

Emma Banker

LEHIGH UNIVERSITY 2021

Integrated Degree in Engineering, Arts & Sciences

Electrical Engineering and Cognitive Science

Minor in Aerospace Engineering

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Introduction



I am a Junior at Lehigh University enrolled in an Integrated Degree in Engineering, Arts & Sciences (IDEAS) program, a highly selective honors program with majors in Electrical Engineering and Cognitive Science and a minor in Aerospace Engineering. My double major and minor reflect my desire to continue growing my analytical and problem-solving capabilities in technical fields, while my extracurricular activities provide me with opportunities to apply my knowledge to real world situations.

Table of Contents

Lehigh Formula SAE

- Dashboard
- Engine Control Unit
- Brake Light



"X49" Dash

Independent Research

- Timeline and Highlights



Aircraft Flight Management System

Work Experience

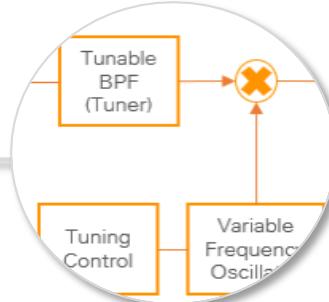
- Department of Defense
- Sikorsky



Sikorsky S-76D

Personal Projects

- Cadence



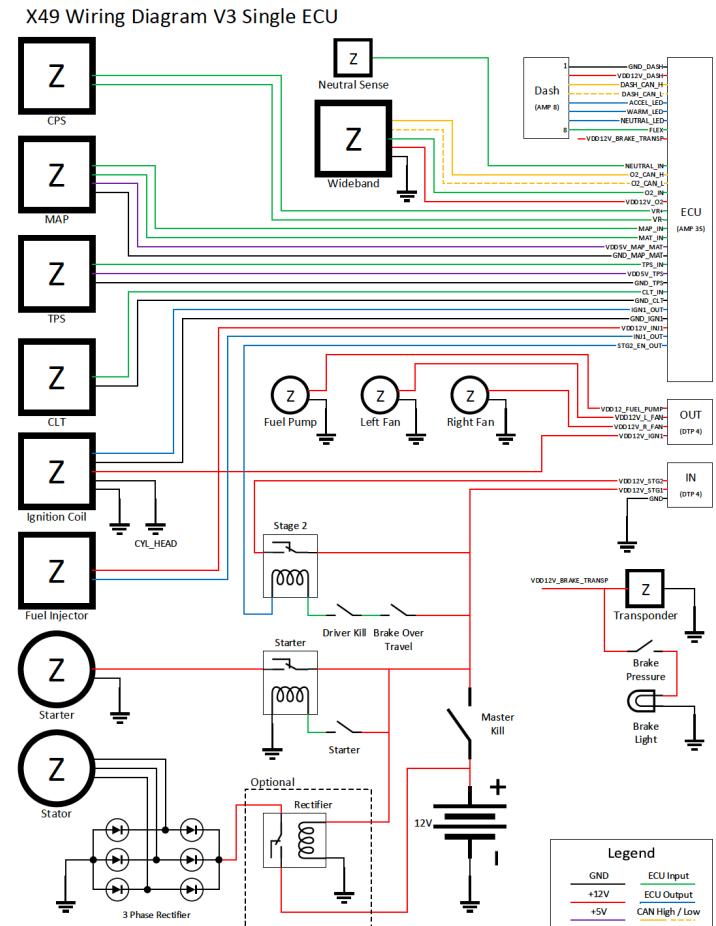
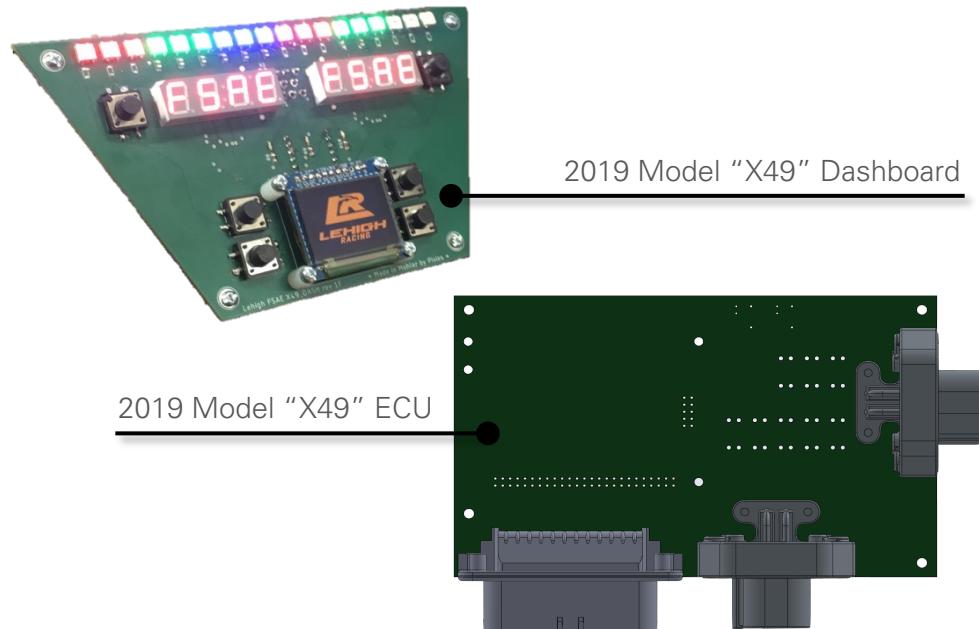
Formula SAE

Member: Fall 2017 – Present
Electrical Team Design Lead: Summer 2019 – Present

Formula SAE Electronics Team

As Electronics Team Design Lead, I oversee all production and installation of electronic systems, and coach other members to support their skill development. I lead design of wire harness and institute effective methods of collecting and analyzing data in order to maximize vehicle performance and optimize weight and cost. Utilizing Eagle, I design and assemble printed circuit boards and I research new advanced technologies to be included with the vehicle. I assist in designing and manufacturing of the data acquisition system and the main wire harness.

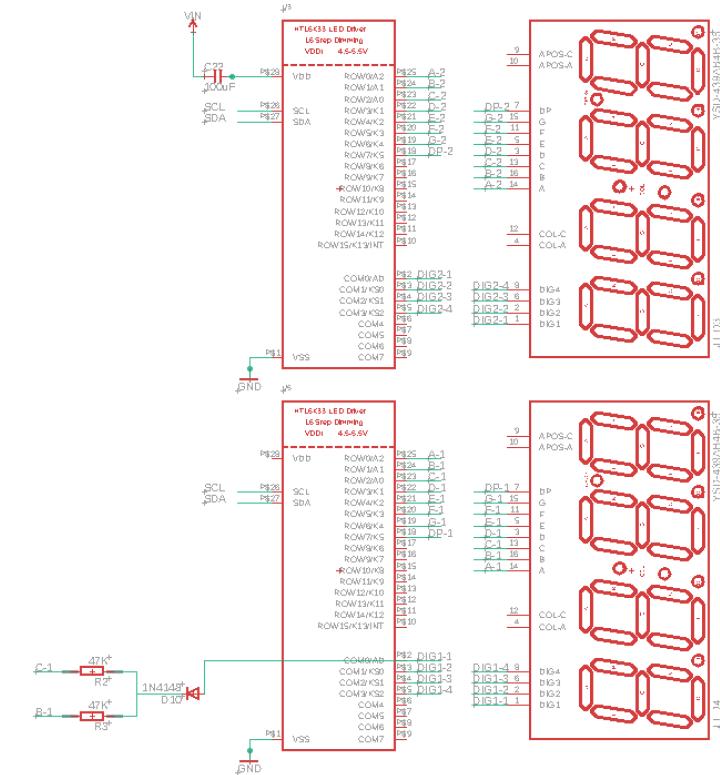
The Electronics Team supports all other sub-teams such as driver ergonomics, engine and powertrain and vehicle dynamics.



X49 and X50 utilize a CAN bus to minimize the number of wires on the main harness and the data acquisition harness.

Eagle

Since the PCBs on the vehicles are custom and use a myriad of displays, I created Eagle libraries for parts such as the GPS and BeagleBone. By taking precise measurements I was able to develop libraries for parts with pins and pads

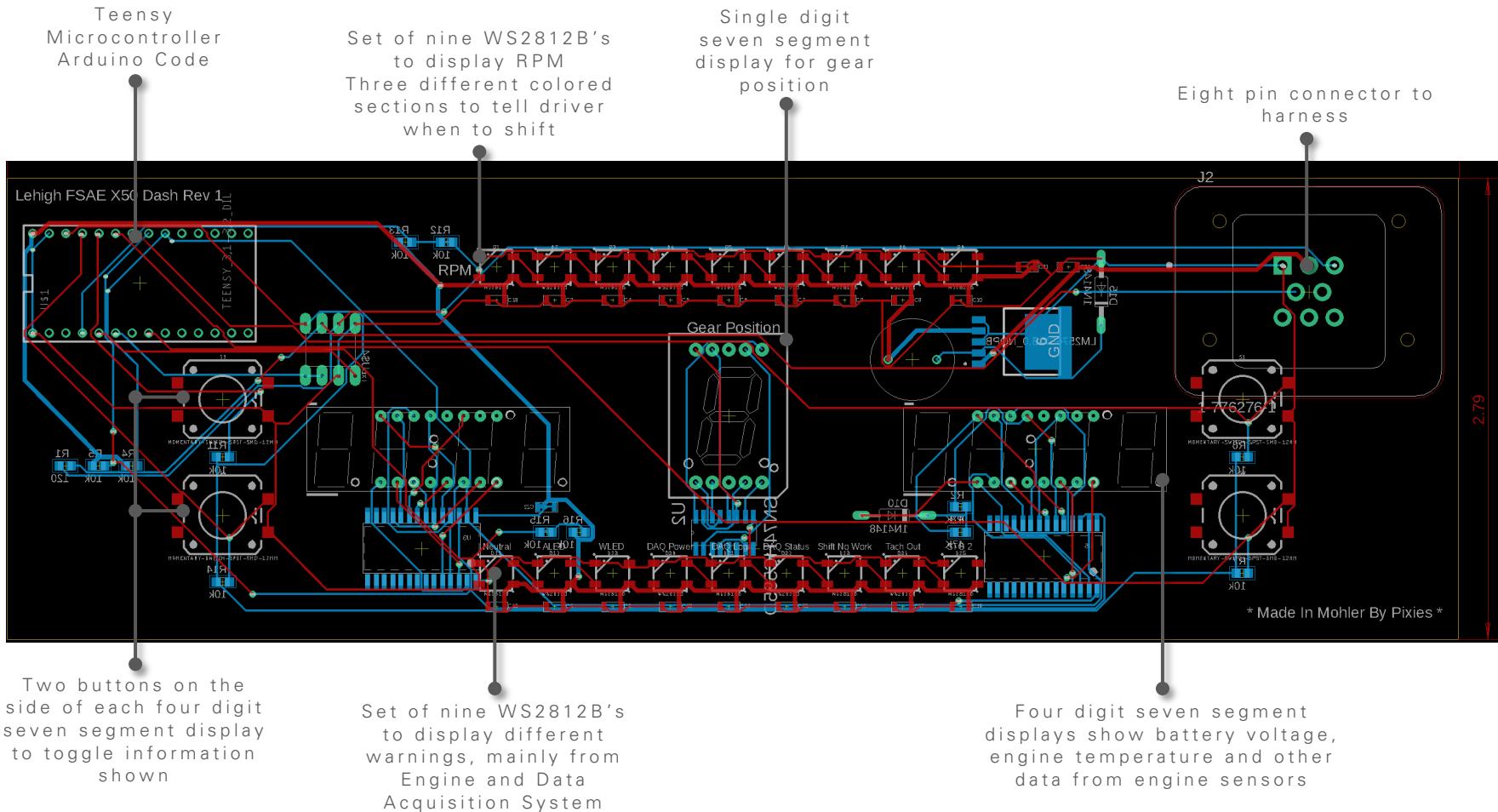


The Formula SAE car is powered by a 12V battery and many components on the PCBs require 3.3V or 5V, the electronics team had to design components to step the voltage down. Initially, the team utilized a linear voltage regulator, but due to the nature of the components, this method failed. I designed a switching voltage regulator that utilizes an inductor to dissipate the excess voltage without creating too much heat.

$$\text{The width for the traces was calculated utilizing the following equation: } \text{Width[mils]} = \frac{\text{Current}}{\frac{1}{\text{Area}[mils}^2]} = \frac{\text{Current}}{\frac{1}{(\text{Thickness}[oz]*1.378[\frac{mils}{oz}])^{0.725}}} = \frac{\text{Current}}{(0.048*20^{0.44})^{0.725}} = 1.378$$

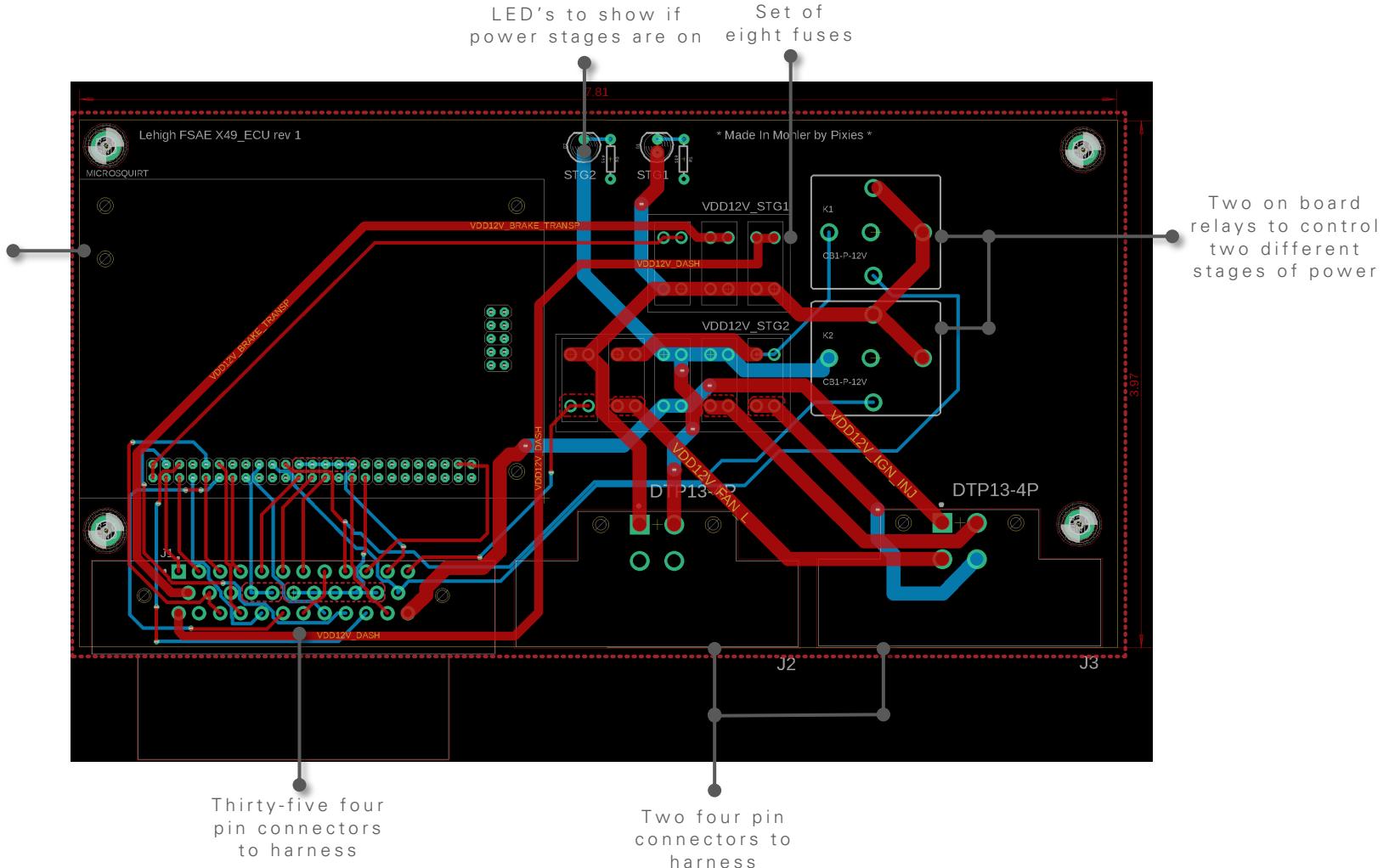
X50 Dash

Based on driver input, we changed multiple displays since the others were not visible in full sunlight. Small surface mount LED's were replaced by bigger, brighter WS2812B's. Instead of having a small OLED display, the information is shown on the four digit seven segments which can be toggled and more readily available to the driver.



X50 Engine Control Unit

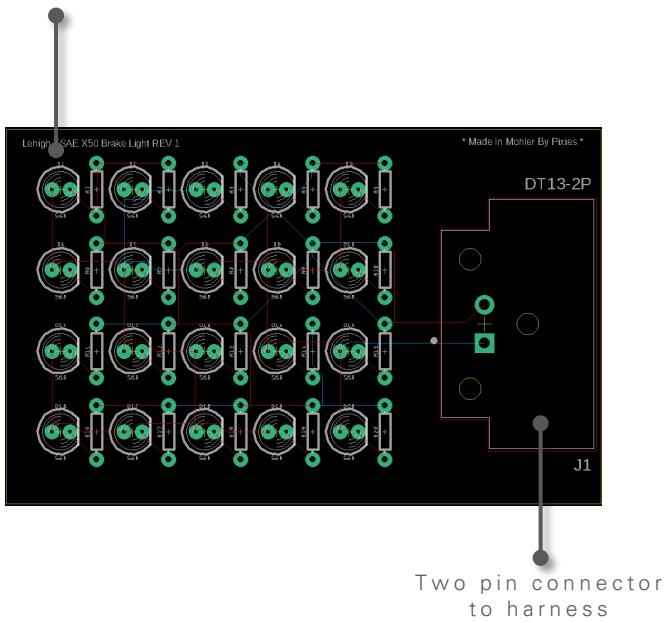
In order to simplify the harness, the X50 ECU, or Power Distribution Board, has two on board relays and is the main power hub on the car. The Microsquirt controls the engine output and connects to the warning lights on the dash.



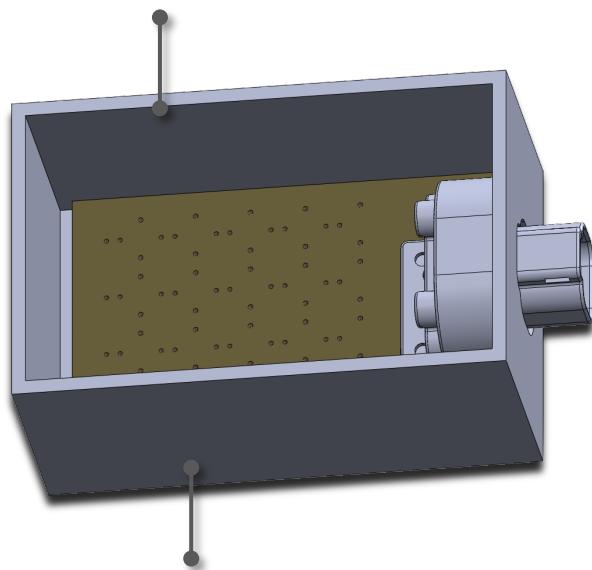
X50 Brake Light

Out of all the PCB's, the brake light has the most restrictions placed by the Formula SAE rules. We had to test many different LED's to ensure they were bright enough in full sunlight, ensure the light was a certain area, and the background was black.

Twenty Super bright
LED's and resistors



Brake Light PCB and
connector in enclosure
designed in SolidWorks



Utilized black resin potting
compound to comply with FSAE
rules and improve
waterproofing

Independent Research

Spring 2020 – Present

Analysis and Development of Autonomous Aerial Robots

To delve deeper into my aerospace concentration, I proposed an independent study where I would analyze and design an autonomous aerial vehicle. My first semester with this project was primarily researched based where I developed a paper outline guidelines by specific organizations and analyzed different aviation accidents. Throughout my senior year, I plan to design and manufacture a drone with a data acquisition system, integrating my electrical engineering and mechanical engineering backgrounds.

Propose Project and Receive Approval

The objective of this research project is to study how sensor redundancy relates to reliability and precision, and to create an autonomous drone that displays the principles of autonomous flight.

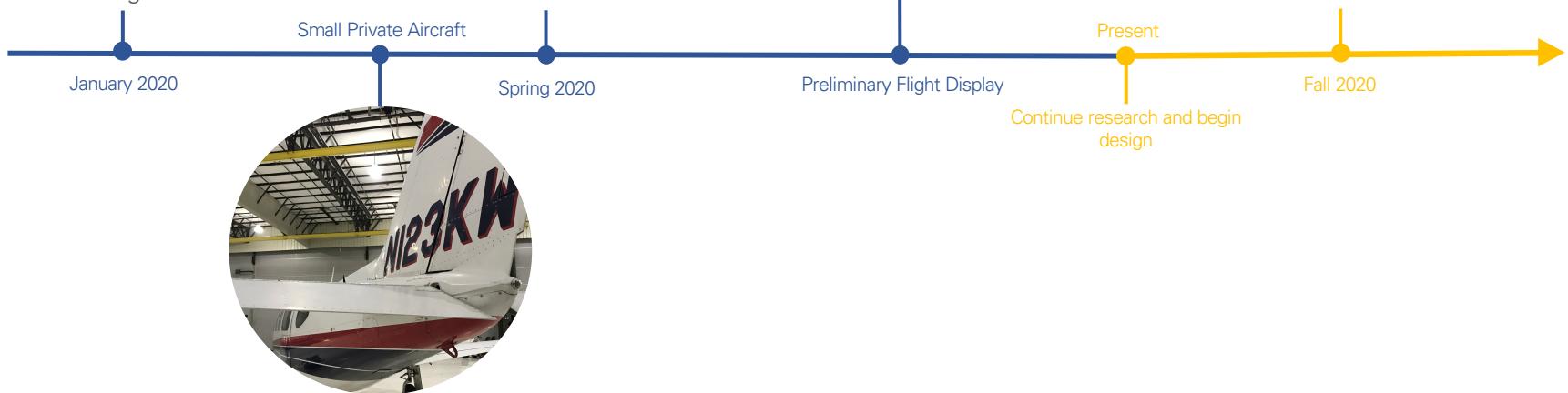
Research

Discuss aviation safety and automation with former and current pilots and analyze papers from AIAA, NASA and other aviation organizations.



Fall Goals

Utilize SolidWorks to design an autonomous drone. 3D print and assemble the drone. Design the harness and spec sensors for the data acquisition system.



Work Experience

Summer 2018 – Present

Department of Defense

Data Center Management Intern, Summer 2018

Elements of my internship included:

- Independently researching elements of facility design and evaluating effectiveness
- Assisting in designing power, HVAC engineering, telecommunications, and business considerations
- Developing facility layout recommendation incorporating forward-thinking components
- Gaining TS/SCI clearance through full scope polygraph



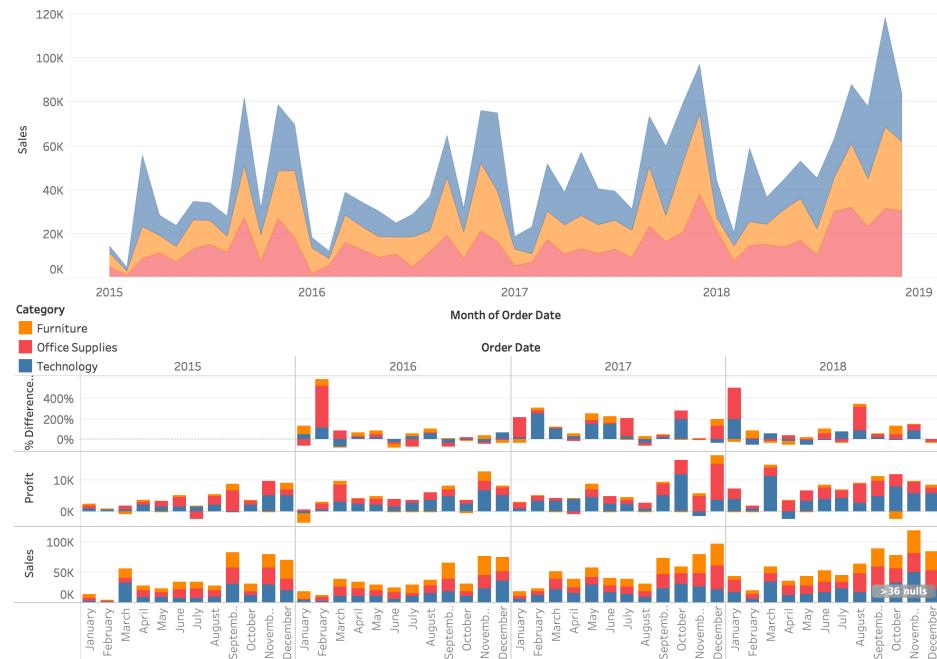
Sikorsky, A Lockheed Martin Company

Avionics Quality Engineering Intern, Summer 2019

Throughout my internship, I worked to improve Avionics Quality department data collection and analysis processes by leveraging Tableau to integrate multiple data sources and building dashboards to display key operating metrics, highlighting opportunities for improvement. Tableau is a platform that allows companies to directly connect to their databases and create visuals, streamlining the process of developing presentations. This ensures that all data is correct and eliminates intermediate steps, such as utilizing PowerPoint and Excel.

- Tableau permits the user to choose from a multitude of different graphs, each of which is customizable
- To further customize data, I learned the different Tableau functions and SQL
- I was able to integrate multiple different databases in order to visualize the maximum amount of data
- Since the data is sourced directly from the databases, I was able to correct some of the incorrect data from past presentations and ensure that all data would be correct going forward

Tableau Example Dashboard



Sikorsky, A Lockheed Martin Company

Avionics Quality Engineering Intern, Summer 2019

I developed a methodology and process flow to track aircraft wires throughout the wire harness manufacturing processes utilizing a Microsoft Access database. I collaborated with wire harness builders and manufacturing engineers to ensure that the solution properly addressed business needs.

Analyze the Issue

I needed to develop a methodology and process flow to track aircraft wires throughout the wire harness manufacturing process. I had to know the current process for harness manufacturing.

Discuss

Discuss current problem and potential solutions with those involved. I produced multiple different plans. These became different stages of adaptation to ease the transition for all the workers along the process.

Develop Database

I created a Microsoft Access database using VBA that would store different types of information and that was easy to use for those accustomed to their position.

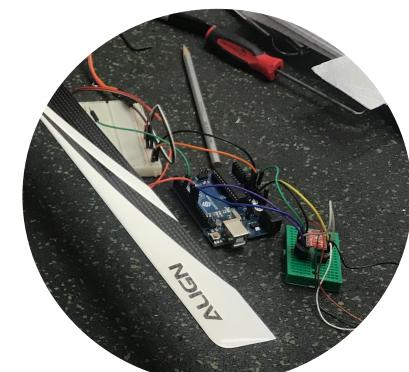
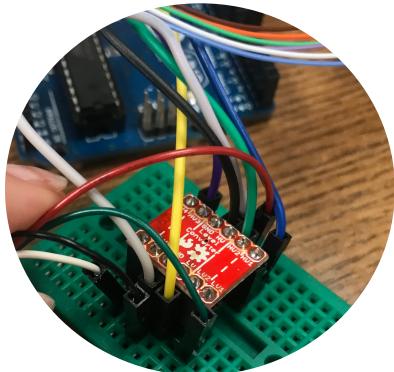
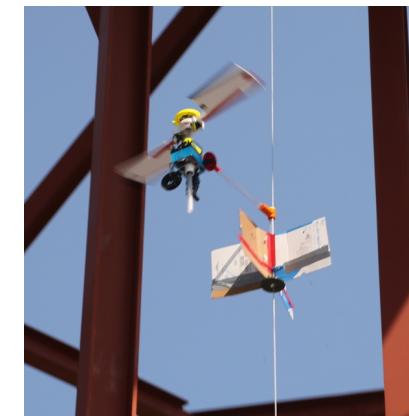
Test Database

I tested the database with many workers throughout the process and made changes based on their feedback accordingly

Sikorsky, A Lockheed Martin Company

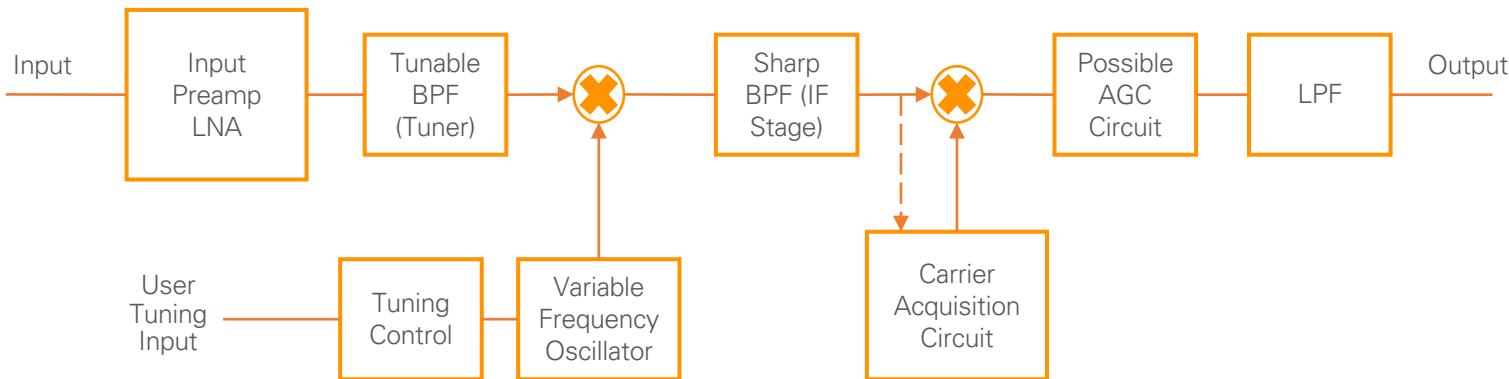
Avionics Quality Engineering Intern, Summer 2019

About 100 interns competed in an intern design competition to design a model helicopter that when dropped from 60ft, uses the principles of autorotation to land without crashing. I wired and coded an Arduino to move servos based to manage blade pitch on a distance fed to the Arduino by a TF Mini Micro LiDAR and logic converter. My team was a top finisher in intern competition out of ten teams and we won a ride in a helicopter!

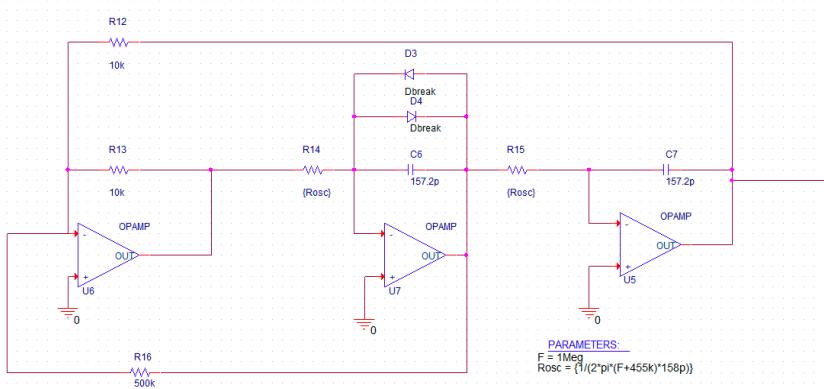


Personal Projects

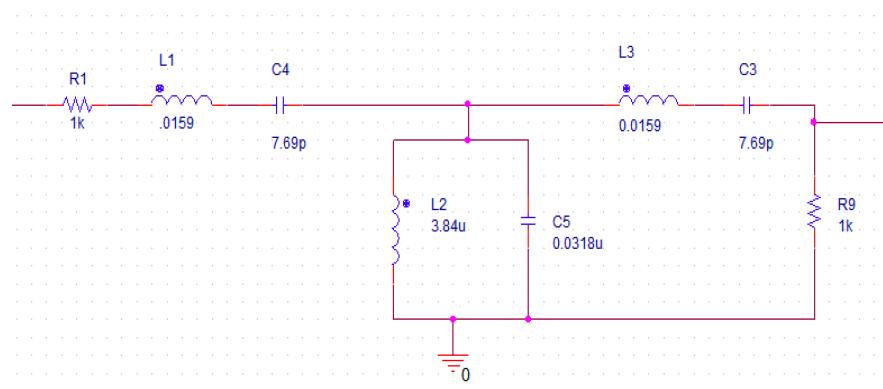
Cadence AM Radio Receiver Design



I designed a superheterodyne AM radio receiver that could be tuned to different stations. Utilizing Cadence Allegro PCB Designer, I constructed and simulated the different circuits to determine if the outcome was correct.



Variable Frequency Oscillator



Sharp BPF (IF Stage)