BME Design

Microscope Low-Cost Motorized Stage

Design Team:

Mark Nemcek, Team Leader
Corey Steinhauser, Co-BWIG
Nate Burkard, Communicator
Caitriona Treacy, BSAC
Alex Nadolski, Co-BWIG
Charlie Fisher, BPAG

Client:

Dr. John Puccinelli, Department of Biomedical Engineering

Overview

Problem Statement

Background

PDS

Competing Designs

Preliminary Designs

Design Matrix

Future Work

Problem Statement

- The inverted fluorescence microscopes in the BME teaching labs have stages with manually controlled knobs
- Manual knobs can make finding or moving the sample hard
- Many motorized microscope stages are expensive

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
- The integration of a motorized microscope stage makes collecting this data easier and more time efficient, and allows for automated imaging and stitching.

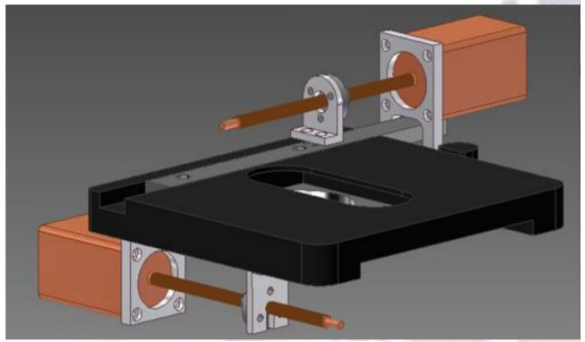
Nate Burkard

Product Design Specifications

- Movements of the stage must be motorized, and should be able to be controlled by joystick or computer software.
- Detachable.
- Should be able to perform automated imaging and stitch images together.
- The resolution should be 1-10 microns in x and y direction.
- There should be a fast and slow mode for the joystick.
- Should be powered by a wall outlet, with an on-off switch.
- Must be less than $100.

Competing Designs

- Research Projects



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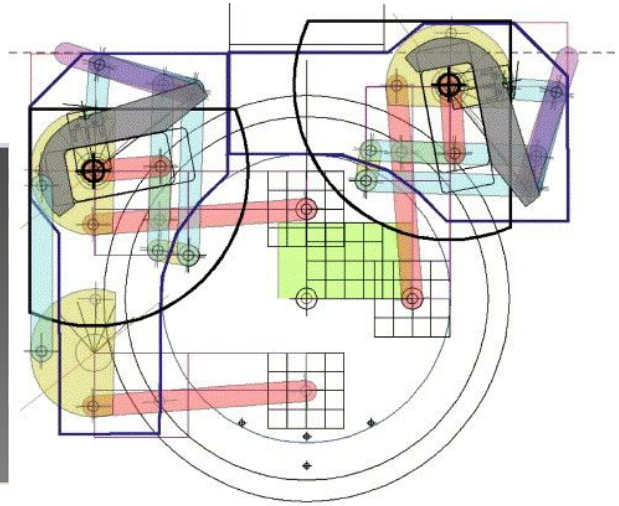

- Market Products

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Design 1 - Replaceable Stage

Benefits:

- Customizable
- Not reliant on manual knob

Drawbacks:

- Time Consuming
- Expensive
- Difficult Integration

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Alex Nadolski

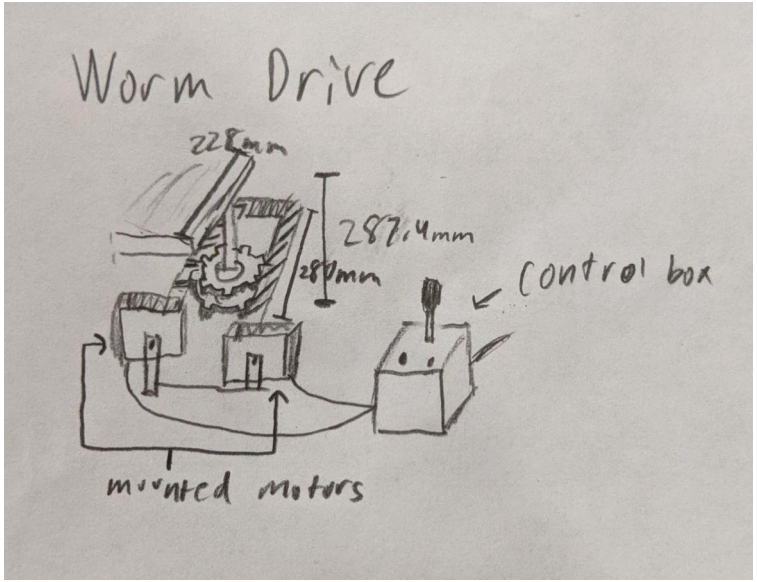
Design 2 - Worm Drive Gears

Benefits:

- Easier to manufacture
- Cheaper parts and assembly
- Easy to take on and off

Drawbacks:

- May fail over long periods of heavy use
- Takes up more space



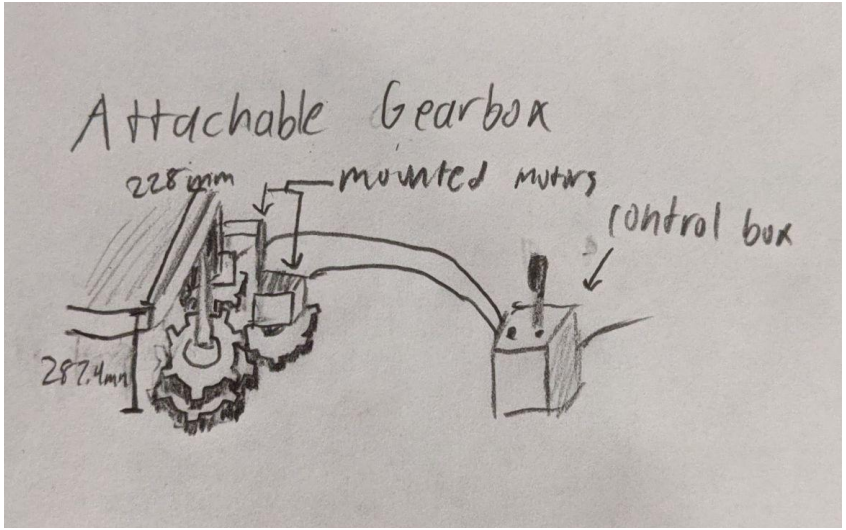
Design 3 - Attachable Gearbox

Benefits:

- Consistent over long periods of time
- Calibration is easy to set up

Drawbacks:

- More difficult to take on and off
- May put strain on the stage over time
- More moving hazards comparatively



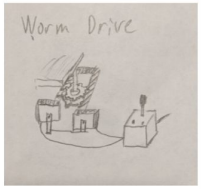
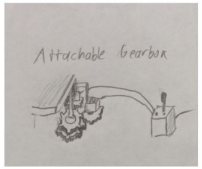
Design Matrix Criteria

In Order of Decreasing Priority:

- **Accuracy** - Will the device be effective?
- **Cost** - Projected to be within $100 budget?
- **Detachability** - Can the design be easily removed?
- **Ease of Use** - How intuitive is the design to a user?
- **Longevity** - What is the expected shelf life?
- **Ease of Fabrication** - Is it reasonable to fabricate given our resources?
- **Safety** - Are there any extra risks associated?

Design Matrix

- After totalling up scores
  - 3rd- Replaceable Stage
  - 2nd- Attachable Gearbox
  - 1st- Worm Drive
- Close between Worm Drive and Attachable Gearbox
  - Worm drive ended up winning
  - Better in accuracy and detachability
  - Two of our most important

	Replaceable Stage		Worm Drive		Attachable Gearbox	
Design Criteria						
	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Accuracy (25)	5/5	**25**	4/5	20	3/5	15
Cost (20)	1/5	4	3/5	**12**	3/5	**12**
Detachability (20)	2/5	8	4/5	**16**	3/5	12
Ease of Use (15)	3/5	9	5/5	**15**	5/5	**15**
Longevity (10)	5/5	**10**	4/5	8	5/5	**10**
Safety (5)	4/5	**4**	3/5	3	3/5	3
Ease of Fabrication (5)	1/5	1	3/5	3	5/5	**5**
Total (100)		**61/100**		**77/100**		**72/100**

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Future Work

- Polish off all aspects of design
- Make a material list
  - Already have motors from last year
- Begin fabrication
  - Will 3D print both gears of worm drive
  - Assembly with wiring and motors
- Start writing a code for independent use
- Testing

Acknowledgements

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  - Riley Pieper
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  - Noah Trapp
  - Dylan Von Heimburg
  - Jacob Cohn

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References

[1] Bhakti, T., Susanto, A., Santosa, P. and Widayati, D., 2021. *Design of Motorized Moving Stage with Submicron Precision*. [online] Citeseerx.ist.psu.edu. Available at: <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.589.55&rep=rep1&type=pdf> [Accessed 15 October 2021].

[2] Hatiboglu, C. and Akin, S., 2021. *A new computerized moving stage for optical microscopes*. [online] Pdf.sciencedirectassets.com. Available at: <https://www-sciencedirect-com.ezproxy.library.wisc.edu/science/article/pii/S0098300404000615> [Accessed 15 October 2021].

[3] Discover-echo.com. 2021. *Revolve Fluorescence Microscope by Echo*. [online] Available at: <https://discover-echo.com/revolve> [Accessed 15 October 2021].

[4] Prior Scientific. 2021. *114 x 75 mm travel stepper motor XY stage for routine applications (inverted) - Prior Scientific*. [online] Available at: <https://www.prior.com/product/optiscan-es107> [Accessed 15 October 2021].

[5] Holmarc.com. 2021. *Microscope Translation Stage*. [online] Available at: <https://www.holmarc.com/microscope_translation_stage.php> [Accessed 15 October 2021].

[6] Docs.google.com. 2021. *Microscope Design Matrix*. [online] Available at: <https://docs.google.com/document/d/1TQr9r9WgFazGO2zckNPS9tDrJVDsrEQy3ESrkYWn2hA/edit> [Accessed 15 October 2021].

[7] “Puccinelli, John - UW-Engineering Directory: College of Engineering @ The University of Wisconsin-Madison,” *College of Engineering University of WisconsinMadison*. [Online]. Available: https://directory.engr.wisc.edu/bme/Faculty/Puccinelli_John/. [Accessed: 15-Oct-2021].

[8] “Skala, Melissa,” *Department of Medical Physics*, 01-Jan-3851. [Online]. Available: https://www.medphysics.wisc.edu/blog/staff/skala-melissa/. [Accessed: 15-Oct-2021].

[9] “BME Design Projects Better Health By Design,” *Microscope low-cost motorized stage*. [Online]. Available: https://bmedesign.engr.wisc.edu/projects/s21/motorized_stage. [Accessed: 15-Oct-2021].