

Motorizing Economical 3D Printed Optical Mounts with Arduino-Driven Software Allows for Precise Manual Control over Mirror Tilt.

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Abstract & Paper



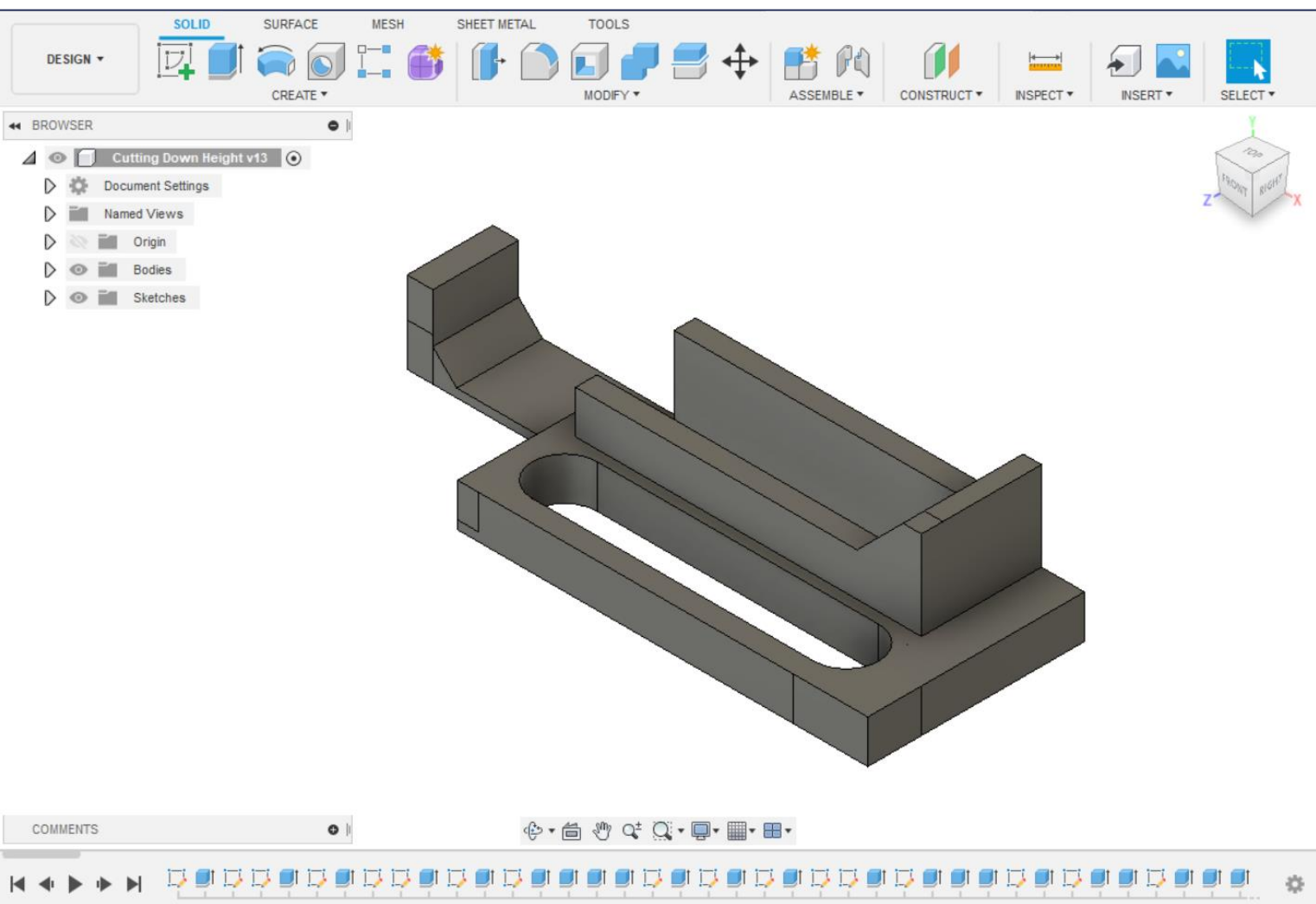
Summary Video

Research Focus

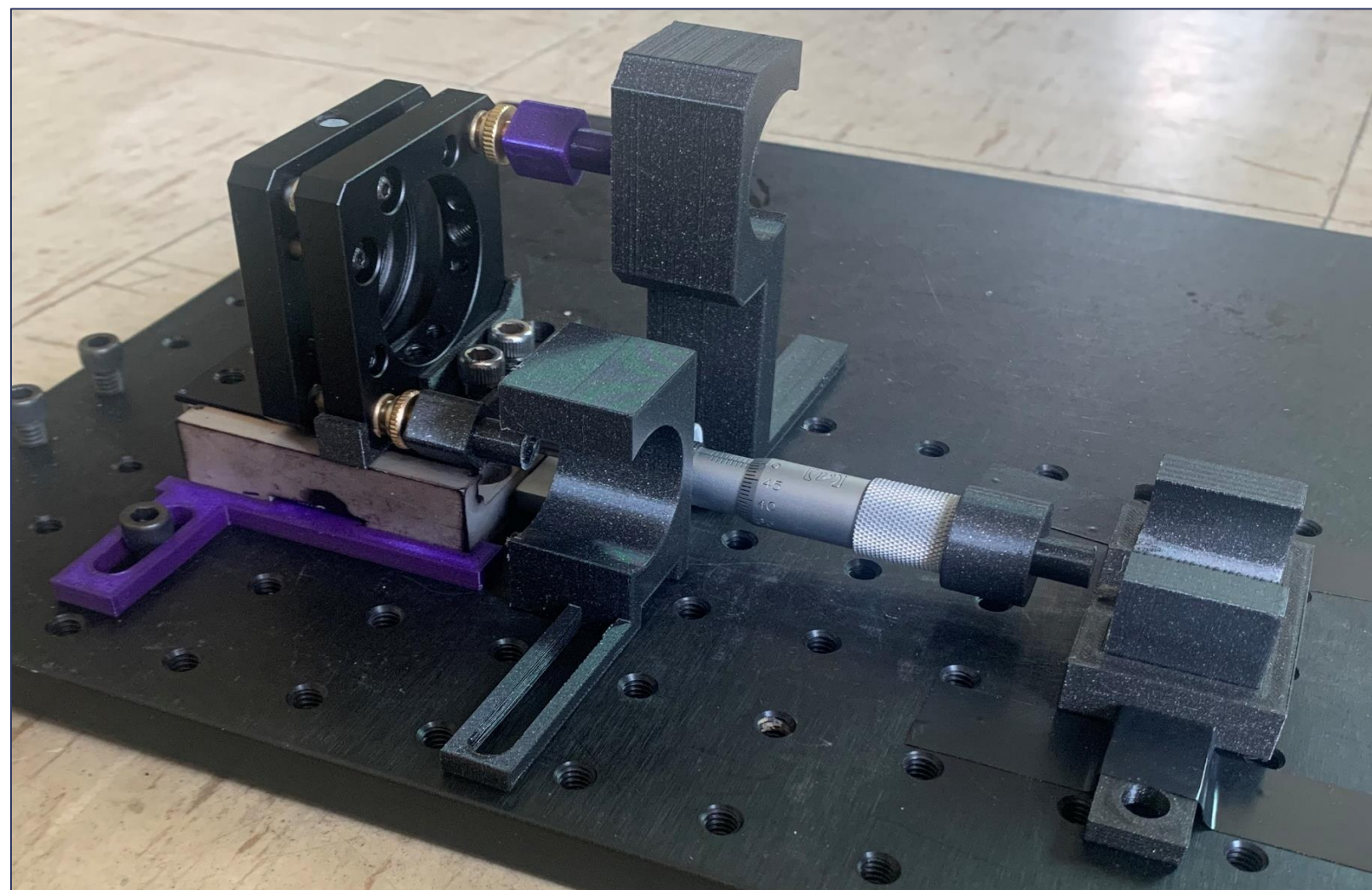
As part of an ongoing effort to replace costly optomechanical equipment with 3D printed parts, this project aims to control motorized optical mounts with Arduino-driven software.

Important Points!

- Aims to make optics accessible to lower-budget schools & independent researchers.
- Mirror tilt controlled by a joystick & Arduino program for movement in three axes.
- The measured precision of this system is sufficient to control optical lasers / waves.
- This suggests its potential application in interferometric experiments.



Fusion 360 (CAD Program) is used to sketch, model, and simulate the optical mount designs.



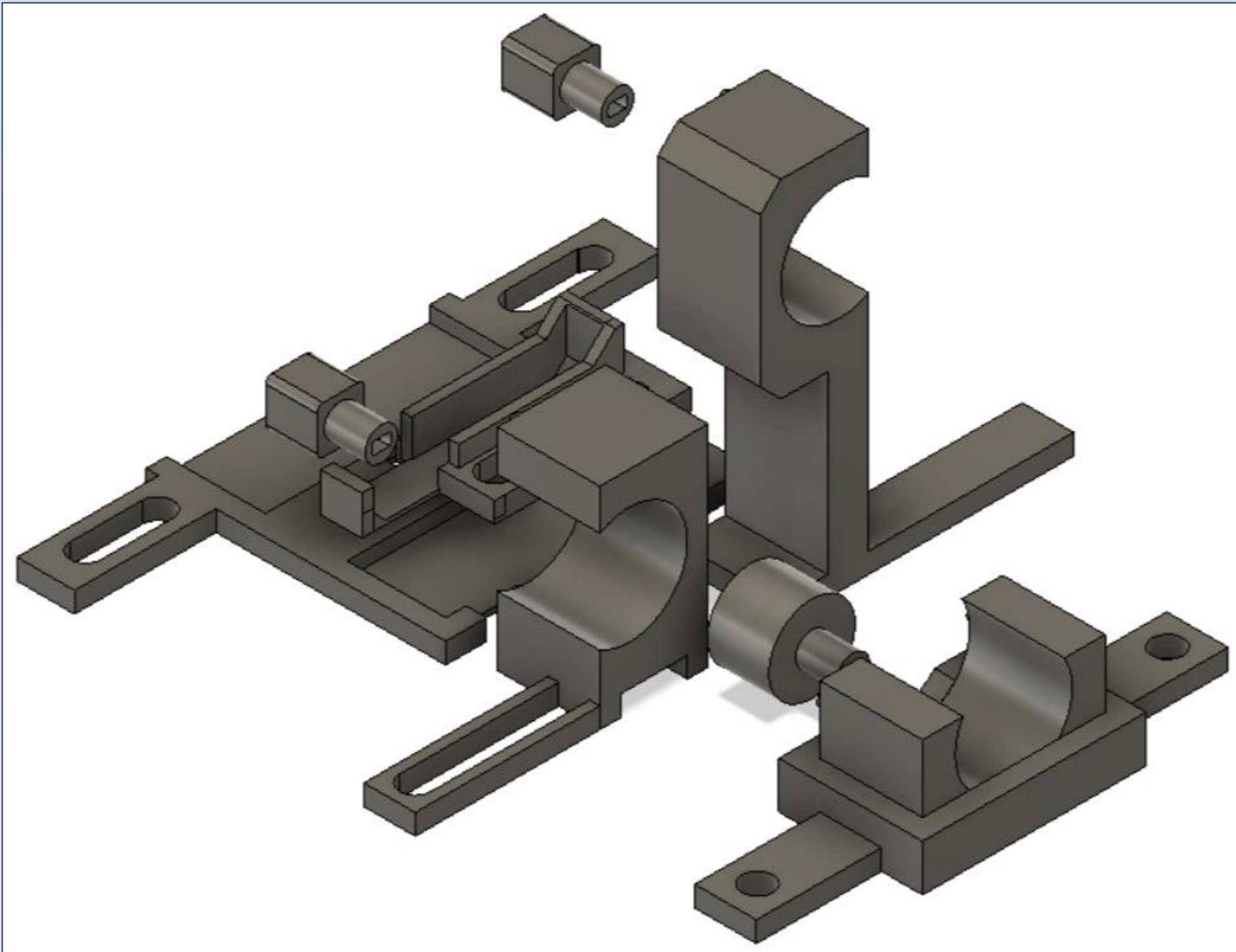
These 3D printed pieces are used to attach the optomechanical components to the breadboard.

Background

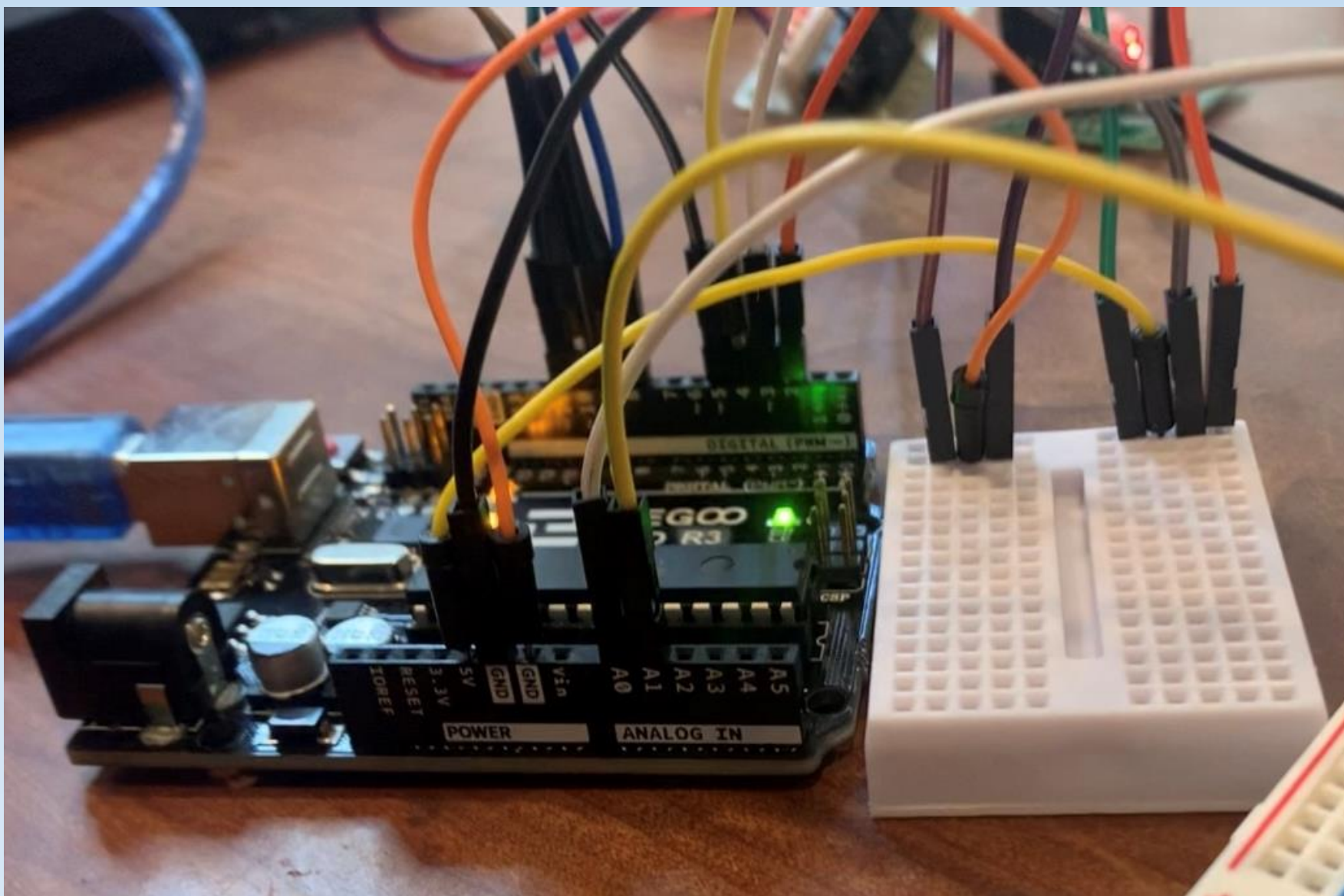
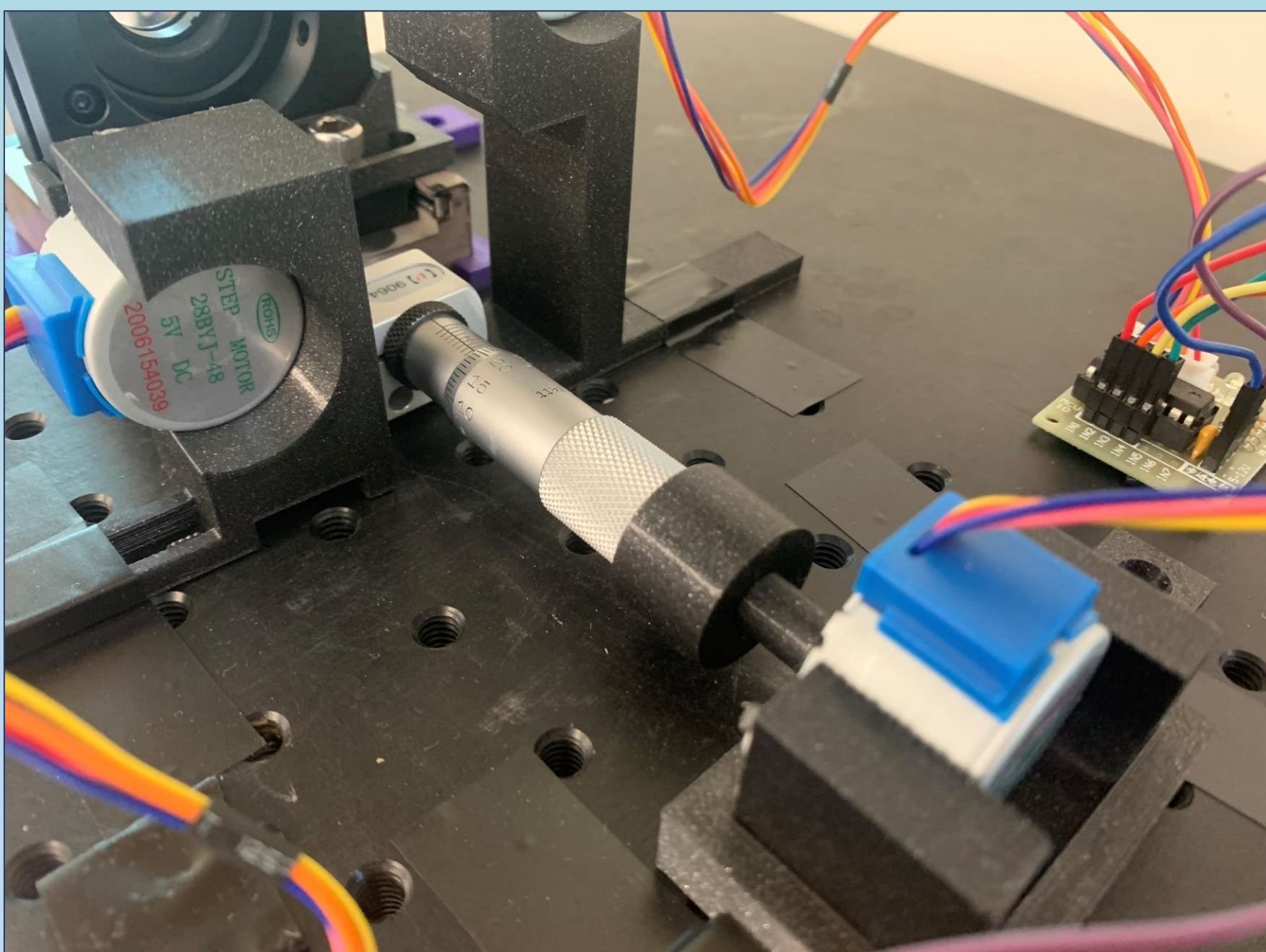
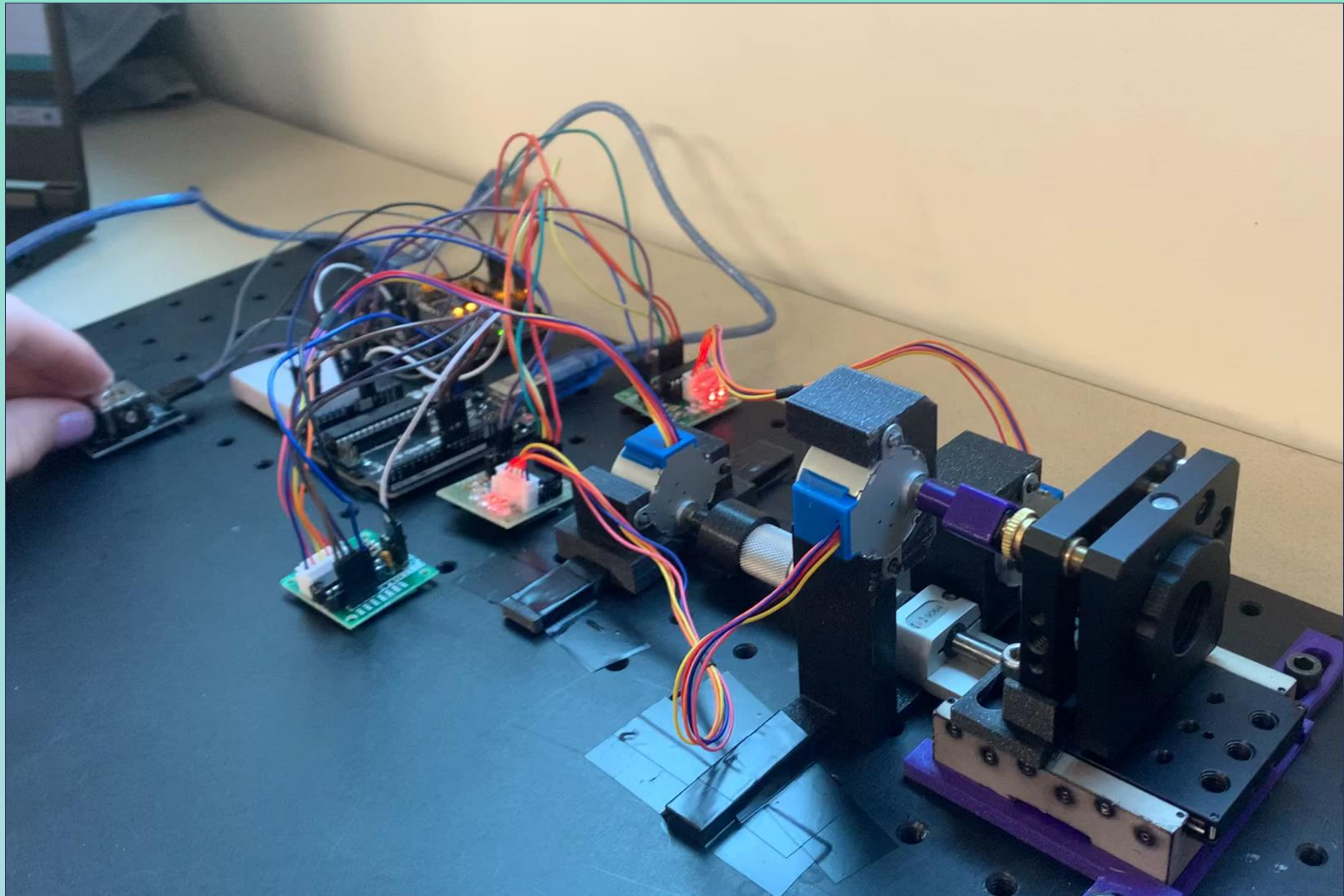
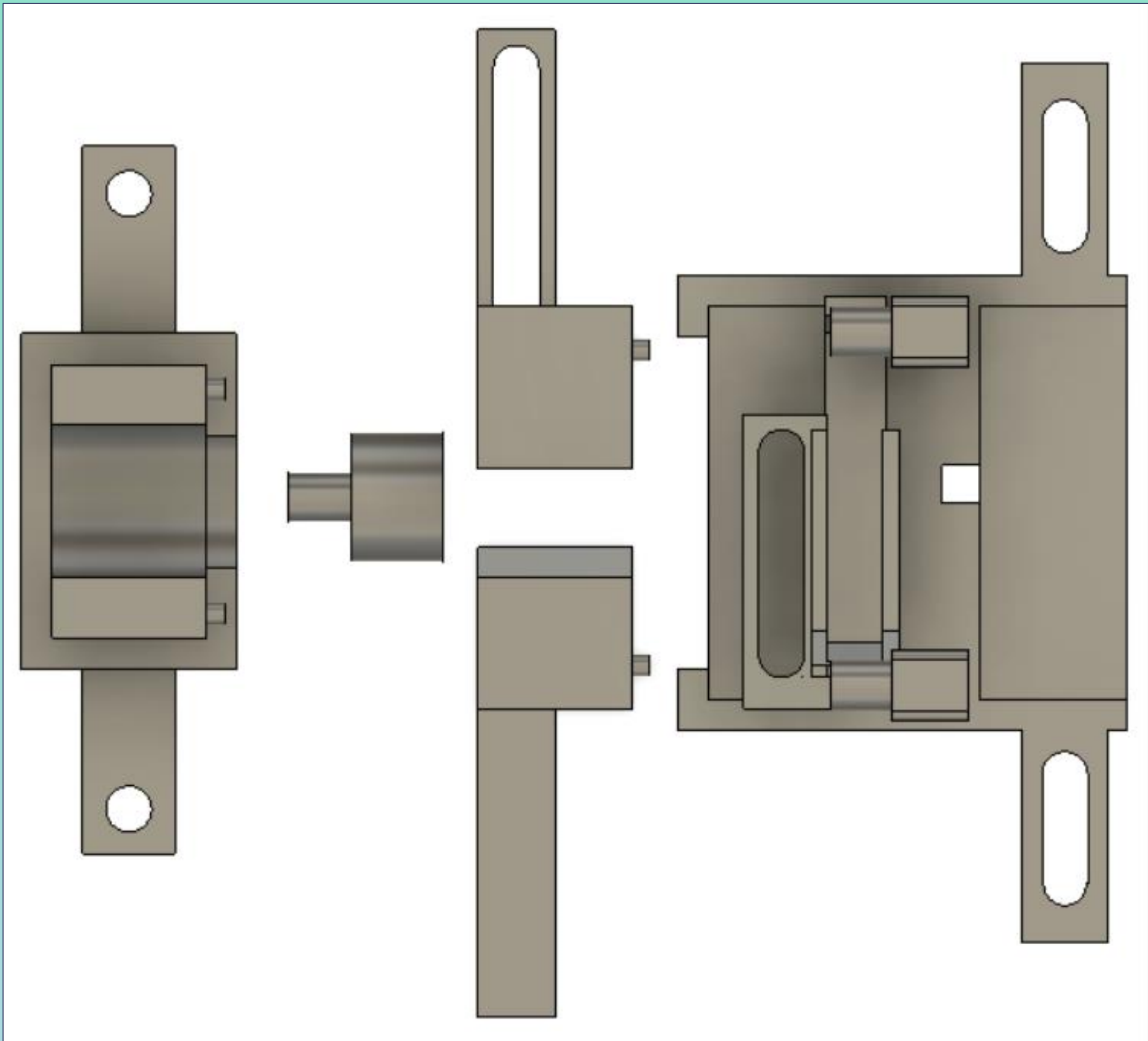
This is the latest focus in a series of investigations performed over the past four years.

The overarching goal for these projects has been to create inexpensive alternatives for lower-budget educational settings to what is available through professional-grade sources.

By motorizing a three-axis kinematic mirror mount both for manual adjustment and the automation of the measurement process, a new level of consistency can be achieved that would facilitate systematically taking rapid measurements at regular intervals as well as the creation of an active control system to keep the system aligned under stress.



Schematic and Pictures



Discussion

Three stepper motors were used to control the vertical and horizontal deflection angles as well as the position of a kinematic mirror mount on the optical axis. These motors were attached via 3D printed attachments connected to two manually controlled screws situated diagonally on the mirror and to the micrometer head of a linear translation stage. All three stepper motors were controlled with the use of two sketches (programs) and Arduino microcontrollers. First, two drivers controlled the motors mounted on the diagonal screws, allowing for simultaneous control of the kinematic mirror using a joystick as a manual / human interface (with each axis controlling a motor). The third driver controlled the movement of the micrometer on the z-axis to allow for precise measurements to be taken by moving the mounted mirror in consistent increments through a spectrum using a micrometer. This investigation contributes a system that can combine inexpensive components with 3D printing and customizable programming to create an economical alternative that can approximate the quality of professional-grade equipment.

item desc.	manufacturer	man. part #	unit price	qty ordered	total price
Stepper Motor, Drive Module Board	Aoicrie	28BYJ-48, ULN2003	\$ 4.50	3	\$ 13.50
UNO R3 Board	elegoo-shop	EL-CB-001	\$ 14.00	2	\$ 28.00
Joystick Module	SainSmart	101-50-136	\$ 7.00	1	\$ 7.00
20 mm Mirror Mount	WaveDynamic	N/A	\$ 30.00	1	\$ 30.00
Linear Micrometer Stage	New Focus	N/A	\$ 60.00	1	\$ 60.00
PLA Filament	prusa3d	FLM-PLA-175-WHT	\$ 23.00	N/A	\$ 2.02