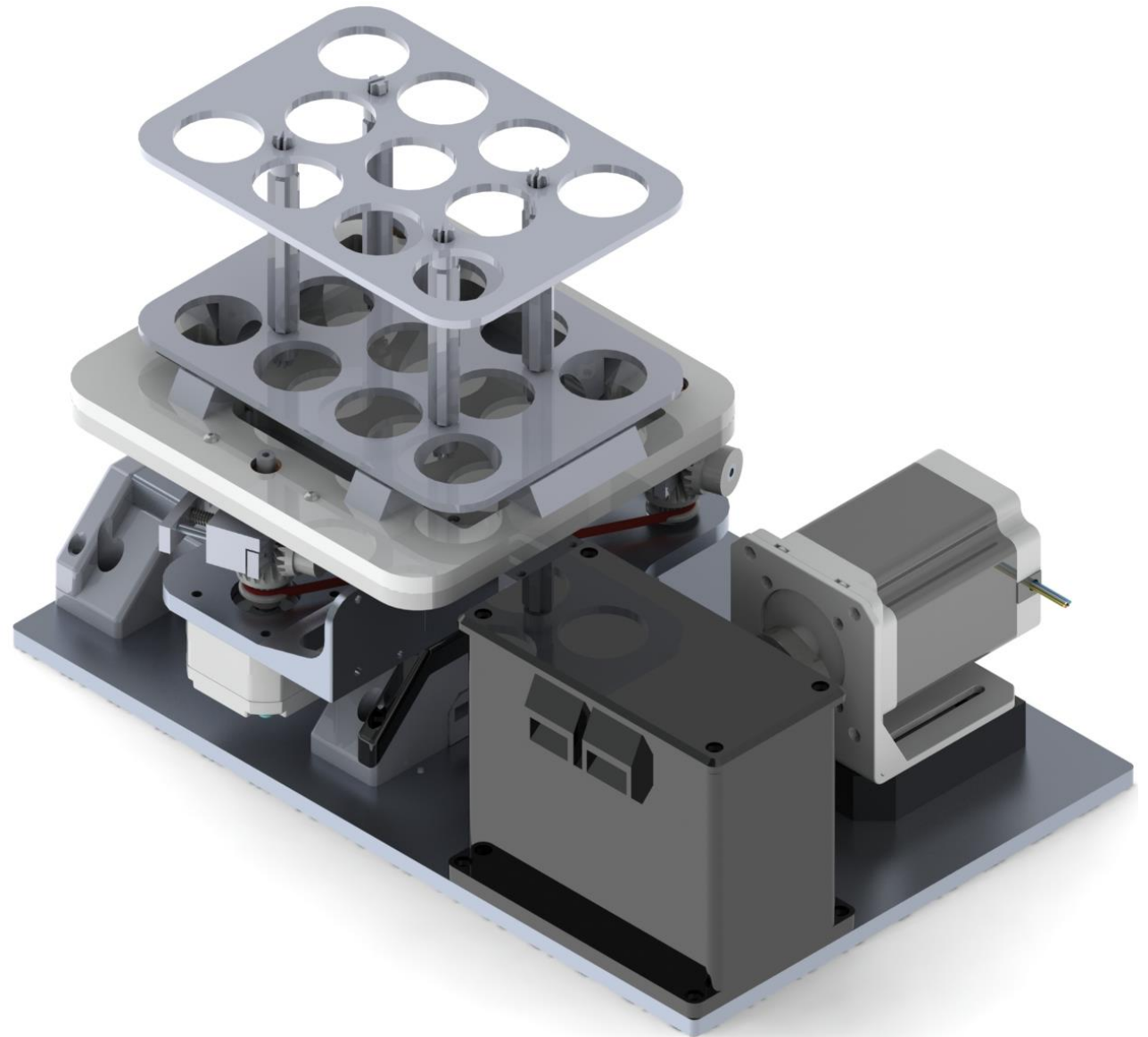


SHAKE IT OR BREAK IT

# 748Y MK1

ZANE CHAPMAN, AUGUSTUS HEAL,  
JOSHUA HORNILLA, VINCENT ONESSIMO,  
ALLAN OSMAR, JENNA SCOTT, OSCAR  
TORRES CRUZ



# The Team



Zane Chapman



Augustus Heal



Jenna Scott



Joshua Hornilla



Vincent Onessimo



Allan Osmar



Oscar Torres Cruz

# Our Task

Requirements	Required Value
Uniformly shakes plates & tube racks in a linear pattern	25 mm travel length
Uniformly shakes plates & tube racks in an orbital pattern	Orbit size $\leq$ 25 mm
Uniformly shakes plates & tube racks in a double orbital pattern	25 mm major axis
Programmable revolution speeds	Rotational speed $\leq$ 350 rpm
Function in extreme environments	Temp. range: 4-70°C
Corrosion resistant to chemicals present in BSL-2 lab spaces	Non-reactive components
Substantial operational lifetime	5 years
Compatible with existing form factors of culture plates and conical tube racks	8 form factors
Visual indicator for selection of shaking pattern and remaining time	N/A
Capable of continuous run times ranging from one hour to two weeks	1 hour $\leq$ Run time $\leq$ 2 weeks
Emergency shut-off	N/A
Not impede on the function of other subsystems and fit within the existing reactor housing	N/A

# Outline

1. Specifications

Initial Phase

2. Demonstration

3. General Design

4. Key Features

5. Design Evolution

Design Phase

6. Cost Analysis

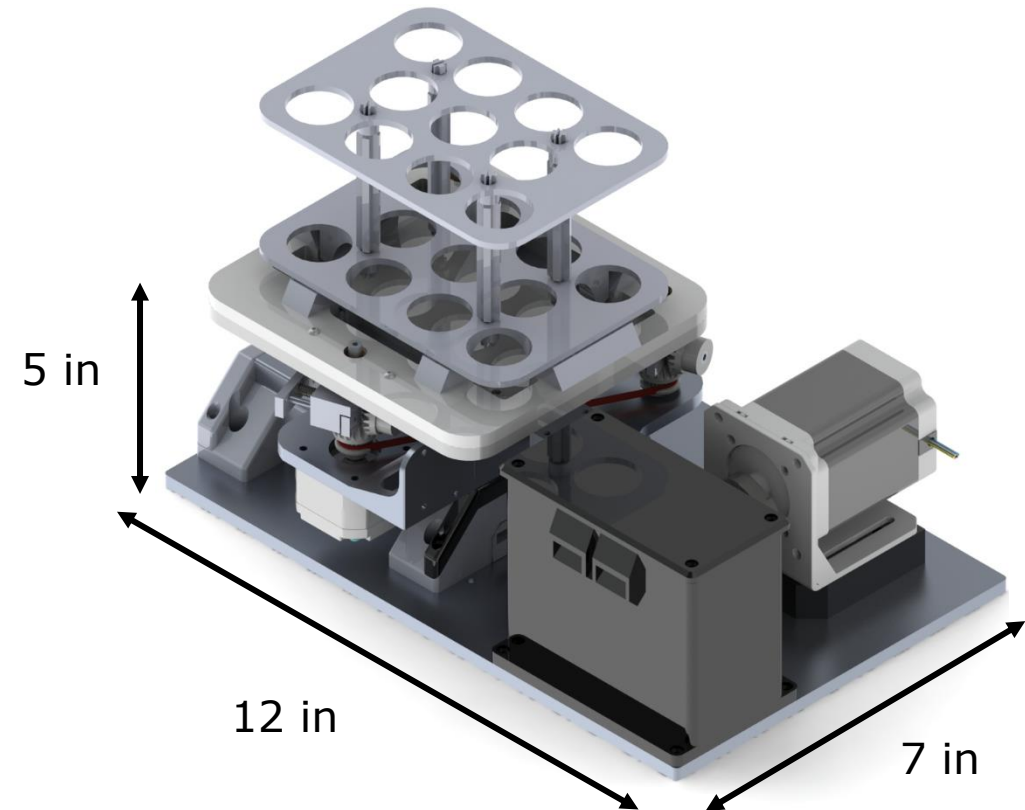
7. Conclusion

Prototype Phase

# 1. Key Product Specifications

# Specifications

- Overall Dimensions:  
12" x 7" x 5" (305mm x 178mm x 127mm)
- Mass: 3962 grams
- Cost:
  - Single: \$1,490
  - Mass Production: \$1,285
- Orbital Pattern:
  - Speeds: 0-350 rpm
  - Diameters: 0-25mm
- Linear Pattern:
  - Speeds: 0-350 rpm
- Double Orbital Pattern:
  - Speeds: 0-120 rpm
  - Width/Height: 12.5 mm x 25 mm orbits



## 2. Demonstration

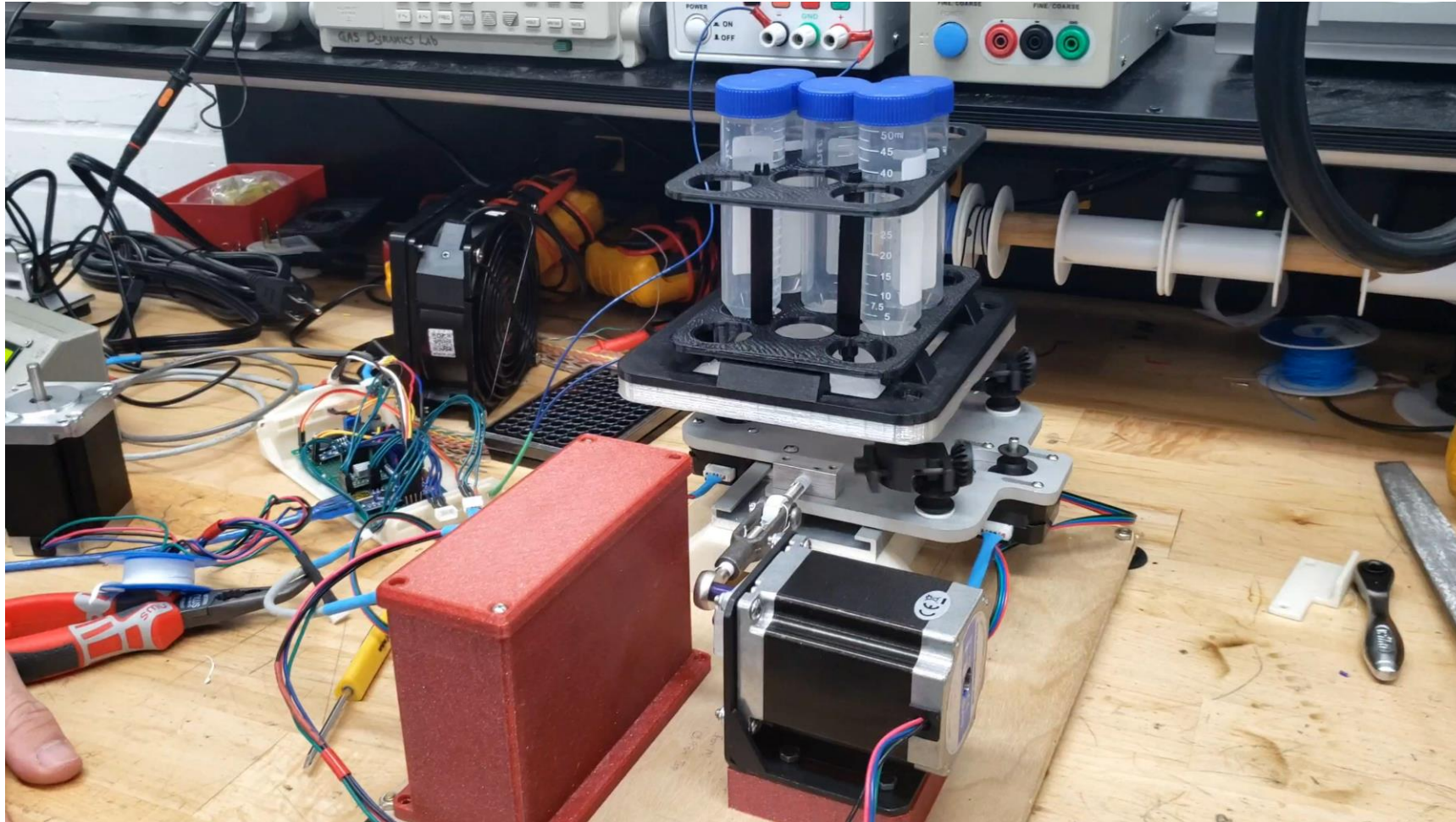
Linear and Orbital Patterns

# Linear Motion





# Orbital Motion

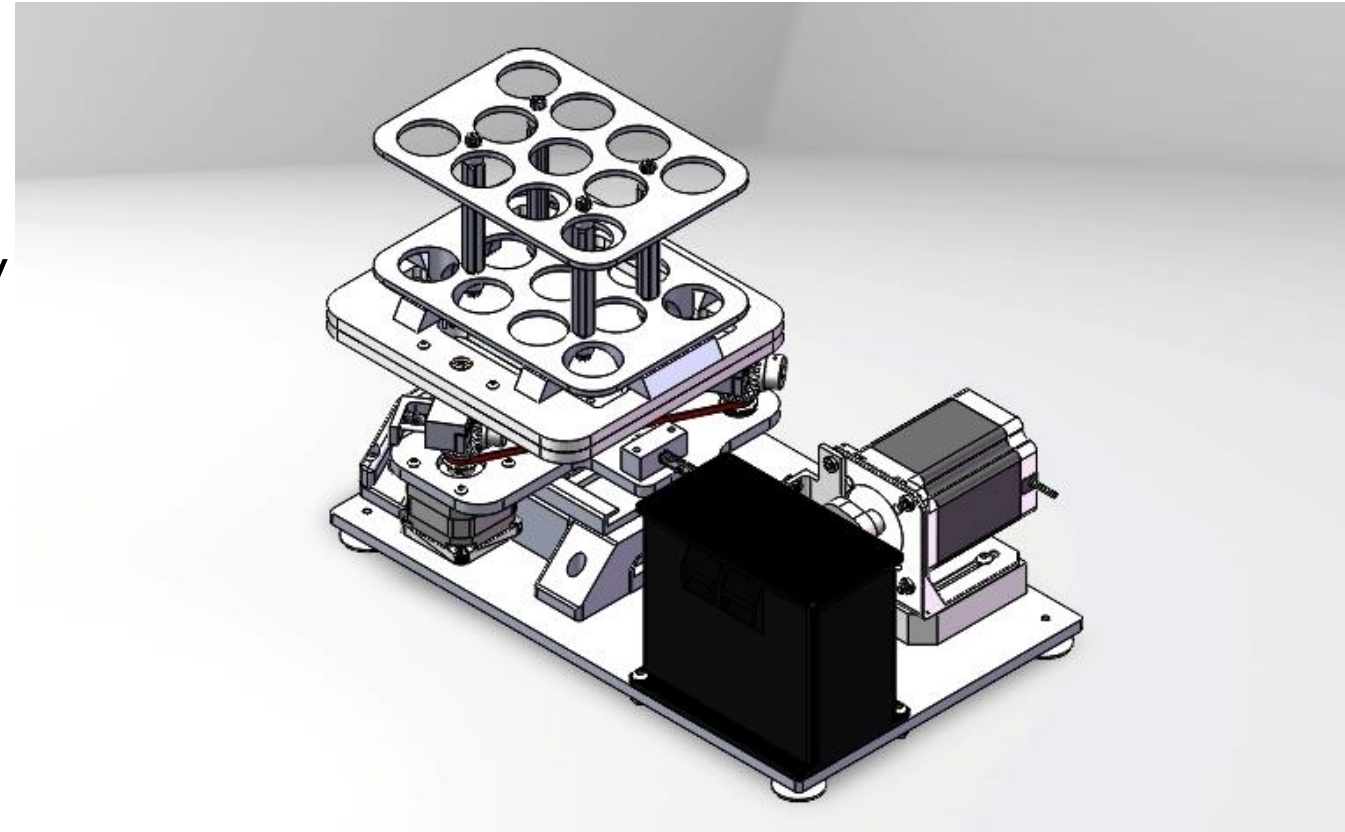
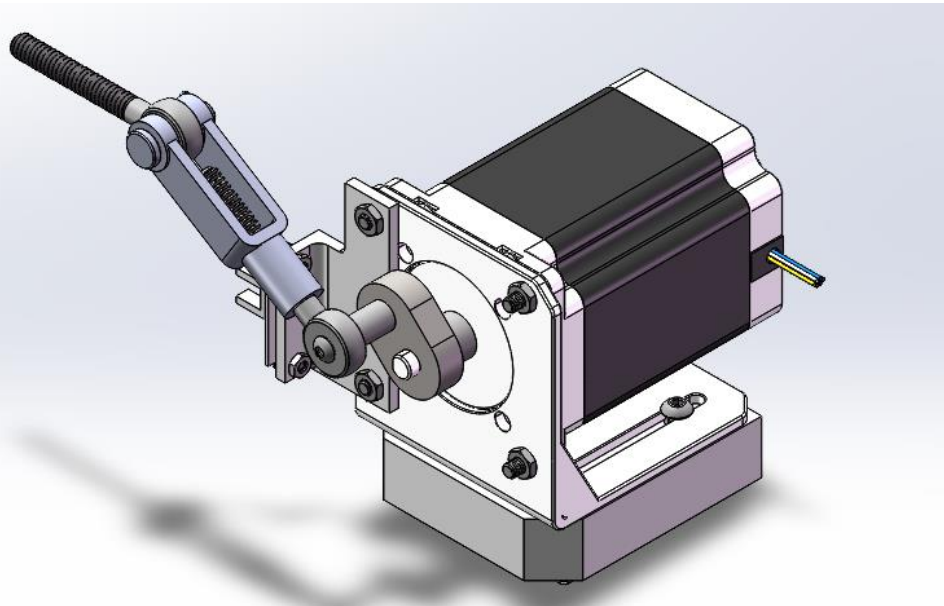


# 3. General Design

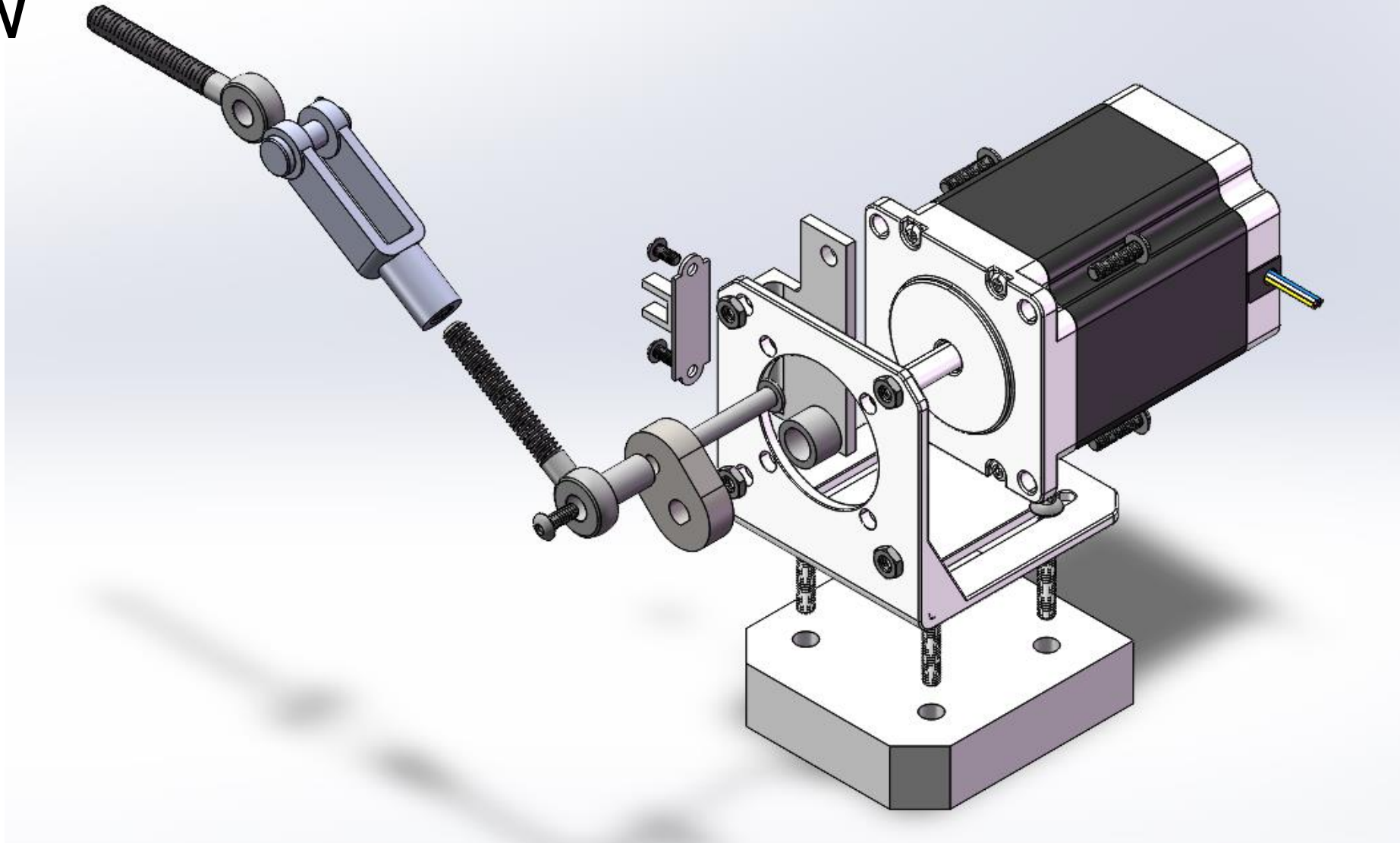
Linear, Orbital, and Electronics

# Linear Subsystem

- Composed of Nema 23 motor
  - Motor shaft is attached to a crank arm
  - This motor provides the necessary torque for smooth operation
- No motor reversals

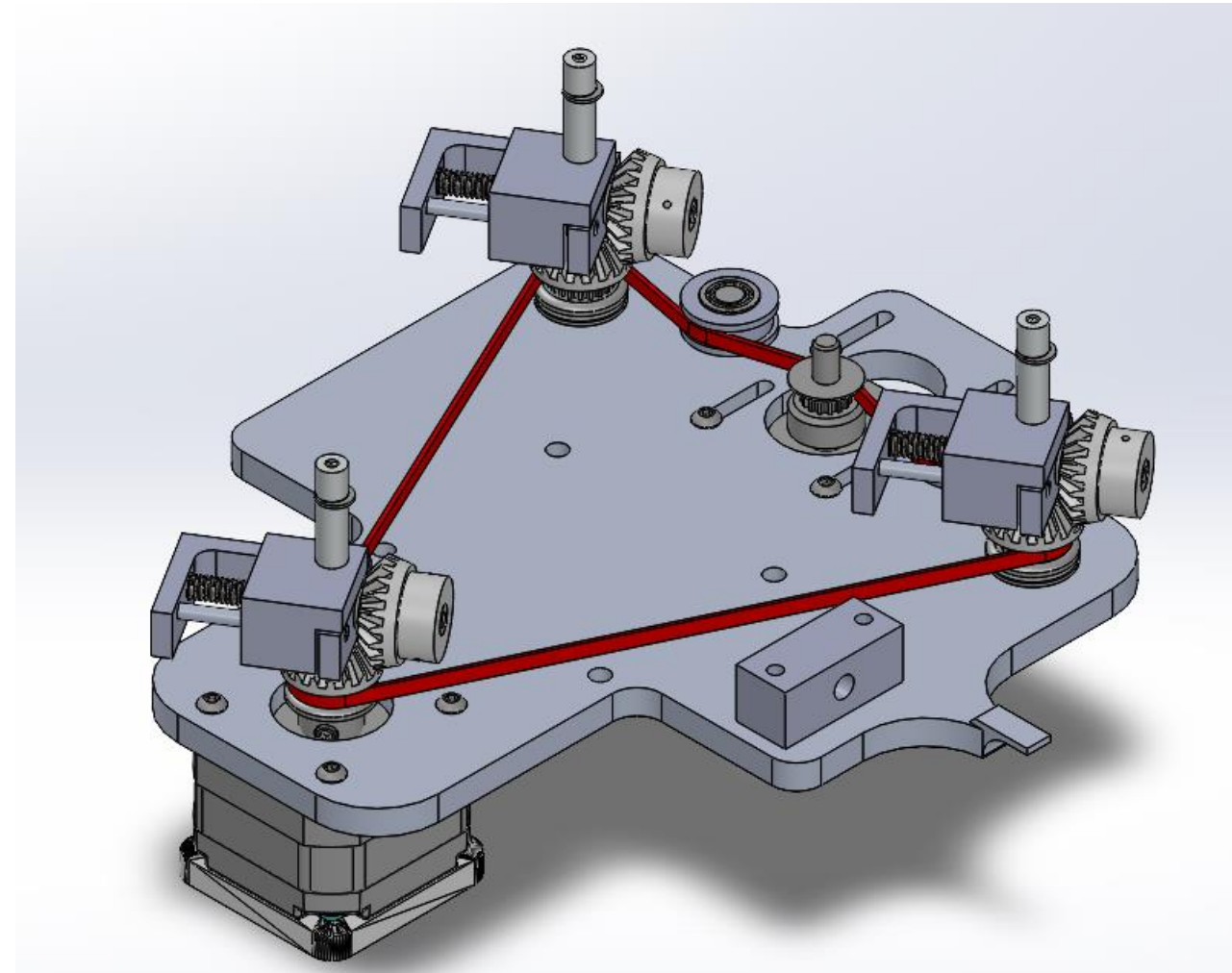


# Linear Subsystem – Exploded View

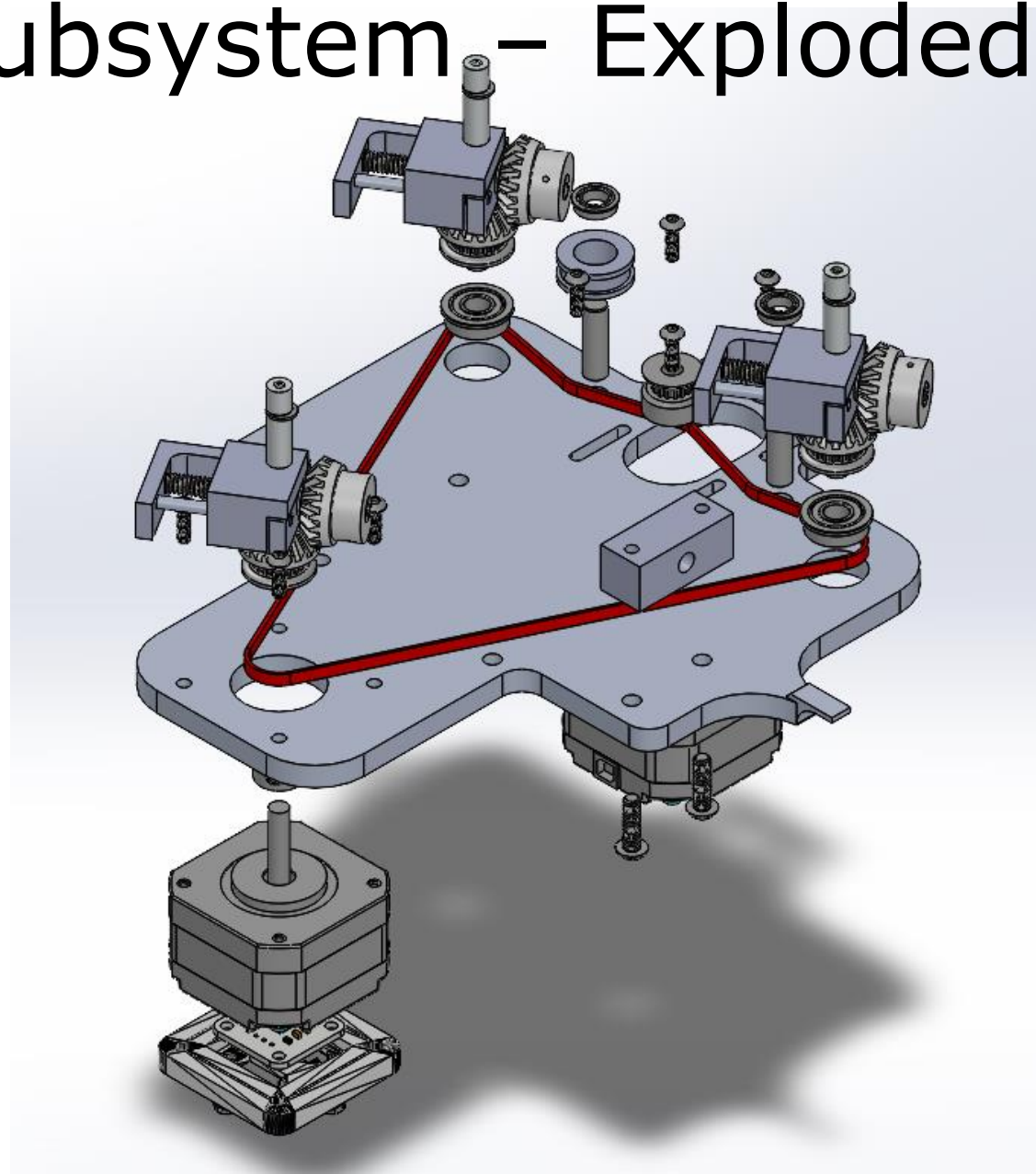


# Orbital Subsystem

- Driven by a Nema 17 motor
  - Has an additional motor that varies the orbital diameter
- Allows for an OD/FI system
- Belt ensures that all motors stay in sync
- Easy removal of plate holder

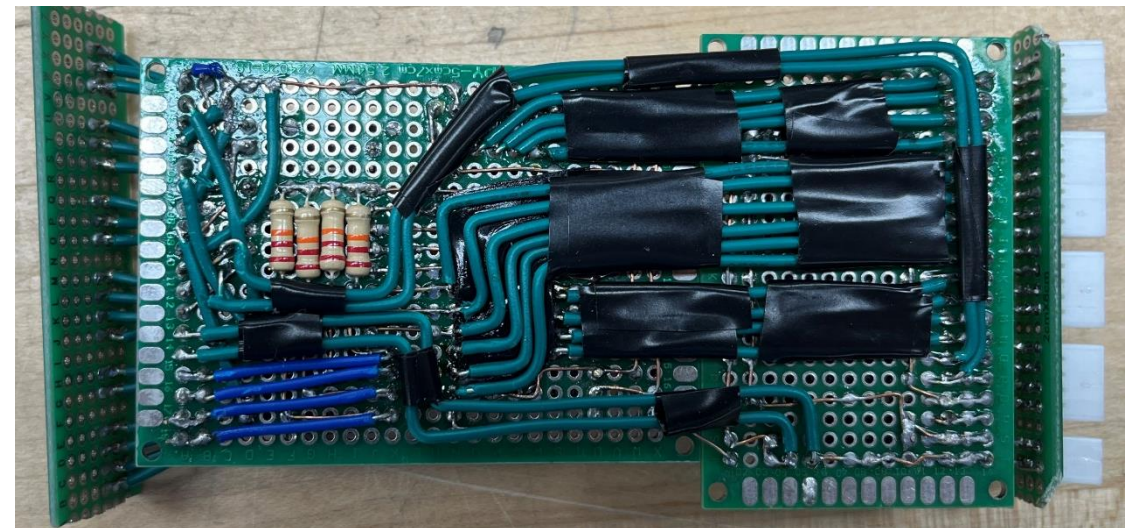
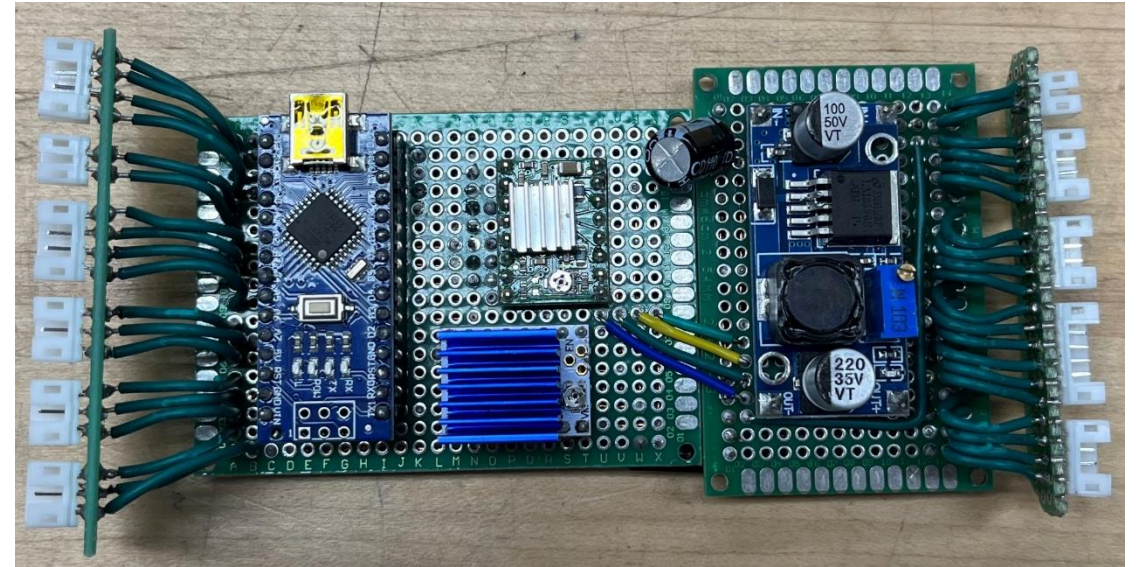


# Orbital Subsystem – Exploded View



# Electronics

- Compact perfboard design fits underneath the shaking platform while still being water and dust resistant
- Utilizes OTS JST connectors to easily replace peripherals
- An Arduino Nano controls three stepper motor drivers and handles all processing
- Powered by a 24V 15A DC power supply with a 5V downstepper



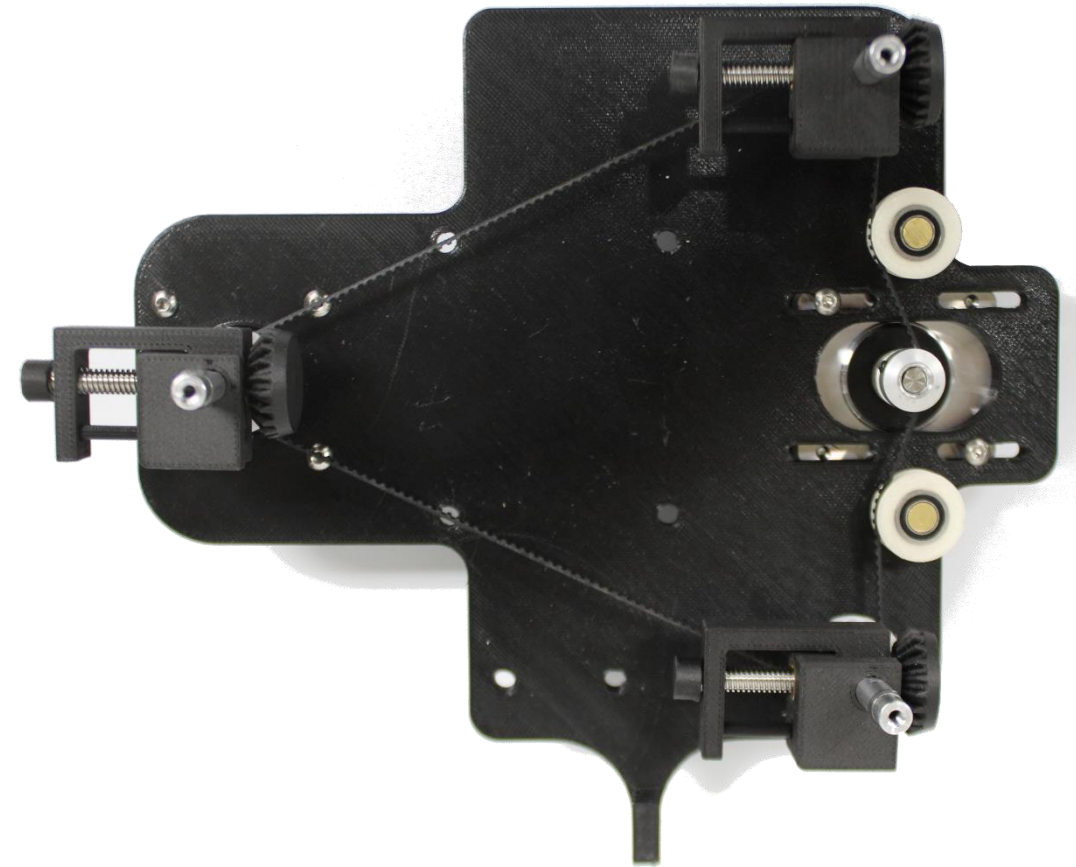
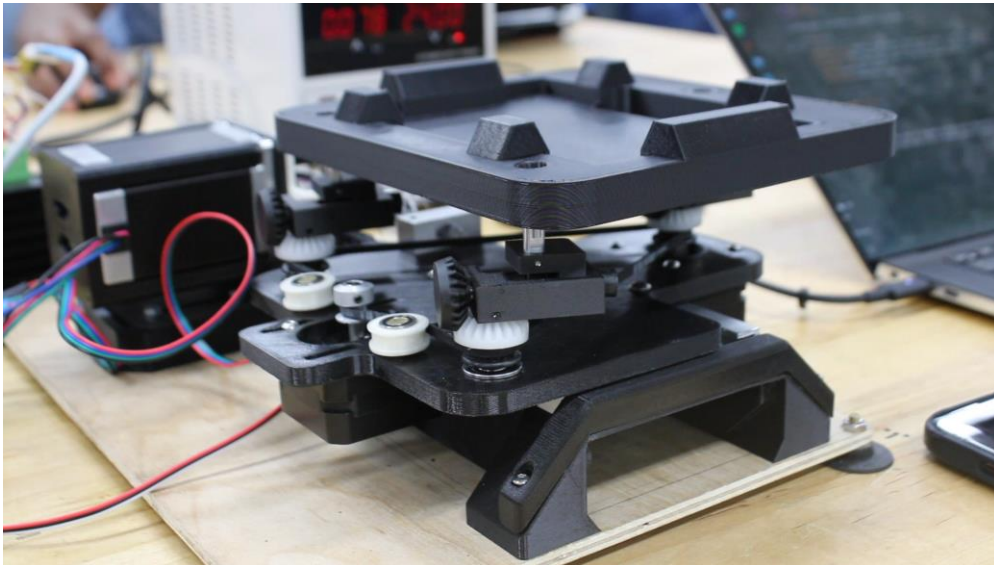
# 4. Key Features

Automatic Orbit Adjustment



# Orbit Diameter Adjustment

- Controlled on LCD screen user interface
- High precision
- Requires no additional or swappable parts



# Plate Holder

- OD/FI system fastened to transparent polycarbonate base
- Pockets allow automatic specimen pickup/drop-off
- Bumps ensure fast drop-off of specimens

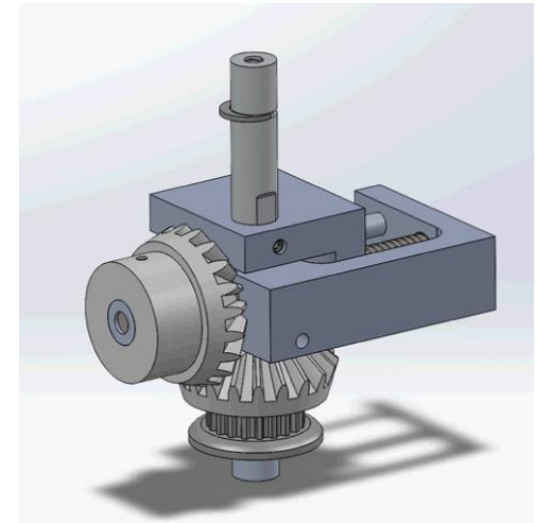
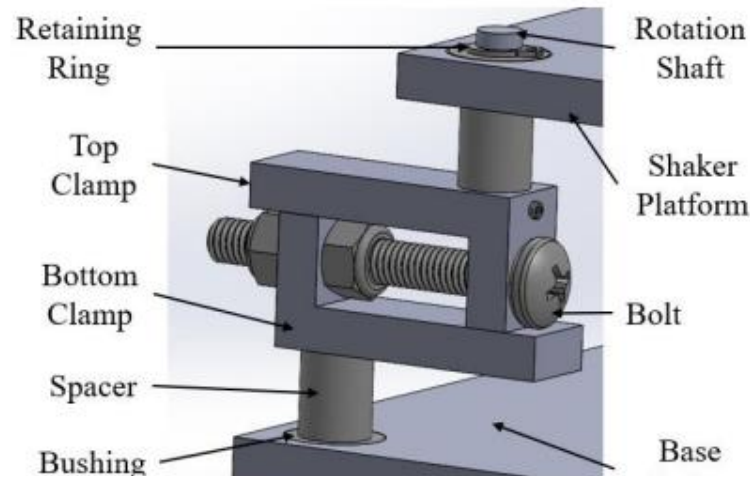
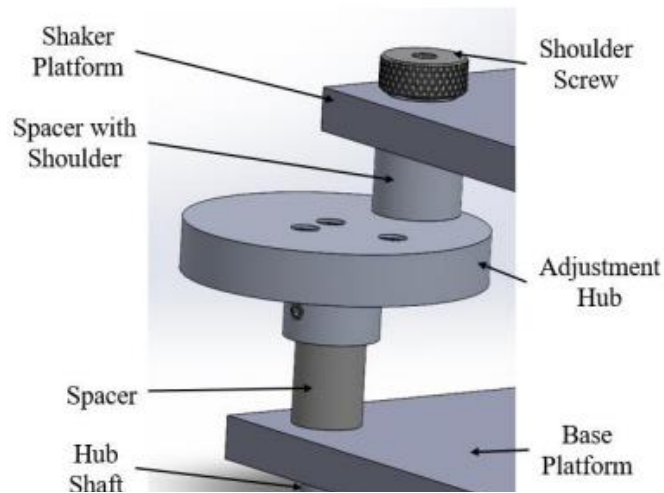


# 5. Design Evolution

Electronics, Orbital assembly, Plate Holder

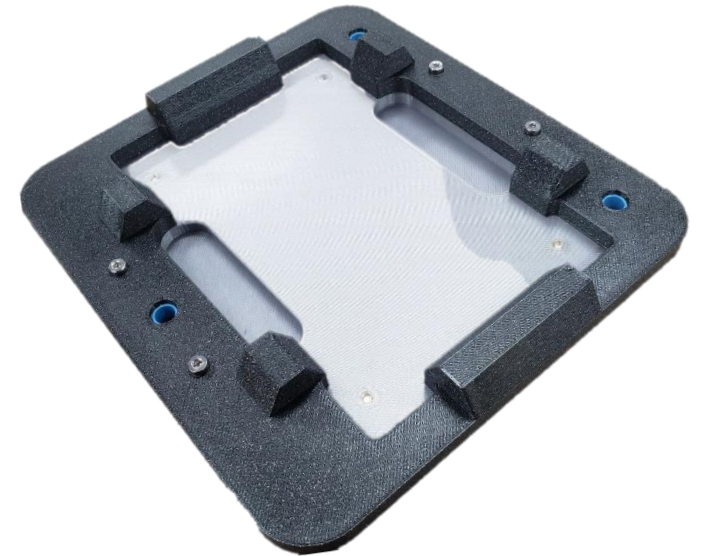
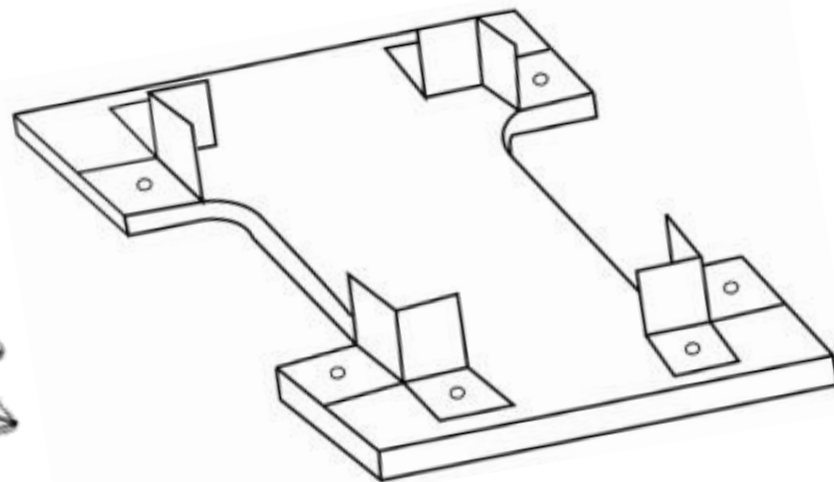
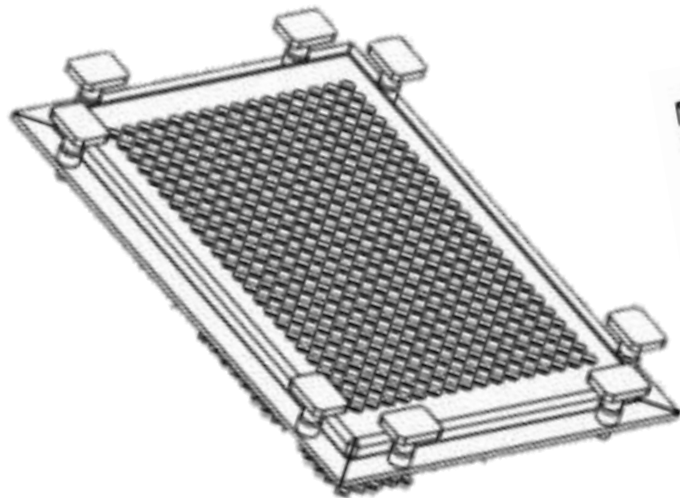
# Orbital Evolution

- Iteration #1
  - Had only 3 orbital sizes to choose from
- Iteration #2
  - Allowed for a varying orbit size dependent on the number of threads
- Iteration #3
  - Automatic and precise orbital diameter selection



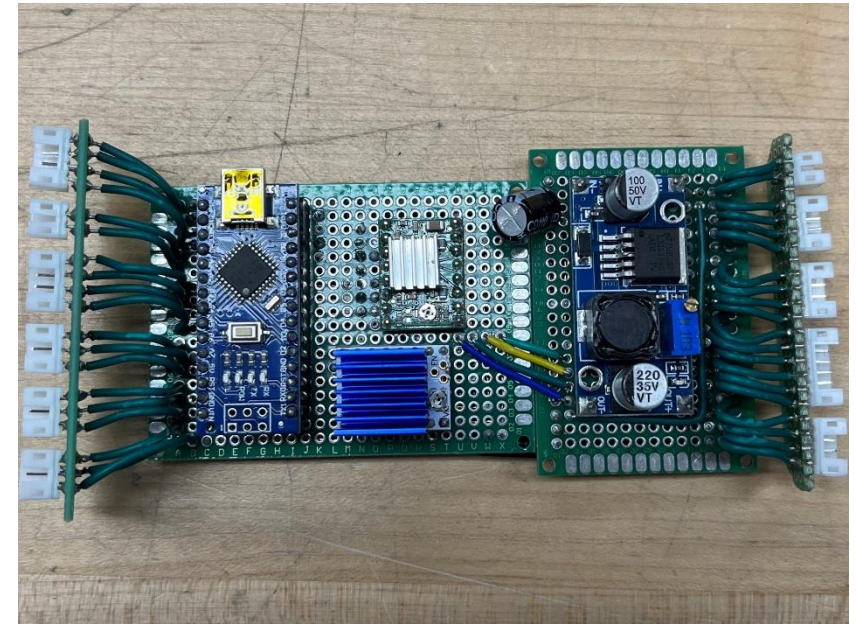
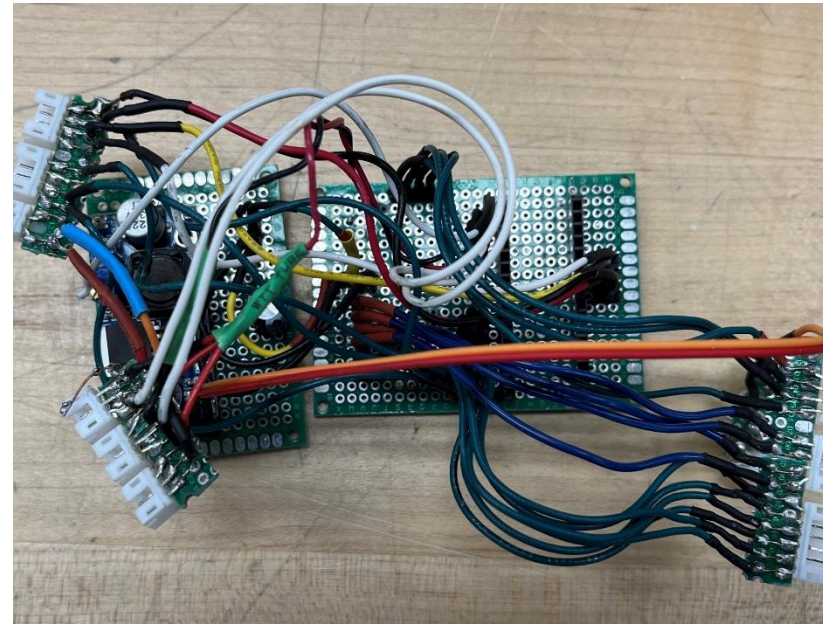
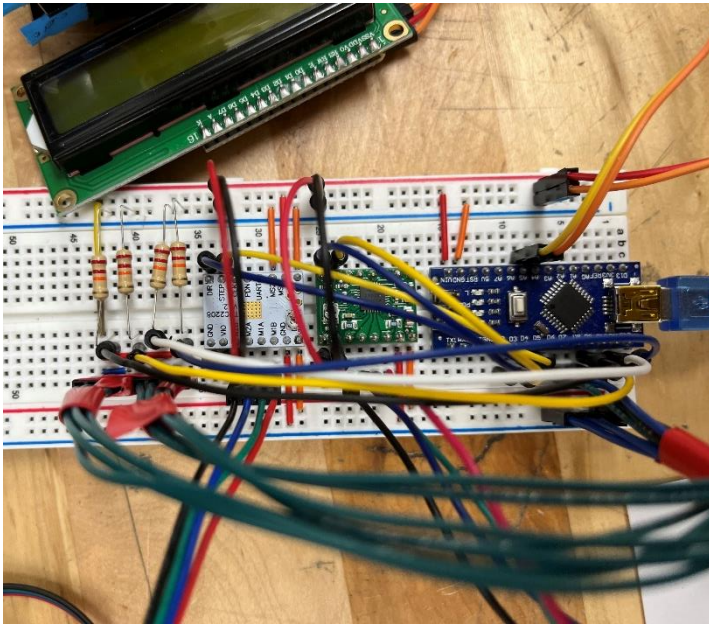
# Plate Holder Evolution

- Simplified construction
- Ease of manufacturing
- OD/FI integration
- Future proof



# Electronics Evolution

- Compacted breadboard prototype to more permanent perfboard
- Organized wiring and reduced connections liable to have loose/bad contact



1

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# 6. Cost Analysis

Operational Cost

# Cost

	Single Product	Mass Production
OTS Parts	\$502.80	\$345.33
Manufacturing	\$455.25	\$455.25
Raw Material	\$531.57	\$484.69
<b>Total Cost</b>	<b>\$1,489.62</b>	<b>\$1,285.27</b>



- Thank you for your time!

