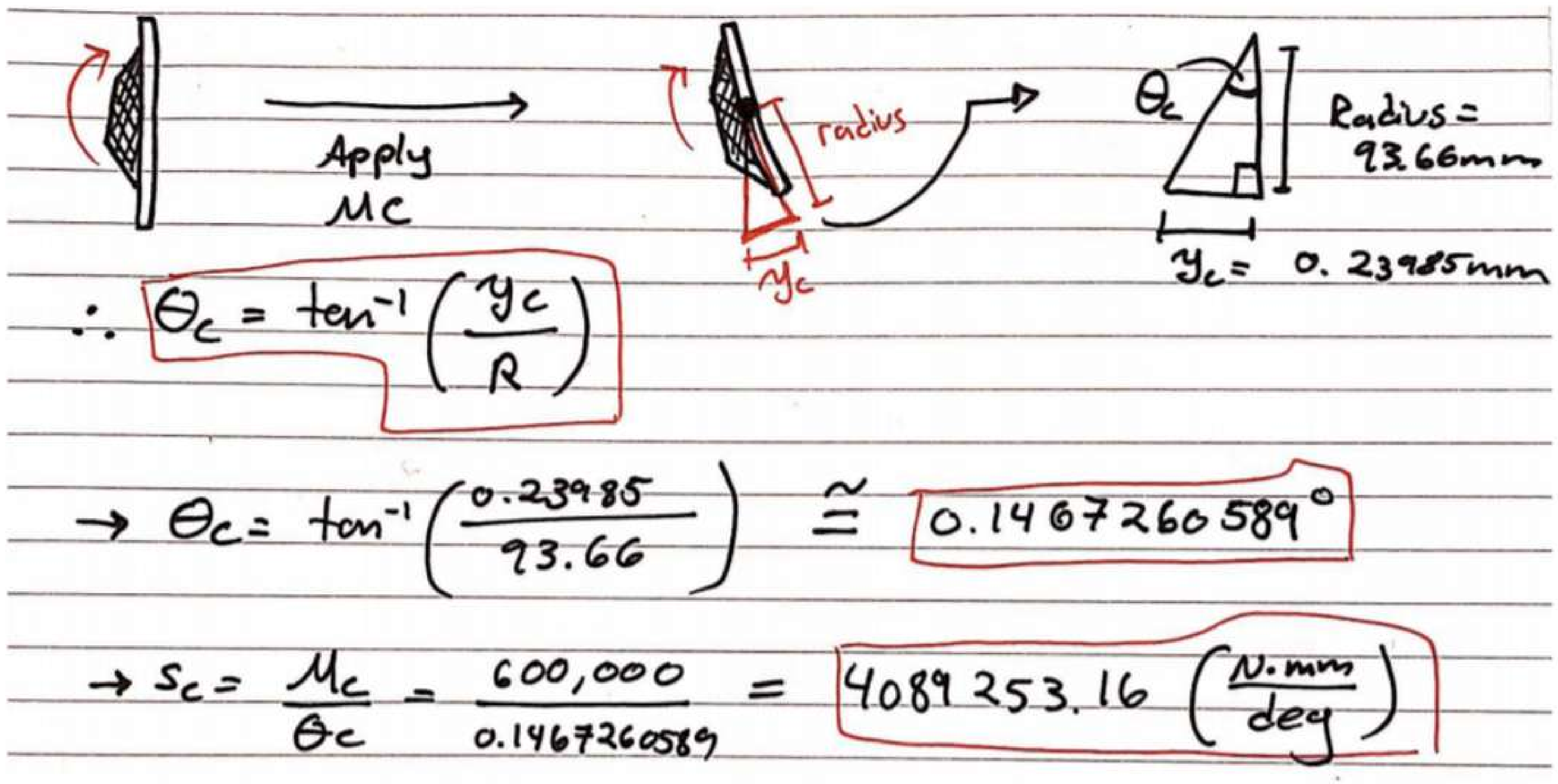
- Reduce weight by 10%
- Maintain torsional stiffness
- Easy-to-install
- Withstand dynamic loads cases from braking and cornering

Student Team:
UTFR

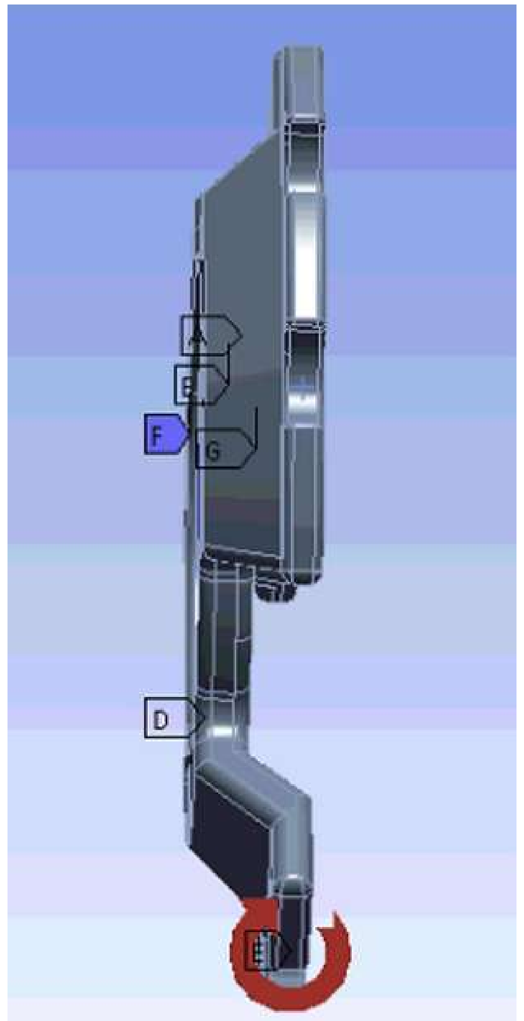
Role:
Suspension Engineer



Solo Project - Sep 2020 to Dec 2020 | Vehicle Dynamics | FEA | Data Analysis



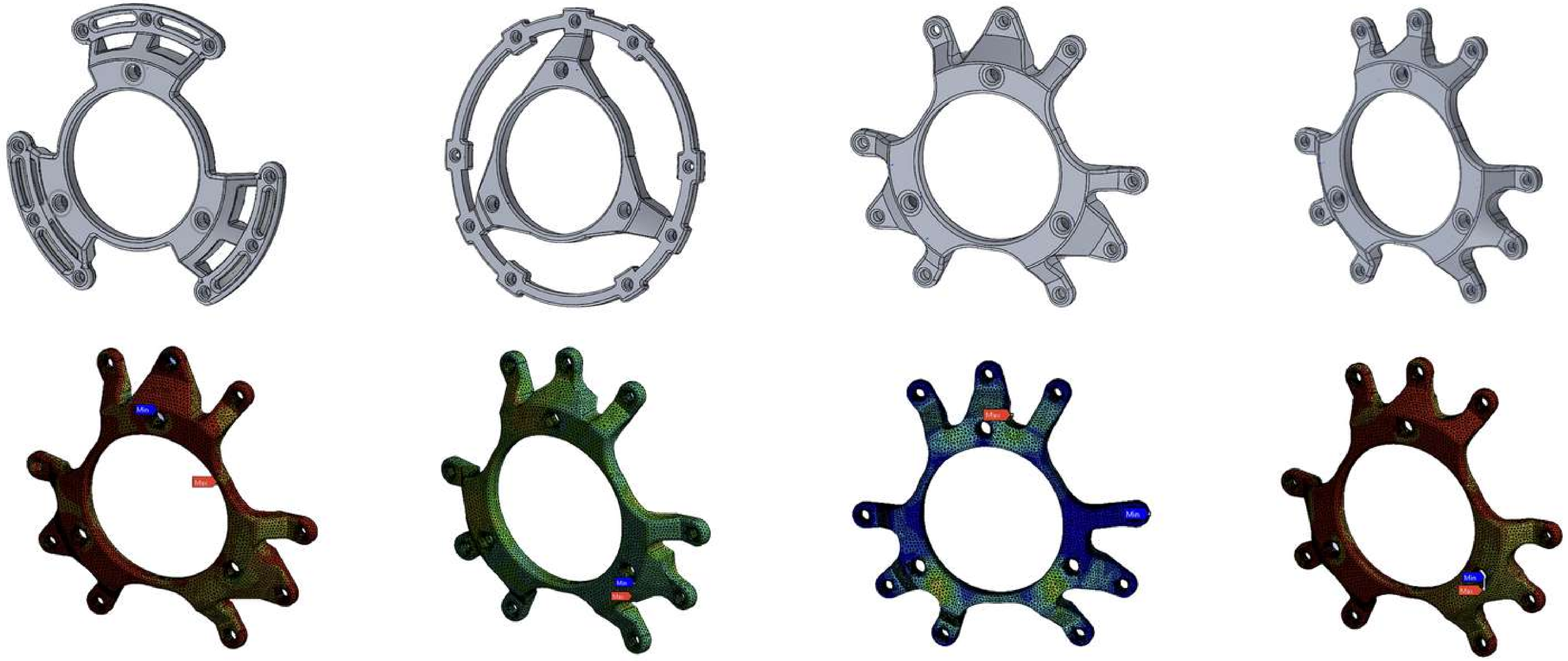
Calculation example for quantifying the camber stiffness of the wheel centre



Final Product - Wheel centres made from 6061 aluminum

Design Highlights:

- Designed 10+ iterations of the new wheel centre to reduce the overall mass by 31% (0.78 pounds to 0.54 pounds)
- Failure criteria for all realistic loading cases fulfill the design requirement for a factor of safety of 1.75
- Torsional stiffness increased by 27% in comparison to previous iterations
- Created professional engineering drawings to receive manufacturing quotes

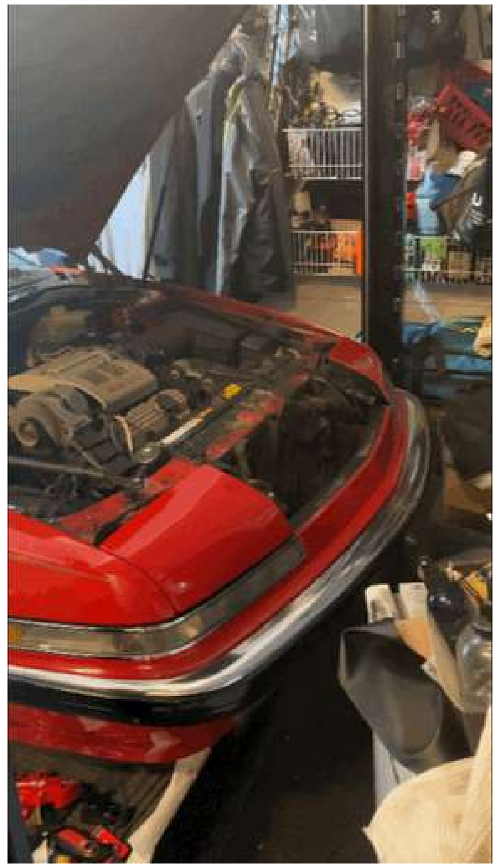


Went through several static analysis simulations to reduce mass while maintaining torsional stiffness.

REATTA REVIVAL

'89 Buick Reatta restoration

The car that started it all.
Back when I was working at CleanSlate UV in 2020, an old manager of mine - Kevin Truong - inspired me to take curiosity into my own hands. While learning the technical foundation of design in class is great, Back then, I had no idea what I wanted to design, but considering I play many adrenaline-filled sports, fast cars were a good place to start. So, I decided to restore my mom's old 1989 Buick Reatta to learn some of the fundamentals of automotive design by getting some hands-on experience in my own garage.

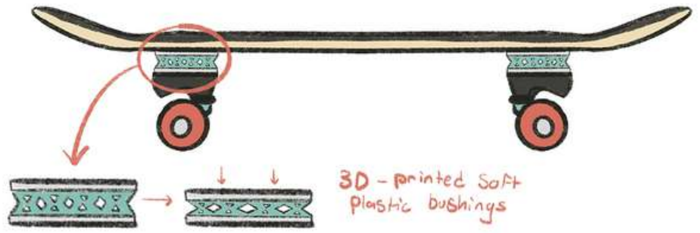


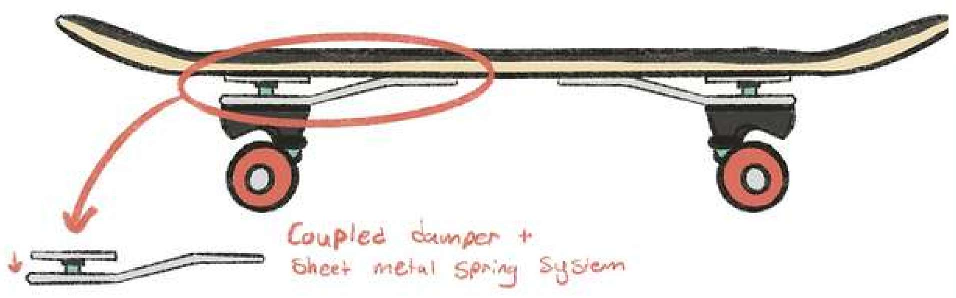
- Took apart the entire front end of the car to replace the headlight motors
- Diagnosed different component failure cases before repair (Oxygen sensor, speaker PCBs)
- Repolystered the interior
- Replace brake rotors
- Made 10+ Mixtapes

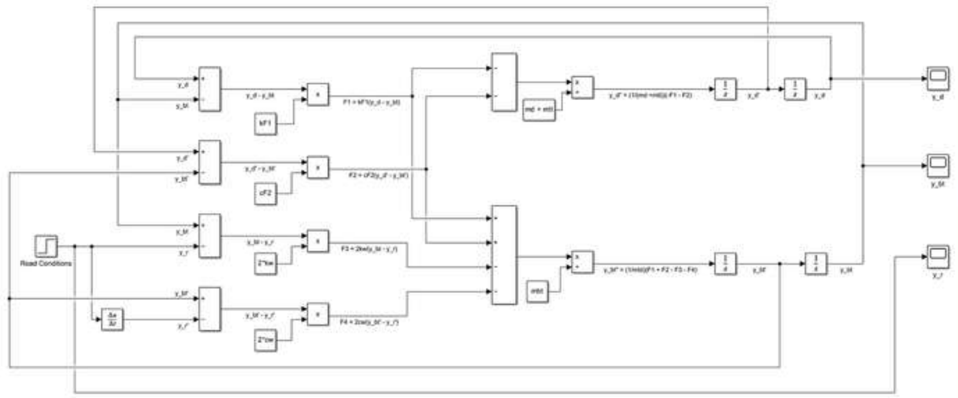
IN PROGRESS

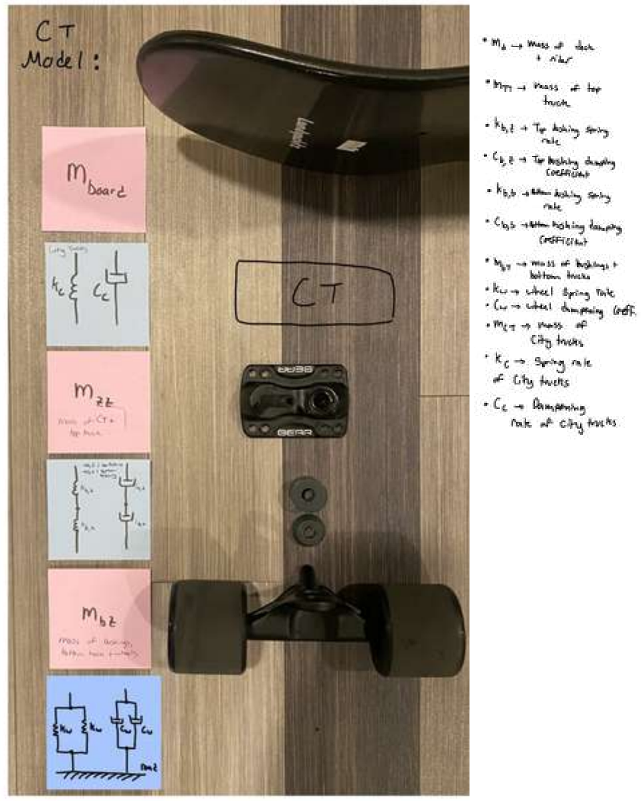
City Trucks

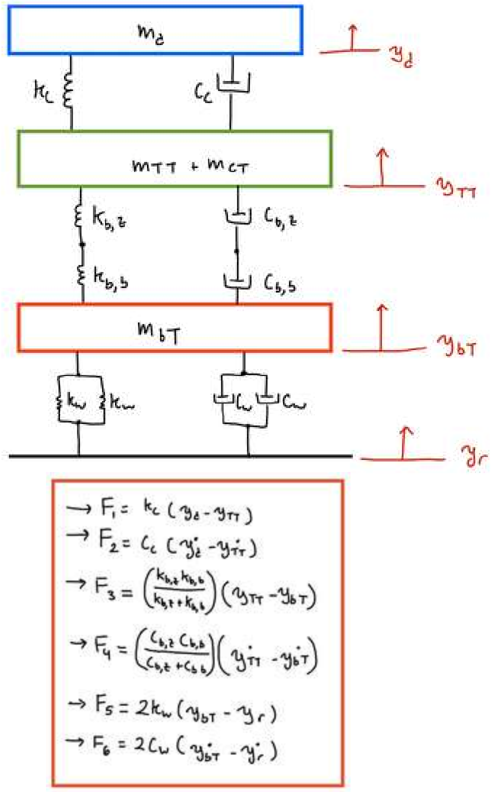
Skateboarding on city streets can be uncomfortable, irritating, and dangerous due to the varying ground conditions and the way the skateboard reacts to them. These vibrations are transferred to the skater's body which can cause a sense of discomfort and panic. The purpose of the City Trucks suspension is to give the skater a sense of increased comfort and control when traveling on adverse city roads.









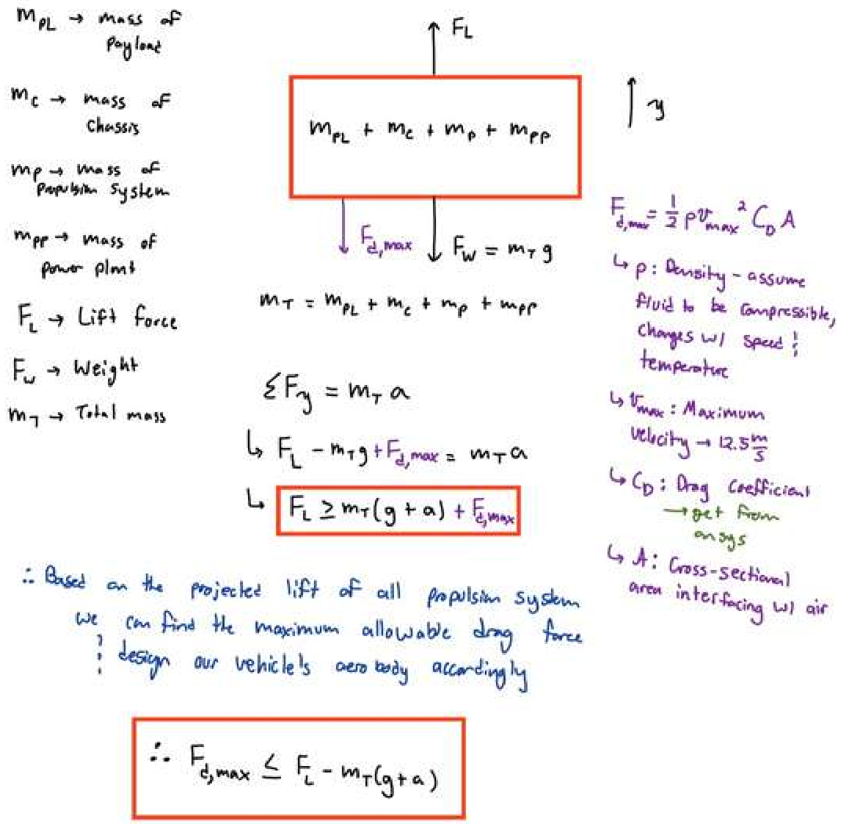


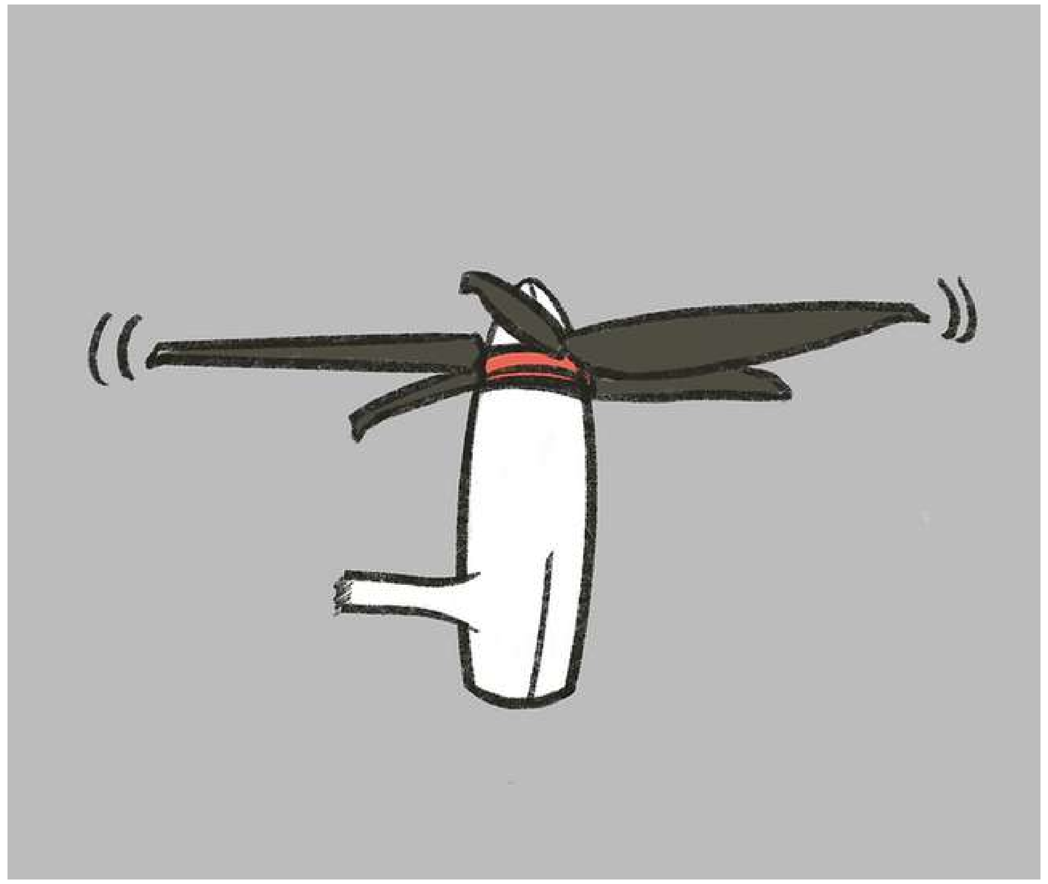
Solo Project - Oct 2022 to Present | Skateboard Dynamics | FEA | Rapid Prototyping

Arial Rescue Vehicle Propulsion

Currently, I am the propulsion lead for my final year capstone project where our team has been tasked to design and prototype a scaled aerial rescue vehicle. The purpose of the vehicle is to carry 6-7 pedestrians safely down from a high-rise building during a variety of natural and manmade catastrophes. At the moment, I've developed a first-principles aerial dynamic propulsion model to quantify how much thrust and how many propellers are vehicle needs to carry a payload of 500kg. In addition, I'm in the midst of designing several propeller designs to be simulated with static analysis and CFD.

MECHANICS AND AEROSPACE DESIGN LAB





Collaborative Project - Sep 2022 to Present | Propulsion | CFD | Surface Modelling

My design philosophy:

To enhance the human experience.