EANA HAN PORTFOLIO

BASc in Mechatronics Engineering
with Computing Option

Content

My portfolio includes projects from internship experiences and undergrad course work

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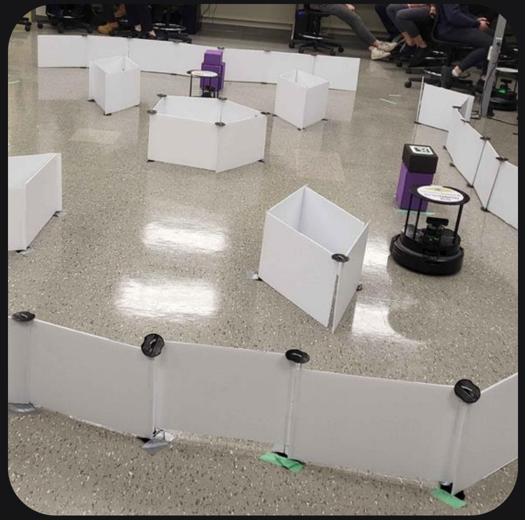

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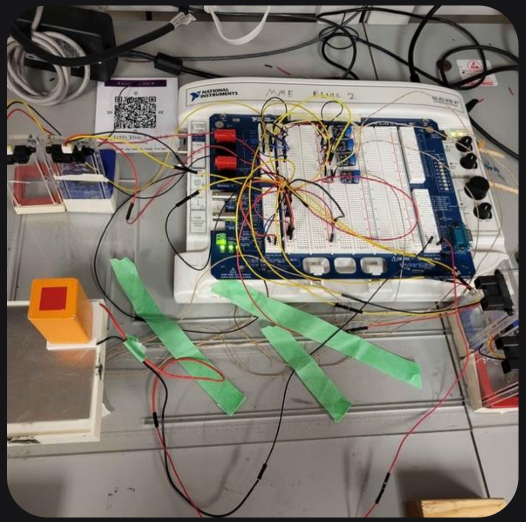

Sensor Fusion Lab

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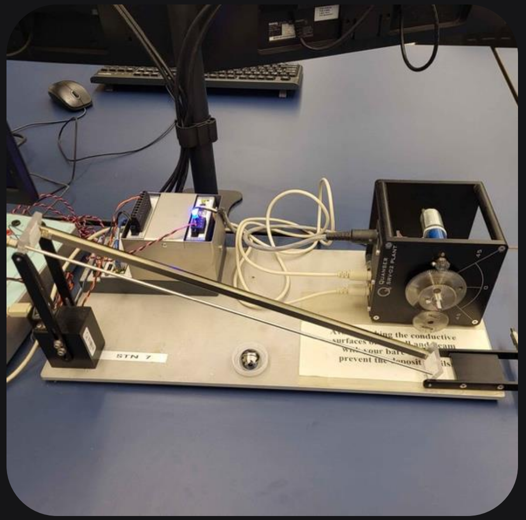

Controls Project

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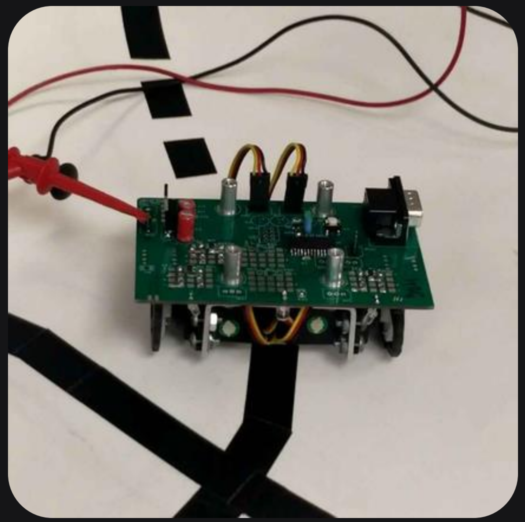

Line Following Robot

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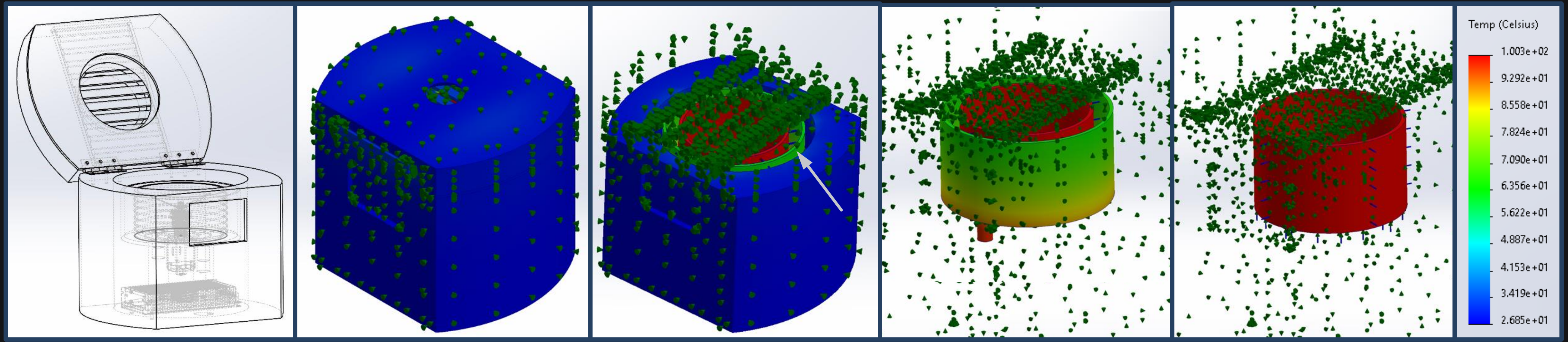
CAD Art Project

Apple Crisp: Prototype Development

Capstone Project

SolidWorks | AutoCAD | 3D Printing | Arduino | Soldering | KiCad

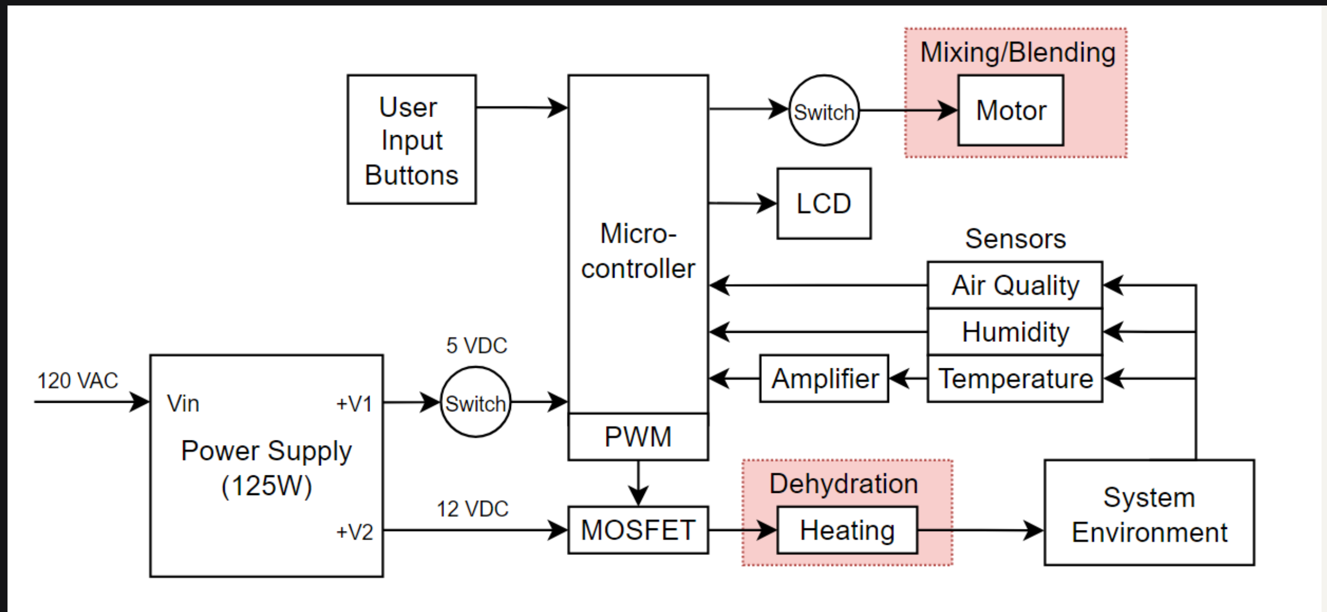
3D CAD Model & Thermal Simulation - SolidWorks

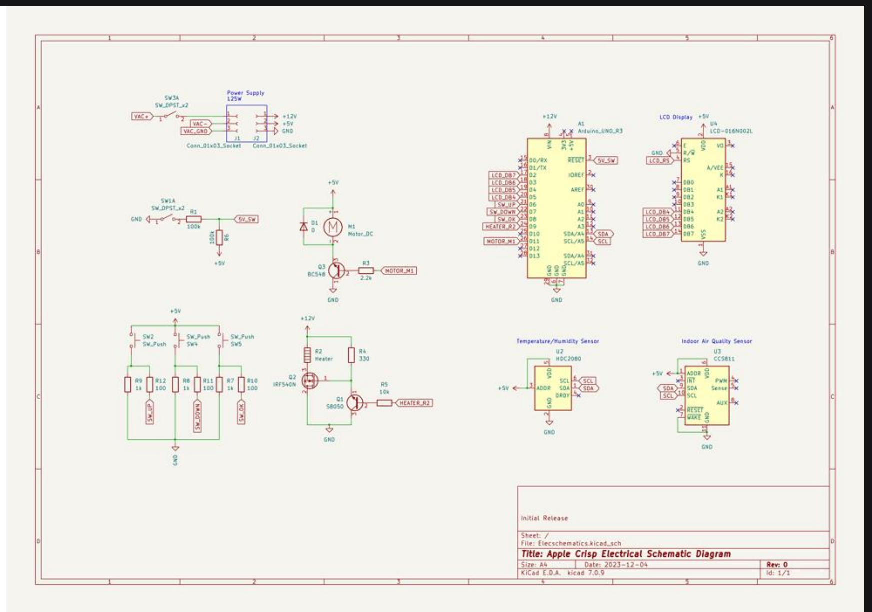


Initial CAD Model | Thermoplastic Outer | Melamine Foam Insulation | Stainless Steel Compartments | Nichrome Wire Outside Input Bucket

- External temperature is within 27 °C through simulation which meets user safety constraints.

Electrical Drawings - KiCad

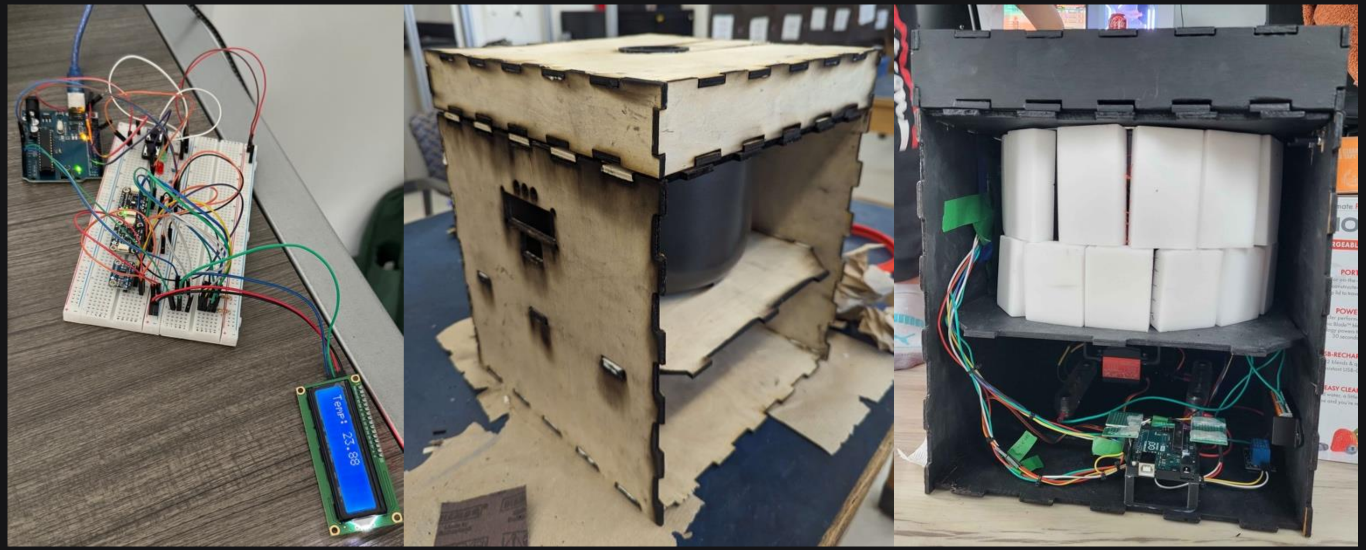




Problem Statement

- Across multi-residential buildings, there is limited access to organics collections.
- Apple Crisp is a kitchen companion that dehydrates organic waste to reduce the volume of waste that end up in landfills.

Testing & Assembly – Arduino, AutoCAD, 3D Printing



- Tested Arduino code by connecting to breadboard.
- Soldered onto the circuit board.
- Designed case on AutoCAD for laser cutting.
- 3D printed component mounts and assembled the system.

Group members: Denise Tsui, Nicole Tao, Hoang Vu

check out our website

Apple Crisp: Final Product

Capstone Project

SolidWorks | AutoCAD | 3D Printing | Arduino | Soldering | KiCad

Problem Statement

- Across multi-residential buildings, there is limited access to organics collections.
- Apple Crisp is a kitchen companion that dehydrates organic waste to reduce the volume of waste that end up in landfills.

Testing

- Various food scraps are inputted to Apple Crisp including celery, peels (apple, potato, carrot) and leafy greens.
- After every ~1 hour of heating time, the scraps are taken out to be weighed.

0 hr | 1.5 hr | 3 hr | 4.5 hr | 6.5 hr

Results

50% minimum volume reduction

70% minimum weight reduction in 6-8 hour heating cycles

Apple Crisp was nominated for the **Sustainability Award**

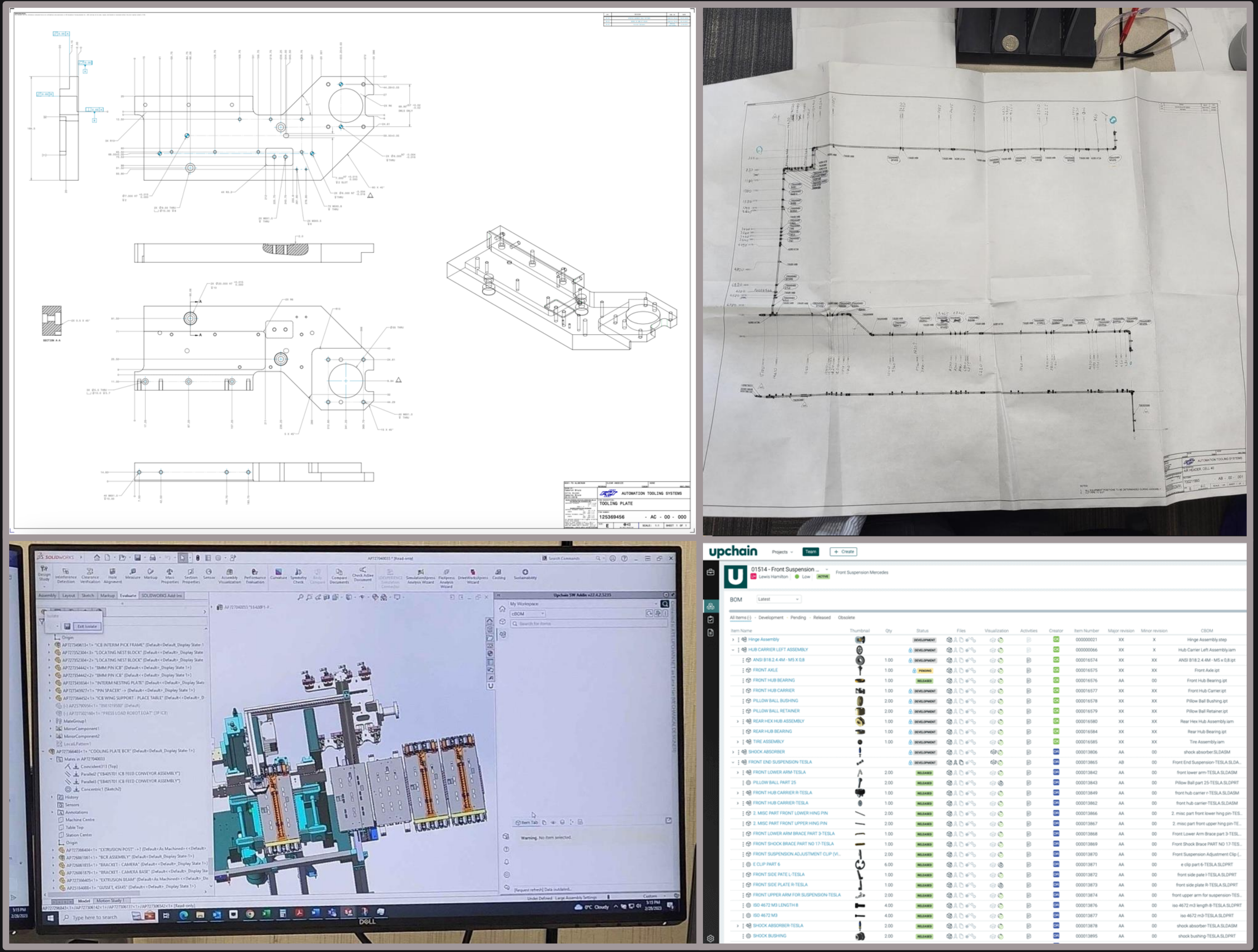
Group members: Denise Tsui, Nicole Tao, Hoang Vu

EV Battery Automation Cell

SolidWorks | PLM | Ladder Logic

Internships: Worked on designing and automating manufacturing cells for General Motor's EV battery modules.

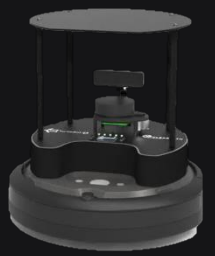
Mechanical Designer – SolidWorks, Upchain PLM



- Created and modified 3D CAD models and 2D mechanical drawings for automation cells.
- Verified specifications with vision engineers to modify assembly for optimal camera scanning.
- Used Upchain PLM to update CAD design revisions, BOMs, and track tasks.

Controls Engineering – Rockwell Studio 5000, FactoryTalk View

- Integrated control systems by verifying PLC Ladder Logic code and doing I/O checks.
- Assisted in dry cycles to check motion paths and calibrate the mechanical systems.



TurtleBot

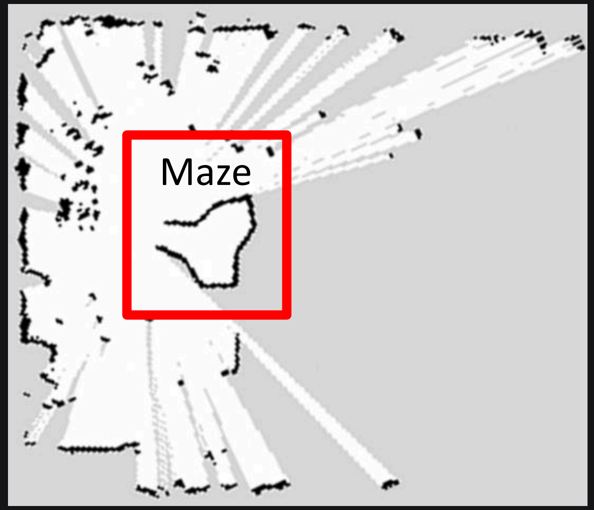
Autonomous Mobile Robots Course Project

Python | *ROS2* | *PID Control*

Gazebo | *RViz* | *Ubuntu*

Sensor Data Processing

IMU, Odometry, LiDAR sensors



Laser scan of maze

Closed Loop Control - PID

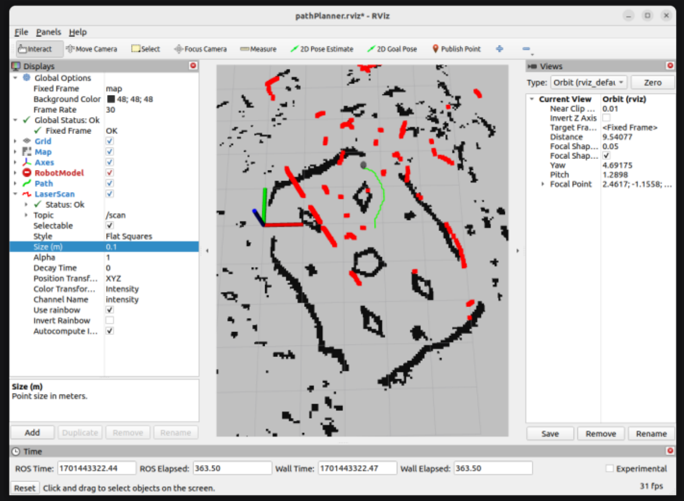
Analyzing agility y, accuracy, and overshoot to fine tune PID values

Localization

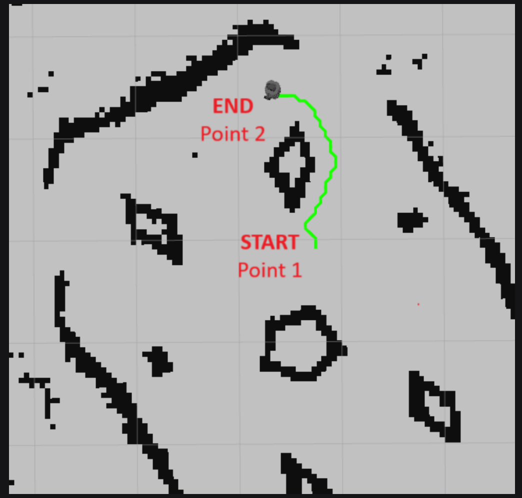
- Kalman Filter and EKF
- Fine tuning Q & R values

Path Planning & Navigation

A*, RRT, RRT* path planning algorithms



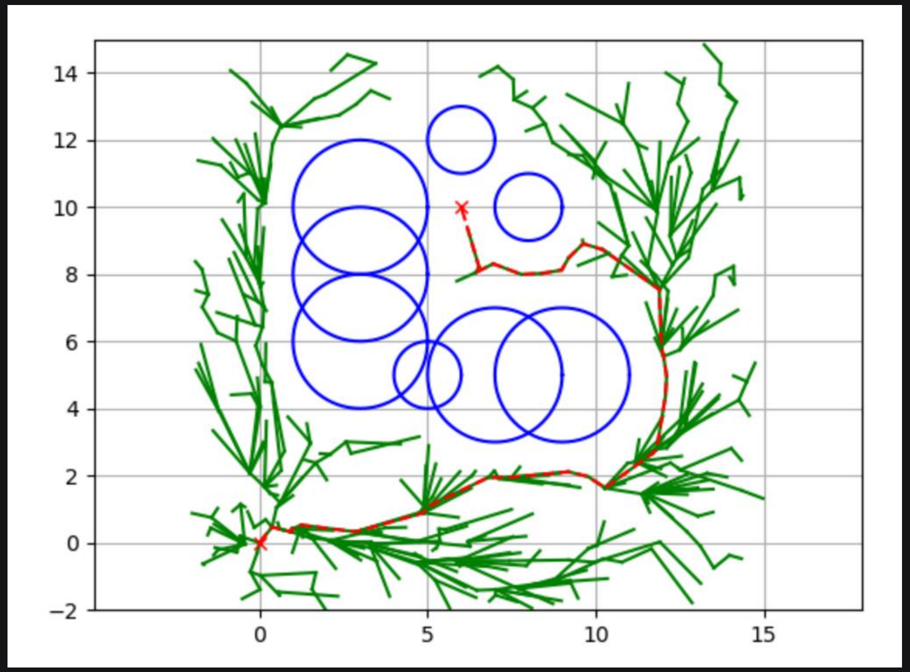
RViz – Select destination point



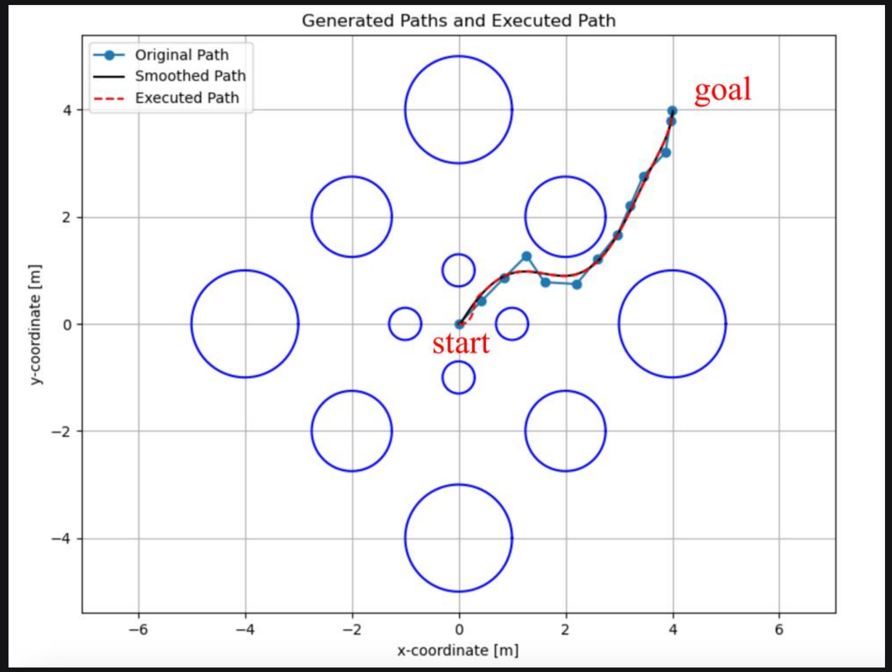
A* path planning

Lab room environment – execute path

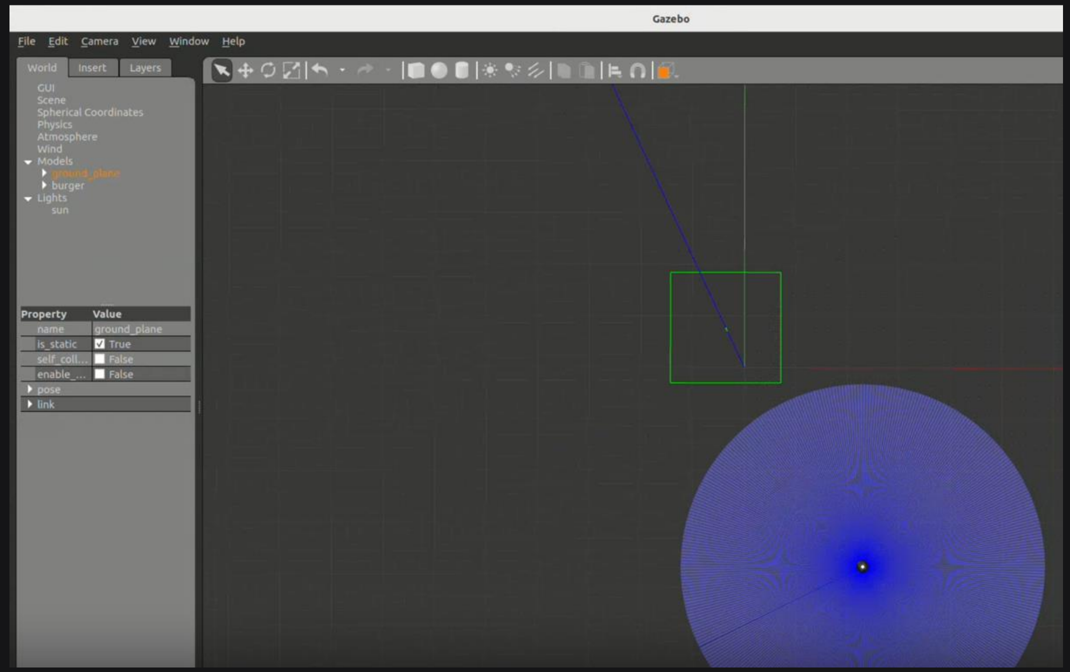
Simulation for Path Planning and Execution



Implementing RRT* algorithm



Path generated while avoiding obstacles

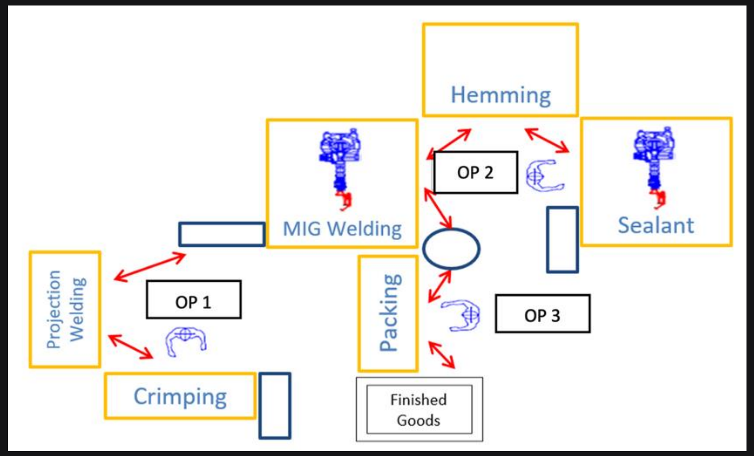


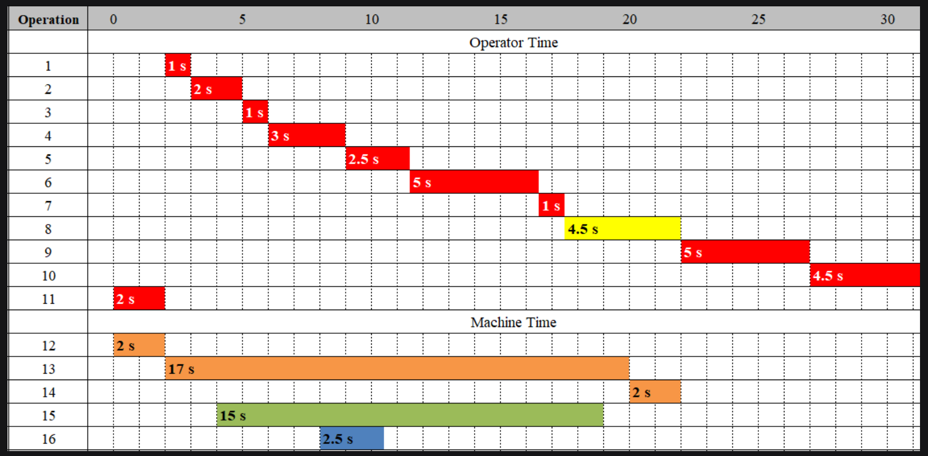
Simulated TurtleBot following the path in Gazebo

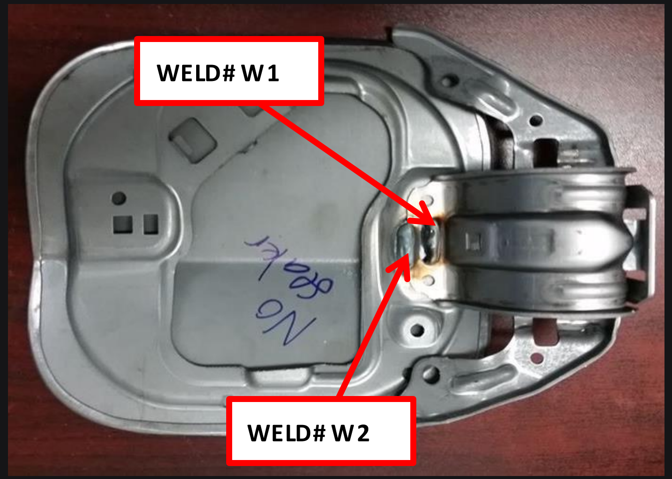
Automotive Manufacturing

Manufacturing Engineering Intern

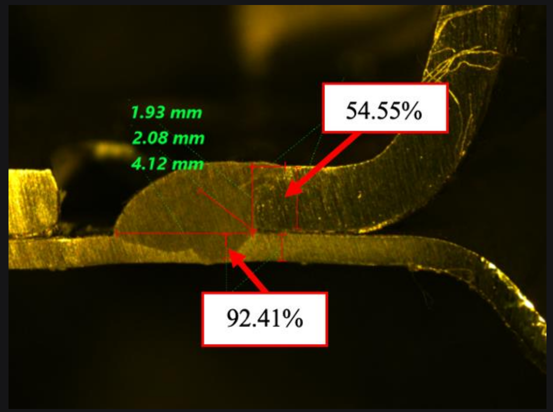
Honda Fuel Door Cycle Time Reduction – Welding Robot Adjustment



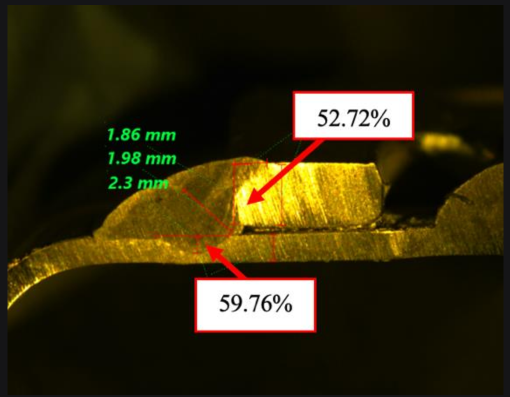




Weld #W1



Weld #W2



- Conducted cycle time studies to figure out the bottleneck.
- Adjust robot path and weld parameters to reduce MIG weld work time.
- Verified weld quality is preserved.

$$Annual\ Production\ Time\ Saving = \frac{Annual\ Volume}{Original\ Rate} - \frac{Annual\ Volume}{New\ Rate}$$

$$Annual\ Production\ Time\ Saving = \frac{305{,}061\ parts}{113\ parts/hr} - \frac{305{,}061\ parts}{125\frac{parts}{hr}} = 259.17\ hours$$

$$Annual\ Cost\ Savings = 259.17\ hr \times \frac{\$33}{operator \cdot hr} \times 3\ operators = \$25{,}657.52$$

Ford Spacer Scrap Reduction – Weld Rework

- Noticed excess of scrap parts for ford spacers from defective welds.
- Worked with maintenance team to fix welding fixtures.
- Created rework instructions to eliminate scraps, resulting in cost savings.

$$\mathrm{ROI} = \frac{Total\ Annual\ Rework\ Cost}{Total\ Annual\ Scrap\ Cost} \times 12\ months$$

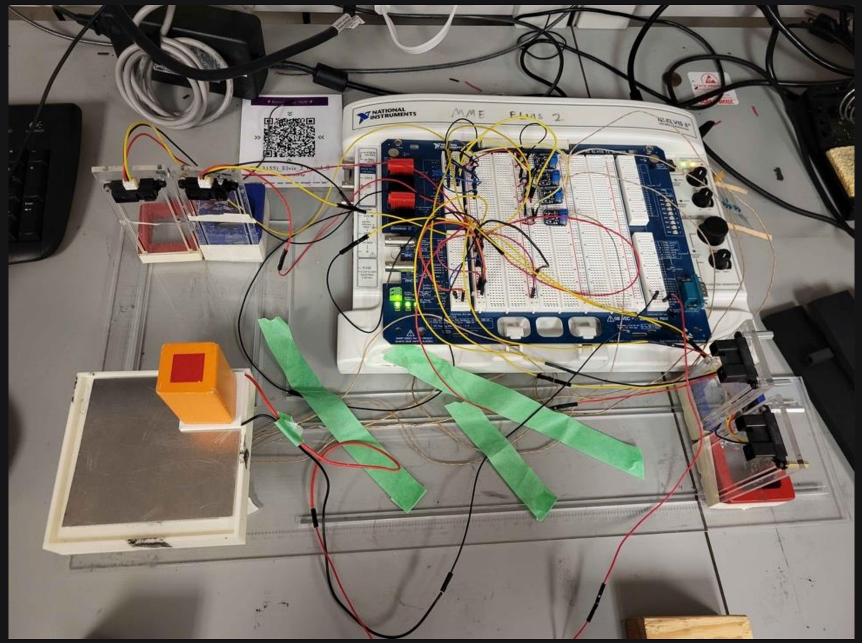
$$\mathrm{ROI} = \frac{\$1343}{\$9{,}109} \times 12\ months = 1.8\ month$$

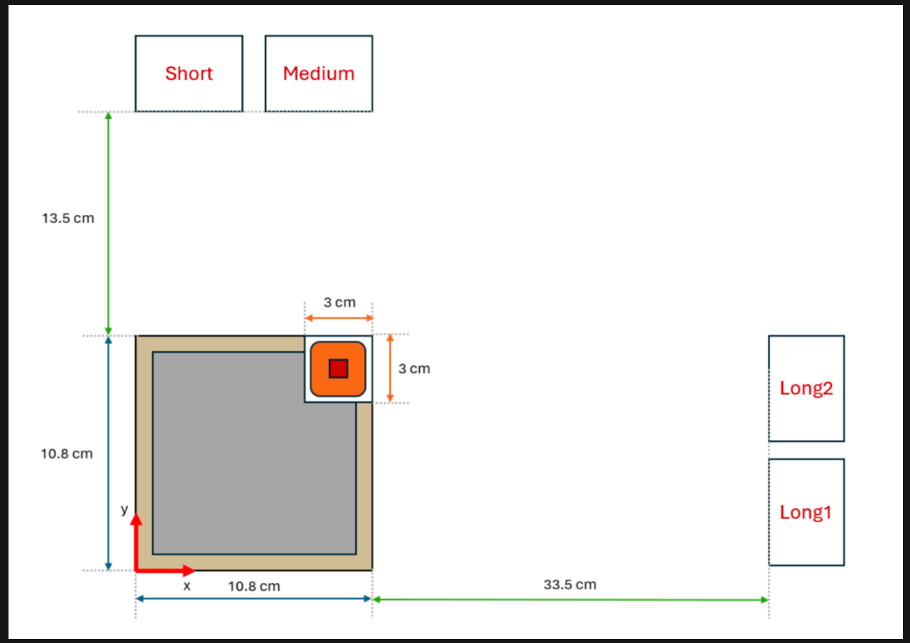
Multi-Sensor Data Fusion Lab

Coursework

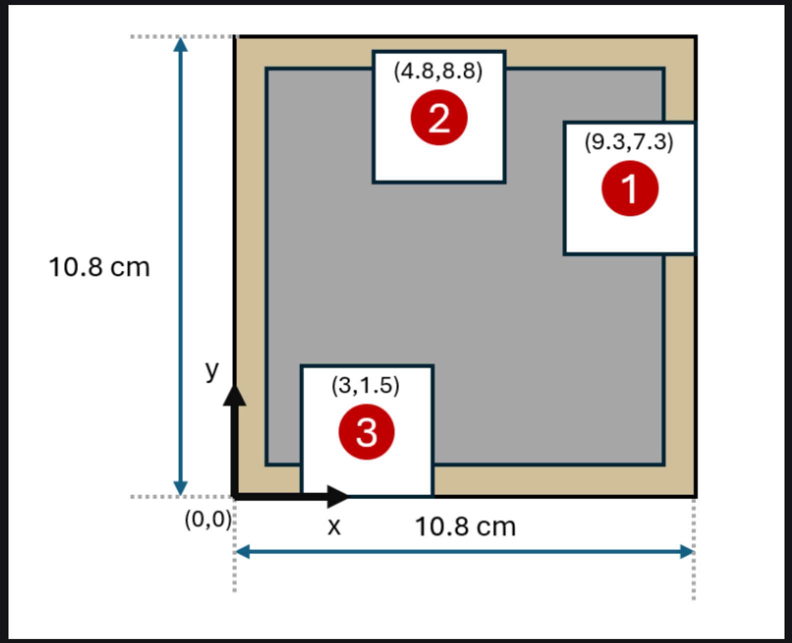
MATLAB *Wiring* *Algorithms*

Sensors Setup – 4 IR Sensors, 4 Thermocouples





Test Points



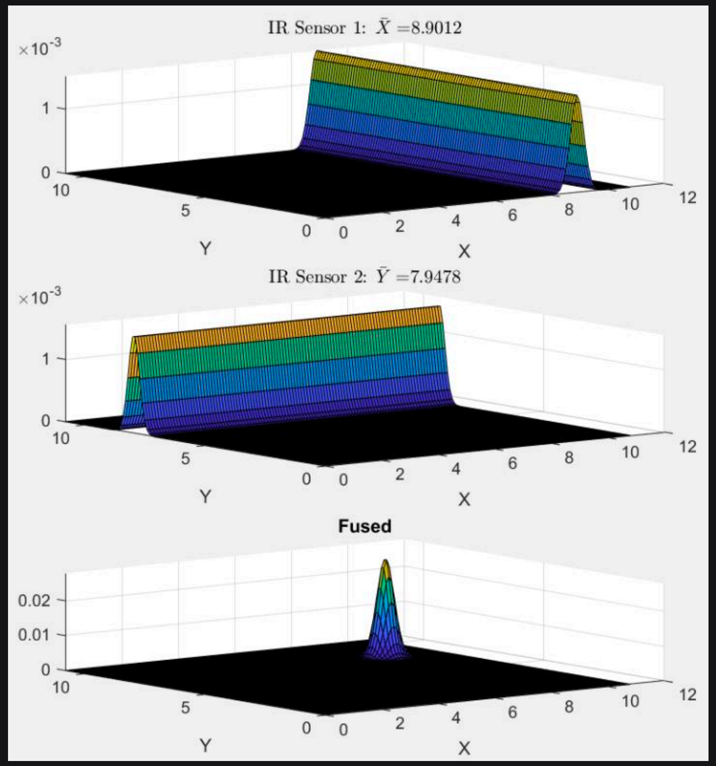
Data of Test Point 1 is shown below

Problem Statement

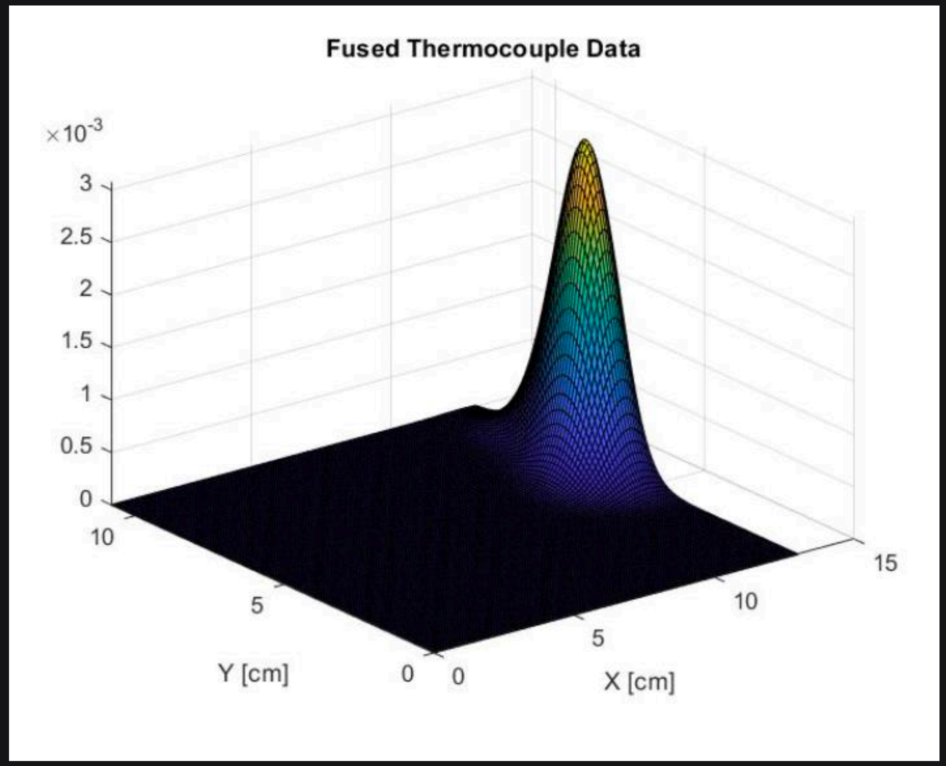
Combine the data collected from IR sensors and thermocouples to find the location of the orange block.

- Train model with 9 positions of block.
- Filter data and curve fit for distance and temperature, then fuse data.
- Evaluate the model with test points.

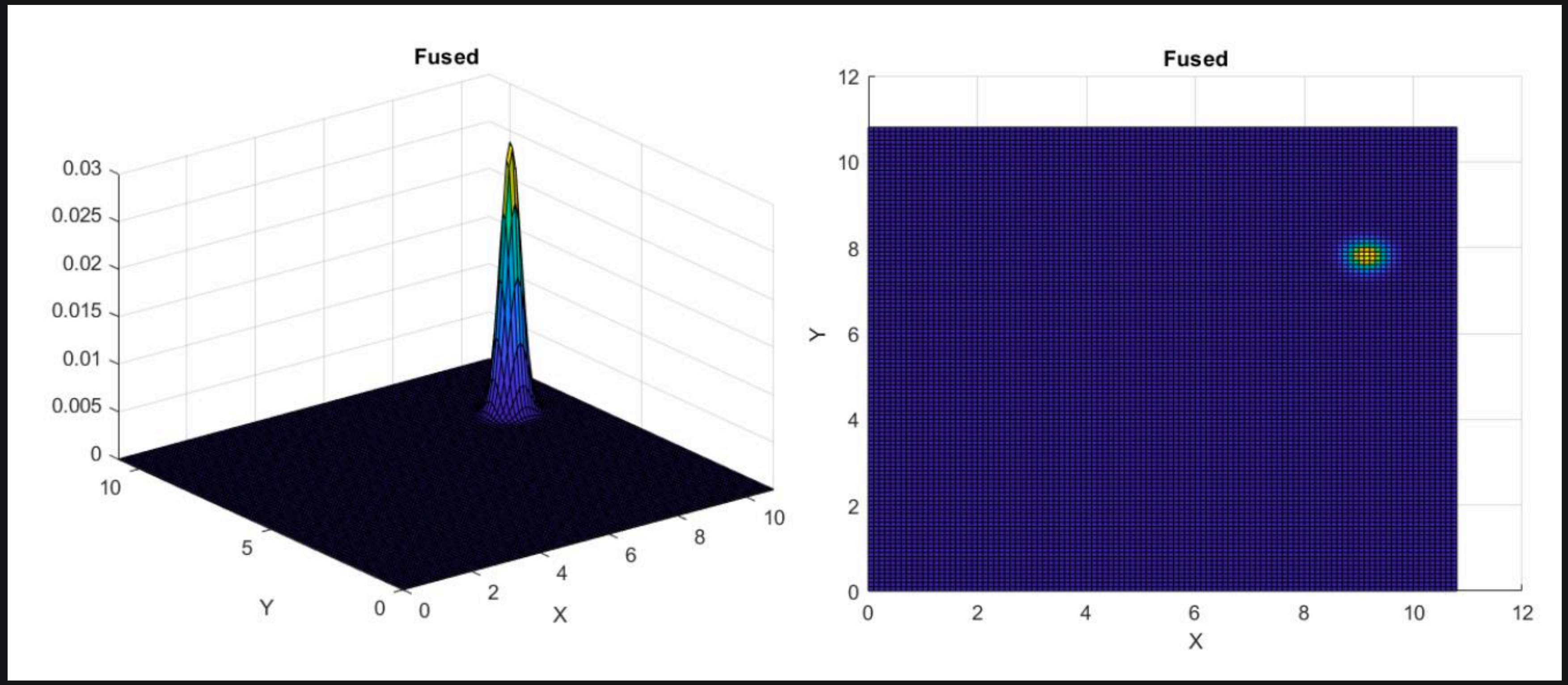
Data Fusion Results for Test Point 1



Fused IR sensor data



Fused thermocouple data



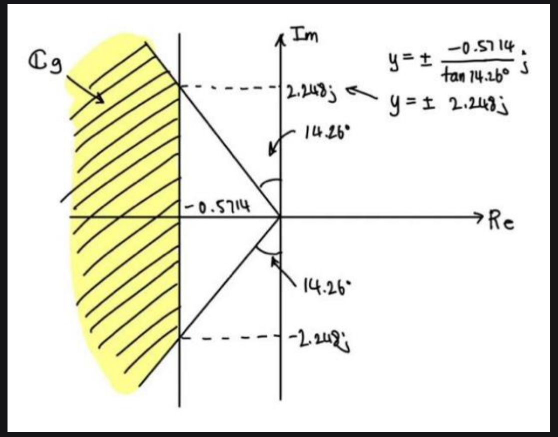
Fused data of all sensors shows the most probable location of the block, which is very close to the actual point (shown above)

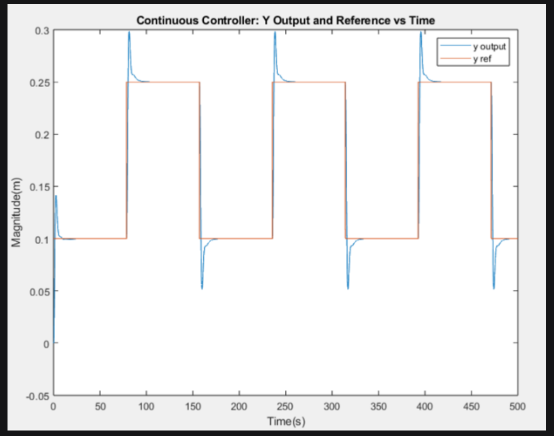
Ball and Beam Controller

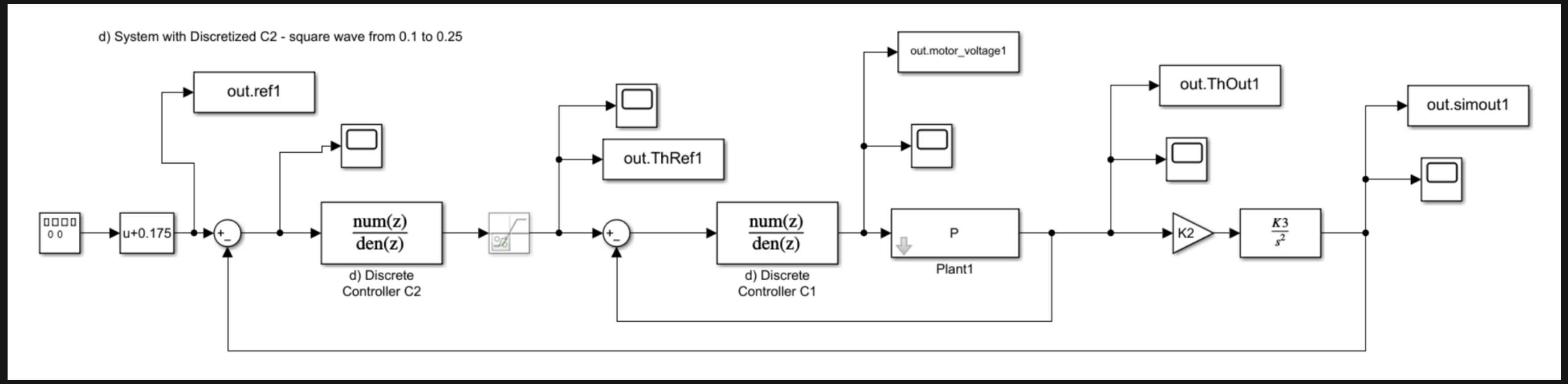
Digital Control Applications Course Project

MATLAB | Simulink | C++ | NI LabView

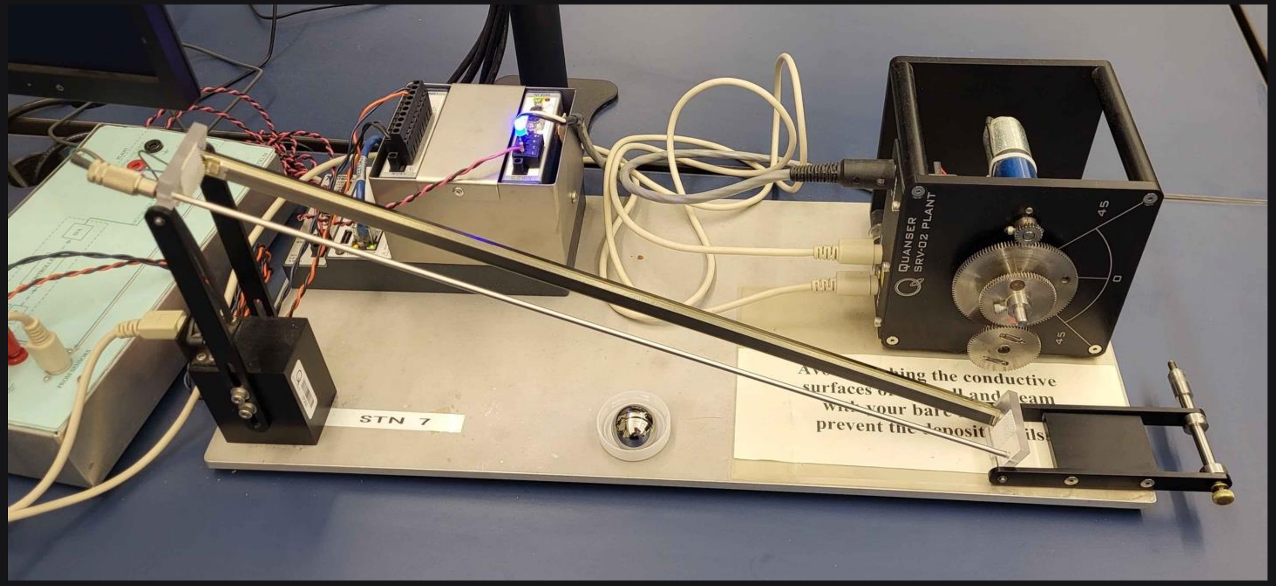
Simulation – Pole placement, MATLAB, Simulink

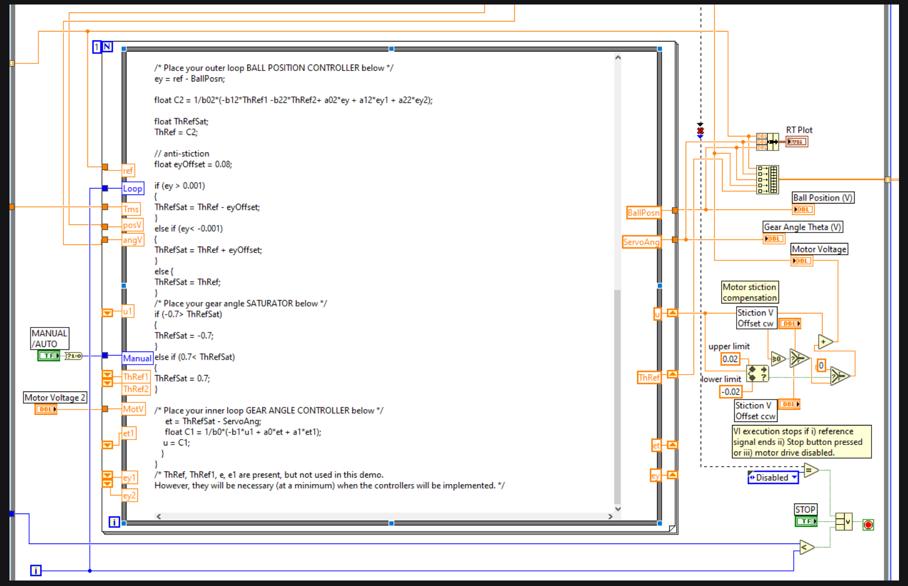






Implementation – C++ Programming, NI LabView





Problem Statement

- Create a ball and beam apparatus to move the ball that resembles a square wave.
- The beam tilts its angle according to the potentiometer voltage that was fed to vary the gear angle.
- The ball position wave must be within overshoot, steady state error, settling time, and saturation specifications

Process

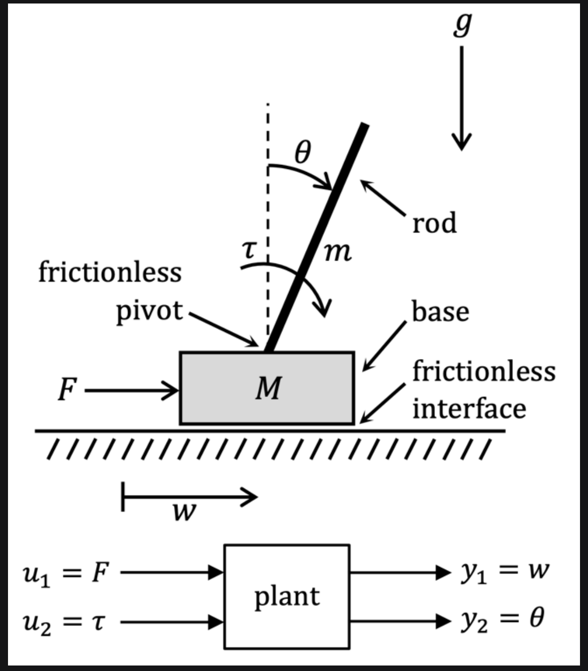
1. Ball and beam set up with CompactRIO PLC.
2. Calculations for pole placement for the initial controller.
3. Code C++ in NI LabView to test physical system.
4. Import data to MATLAB to design controller and use. Simulink to verify if output from controller is within specs.
5. Update LabView code and test actual ball position to verify discrete controller.

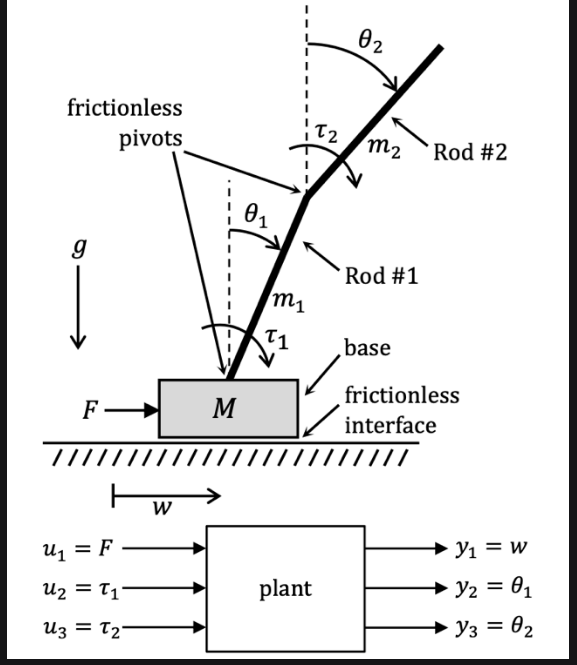
Aiming System Control Design

Control Theory | MATLAB | Simulink

Multivariable Control Systems Course Project

One & Two Rod Aiming Systems



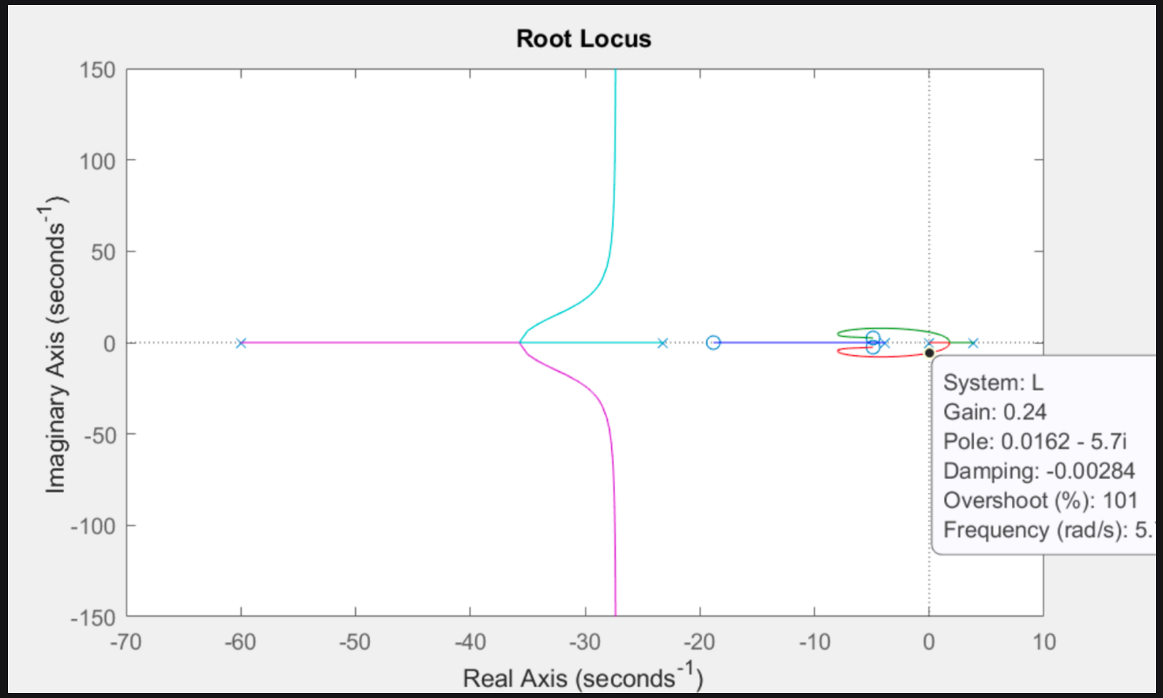


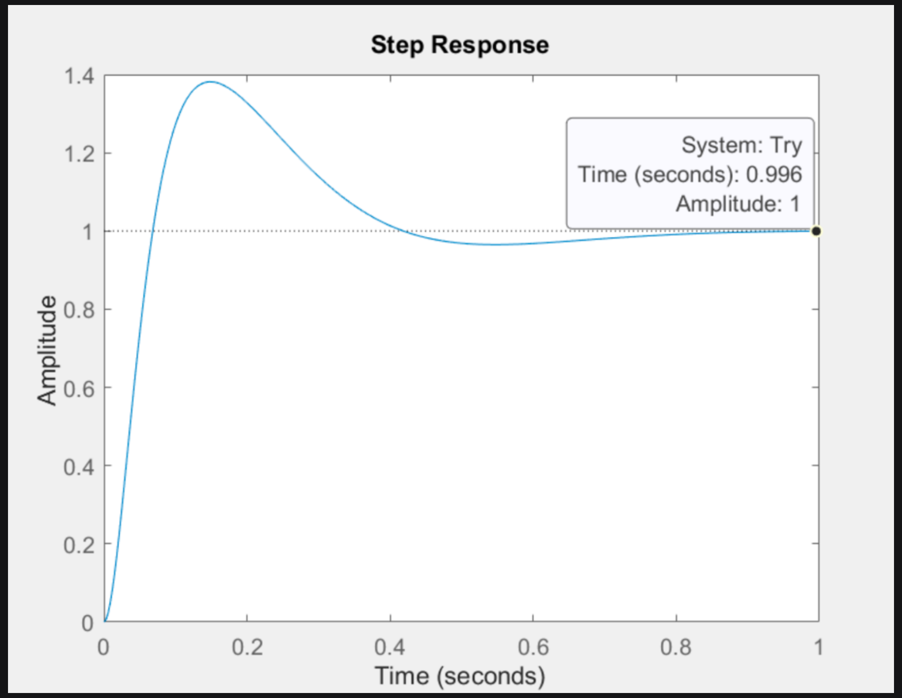
- Derived and calculated requirements for the controller based on model specifications.
- Used MATLAB to design control systems and analyze system responses.
- Refined the design by applying different control techniques.

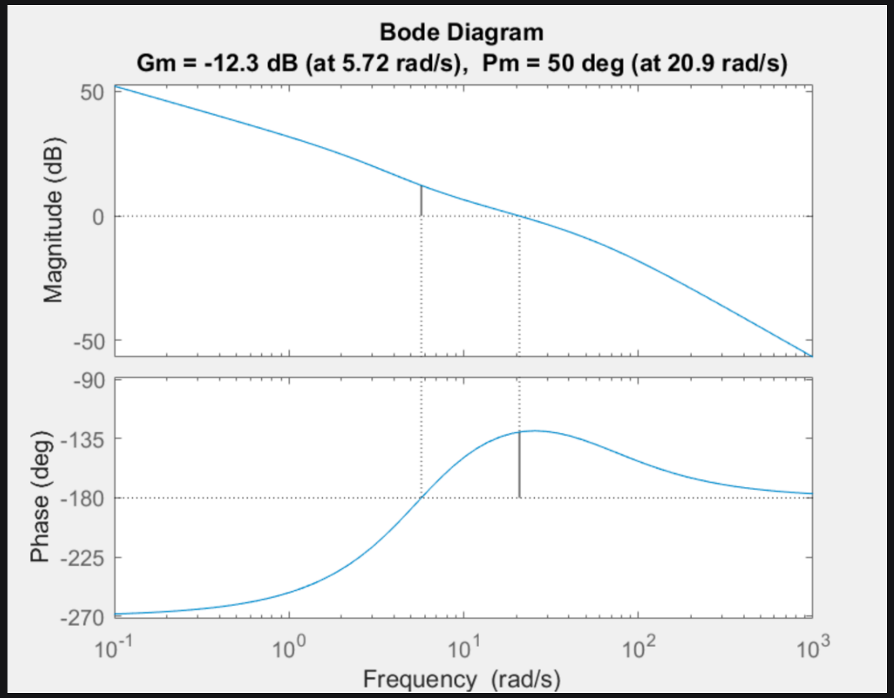
Problem Statement

Design and implement control systems for SISO and MIMO aiming systems using MATLAB, applying control system theory.

Simulation and Analysis







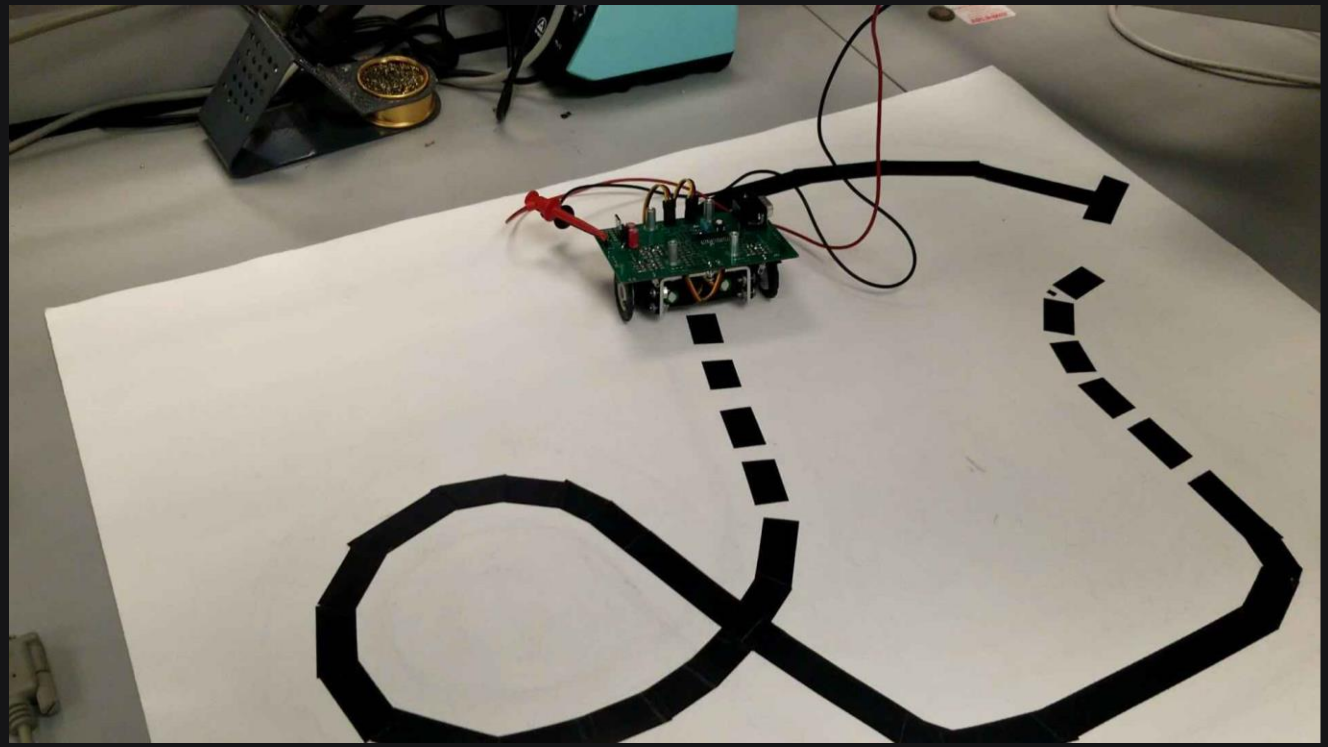
Line Following Robot

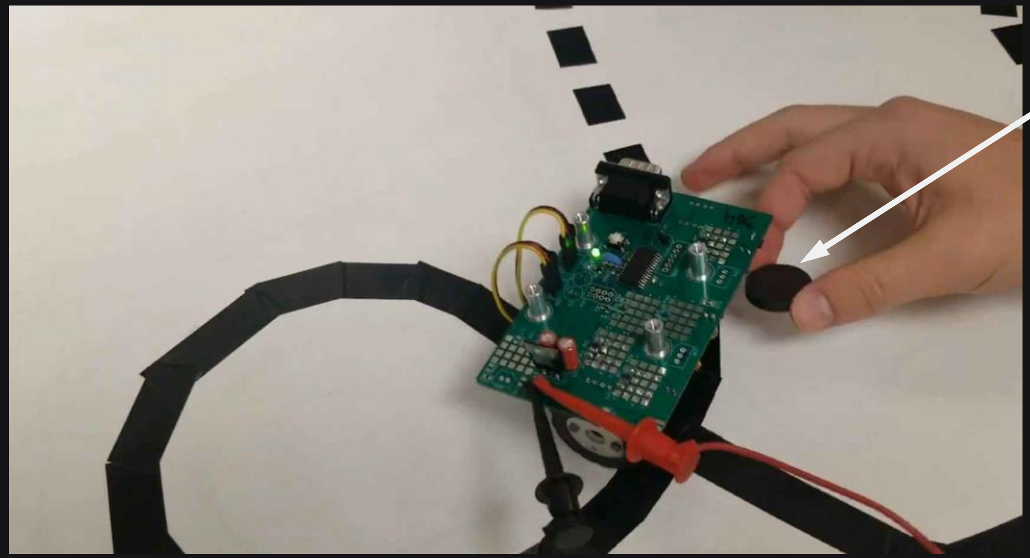
Circuit Design | Soldering | C Programming

Sensors and Instrumentation Coursework

Test Track

Final track (no photos were allowed to be taken) had multiple sections with dashed track lines, steep curves, and ramps. Our robot successfully finished the final track.

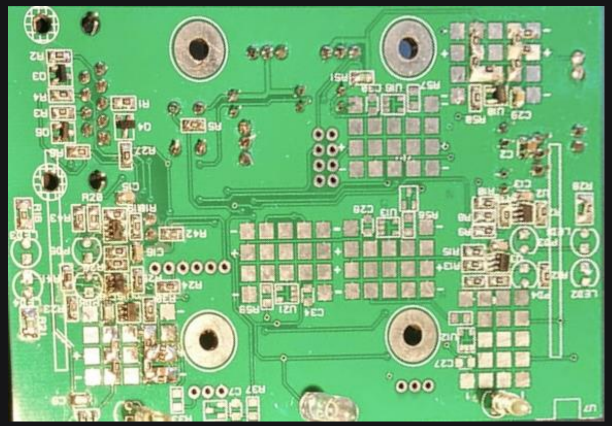




Robot stops when magnet detected

Problem Statement

Create a robot that follows the track made of black tape and only stop when a magnet is detected or at the end of track.



- Soldered hardware onto PCB.
- Used photodiodes to detect the track.
- Used Hall effect sensor to detect the presence of the magnet.
- Wrote C code to feed inputs through op-amps and into the PIC microcontroller to run the robot.

Group member: Aidan Hopkins

CAD Art Project

Fine Arts Coursework

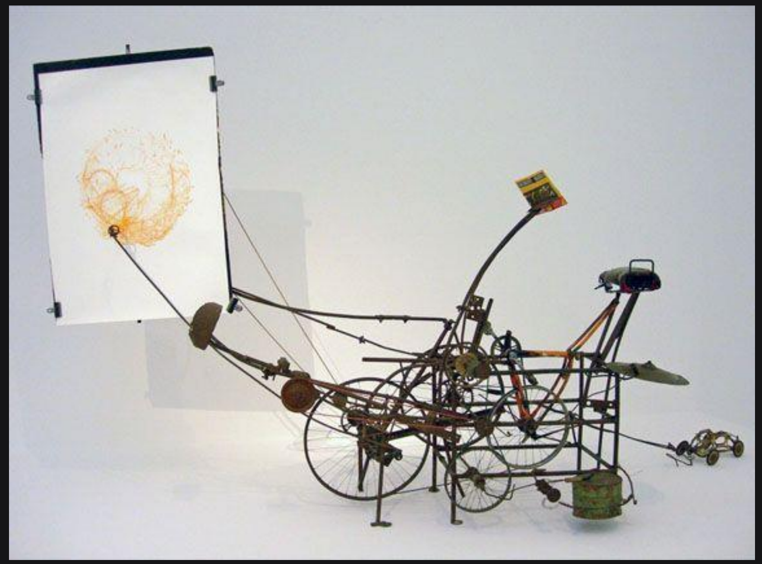
SolidWorks *3D Printing* *Arduino*

Project Description

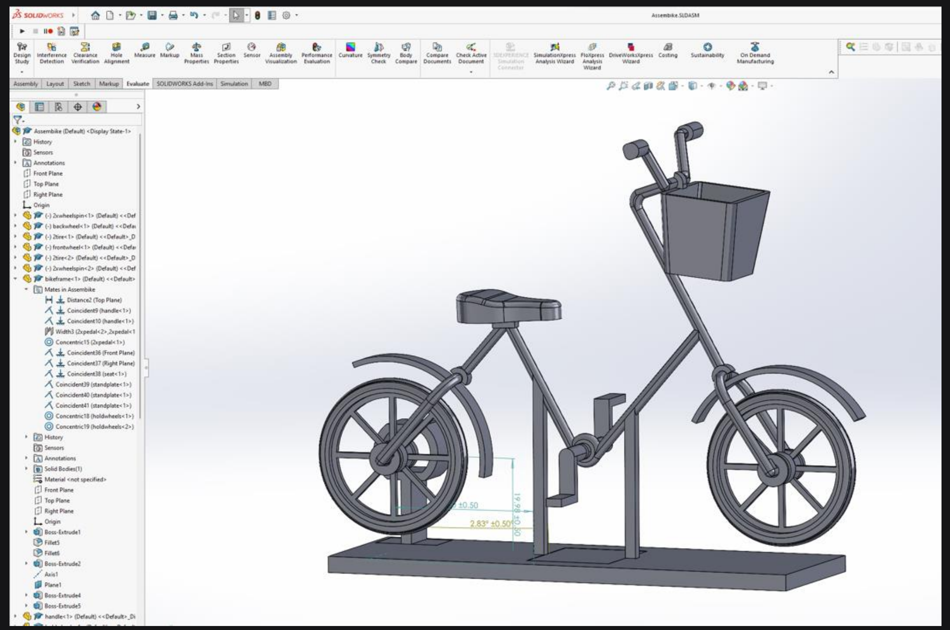
As a mechatronics engineering student, I embarked on a project that delves into the heart of contemporary art, exploring the interdisciplinary nature of my field and its connection to everyday life. The focal point of this exploration is a kinetic art sculpture titled "It was a most excellent ride..."

Inspiration

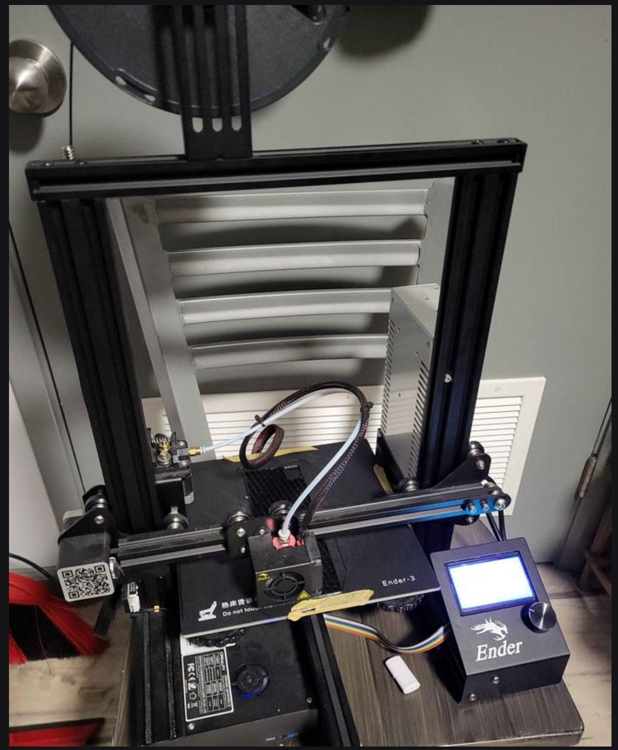
Jean Tinguely, a Swiss artist's kinetic sculptures that use concepts from bikes.



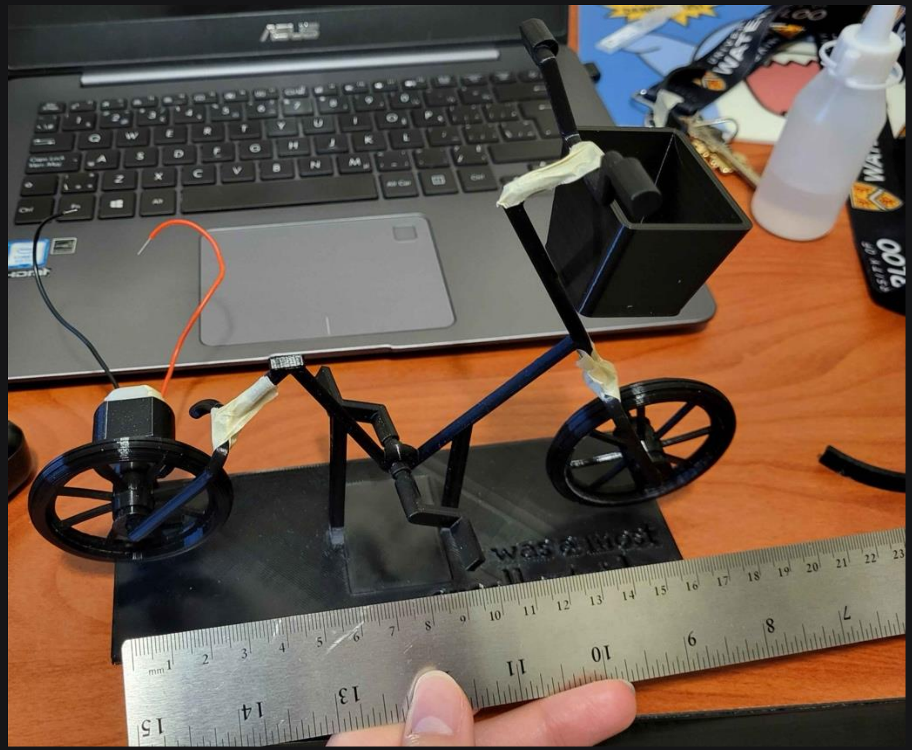
CAD Modeling - SolidWorks



3D Printing



Assembly



Demo - Arduino