Microscope Low-Cost Motorized Stage

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Client:

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Advisor:

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Overview

Problem Statement

- The inverted fluorescence microscopes in the BME teaching labs have stages with manually controlled knobs
- Manual image stitching is an ineffective use of time, increases human error
- Motorized microscope stages are very expensive
- Automated stitching needs accurate motor control
    - Method of stabilizing the motor is essential

Background

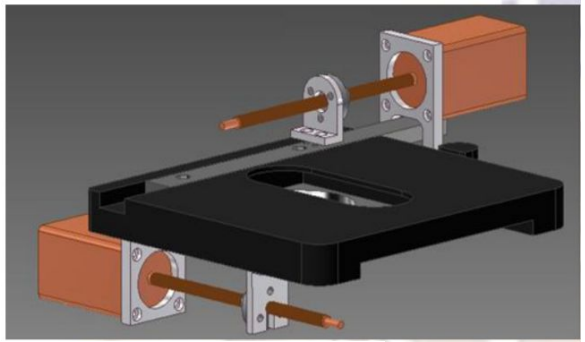
- The BME Teaching labs have two microscopes, Nikon Eclipse Ti-U and the Olympus IX71
- Nikon Elements Basic Research is an imaging software capable of processing, measuring, and analyzing images
- µManager is a microscope hardware automation software that is compatible with Arduino [1]
- The integration of a motorized microscope stage makes collecting this data easier and more time efficient, and allows for automated imaging and stitching

Product Design Specifications

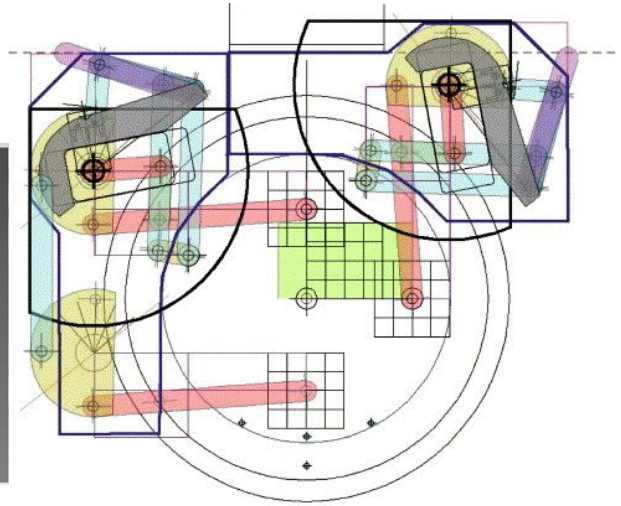
- Movements of the stage must be motorized, and should be able to be controlled by joystick or computer software
- Motors required to move with control knob
- Detachable
- Should be able to perform automated imaging and stitch images together
- Accuracy of movement between 1 - 10 microns
- Cannot drift during imaging cycles
    - Main focus of our design this semester
- Must be less than $100

Competing Designs

- Research Projects



[1]



- Market Products

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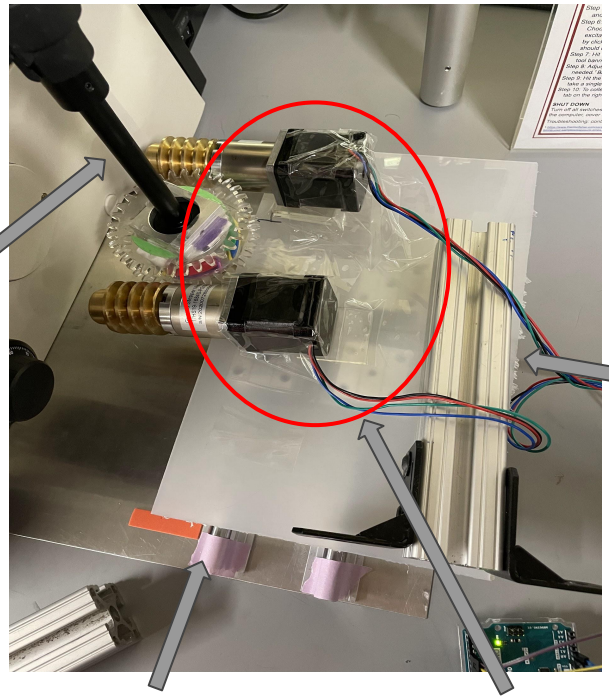
Last Semester…



Manual control knob moves in the y-direction with stage

Counterbalance for heavy motors

Rail system moves motors as control knob moves

Tape was used to stabilize motors

Design 1 - One Rail System

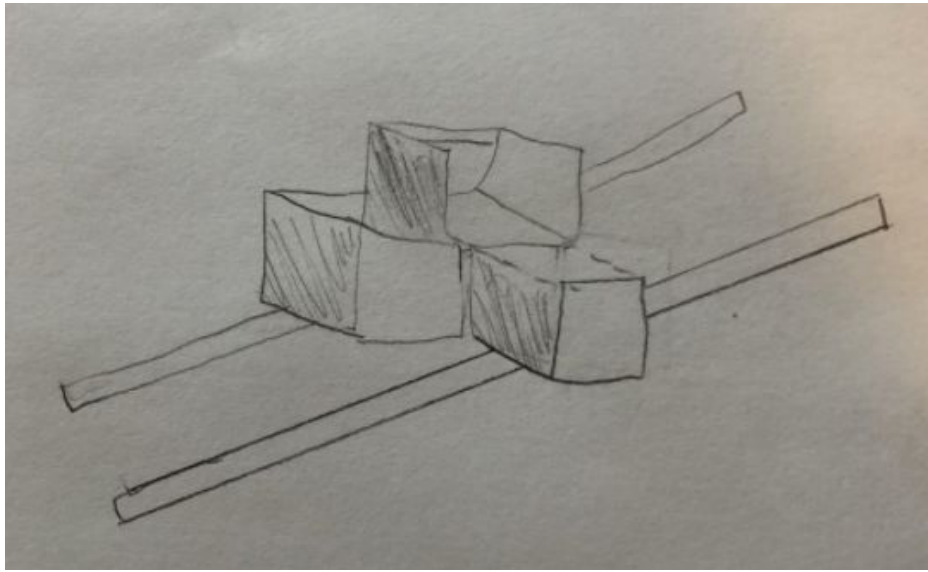
Benefits:

- Motor and stabilizer are fully detachable
- Cost effective
- Easier fabrication

Drawbacks:

- Provides less stability and balance

Design 2 - Two Rail System



Benefits:

- Similar to one rail system, with increased stability from two rails
- Increased balance of heavy motors

Drawbacks:

- Not compact
- Heavy
- More expensive

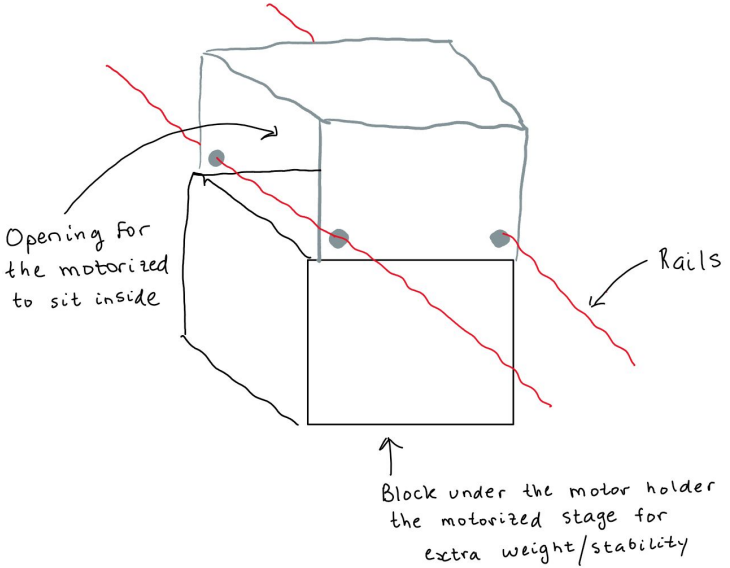
Design 3 - The Tarp

Benefits:

- Additional stability provided by the rails going through device

Drawbacks:

- Cost and amount of material required for production
- Detachability

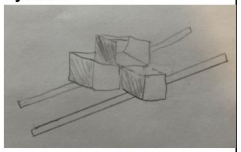
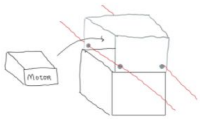


Design Matrix Criteria

Design Criteria:

- **Stability**: How effective our design is at stabilizing the motors, and moving along the rails?
- **Detachability**: How easy our motor stabilizer is able to be detached and reattached to the microscope?
- **Balance**: How effective does the motor balance on the stabilizing system while the microscope is being operated.
- **Cost**: How much the design costs?
- **Ease of fabrication**: How easy it is to create a prototype of the design?
- **Weight**: How light our design is. Lighter weights would be better for ease of detachability?
- **Compactness**: How compact our design is? The more compact it is, the easier it will be to implement onto our microscope, and will take up less space for the user.

Design Matrix

Design Criteria	Design 1: One Rail System 		Design 2: Two Rail System 		Design 3: The Tarp 	
	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Stability (25)	3/5	15	5/5	25	4/5	20
Balance (20)	2/5	8	4/5	16	3/5	12
Detachability (20)	5/5	20	5/5	20	1/5	4
Compactness (15)	5/5	15	2/5	6	4/5	12
Ease of Fabrication (10)	4/5	8	3/5	6	2/5	4
Cost (5)	5/5	5	3/5	3	2/5	2
Weight (5)	5/5	5	2/5	2	3/5	3
Total (100)		**76/100**		**78/100**		**57/100**

- After totalling up scores
  - 1st - The Two Rail System
  - 2nd - The One Rail System
  - 3rd - The Tarp

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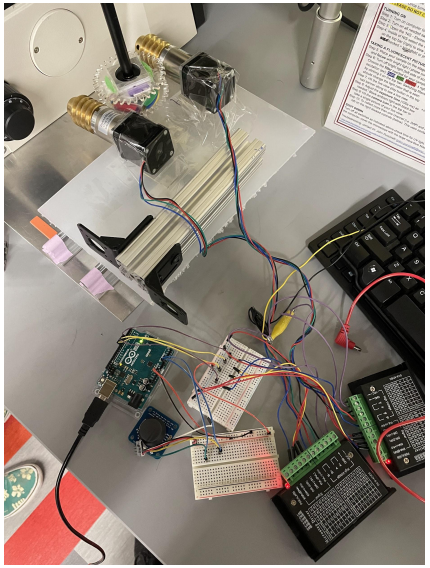
Future Work

- Clean up electronics
- Begin fabrication
  - Will 3D print the motor stabilizers
- Write code for joystick control and Nikon Elements integration
- Testing



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  - Jacob Cohn

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