Jeongyun Jeong

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SUMMARY OF QUALIFICATIONS

- Experienced in leading and participating in multiple projects simultaneously, with effective time management.
- Extensive practical knowledge and experience in manufacturing processes (Carbon fiber and fiberglass layups, CNC machining, laser cutting) and highly proficient in 3D printing (Ender 3 S1 Pro, BambuLab P1S).
- Skilled in design and simulation software programs, including SolidWorks (CSWA & CSWP Certification), Fusion 360, Blender, Unreal Engine 4, ANSYS (FEA), MATLAB, Multisim, Simulink, and KiCAD.
- Proficient in Microsoft Office Suite (Word, Excel, PowerPoint) and GitHub for management, documentation, and presentation.

EDUCATION

Bachelor of Engineering (B.Eng.): Mechatronics Engineering, Toronto Metropolitan University, Toronto, ON *Sep 2020 – Apr 2025*

CAREER

Undergraduate Research Assistant MIMS LAB, Toronto Metropolitan University *Mar 2022 – Feb 2025*

- Developed a UV-mapped image texture and 3D modeling of downtown Toronto buildings and aircraft cockpit components for a VR/AR flight simulation project, enhancing realism and immersion using Blender and Unreal Engine 4.
- Helped product development and resolved critical design constraints during the finalization phase of a patent project, ensuring functionality and design integrity.
- Supported a PhD student's project focusing on an air-taxi operations simulation with an aircraft model Boeing 737 aircraft model using Unreal Engine 4.
- Researched and modified AR/VR haptic glove design

EXTRACURRICULAR EXPERIENCE

Team Manager, TMet Aero Design (TMAD), TMet University, Toronto, ON. *July 2023 – August 2024*

- Spearheaded **financing strategies**, **event coordination**, and **tutorial planning**, ensuring efficient resource allocation and enhanced team learning.
- Assisted in **acquiring sponsorships**, securing over $4000 CAD in essential materials and components for the project.
- Oversaw **material procurement** and preparation, guaranteeing the **timely availability** of resources for project execution.
- Conceptualized, developed, and managed Radio Control Courses and Competitions (RC3), a 3-month-long summer program to provide an efficient **transfer of knowledge** within the team for the new members while **expanding the team structure**.
- Led subteam management and member coordination with overall knowledge of the team while actively participating in the SAE Aero Design East Competition in Florida, demonstrating leadership and teamwork in a competitive environment.

Ground Transportation Vehicle (GTV) Lead, TMet Aero Design (TMAD), TMet University, Toronto, ON. *Sept 2022 – July 2023*

- Designed and manufactured a **specialized lightweight radio-controlled car** optimized to transport 2 lb of water, emphasizing minimalistic design for **easy deployment** for use in the SAE Aero Design Advanced-Class competition.
- Worked closely with the Powered Autonomous Delivery Aircraft (PADA) subteam for **integration** of GTV into PADA as **payload**, contributing to collaborative design and innovation efforts.

Specialization: Fibreglass & carbon fiber layups, 3-D printing, plastic covering film.

ACADEMIC DESIGN PROJECT

Capstone: Mechanical Arm Integration on UAV with Autonomous System

- Designed a **4-bar linkage gripper** using Fusion 360 and worked on force, angular velocity analysis, as well as torque calculation to ensure the mechanism was capable of performing the intended task.
- Worked on a **Python code for manual control** of the arm with an object detection program in **Raspberry Pi 5** and an **electrical system** using KiCAD.
- Utilized MATLAB and Simulink for **kinematic simulation** that was used to validate hand calculations.

Mechanical Gripper with Proportional Controller Using Data Acquisition

- Designed and prototyped a lightweight **robotic gripper** using 3D printed components and a **rack-and-pinion mechanism**, meeting a **25g weight constraint**.
- Calibrated a **touch-sensitive force sensor** and developed a voltage-mass curve for **real-time grip force measurement**.
- Implemented a LabVIEW-based **proportional feedback controller** with NI USB-6001 DAQ and L293D H-Bridge for **closed-loop motor control**.
- Integrated mechanical design, sensor calibration, and control systems into a fully functional PID-based force control system.

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MECHATRONICS ENGINEERING AT TORONTO METROPOLITAN UNIV.

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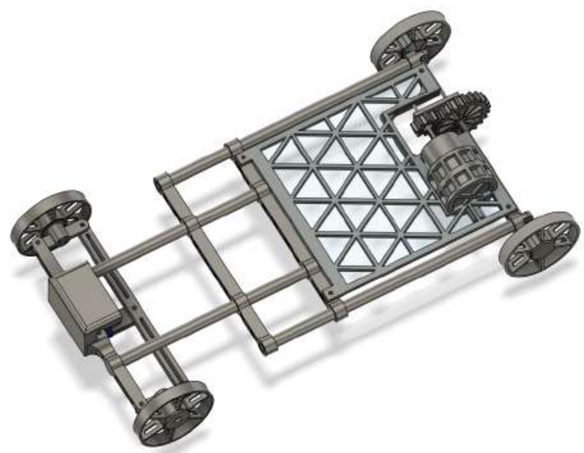
Student Design Team Work

Ground Transportation Vehicle



For the **SAE Aero Design Advanced-Class** competition, one of the core **mission objectives** was to deliver a **water payload** to a designated **ground target** using a remotely controlled **Ground Transportation Vehicle (GTV)**. This vehicle had to be deployed after touchdown by a small **autonomous parasite aircraft** known as the **Powered Autonomous Delivery Aircraft (PADA)**, which itself was released by the **primary mothership aircraft**. Given the strict **weight constraints** for the parasite aircraft, the team adopted a **design strategy** that prioritized **minimizing the mass** of the GTV to ensure the overall **flight performance** and **payload capacity** of the PADA could be maximized.

In close coordination with the **PADA subteam**, **dimensional** and **mass constraints** were finalized early in the **design phase**, with a strict target of keeping the GTV under **200 grams**. This required a careful balance between **mechanical functionality**, **durability**, and **weight efficiency**. Several key **design strategies** were employed to meet these constraints: first, the **slicing parameters** for **3D printing** were optimized to minimize **material use** while maintaining **structural integrity**. Second, the **mechanical design** was intentionally simplified to include only **essential components**, allowing for **fast** and **tool-free assembly** upon delivery. Lastly, a **flat base plate architecture** was selected, enabling all components—**motors**, **electronics**, and **structural supports**—to be laid out on a single plane, maximizing available space for **securing** and **transporting water bags**.

To address the **high rotational speed** of the motor and improve **control** during ground navigation, a compact **reduction gear** was incorporated into the **drivetrain**. This addition provided better **torque output** without compromising weight, ensuring **reliable ground mobility** post-drop.

This project marked my first **hands-on experience** with **prototyping from concept to completion**. Through this process, I significantly improved my **design** and **iteration skills**, particularly in **optimizing weight distribution**, **modularizing components**, and **managing payload constraints**. The result was a **lightweight**, **functional**, and **mission-ready GTV** that successfully contributed to reducing the **payload burden** on the PADA and enhancing the overall **system performance**.

Student Design Team Work

Fibreglass Layups of Nose, Tail Cones, and Top Plates

At the start of my involvement with the **Toronto Metropolitan Aero Design (TMAD)** team, I was tasked with **manufacturing fiberglass layups** for key **aircraft components**, including the **nose cone**, **tail cone**, and **top plates**. These structures were critical in protecting **avionics** and **payload modules**, requiring a balance between **structural durability** and **lightweight construction**. This experience introduced me to **composite manufacturing techniques** and taught me the importance of **precision** and **material handling** in **aerospace fabrication**.

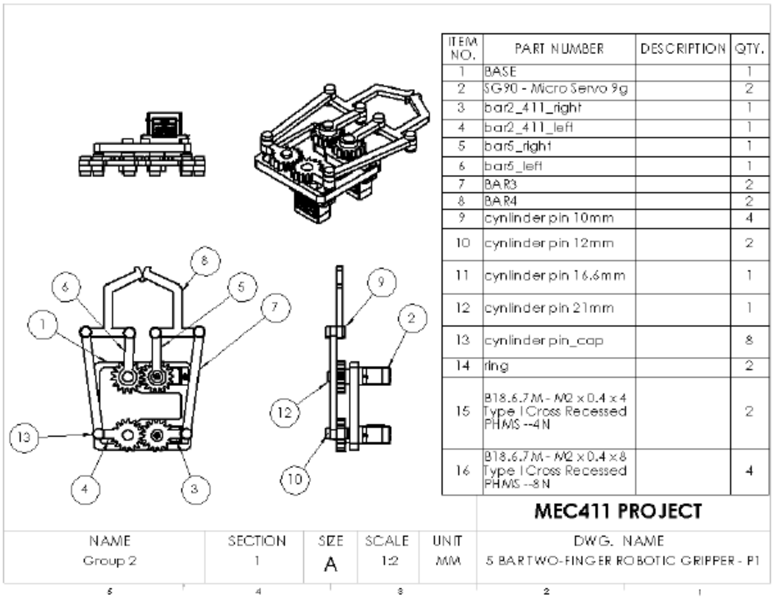
The **layup process** began with the creation of **molds**, which were **3D printed** using **PLA filament** on either the **Ender 3 S1 Pro**, and in later years, the **BambuLab P1S**. To achieve a **smooth surface finish**, the interior of each mold was carefully **sanded** using **300 and 500-grit sandpaper** and water. Multiple coats of **release agent** were then applied to the sanded surfaces to ensure **easy separation** after curing and to protect the **mold integrity** for repeated use.

Once the **mold preparation** was complete, **epoxy resin** was mixed at a **3:1 weight ratio** using **West System 105 resin** and **206 hardener**. Careful attention was paid to the **mixing process** to ensure there were no **bubbles**, which could result in **gaps** leading to **degraded structural integrity**. Two to three layers of **fiberglass fabric** were laid into the mold, depending on the **structural requirements** of the component. The **epoxy mixture** was then evenly distributed across the fabric, working methodically to minimize **air bubbles** and ensure **uniform wet-out** throughout the surface.

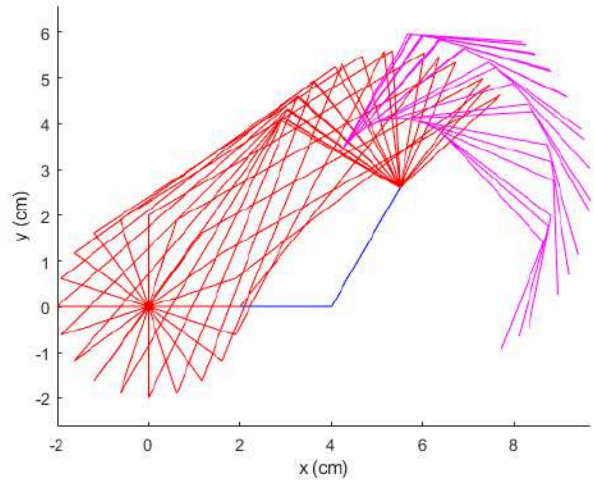
This **hands-on process** deepened my understanding of **composite materials** and their behavior during fabrication. It also strengthened my appreciation for **clean workflow practices** and **attention to detail**, skills that have proven critical in later stages of **prototyping** and **design development**.

Academic Project

5 Bar Linkage Gripper



Engineering Drawing of Final Product



Motion Simulation of a 5-Bar Linkage System with a Claw

For the **MEC411 Mechanics of Machines** final project, the objective was to **design** and **prototype** a **robotic gripper** capable of lifting a **100g cup** using a **five-bar linkage mechanism**. The project emphasized understanding **dynamic motion** in **mechanical systems** and applying **theoretical analysis** to **real-world design** and **fabrication**.

My primary responsibilities included calculating the **torque** required to actuate the **linkage system** and selecting an appropriate **servo motor** to meet those demands. The analysis involved identifying the **positions of key joints** throughout the motion cycle and determining **worst-case loading conditions** based on the **weight** and **reach** of the **end-effector**.

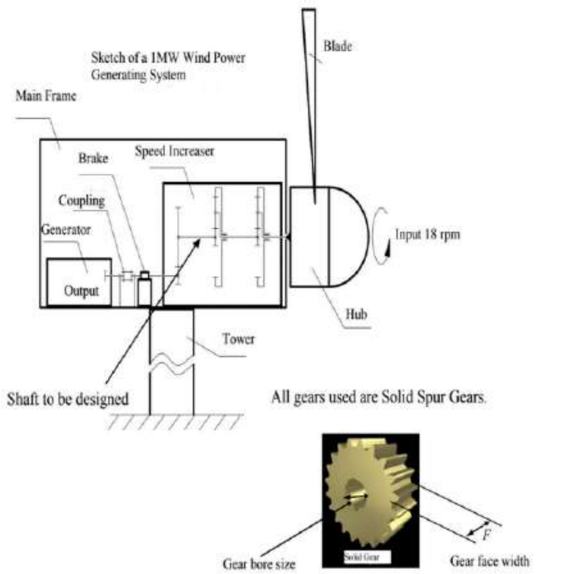
To verify the system's motion and evaluate its **range** and **stability**, I developed a **dynamic simulation** of the **five-bar linkage** in **MATLAB**. This simulation modeled the **kinematics** of the mechanism, including the **gripper claw**, allowing us to visualize **movement paths** and refine the **link lengths** and **joint angles** before physical fabrication.

Once validated in simulation, I proceeded to **3D model** all mechanical components, including the **base**, **link arms**, and **claw**, and manufactured the assembly using **3D printing** and **fasteners**. To improve the performance of the **end-effector**, I added a **rubber-like material** to the inner faces of the **gripper tips**. This significantly increased **grip reliability** by enhancing **friction** at the contact surface.

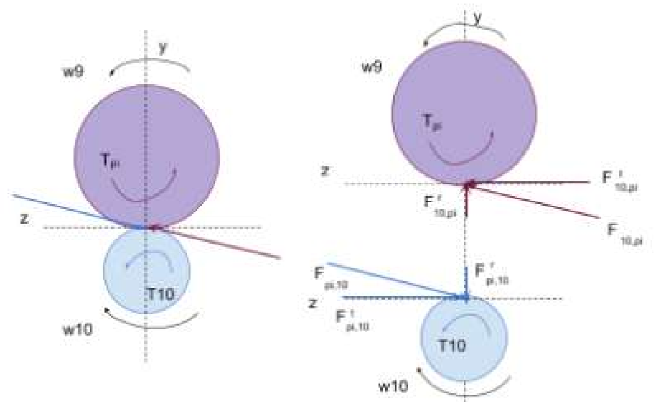
This project was an excellent opportunity to deepen my understanding of **mechanical linkages**, **torque estimation**, and **actuation system design**. It also strengthened my skills in **mechanical simulation**, **CAD modeling**, and **hands-on prototyping** of **complex kinematic systems**.

Academic Project

Central Shaft in a Multi-Stage Gear Box Project:
Speed Ratio Analysis of Planetary Gear Train - Torque And Moment Calculation



System Diagram of Wind Turbine Gearbox



Gear Reaction Force Diagram for Pinion and Gear on Generator

Final Design of the Shaft

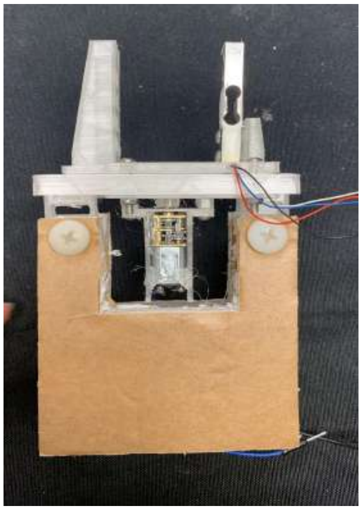
As part of the **MEC613 (Machine Design I)** group project, our team was tasked with designing a **gearbox shaft for a wind turbine system**, focusing on structural integrity, efficiency, and power transmission reliability. The project involved detailed mechanical analysis and design of components within a high-load, real-world application.

My primary responsibility was to perform analytical calculations for the **multi-planetary gear train**, a crucial subsystem for achieving the required speed reduction from rotor to generator. I calculated the **speed ratios, torque transmission, and resulting bending moments** on the shaft under various loading scenarios. These calculations informed the shaft diameter, material selection, and keyway placement to ensure safe operation under fluctuating wind conditions.

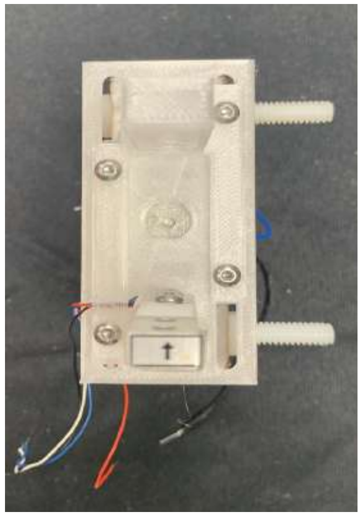
This experience helped reinforce my understanding of powertrain mechanics and planetary gear systems, and gave me hands-on experience applying design principles and failure criteria to a realistic engineering challenge. It also strengthened my ability to interpret mechanical requirements and translate them into manufacturable, analytically validated components.

Academic Project

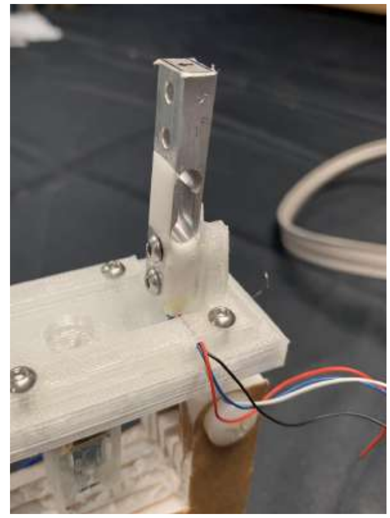
Gripper with Proportional Controller Using Data Acquisition



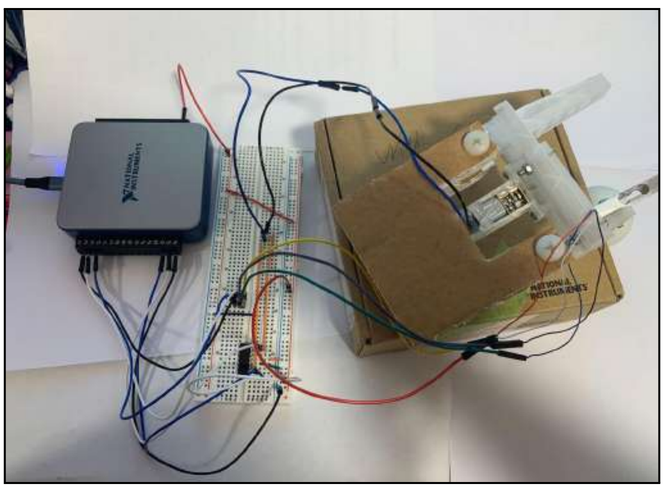
Front view of the mechanism



Top view of the mechanism



Load Cell Placement



Gripper wired to the DAQ, which is connected to the LabVIEW VI

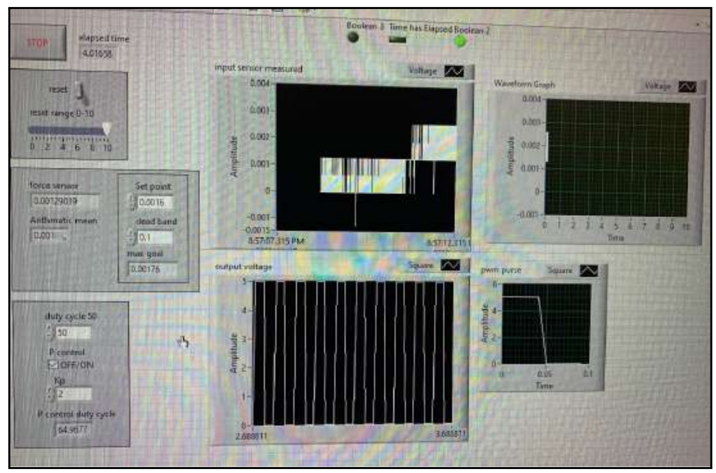
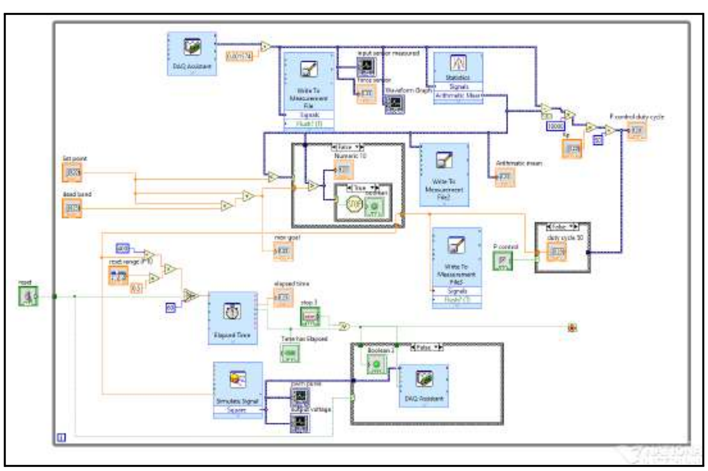
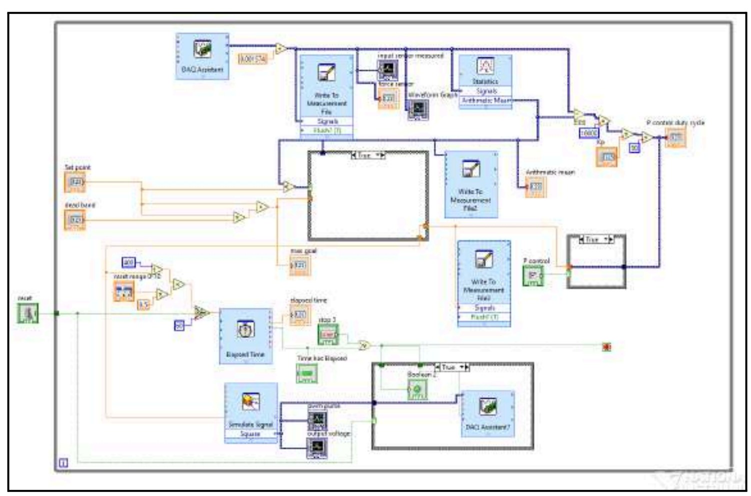


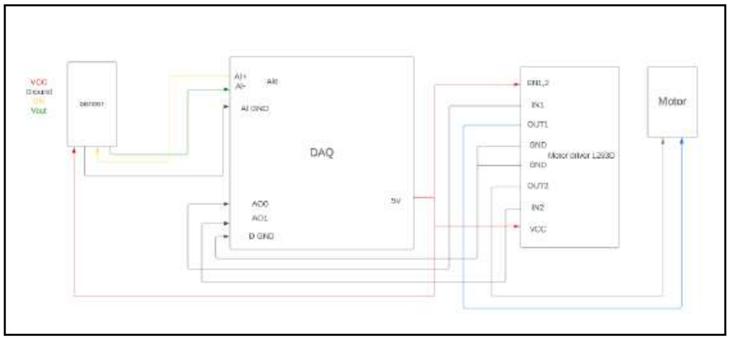
Image of the VI used for Data Collection



LabVIEW VI Diagram 1



LabVIEW VI Diagram 2



Electrical System Schematic Diagram

As part of the **MEC751** course *"Measurements, Sensors, and Instruments,"* I participated in a **term project** that involved **designing** and **controlling** a **robotic gripper system** capable of picking up a **ping pong ball** using **P-based force control** with a **touch sensor**. The objective was to integrate **mechanical design**, **sensor calibration**, and **closed-loop control** into a functional system, while adhering to strict **weight** and **hardware constraints**.

To meet the project requirements, I designed a **lightweight gripper** using a combination of **3D printed components**, **foam board**, and **standard fasteners**. After exploring several mechanical concepts, I selected a **rack-and-pinion mechanism**, where a **central gear** driven by a **DC motor** actuated two **linear racks** to open and close the **gripper tips**. All moving parts of the gripper, including the **gear** and **gripper fingers**, were **3D printed** to ensure **low weight** and **precision**. The **structural base** was fabricated from **foam board**, which was cut, folded, and glued into form, then bolted securely to the gripper assembly. The final assembly of all 3D printed components weighed only **18 grams**, well under the **25-gram project limit**.

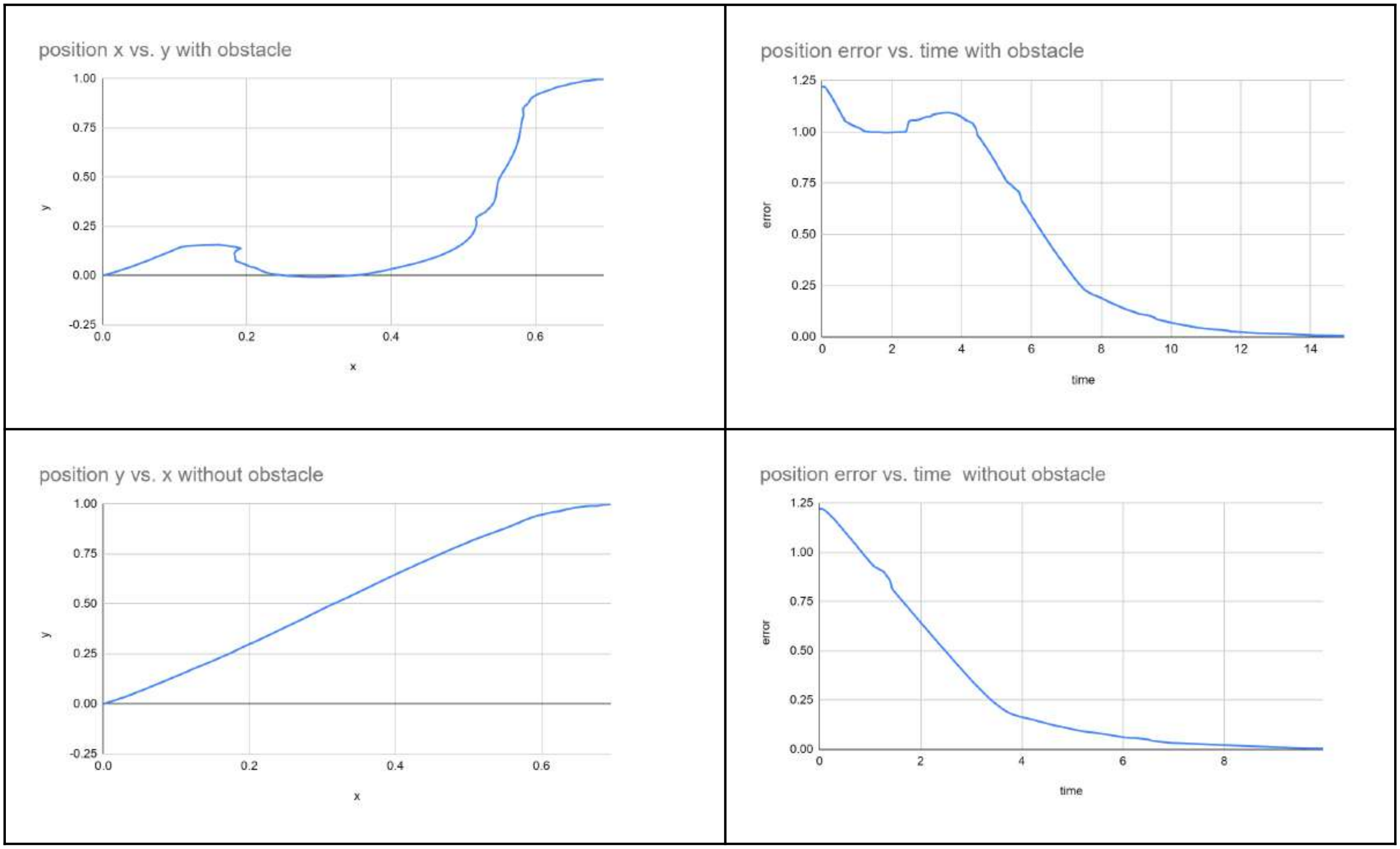
To accurately measure **grip force**, a **touch-sensitive force sensor** was **calibrated** using known weights. **Voltage readings** were recorded as a function of **applied mass**, and the resulting **voltage-mass relationship** was used to create a **calibration curve**. This data was processed to determine the **static calibration specifications** and estimate the total **sensor error**.

For **control implementation**, I used a **LabVIEW Virtual Instrument (VI)** configured with **DAQ Assistants** to read the **sensor input** and output **control signals**. A **proportional (P) feedback controller** was developed to regulate the **grip force** based on the sensor feedback. The control system was implemented using a **National Instruments USB-6001 DAQ module**, and **motor direction control** was handled via an **L293D H-Bridge**, using the **OUT1** and **OUT2 terminals** for **bi-directional actuation**.

This project allowed me to integrate core concepts from **mechanical design**, **instrumentation**, and **control systems** into a single, **functional prototype**. It also deepened my familiarity with **LabVIEW**, **real-time sensor calibration**, and **closed-loop feedback design** using **force-based proportional control**.

Academic Project

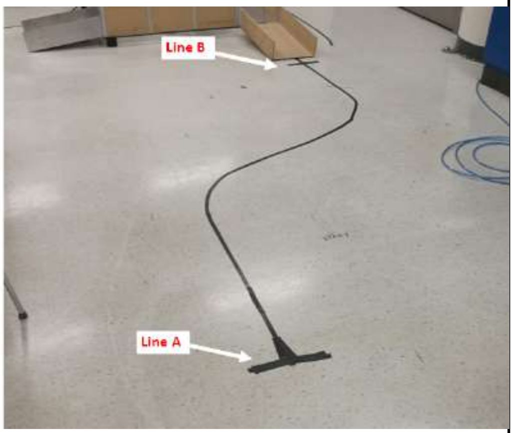
3 Wheeled Vehicle

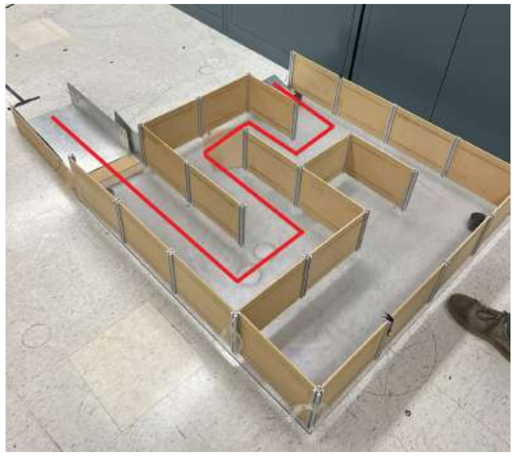


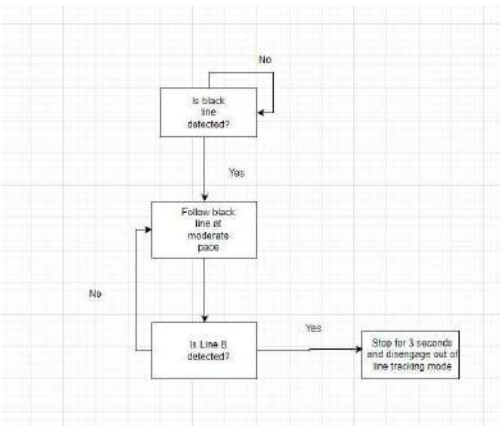
As part of the **ELE719** course *"Fundamentals of Robotics,"* I had the opportunity to learn **how to program a 3 wheeled vehicle** developing a fully **autonomous navigation** and **obstacle avoidance system** using Python. The controller was designed to guide the robot from an initial pose to a specified goal pose (x , y , θ), while avoiding obstacles in real-time using infrared (IR) proximity sensors. I implemented a unicycle-based feedback control law that computes the robot's linear and angular velocity based on distance and heading errors (ϱ , α , β), with carefully tuned gains to ensure smooth and accurate convergence. The robot's motion was commanded through inverse kinematics to compute individual wheel velocities, while odometry (corrected via IMU data) and forward kinematics were used to estimate the robot's pose. Obstacle avoidance was handled dynamically by analyzing sensor data: when an object was detected within a safety threshold, a temporary goal direction was calculated using a weighted combination of valid sensor vectors transformed from the sensor frame to the global frame using homogeneous transformation matrices. This project demonstrates my ability to integrate low-level kinematic modeling, sensor fusion, and closed-loop control in a real-time embedded robotics application.

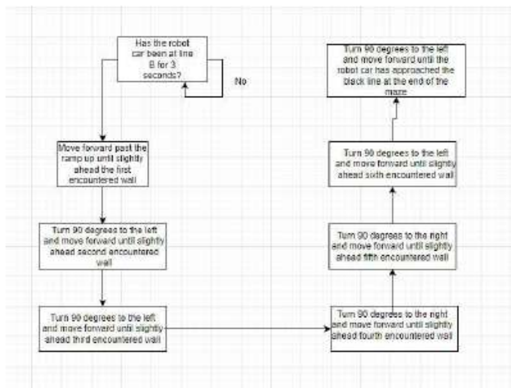
Academic Project

4 Wheeled Robotic Car









In this project in MEC733 (Control Systems), I developed and modified an **autonomous robotic vehicle** using the **Elegoo Smart Car Kit** to complete two key tasks: **line following and maze navigation**. The robot was required to follow a black line from point A to point B and pause for three seconds before entering a maze with dynamic configurations.

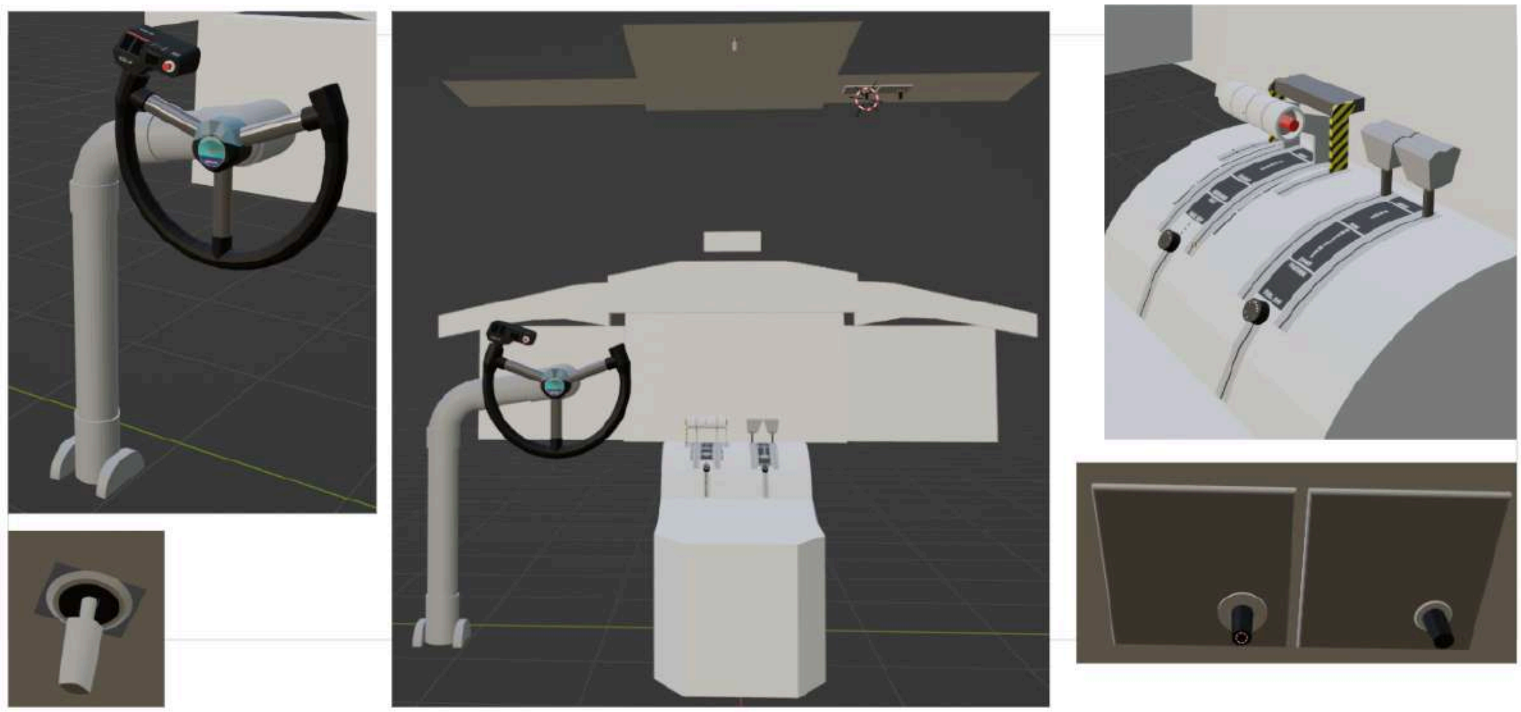
I began by adapting existing code from the Elegoo library, **integrating IR sensor logic to detect the black line** and **implementing conditional motion control to ensure accurate tracking**, including the handling of sharp turns and stopping criteria at line B.

To satisfy the maze requirements, I enhanced the **obstacle avoidance module** using ultrasonic sensors to detect wall proximity and correct orientation. The original control logic was improved by introducing sequential movement logic with precise timing delays and directional decisions based on sensor feedback. This allowed the robot to navigate the maze without collisions and complete the task in under 30 seconds, avoiding penalties. Multiple iterations were tested to refine sensor thresholds, movement timing, and error handling, particularly at sharp corners and during transitions between line tracking and maze navigation.

My contributions included implementing custom stop-detection logic, integrating sensor-based mode switching, and tuning motor commands for smoother movement. This project showcased my ability to **modify embedded code, interpret sensor data in real-time, and iteratively debug hardware-software interaction to meet strict task specifications.**

<u>Research Lab Project</u>

Cockpit Components Design



As part of the Digital Supercluster project, I was assigned the task of developing accurate **3D models** of **cockpit components** for use in a **high-fidelity aircraft simulation environment**. These models were intended to enhance the **realism** and **immersion** of the simulation platform, which relied heavily on **visual** and **functional accuracy**.

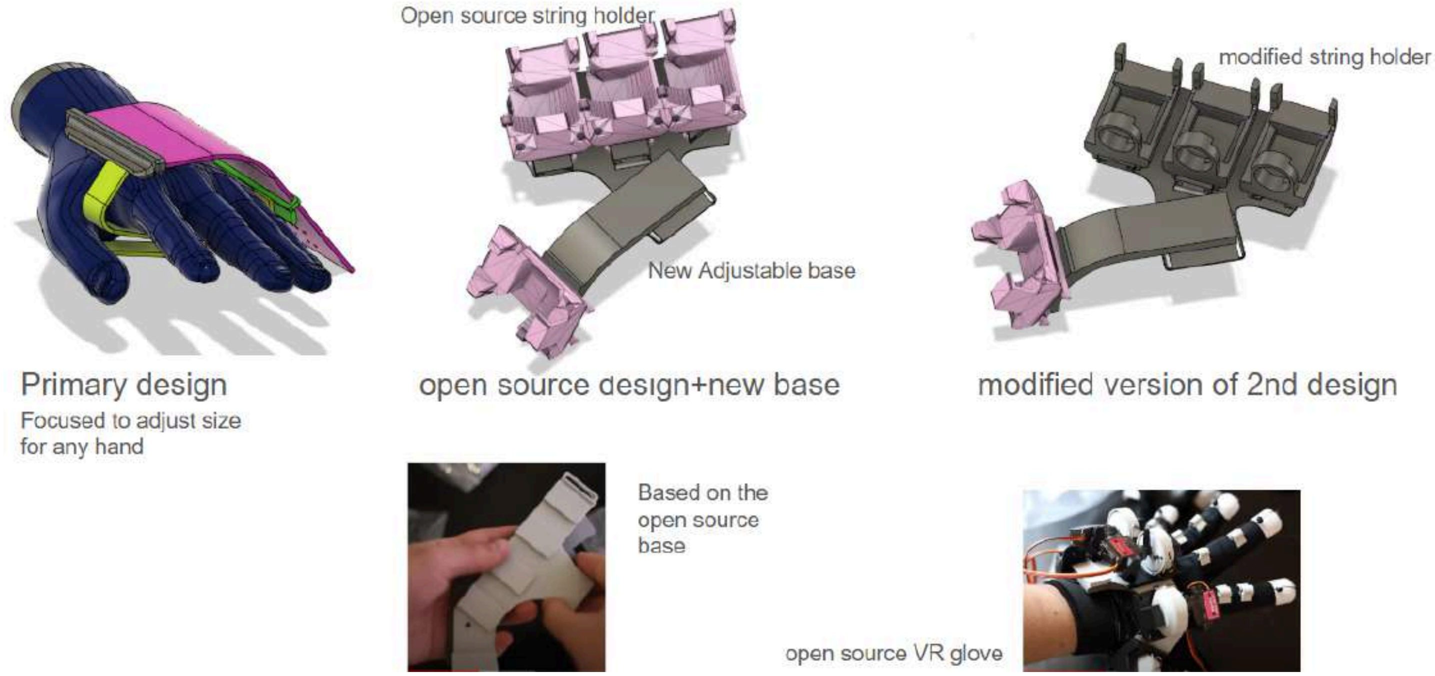
The components I created included **control handles**, **toggle switches**, **rotary knobs**, and **throttle levers**. To ensure **geometric** and **visual accuracy**, I began by collecting **reference images** directly from the **X-Plane flight simulator**, capturing multiple angles of each required cockpit element. Based on this **visual data**, I **modeled** each component from scratch in **Blender**, applying careful attention to **scale**, **proportions**, and **ergonomic detailing**.

Once the **geometry** was complete, I enhanced each model using **texture maps** sourced from **Quixel Mixer**. These **high-resolution textures** were **UV-mapped** onto the surfaces of each component, allowing for **realistic material appearances** such as **metal**, **plastic**, and **rubber**. By fine-tuning the **shader** and **material settings** in Blender, I was able to closely replicate the **visual properties** observed in real cockpit controls.

This project significantly strengthened my skills in **3D modeling** and **texturing**, especially in Blender's **mesh construction**, **UV unwrapping**, and **material node workflows**. It also deepened my understanding of **cockpit layout** and **control element design**—knowledge that directly supports my ongoing work in **aerospace systems** and **simulation**.

<u>Research Lab Project</u>

Cockpit Components Design



During my time at the **MIMS Lab**, I was involved in the mechanical design of a **haptic glove system for VR/AR applications**. The project focused on developing a glove that could deliver force feedback while being size-adjustable and comfortable for users with varying hand dimensions. My role included researching current haptic glove technologies, evaluating their mechanical layouts, and identifying key trade-offs in performance, adaptability, and ease of manufacturing.

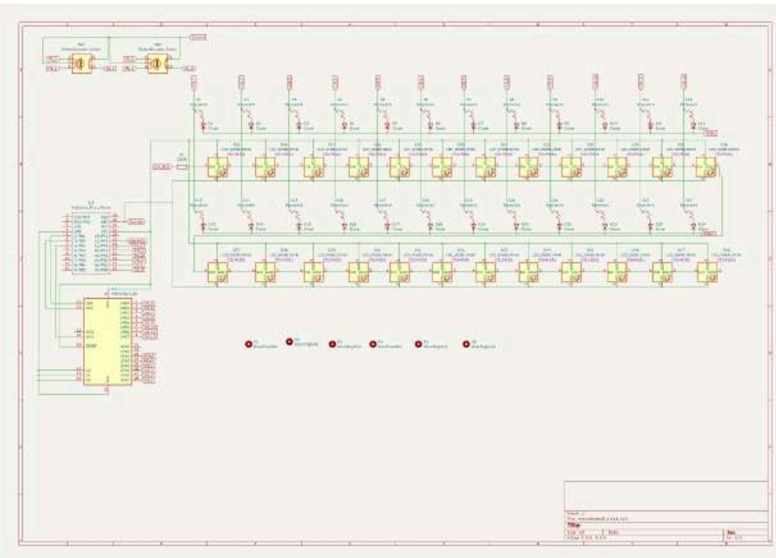
The initial concept involved a custom base structure with a clip mechanism that allowed for wrist and palm size adjustments. However, upon discovering a promising open-source glove design, I shifted my approach toward improving that existing platform. This allowed for faster prototyping while maintaining a high level of mechanical customizability.

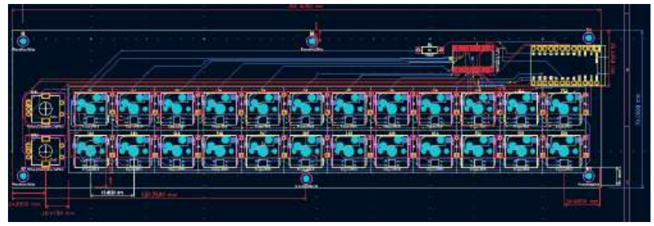
To enhance the adaptability of the glove, I introduced a **sliding clip mechanism** that enabled positional adjustment of the thumb component relative to the main base. This adjustment improved fit and comfort across different hand sizes. Additionally, I redesigned the **string holder**—a key part of the glove's haptic feedback system—to reduce both its volume and its contact area with the base. This minimized interference with hand movement while maintaining secure cable routing for force transmission.

This project expanded my experience in ergonomic mechanical design, iterative prototyping, and integrating haptic subsystems into wearable technology. It also gave me valuable insight into the practical constraints of developing real-world VR/AR hardware platforms.

<u>Personal Project</u>

Macro Board PCB Design 1





As part of a side project focused on enhancing simulation hardware, I was tasked with designing a **custom macro keyboard** to expand input capabilities for aircraft simulation software. The goal was to create a compact, customizable interface that could accommodate a large number of programmable keys while maintaining a minimal physical footprint—ideal for cockpit simulation setups.

To achieve this, I designed a custom **PCB using KiCAD**, leveraging a two-layer layout for efficient signal routing and compact form factor. The board was carefully arranged to support the required number of inputs, and the full 3D assembly—including key switches, encoders, and microcontroller—was visually organized and validated within KiCAD's modeling environment.

For the microcontroller, I selected the **Arduino Pro Micro** due to its compact size and native USB HID support, making it ideal for keyboard emulation. To overcome the I/O limitations of the microcontroller, I integrated an **MCP23017 I/O expander** via the I²C interface, significantly increasing the number of usable input pins without increasing the board size.

The final macro board supports **24 mechanical keys** and **2 rotary encoders with push button functionality**, offering versatile input for various simulation commands such as throttle control, flaps, landing gear, and more. The project gave me practical experience in PCB design, embedded systems integration, and user-centered hardware development, skills directly applicable to both research and industry applications.