

# Low-Cost Motorized Microscope Stage



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# Overview

- Problem Statement
- Background
- Product Design Specifications
- Design Alternatives
- Design Matrix
- Future work
- References



# Problem Statement

Initial reported problem:

- New BME Teaching Lab
  - 2 existing microscopes
- Motorized microscope stages are extremely expensive (thousands of dollars)
- The ability to automate is appealing
  - Image consistency
  - Time efficiency

Goal:

- Design a stage or stage modification that allows for motorized process that can be automated



(Nikon commercial motorized-stage microscope set up)

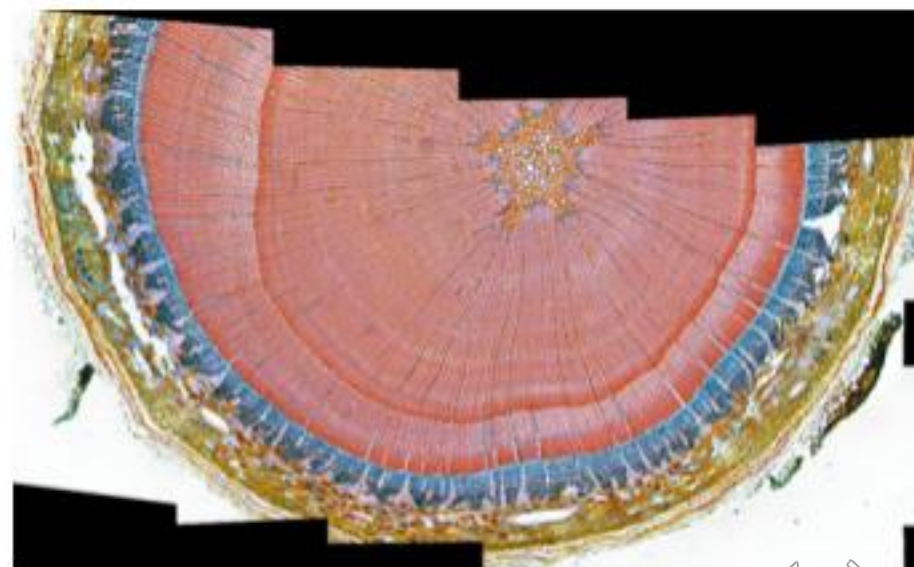


# Background

- Industrial systems exist
  - Prior, ASI
- Cell diameter 10s of microns
- Serial Imaging using Micro Manager
- Image stitching in ImageJ



(Open Source Micro-Manager software)





# Product Design Specifications Summary

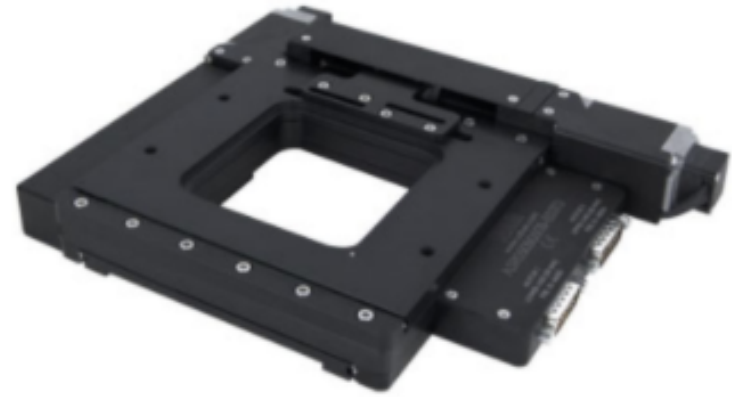
Client Requested Functions:

- Motorized mechanism to move microscope stage
- Used for both the Nikon TI-U Inverted Fluorescence Microscope and Zeiss Axiovert 40 Inverted Microscope
- Use either OpenScan Micro-Manager or NIS-Elements BR software
- Control movement with resolution of 1 micron in x and y direction
- Budget - \$100



# Design 1: New-Replaceable Stage

- *Features:*
  - Involves fabricating stage elements in addition to motor circuitry
- *Appeal:*
  - More precise stage movement
  - Sleek integration
- *Major Drawback:*
  - Difficulty integrating in place of commercial stage
  - Budget constraints

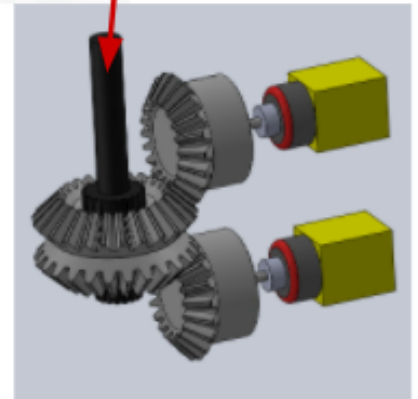
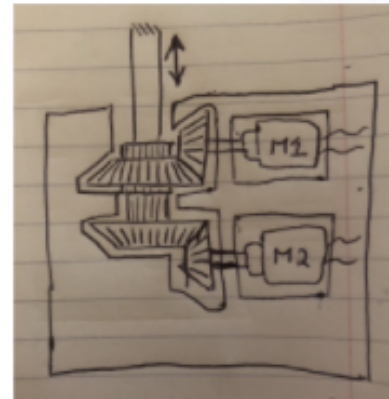


New stage to replace current microscope stage



# Design 2: Removable Gear Cap

- *Features:*
  - Bevel gears within housing unit
  - Gears remain in unit and slide on/off
- *Appeal:*
  - Easiest to attach/detach
  - No permanent modifications
- *Major Drawback:*
  - Difficulty of stabilization and mating

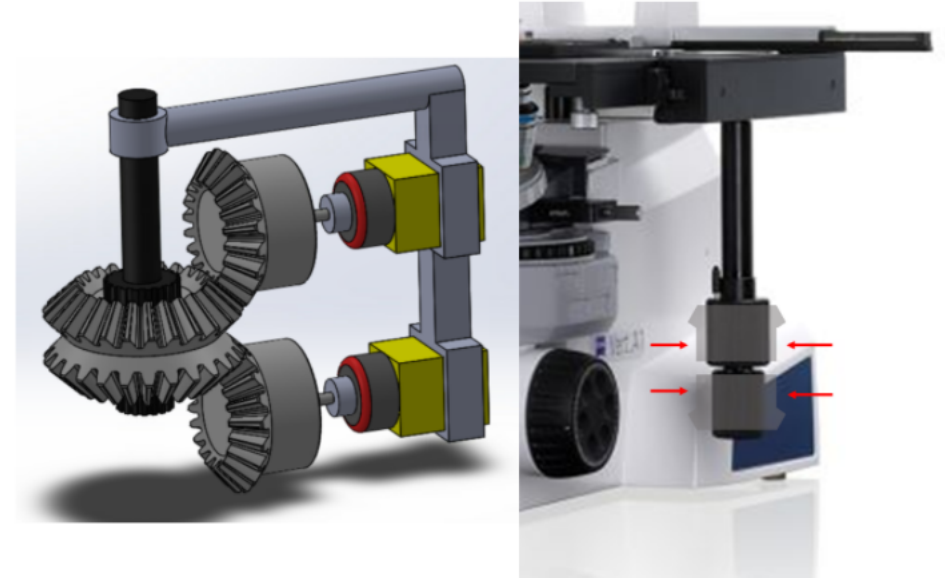


(The housing fixes the gear and motor positions, allowing facile slide-on/off attachment of full cap system)



# Design 3: Gear-Fastened Translational Knobs

- *Features:*
  - Bevel gears fastened to knobs with removable set screws
  - Positioning frame fastened to knob shaft with removable set screws
- *Appeal:*
  - Secure and consistent gear mating
  - Reasonable fabrication
- *Major Drawback:*
  - No immediate attachable/detachable feature



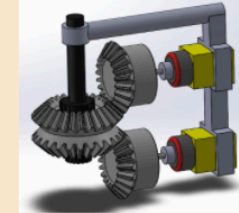
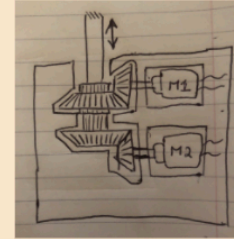
Bevel gears and positioning bracket fastened to translational microscope knobs with set screws



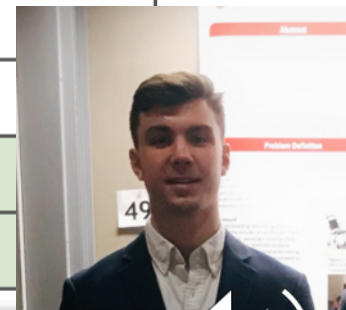


## Preliminary Design Matrix

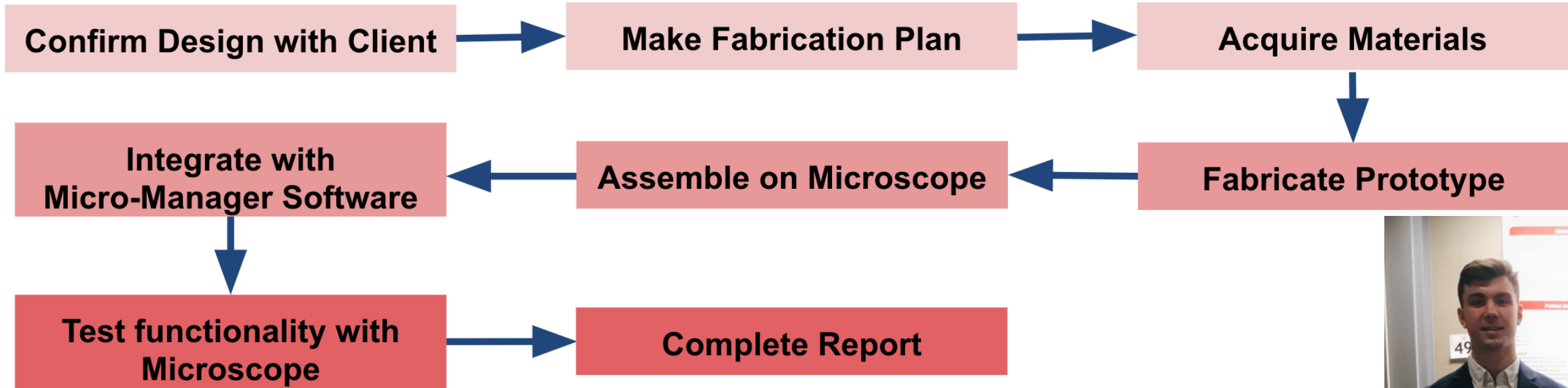
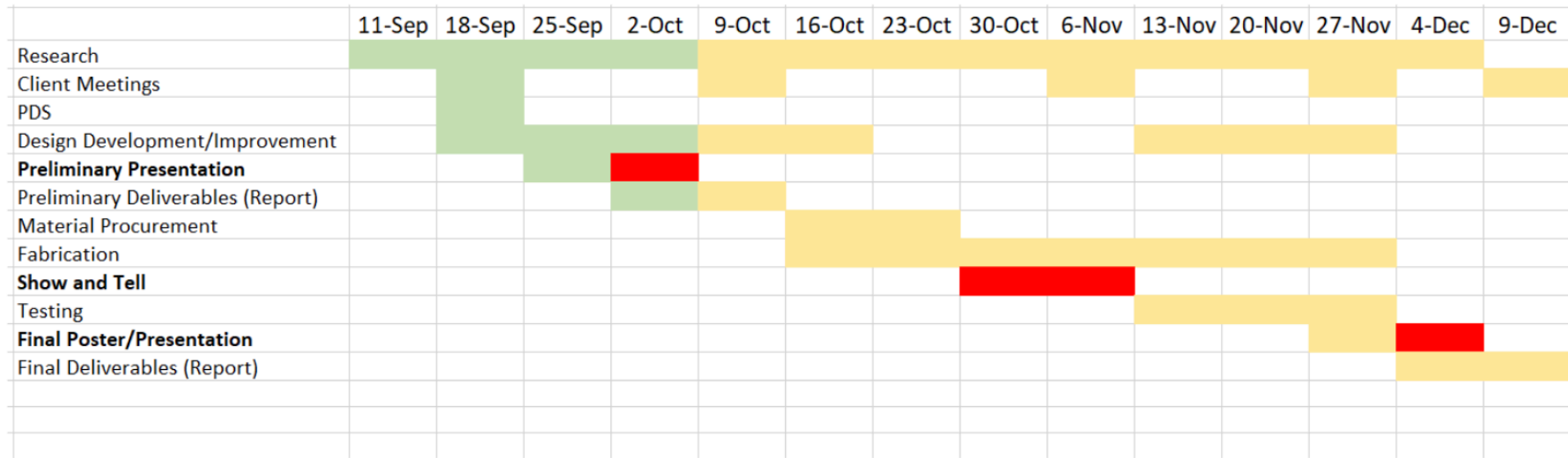
Criteria (weight)	New-Replaceable Stage		Removable Gear Cap		Gear Fastened Translational Knobs	
	Score	Weighted	Score	Weighted	Score	Weighted
Cost (25)	1/5	5	3/5	15	4/5	20
Functionality (20)	5/5	20	3/5	12	4/5	16
Precision (20)	5/5	20	3/5	12	4/5	16
Fabrication (10)	1/5	2	2/5	4	4/5	8
Ease of Use (10)	5/5	10	4/5	8	3/5	6
Detachment (10)	2/5	4	5/5	10	3/5	6
Safety (5)	3/5	3	5/5	5	5/5	5
<b>TOTAL (100)</b>		<b>64</b>		<b>66</b>		<b>77</b>



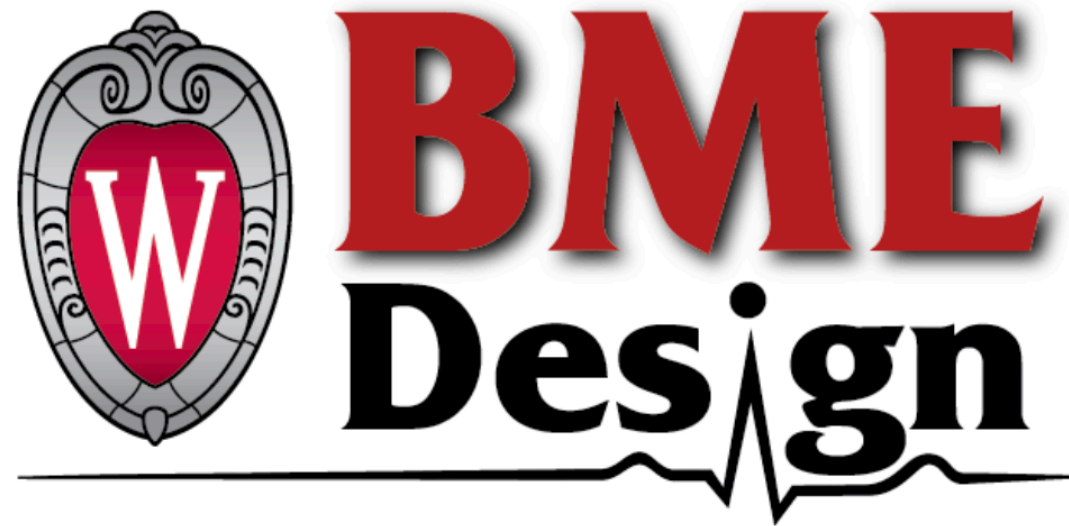
**Gear Fastened  
Translational Knobs**



# Future Work



# Acknowledgements



**Advisor:** Paul Campagnola, Ph. D.

**Client:** Dr. John Puccinelli, Ph. D.



# References

Nikon.com. 2020. *Nikon | Healthcare Products & Solutions (Microscope Solutions) | Inverted Microscopes*. [online] Available at: <<https://www.nikon.com/products/microscope-solutions/lineup/inverted/>> [Accessed 1 October 2020]

Micro-manager.org. 2020. *Micro-Manager*. [online] Available at: <<https://micro-manager.org/wiki/Micro-Manager>> [Accessed 1 October 2020].

