

Relevant Projects

Outlined below are several projects I have been a part of, ranging from high school projects to technical assignments on the UBC Rocket and UBC Concrete Toboggan design teams.

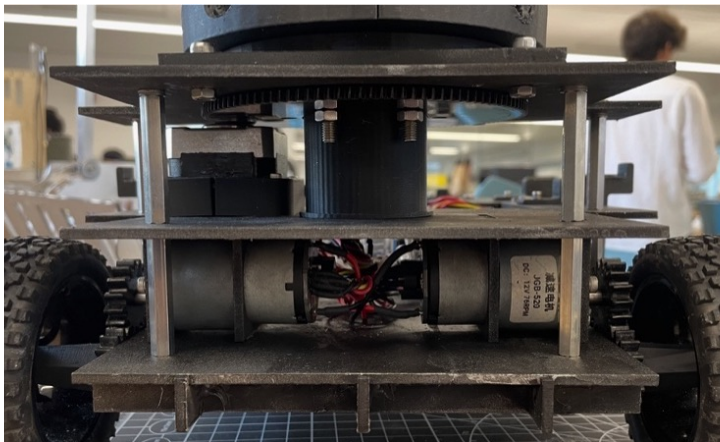
Autonomous Competition Robot

ENPH 253 Design Project | C++, ESP32, PID Control

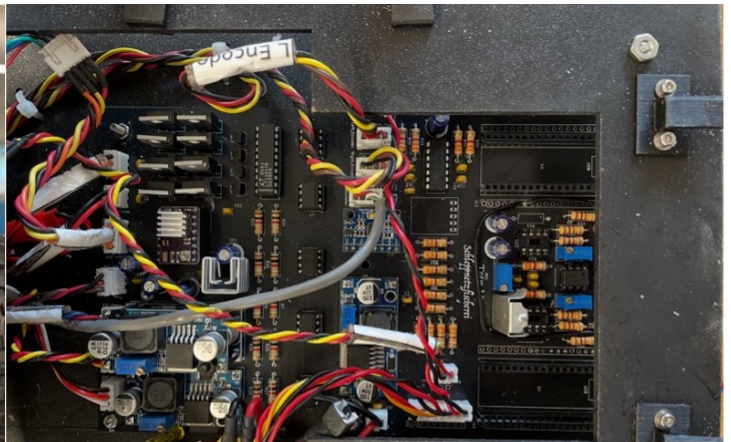
Designed, fabricated, and programmed an autonomous robot from the ground up for the UBC ENPH 253 design competition. The robot secured 4th place overall by successfully integrating mechanical design, embedded electronics, and software control under strict competition constraints.

Mechanical Design: CAD-modeled the complete chassis and drivetrain. Fabricated components utilizing laser cutting, 3D printing, and machining to meet the design specifications.

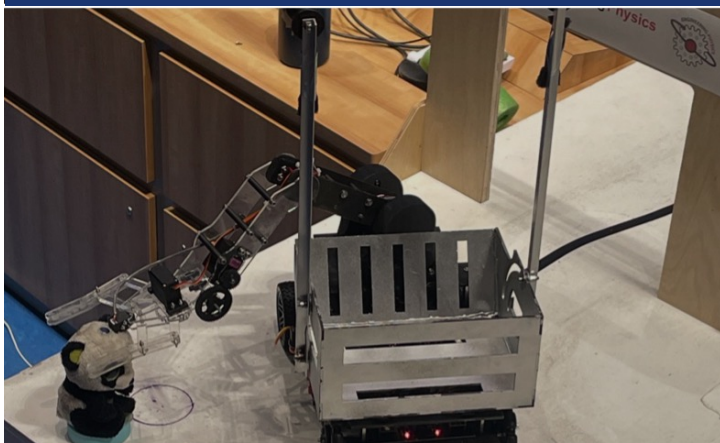
Electronics & Control: Designed the electrical system, integrating motor drivers, encoders, and IMUs into an ESP32 architecture with proper cable management. Implemented a device manager for managing the various I2C peripherals.



Drive Mechanism



Electronics Bay



Pet Retrieval

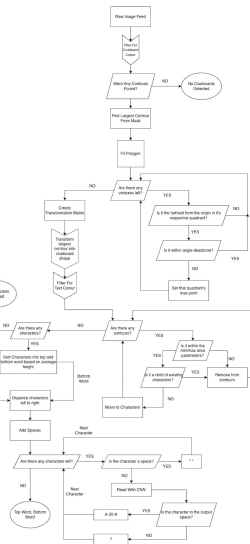


Completed Robot

Dual-Drone Autonomous Agent

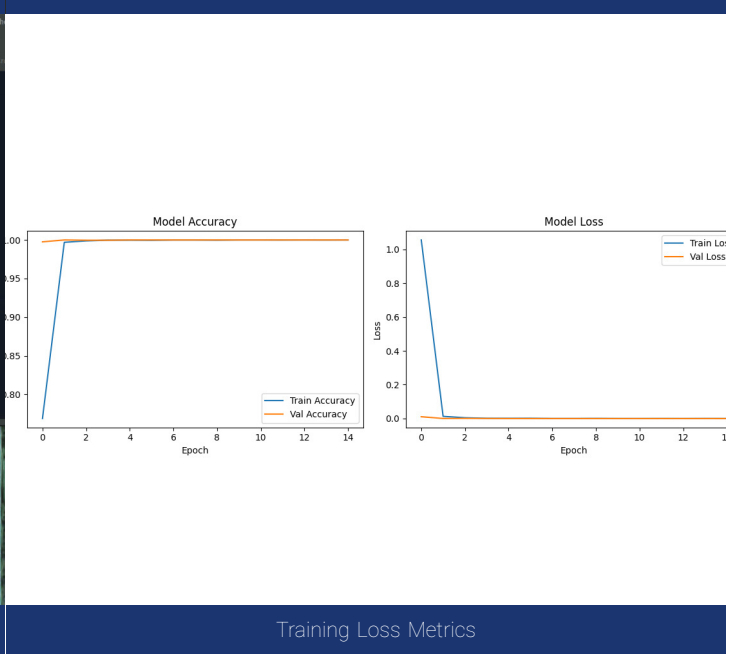
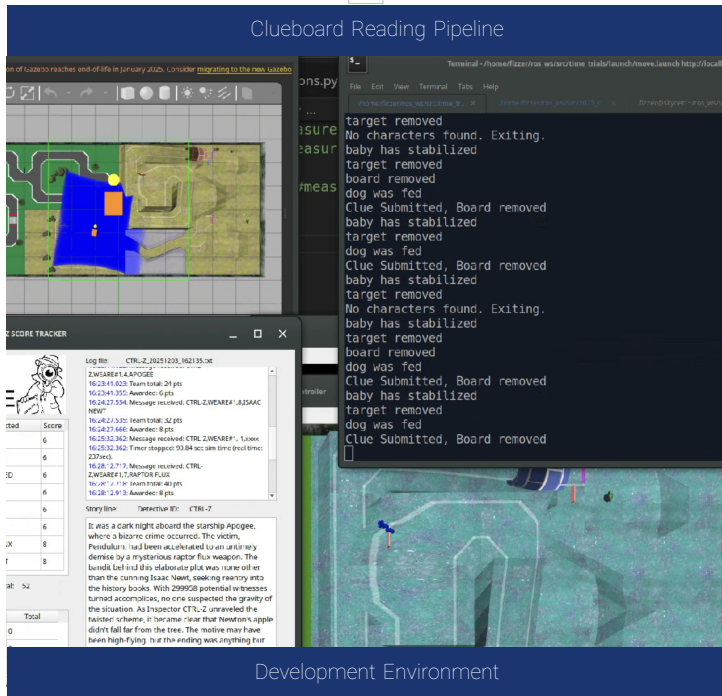
ENPH 353 | ROS, Python, OpenCV, TensorFlow, PID

Engineered a decentralized "Master-Follower" multi-robot system utilizing a high-altitude Master drone for global sensing and a Follower drone for local actuation. The system successfully navigated a complex course, executing autonomous pathfinding and reading alphanumeric targets regardless of viewing angles



Computer Vision Pipeline: Developed a robust OCR system utilizing a custom Convolutional Neural Network (CNN) trained on a synthetically generated dataset of 14,400 images. Created custom algorithm for transforming potential clueboard images into a consistent format for OCR processing.

Sensor Fusion: Integrated Lidar and depth camera data to create a height map enabling dynamic obstacle avoidance.



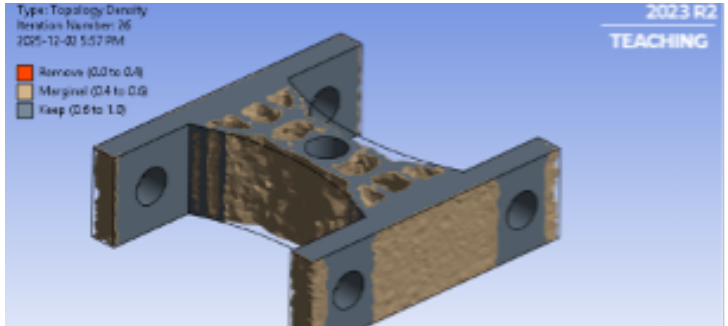
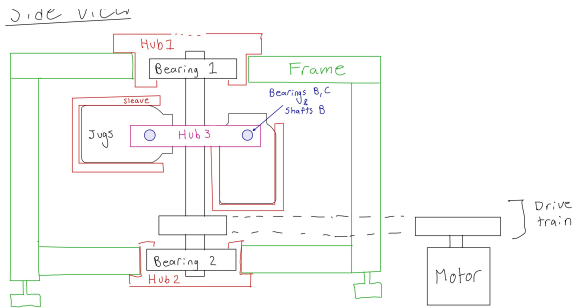
MECH 325 Brewing Centrifuge

Machine Design | SolidWorks, Ansys FEA, Topology Optimization

Designed a vertical-axis centrifuge capable of subjecting 2-gallon brewing batches to 4300 Gs for sediment clarification. The project focused on ensuring structural integrity under high rotational loads while keeping manufacturing costs realistic for small-scale breweries.

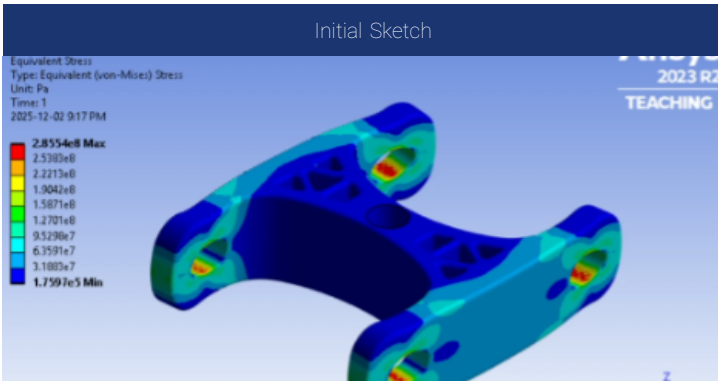
Topology Optimization: Utilized Ansys Topology Optimization tools to reduce hub weight while maintaining structural integrity under operational loads.

Component Selection: Selected appropriate off-the-shelf components such as bearings, pulleys, and a motor based on load calculations and operational requirements. Ensuring a safety factor > 1.5 at 4000 RPM for all components.

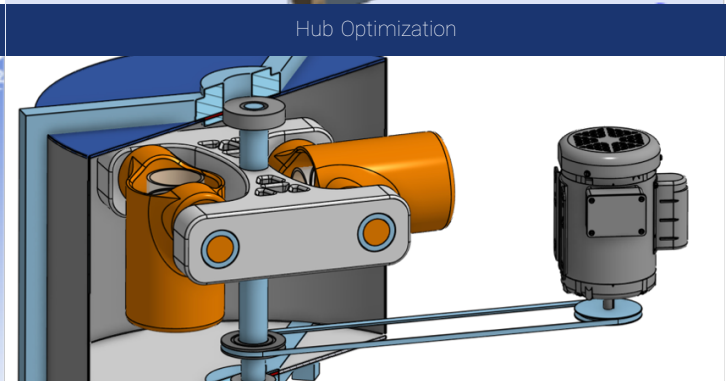


Initial Sketch

Hub Optimization



Hub FEA



Full Assembly Render



Prototype 3D Print

Prototype Mold

Final 3D Print

UBC Rocket Mold Design

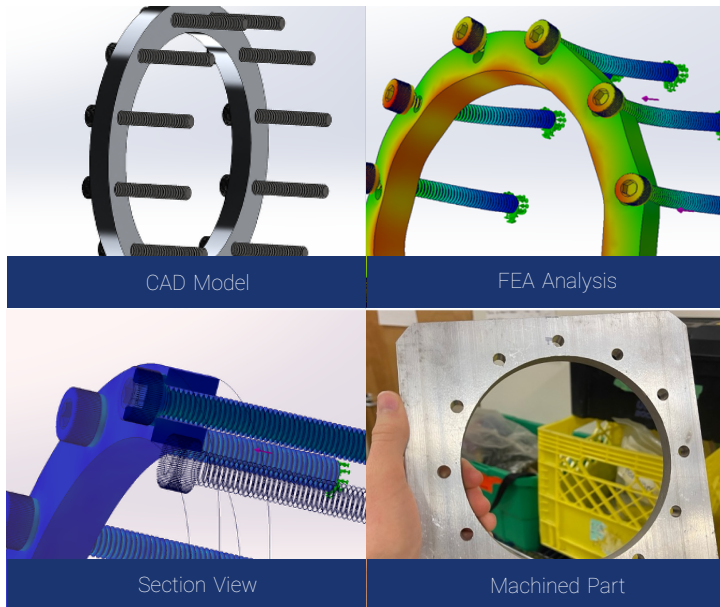
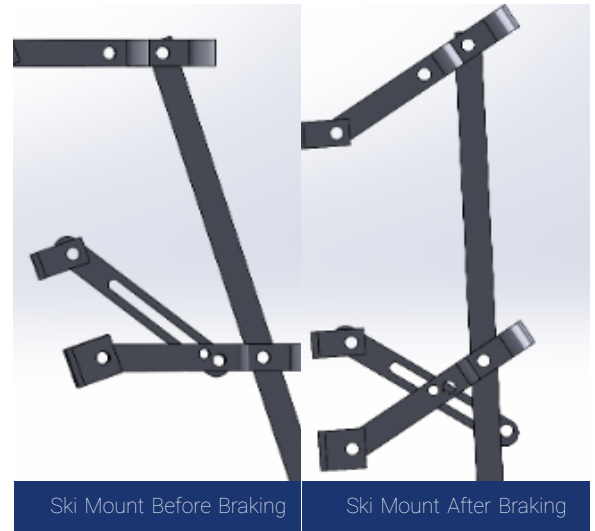
Propulsion Sub-team | SolidWorks, 3D Printing

Designed and 3D printed a mold for casting the combustion chamber of the liquid rocket engine. This involved iteratively prototyping the mold to ensure dimensional accuracy and surface finish quality for optimal chamber geometry. The mold would be inserted into the empty chamber and filled with a high-temperature resistant epoxy "Chamber Safe".

UBC Concrete Toboggan Brake Design

Braking Sub-team | SolidWorks, FEA

Redesigned the braking system to address critical weight penalties from previous years. This involved designing a drop-brake mechanism utilizing ground friction and sled momentum instead of a heavy brake plate dropped into the snow.



UBC Rocket Washer Design

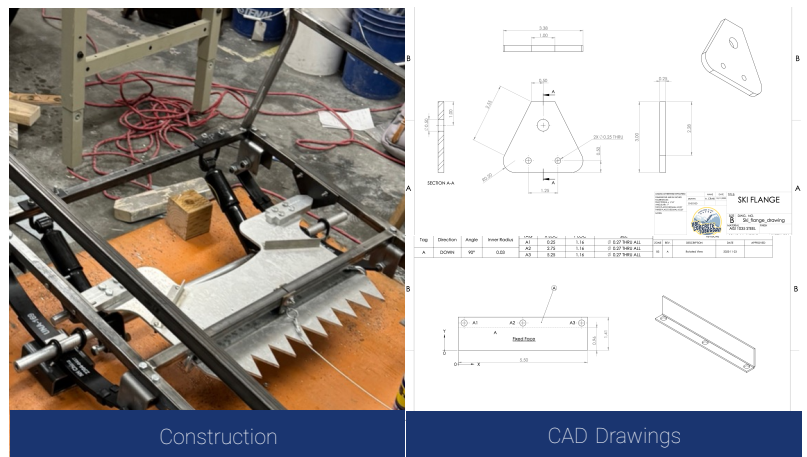
Propulsion Sub-team | SolidWorks, Machining

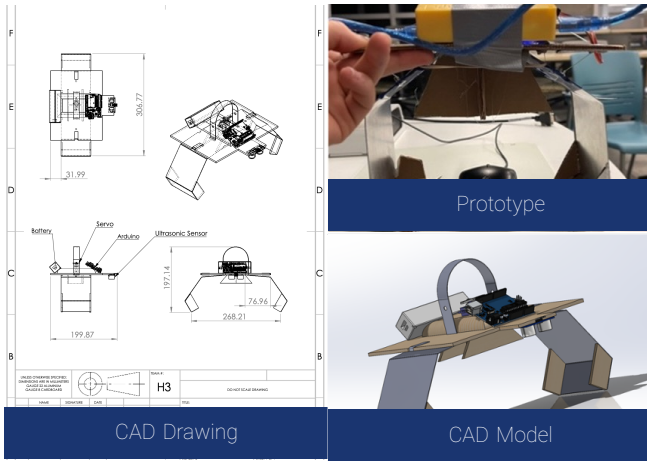
Engineered a high-precision engine mount following a Rapid Unscheduled Disassembly (RUD) event. Optimized the component for structural rigidity using FEA to withstand hot-fire loads.

UBC Concrete Toboggan Part Drawings

Braking Sub-team | SolidWorks

Produced comprehensive SolidWorks engineering drawings for the braking sub-assembly to facilitate manufacturing.





Claw Project CAD Design

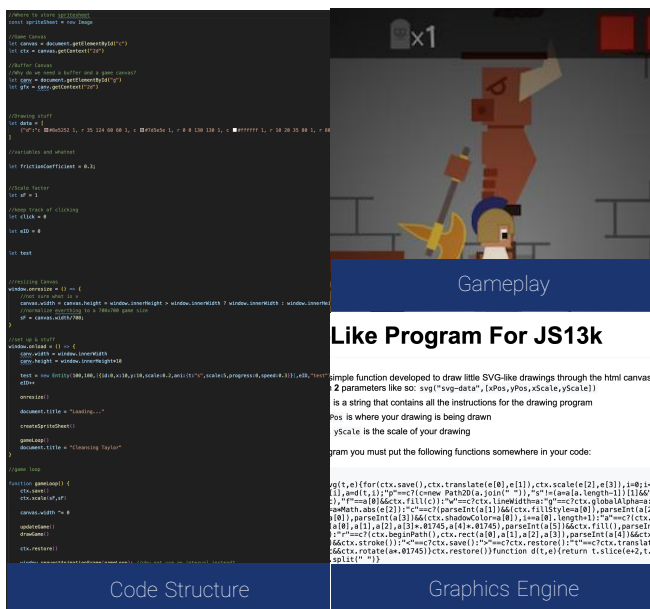
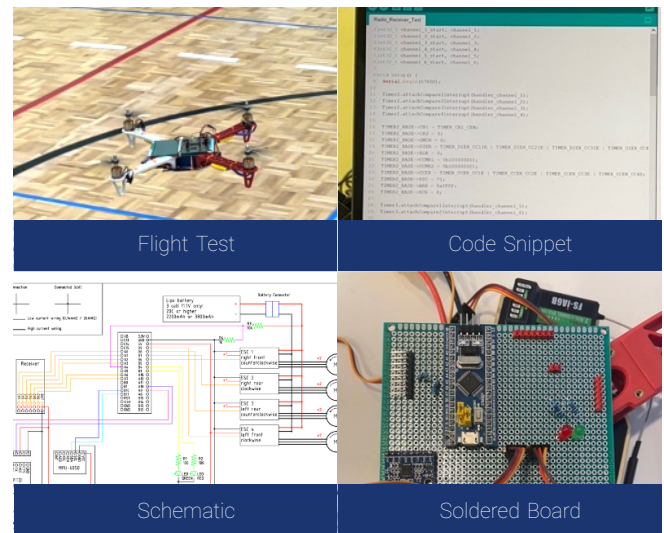
APSC 101 | SolidWorks, Prototyping

Designed and manufactured a mechanical claw mechanism for autonomous object retrieval. Modeled the assembly in SolidWorks and produced engineering drawings to guide manufacturing.

Gr12 Capstone Project

Custom Flight Controller | STM32, C++, Soldering

Developed a custom drone flight controller based on the STM32 microcontroller. This involved soldering the custom flight controller, integrating MPU6050 sensors, RF components, and ESCs.



JS13k Game Competition

Web Game Dev | JavaScript, HTML5, Optimization

Participated in the annual JS13k challenge, creating fully functional browser games within a strict 13kB file size limit. To help facilitate the development, a custom rendering pipeline and procedural generation algorithms were developed.