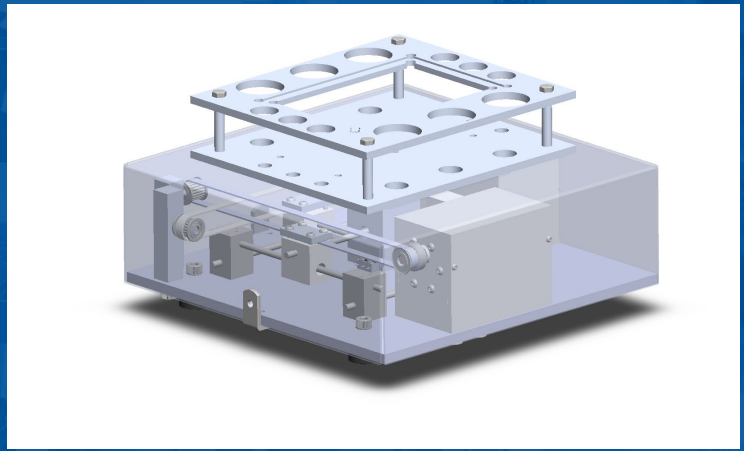
UF Herbert Wertheim College of Engineering
UNIVERSITY of FLORIDA

# 637 Shaker Table



## Group 637U

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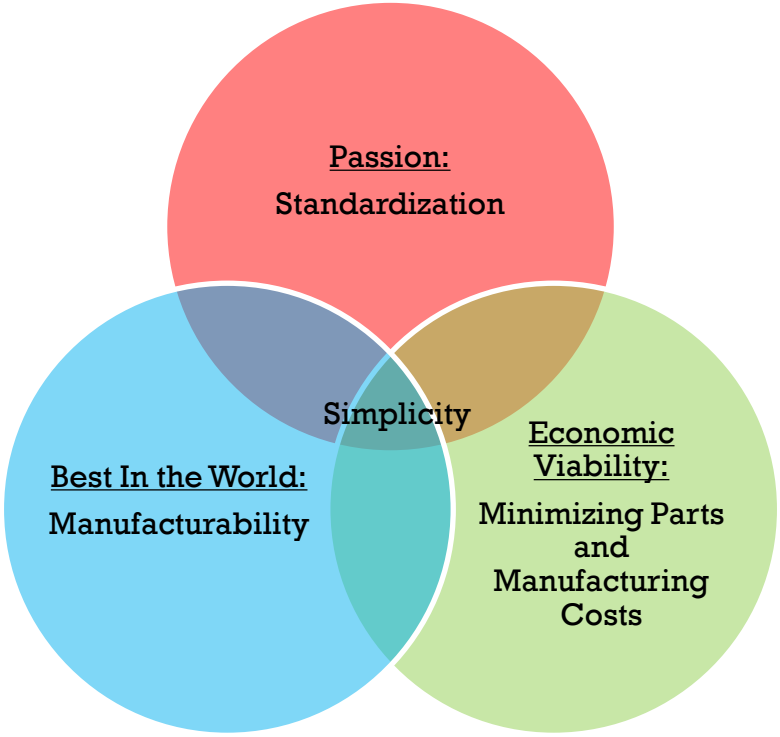
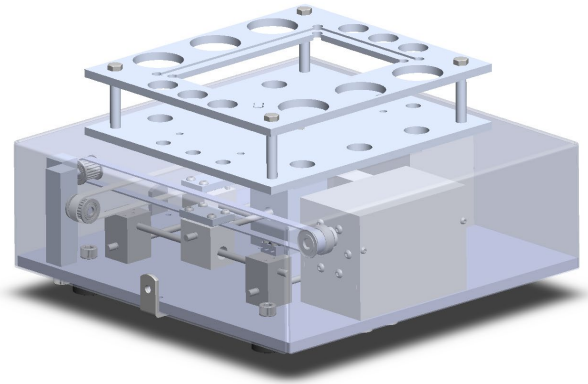
# Hedgehog Concept

- A standardized shaker table that emphasizes manufacturability and reduces manufacturing time and assembly costs without compromising quality or performance.



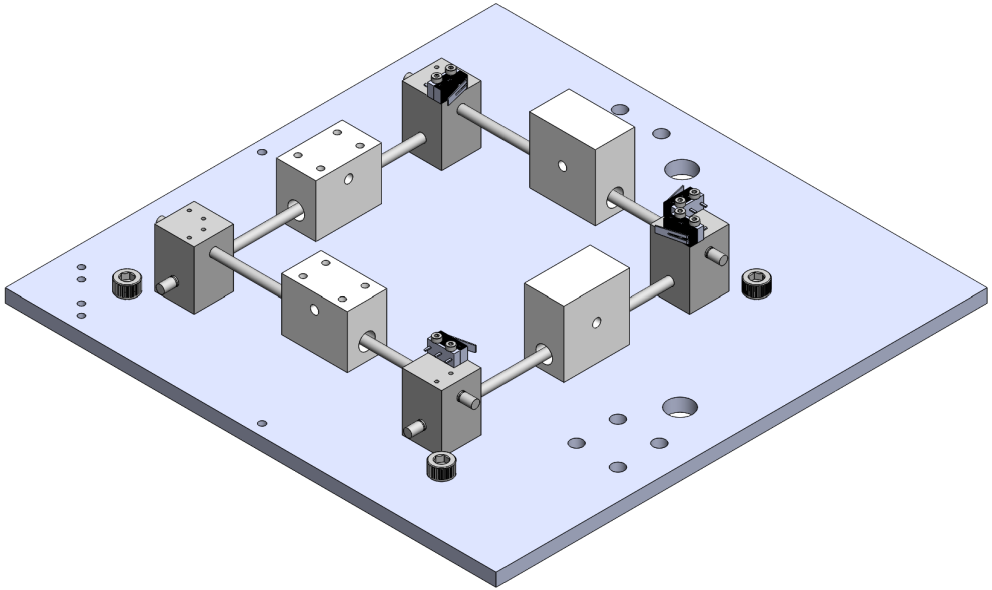
# Key Product Specifications

- Designed for long-term operational laboratory use
  - Customer Needs: (1, 8, 11, 17, 18, 19, 20, 21, 23)
  - Optimal size, noise rating, waterproofing, and safety for laboratory use
- Exceptional Functionality
  - Customer Needs: (4, 13, 14, 24, 25, 26, 36, 37)
  - Product is functional in linear, orbital, and double orbital patterns under extreme conditions
- Nominal Stock Sizes for Components
  - Customer Need 9
  - Ensure simple and quick manufacturing and assembly of components with parts already composed of stock sizes



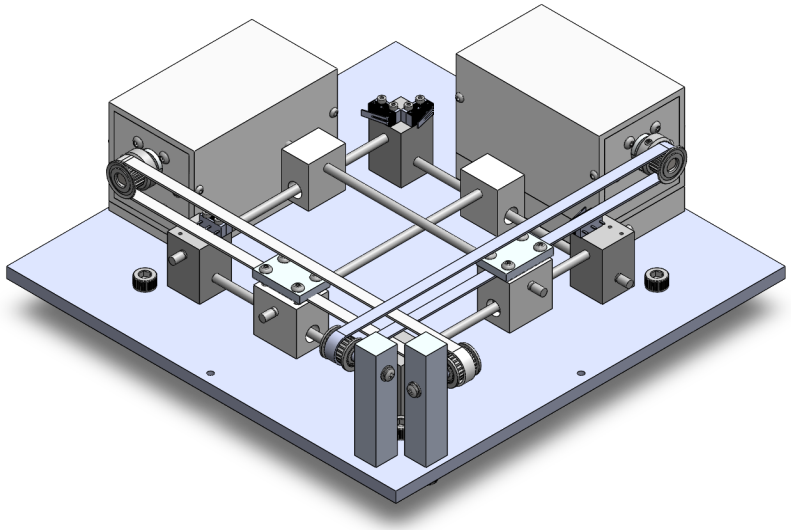
# Base Subassembly

- Blocks mounted to base plate
- Rods and Collars allow for movement of well plate interface



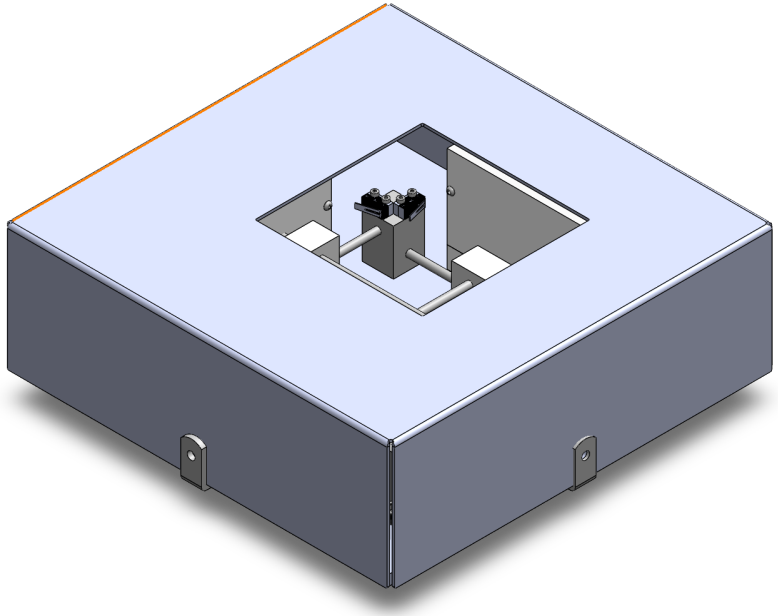
# Drive System

- Belt Driven System
- Motor casing provides IPX5 certification



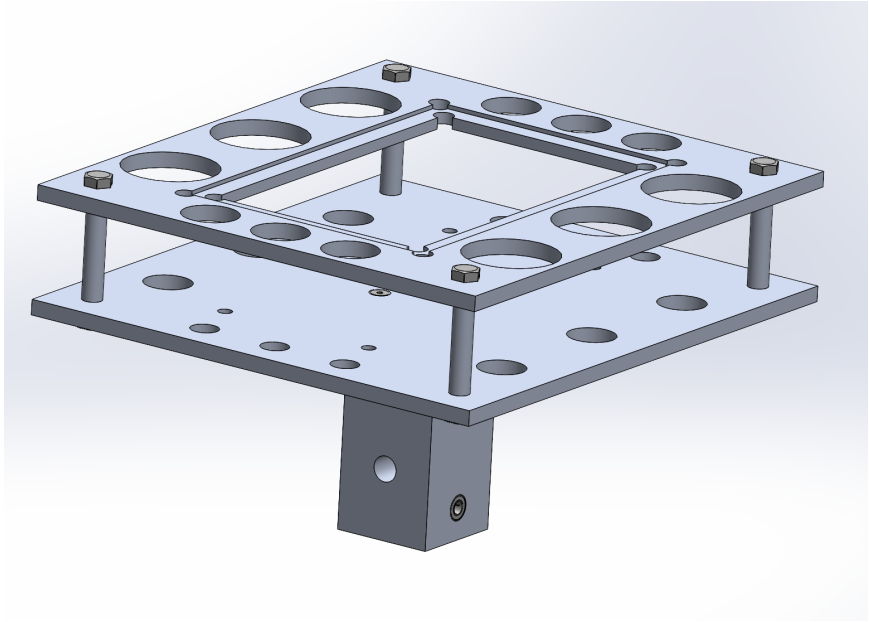
# Outer Casing

- Limit the ability for user to get injured
- Provides a more aesthetic look



# Well Plate Interface

- Well plate interface allows for 6, 50 mL test tubes, 6, 15 mL test tubes, and a well plate simultaneously.
- All parts in the assembly are nominally sized for easy manufacturing.
- Robust and sturdy design

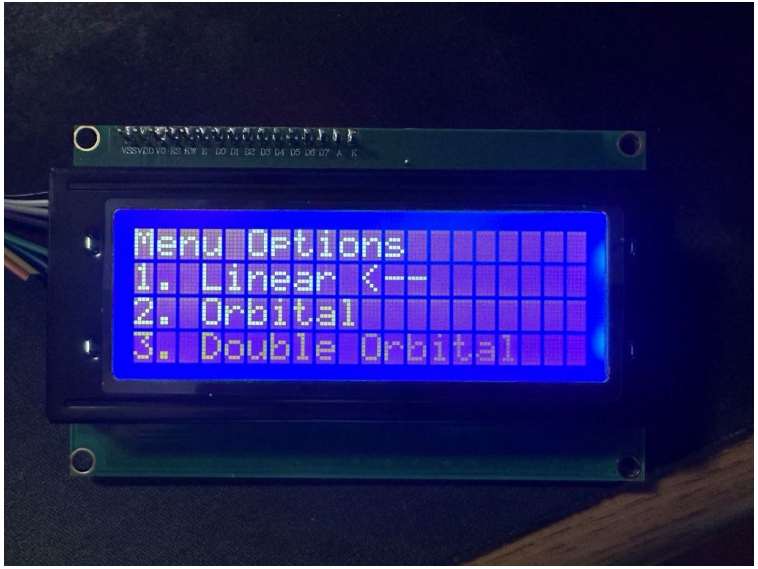


# Control Interface

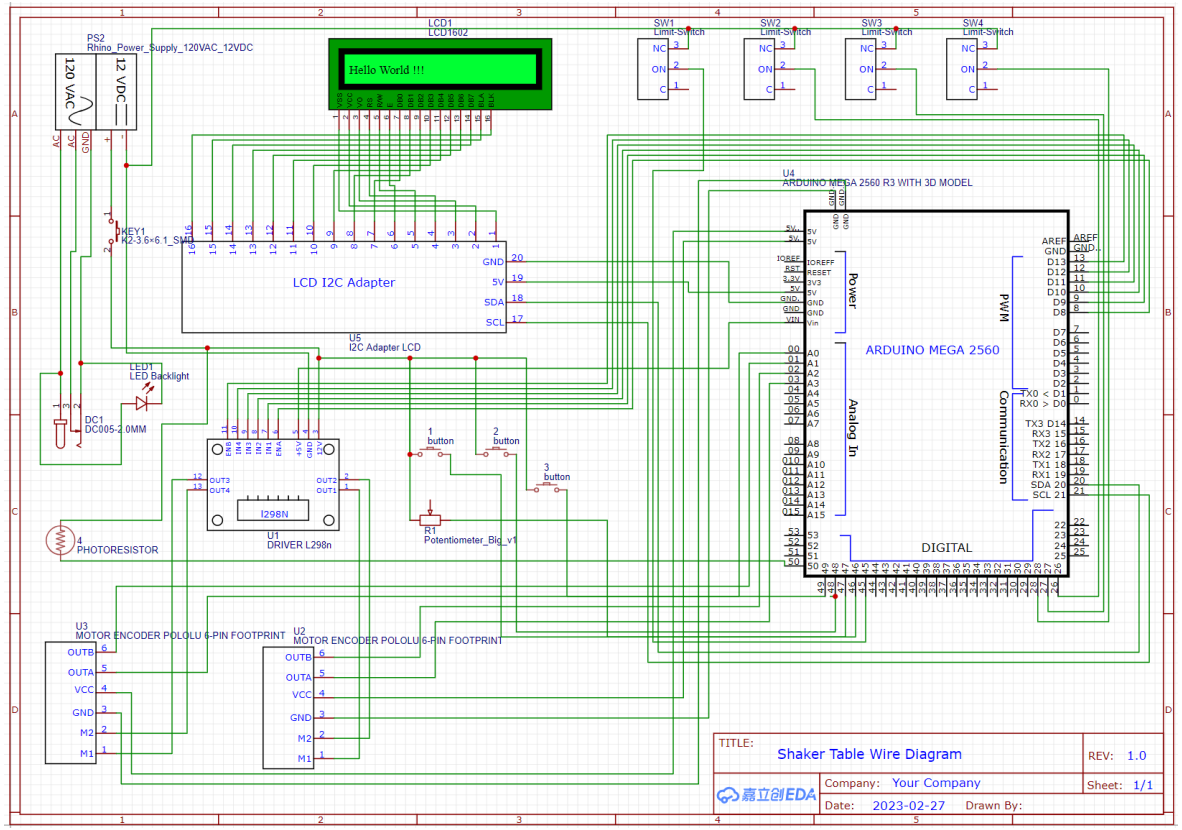
- Houses all the electronics
- Holes for controls
  - 3 buttons, a potentiometer, and a power switch to control the 16x4 LCD screen
- Other features include places to plug in power and run wires to the limit switches and motors

# User Interface

- Easy to use menu
- Allows user to select all cycle parameters
  - Pattern (Linear, Orbital, Double Orbital)
  - Speed
  - Duration
  - Size of pattern



# Electrical Schematic

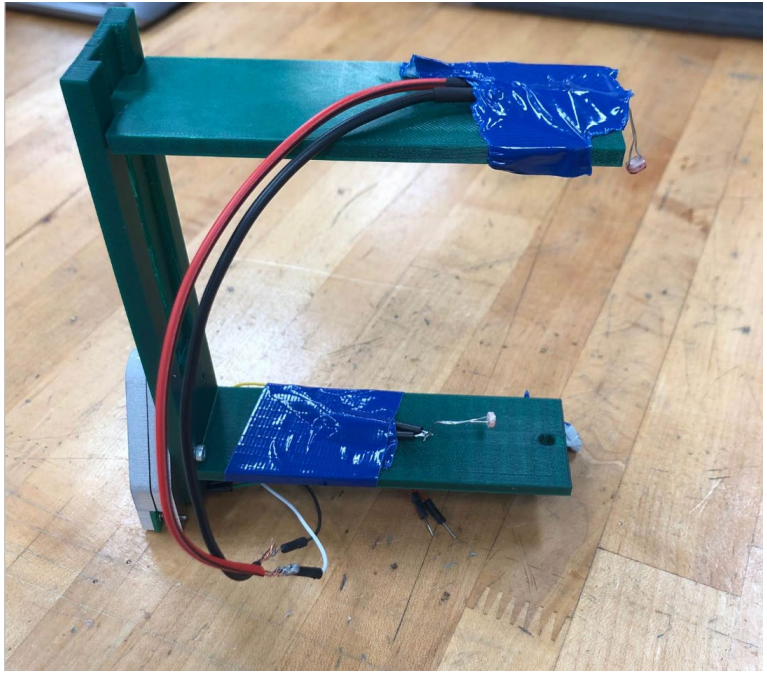


# Performance Evaluation #1:

# IP-X5 Infiltration Test

# Performance Evaluation #2:

# OD/FI Integration Test



# Performance Evaluation #3a:

# Cold Soak Temperature Test

| Material | Temperature |
|---|---|
| Aluminum 6061 | N/A |
| PETG | -10℃ |
| Nylon | -50 ℃ |
| Stainless Steel | -75 ℃ |
| Low Carbon Steel | -30 ℃ |
| Neoprene | -45 ℃ |
| Zinc Plated Steel | -100 ℃ |
| DC motors | -20 ℃ |
| Electrical Wires | -10 ℃ |

# Performance Evaluation #3b:

# Overclock & High Temperature Test

| Material | Temperature |
|---|---|
| Aluminum 6061 | 150 °C |
| PETG | 80 °C |
| Nylon | 80 °C |
| Stainless Steel | 500 °C |
| Low Carbon Steel | 315 °C |
| Neoprene | 120 °C |
| Zinc Plated Steel | 210 °C |
| DC motors | 90 °C |
| Electrical Wires | 80 °C |

# Performance Evaluation #4: Drop Test

## Impact Force and Impact Velocity

$$F = ma$$

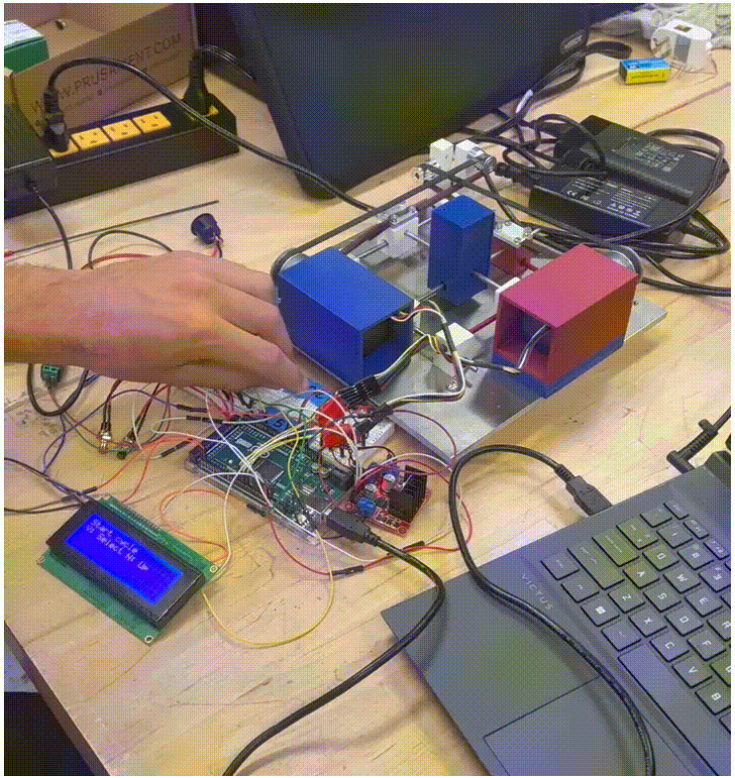
$$F = 2.07kg * \frac{9.81m}{s^2}$$

$$F = 20.3N$$

$$v_f^2 = v_o^2 + 2ax$$

$$v_f^2 = 0 + 2 * \frac{9.81m}{s^2} * 0.75m$$

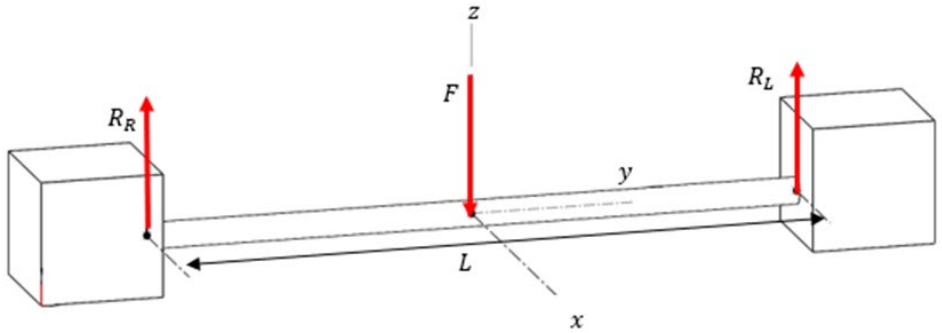
$$v_f = 3.84m/s$$



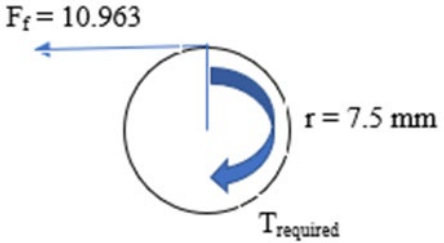
# Design Highlights

- Guide Rail Resizing

$$\delta = \frac{FL^3}{192EI} = \frac{(30\ N) * (0.1016\ m)^3}{192 * (1.9 * 10^{11}\ Pa)(1.26 * 10^{-11}\ m^4)} = 6.86 * 10^{-5}\ m = 0.0686\ mm$$



# Design Highlights

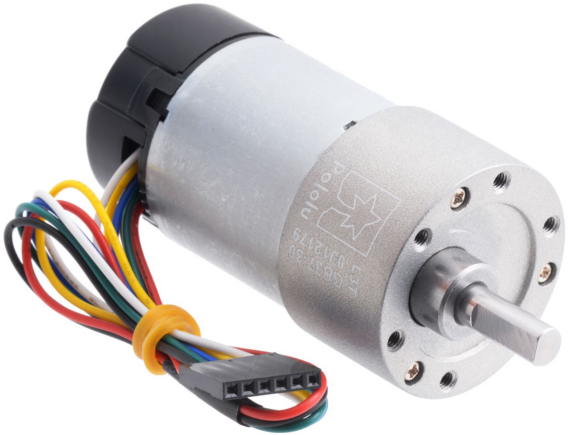



- DC Motor Selection
  - 30:1 Metal Gearmotor 37Dx68L mm 12 V with 64 CPR Encoder

$$F_f = \mu * F_N = 0.54 * 20.3\ N$$
$$= 10.963\ N$$

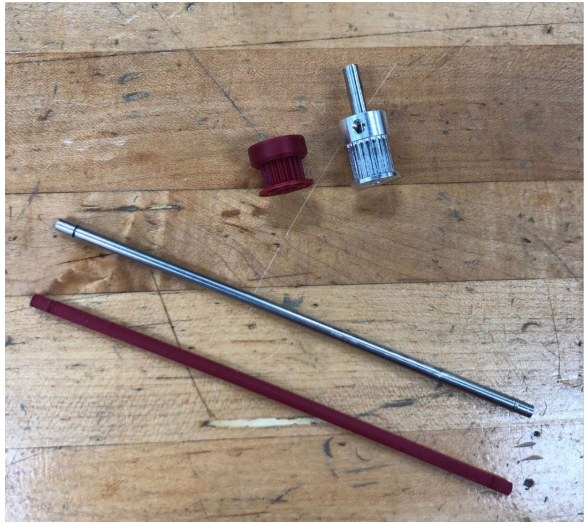
$$T_{REQ} = F_f d = (10.963\ N)(7.5\ mm)\left(\frac{1\ m}{1000\ mm}\right)\left(\frac{141.6\ in\ oz}{1\ Nm}\right) = 11.64\ in\ oz$$

$$T_{MAX} = 42\ in\ oz > T_{REQ} = 11.64\ in\ oz$$



# Evolution of Design

- 3D Printed Parts to 6061 Aluminum
  - 3D printed components converted to 6061 Aluminum to increase strength and durability of components
  - Tensile Strength: 90 MPa for Aluminum compared to anisotropic 37 MPa for PLA and 53 MPA for PETG
- Electrical Circuit Development
  - Temporary breadboard changed to a more permanent soldered perfboard
  - Safer and more permanent use
  - Slowly wired in more components such as OD/FI integration and controls for the user interface



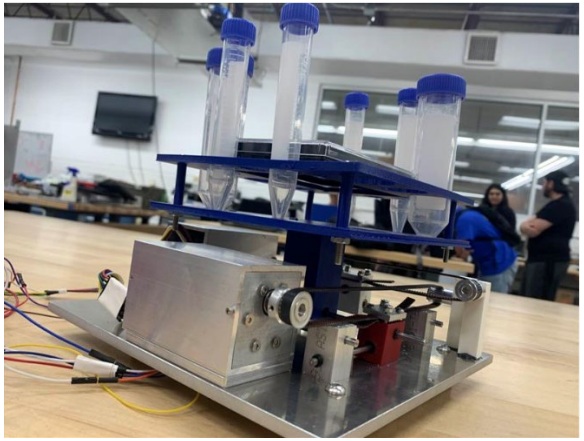
# Cost Table Summary

| Totals | Cost |
|---|---|
| Prototyping Cost | $886.87 |
| 1000 Unit Production Scale Cost | $362.29 |

| Significant Items | Cost |
|---|---|
| DC Motor | $51.95/1 ($47.49/5) |
| Everbeam UV Black Light | $48.99/1 |
| Belts | $24.21/1 |

# Value Proposition – Why Us?

- Simplified design enables an easier and cheaper manufacturing process.
- Efficient shaker table design enables effective testing of equipment with high accuracy.
- Cost-effective design allows for desired profitability from the customer



# Thank you! Questions?