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INSTITUTE of TECHNOLOGY
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# Personalized Ankle Exoskeleton

## Milestone 5 Presentation


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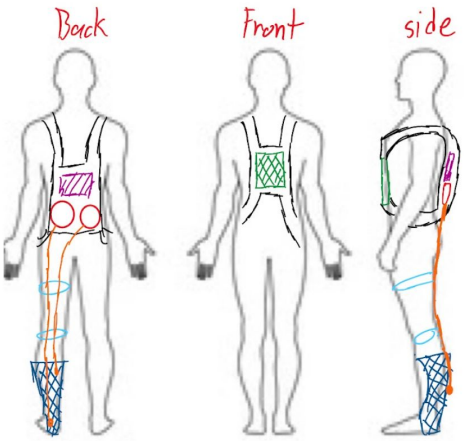
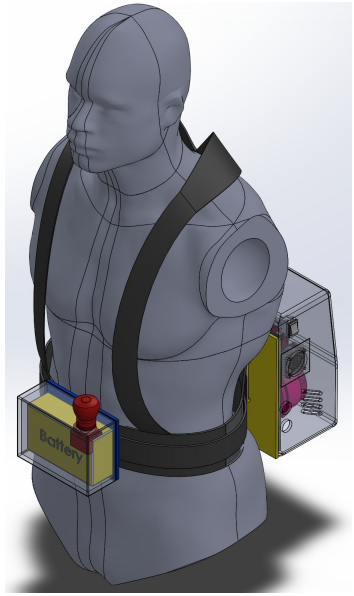
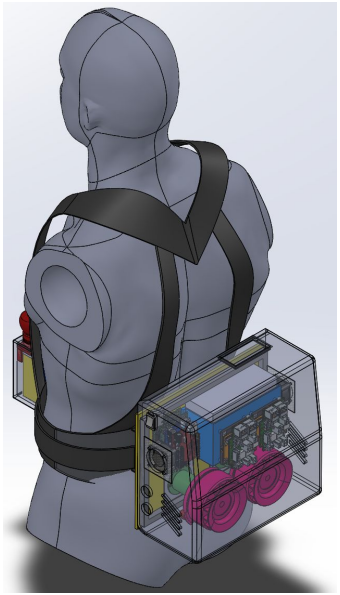
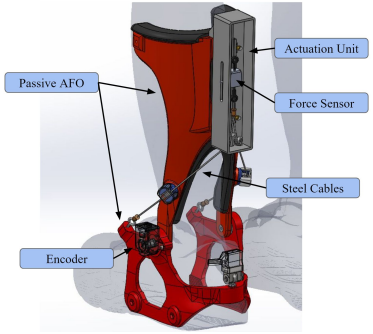
# Concept to Reality



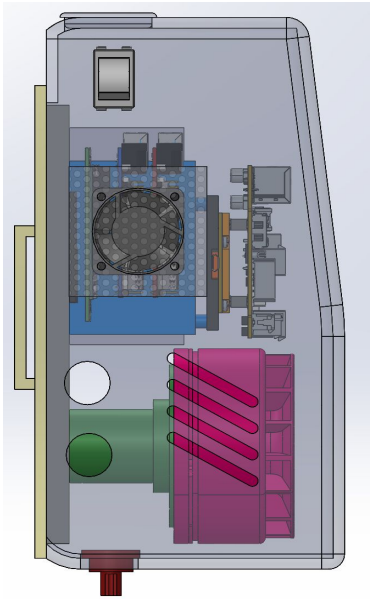



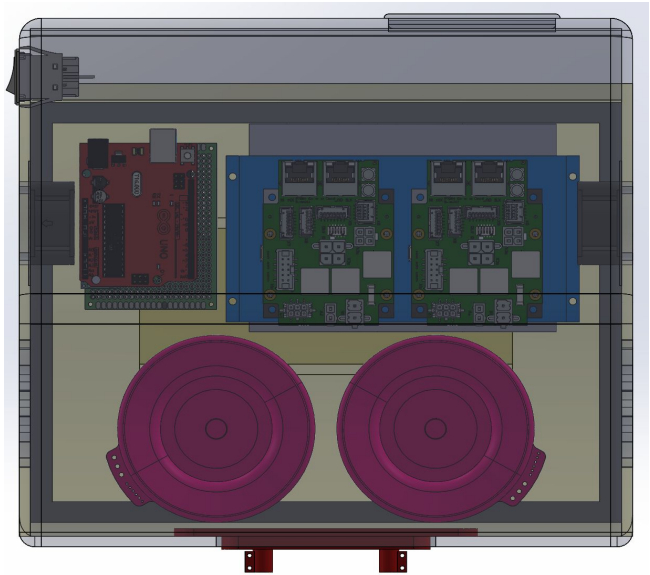



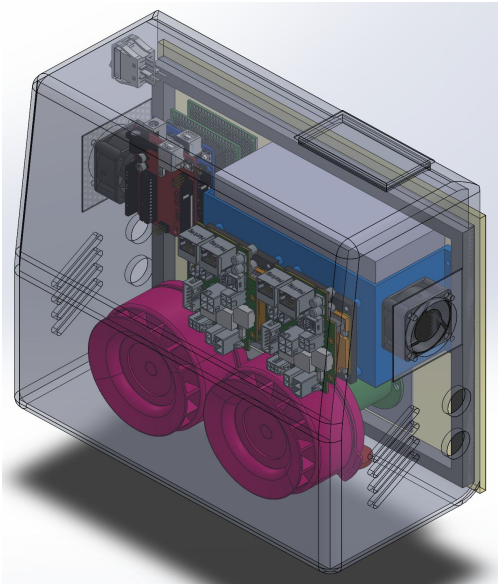



Goal:
Create a active wearable device to assist with rehabilitation of those with gait disorders recovering from brain injury, musculoskeletal injuries, as well as children with cerebral palsy.

# Design Review







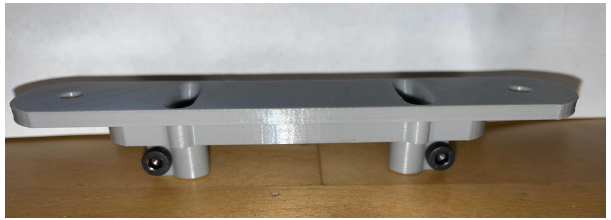
- Changes to EPOS and data acquisition system placement
- Expansion of outer cover

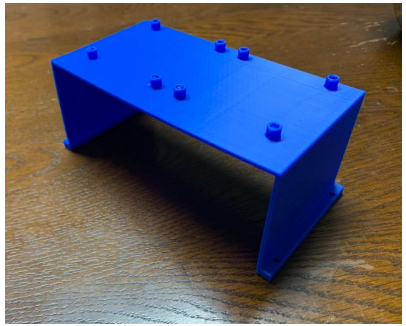
- Motor mount modified
- Implemented robust Bowden Cable holder

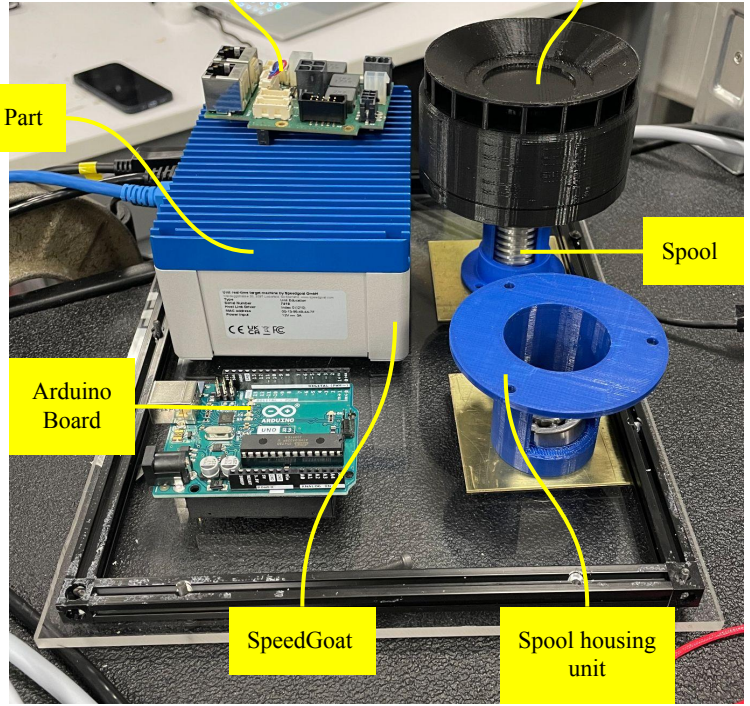
# General Layout

*Mechanical Design*

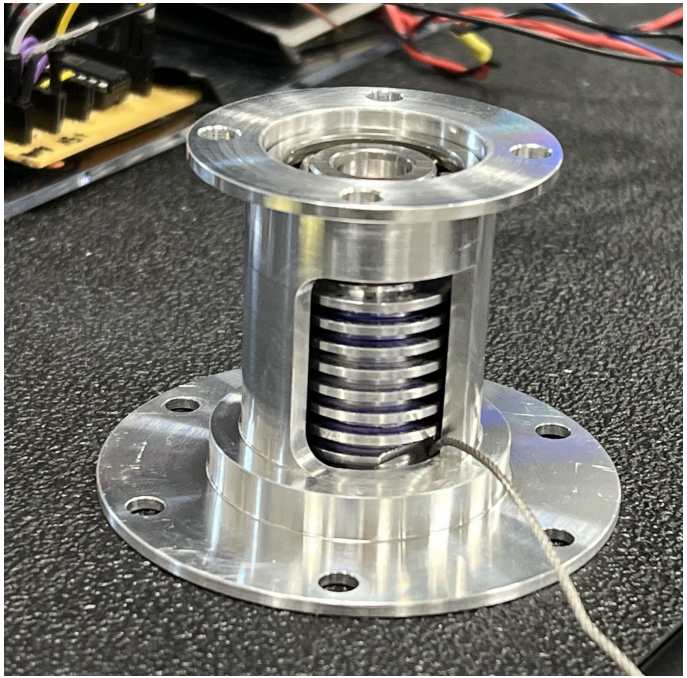
- Outer housing unit expansion
- EPOS mounted above SpeedGoat
- Motor mount modification
- Increasing spool groove depth
- Clamp to connect steel and bowden cables



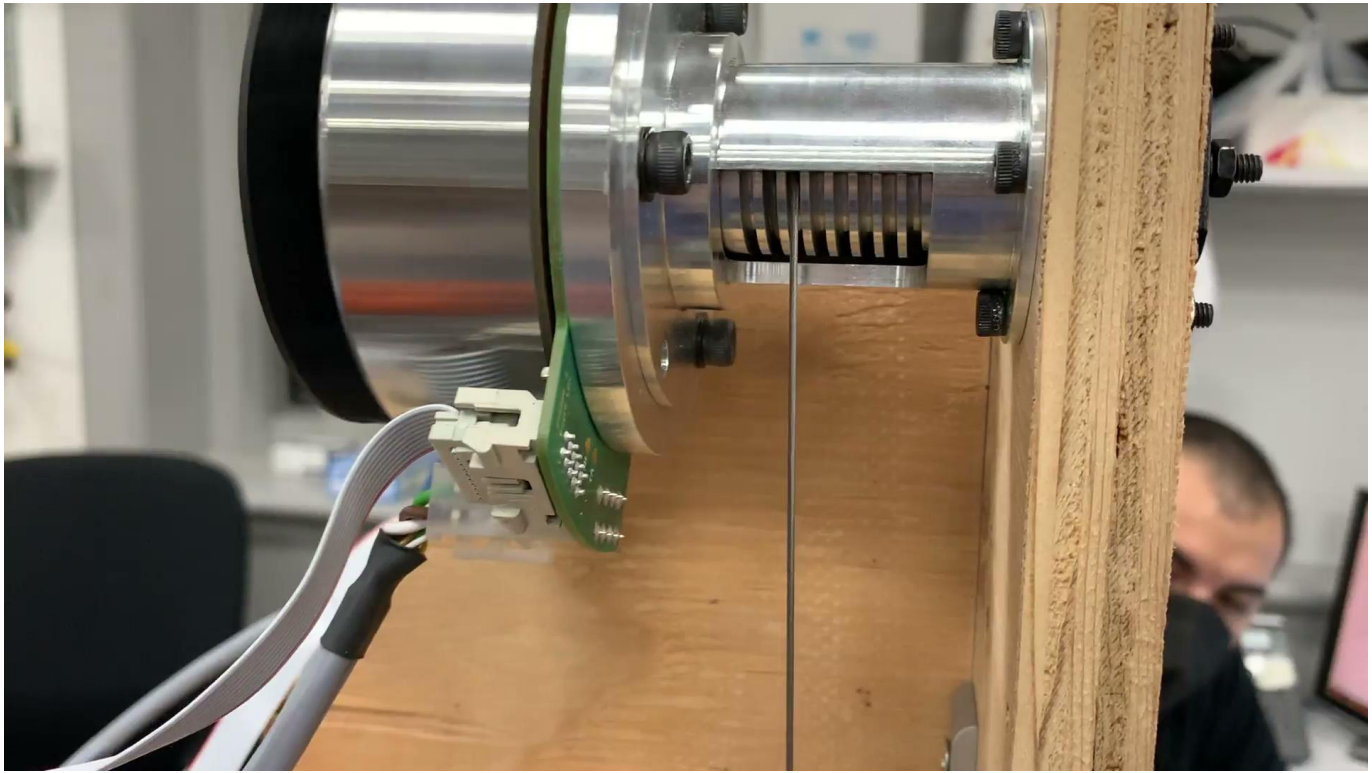




# Machined Components

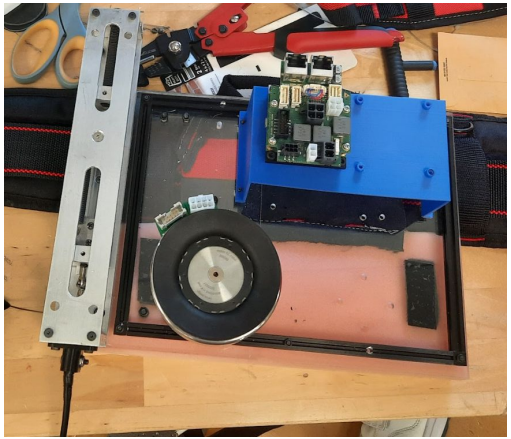


# Spool and Motor Mount in Action



# Implementation of Spring

- Spring was implemented to emulate the dorsiflexion force (left motor)
  - Motor was broken
- Cannot adjust the dorsiflexion force during gait
  - However, will bring ankle upwards
- Was mounted to the left side of the power unit
- Weighs roughly 2-3 pounds

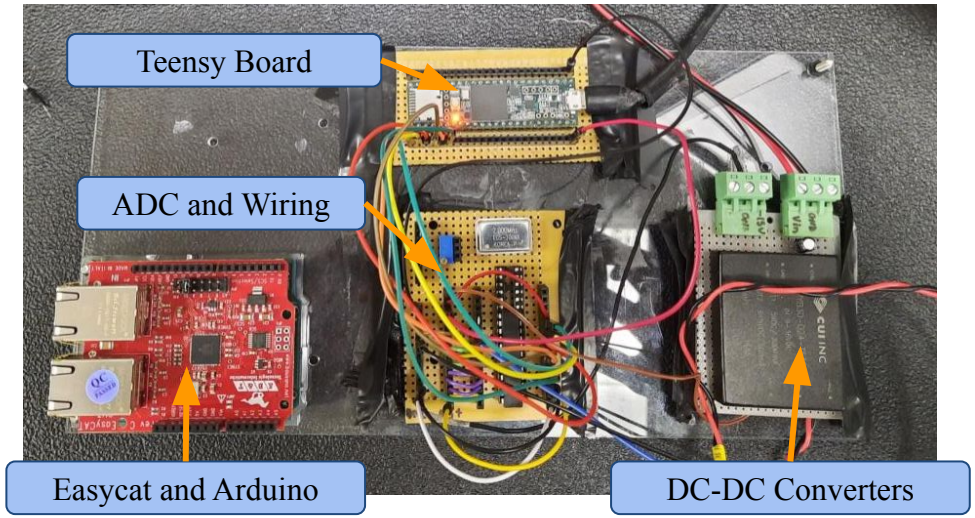


# 3D Printed Housing

- Made out of PLA
- Weighs less than a pound
- 5 panels that screw together
- Fans and switch are screwed into housing
- 11 inches wide, 10 inches high, 6 inches thick

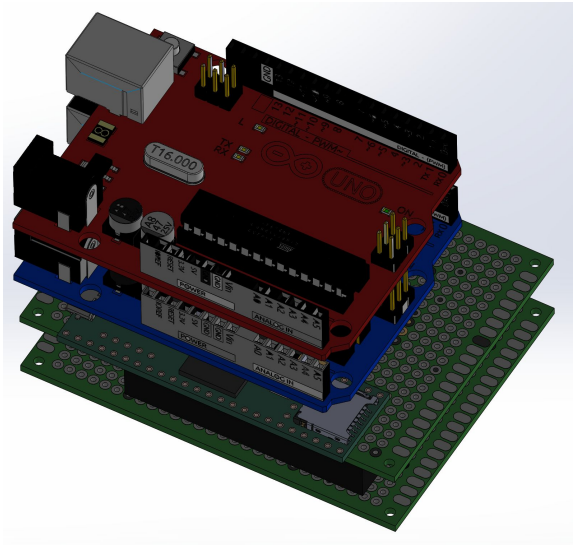
# Data Acquisition System

Benchtop System




Too large and not robust for mobile system

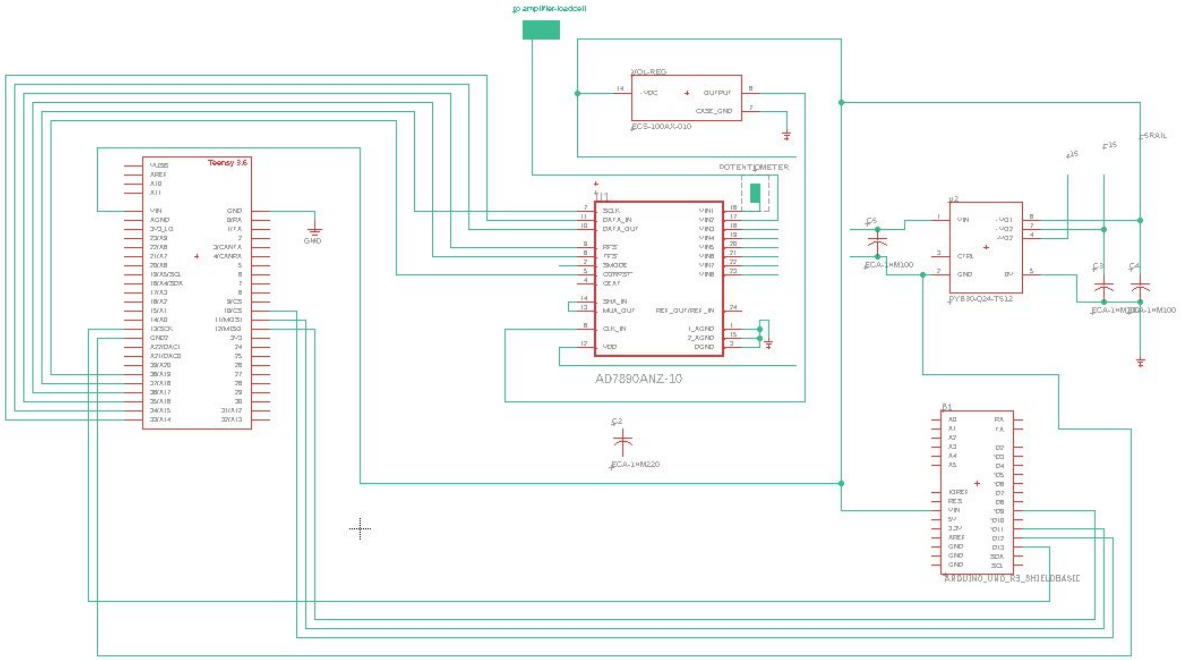
Stacked Design



Features custom PCBS to integrate DC-DCs, wires, and other boards.

# PCB Design

## Eagle File

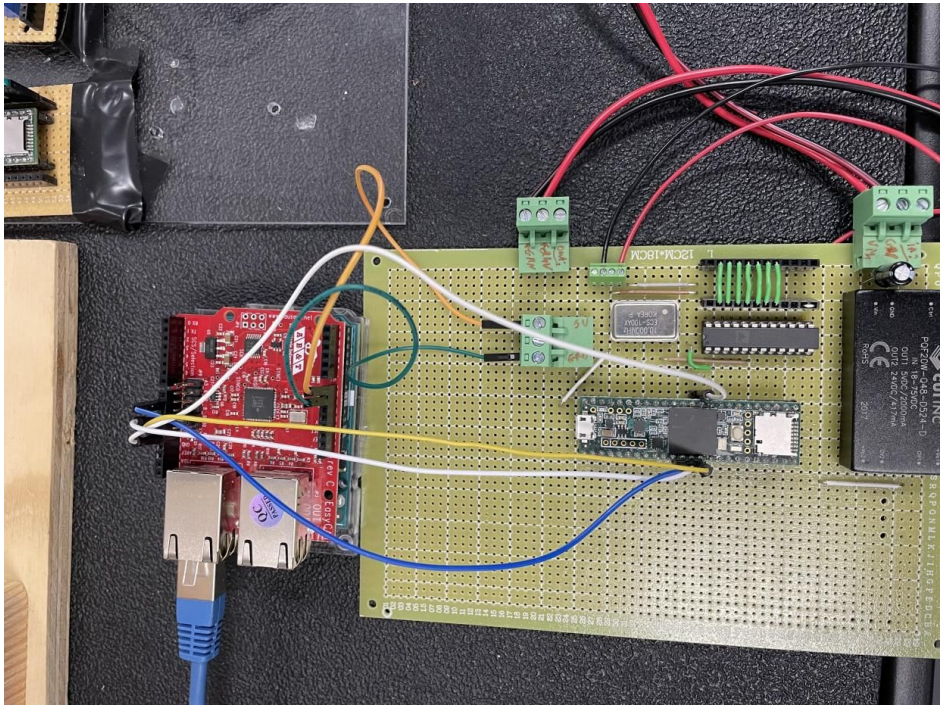



- In the next week, PCB will be processed and sent to a third party developer for printing
- Current board prototype Combines all current data acquisition components onto two double layer PCB

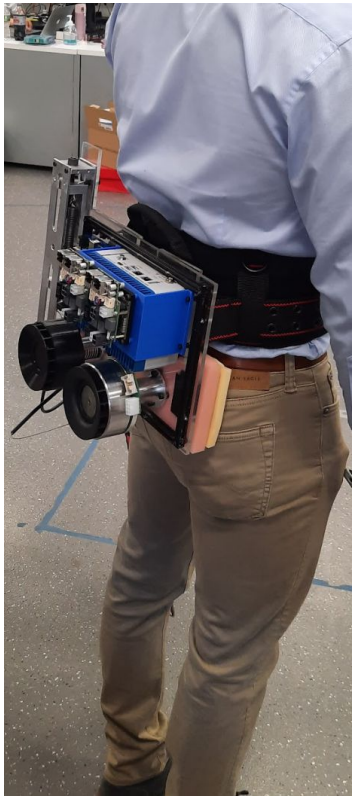
# Completed PCB/ Perfboard

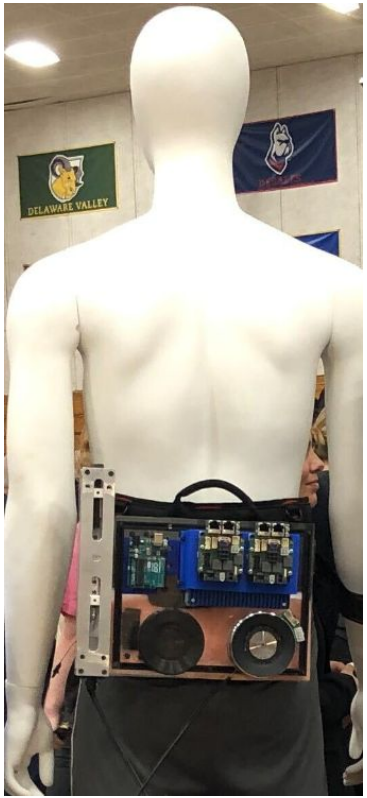
For closed loop system

- Features DC-DC
- Teenseyboard socket
- ADC
- Oscillators



# Result



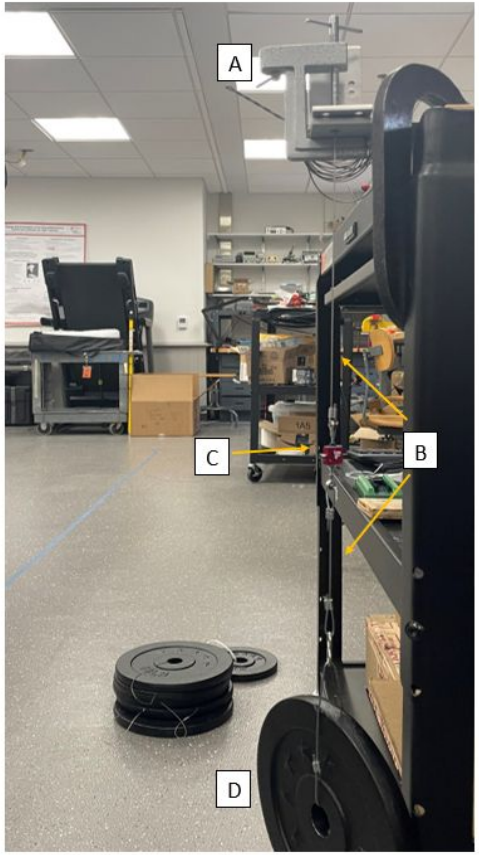


# Benchtop Testing Setups

*Futek Load Cell Test*

- To determine R Squared value to ensure the accuracy of the sensor.
- Load cell was positioned to hang from a clamp
- hold a series of incremental weights.

- A represents the clamp
- B represents the steel cable
- C represents the Futek load cell
- D represents the weights.
- 5,10,15,20,25 lbs tested



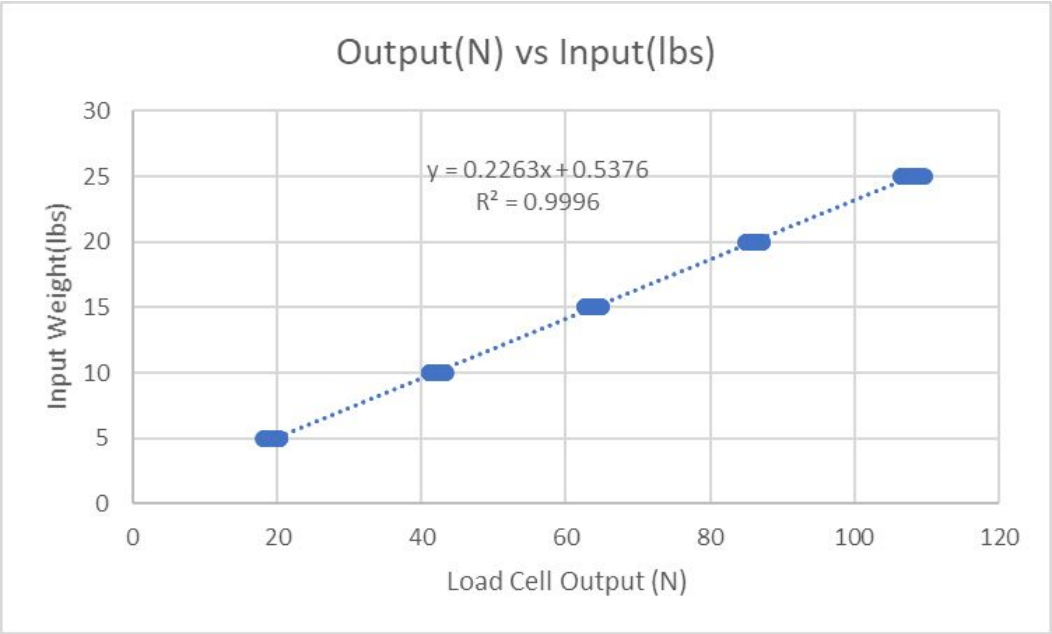

Experimental Setup to test Futek Load Cell

# High Performance Testing & Evaluation

*Futek Load Cell Test*

- Testing was done to ensure the consistency and linearity of the force sensor
- The experiment consisted of 5 lbs weight increments up to 25 lbs total weight

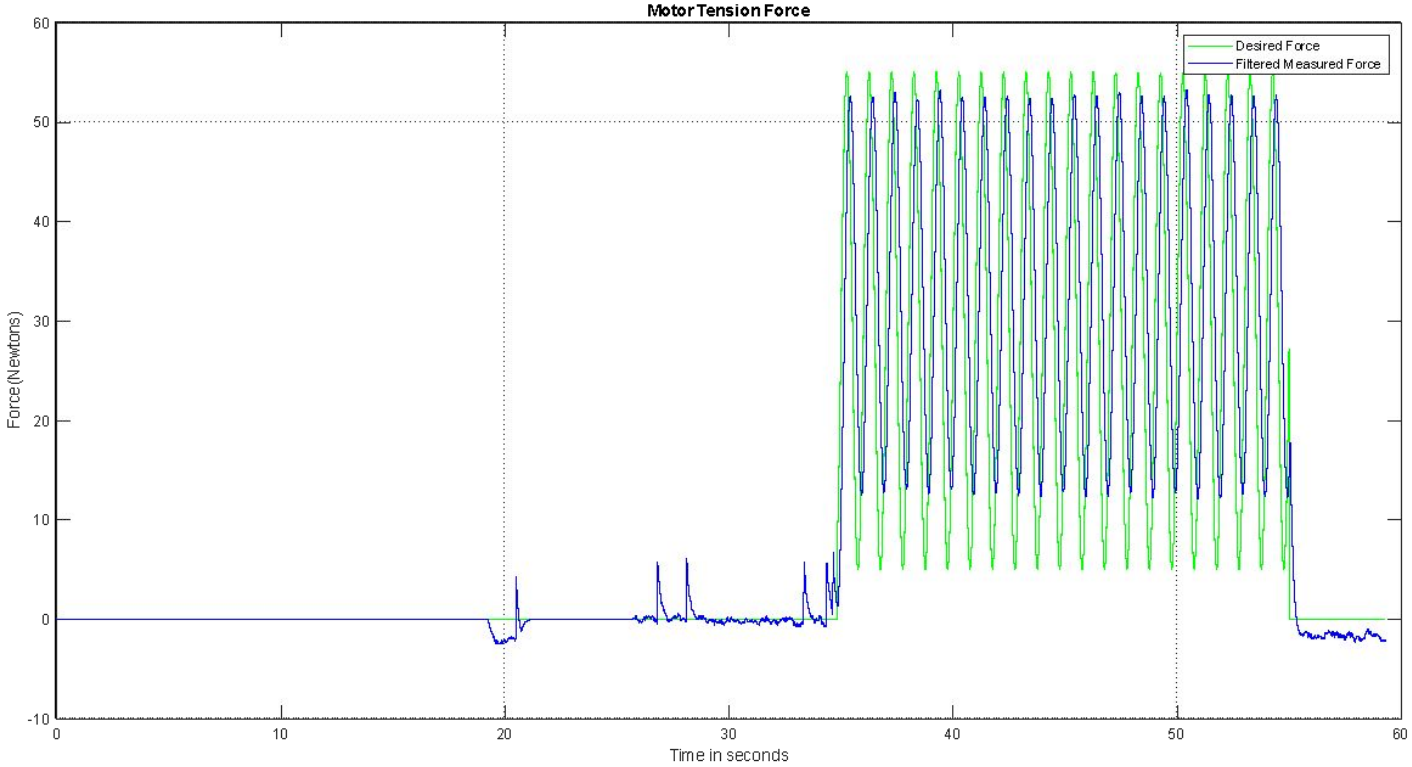
- R squared= 99.96%



# Open Loop Testing Video

# Open Loop Testing

- Does not consider feedback from Futek load cell
- Not as accurate as closed loop system

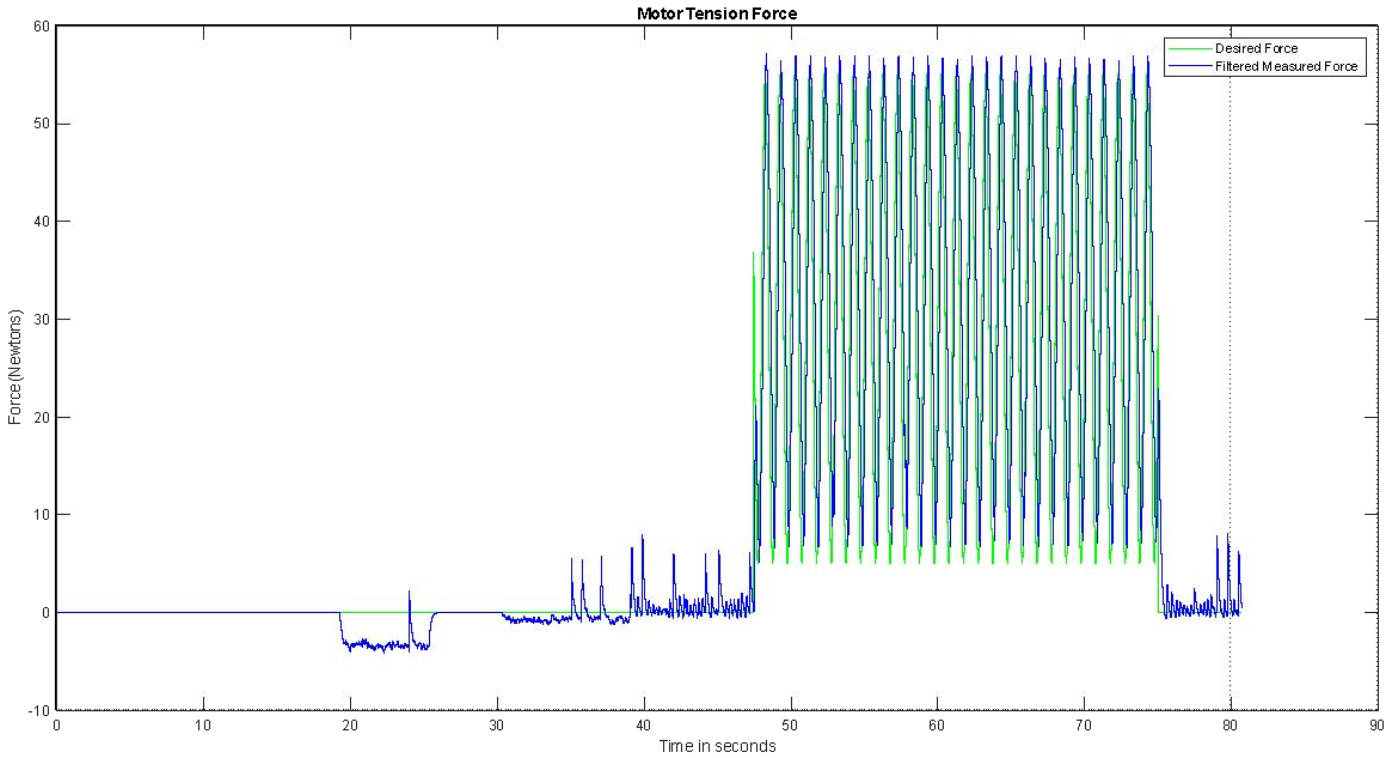


# Closed Loop Testing Setup

- Using the PCB board the following feedback is incorporated
  - Rotary encoder
  - Futek load cell
- The PCB board experienced power problems, due to this we did not move forward with closed loop testing

# Closed Loop Testing

- Too much noise in signal for testing with AFO system
- Replacement of DC/DC is needed reduce noise



# Walking Around

# Resources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**Thank you for your attention! Any questions?**