BME Design-Spring 2022 - MARK NEMCEK
Complete Notebook

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May 04, 2022 @12:22 PM CDT

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Project description

MARK NEMCEK - Feb 27, 2022, 8:16 PM CST

Course Number: BME 301

Project Name: Microscope low-cost Motorized Stage

Short Name: Motorized_Stage

Project description/problem statement:

Inverted fluorescence microscopes are currently controlled using manual translational control knobs. These manual control knobs do not allow for automated imaging and automated stitching of images. Our goal is to design, program, and fabricate a motorized stage to be used for inverted fluorescent microscopes to allow for automated imaging and automated stitching that can be integrated with the Nikon Elements imaging software. The stage must cost less than $100 and the resolution of the stages' movement should be around 1 um.

About the client:

Dr. John P Puccinelli, Associate Chair for UW-Madison's BME Undergraduate Program

https://directory.engr.wisc.edu/bme/Faculty/Puccinelli_John/

Team contact Information

MARK NEMCEK - Feb 27, 2022, 8:13 PM CST

Last Name	First Name	Role	E-mail	Phone	Office Room/Building
Witzenburg	Colleen	Advisor	witzenburg@wisc.edu	(608) 890-3332	Room: 2140 Engineering Centers Building
Puccinelli	John	Client	john.puccinelli@wisc.edu	(608) 890-3573	Room: 2132 Engineering Centers Building
Nemcek	Mark	Leader	mtnemcek@wisc.edu	(262) 366-6381	
Kulkarni	Siddharth	BPAG	sskulkarni4@wisc.edu	(414) 405-2203	
Steinhauser	Corey	BWIG, BSAC	steinhauser2@wisc.edu	(651) 303-4836	
Burkard	Nate	Communicator	njburkard@wisc.edu	(608) 709-6958	

2/9/22 Client Meeting

MARK NEMCEK - Feb 09, 2022, 2:52 PM CST

Title: Client Meeting 1

Date: 2/9/22

Content by: Mark Nemcek

Present: Mark, Corey, Nate

Goals: To meet with the client and establish goals and expectations for the project this semester

Content:

- Talking points:
    - Budget
        - $100
        - Keep track of how the parts you actually need
            - Continuing from last semester
    - PDS
    - Stabilizing the device
    - Further integration of the joystick
    - Nikon Software
        - On the computer an has special key. Password is 2005
        - Micromanager software is downloadable on loci website
    - Improved testing method
        - What does 1-10 microns mean?
            - If we tell it to move 50 microns we want it to be within 1-10 microns in either direction
    - Improvements he wants to see?
        - Electrical box to hide wires

Conclusions/action items: The team will use the information from our client to carry out his wishes to the best of our ability.

2/23/22 Client Meeting With Nikon Rep

MARK NEMCEK - Feb 23, 2022, 2:10 PM CST

Title: Client Meeting 2

Date: 2/23/22

Content by: Mark, Corey, Nate, Sid

Present: Mark, Corey, Nate, Sid

Goals: Meet with the client as well as Nikon representative to discuss the software

Content:

- Probably cannot control arduino with this Nikon software, but can control imaging
- Use 8 bit or possibly 12 bit
- To stitch go to acquire and then grab large image
    - Press windows and tab if the task bar disappears
    - Be within 10 pixels to get an accurate stitch
    - Grab goes left and right, meander goes up and down
- May be useful to see how long the gear needs to rotate to move one full field of view
    - So we set the gears to move a certain amount of time (equal to a full field of view) and then grab another image which will be stitched together
- To determine size of field of view: use hemocytometer. Each square is 1 mm by 1 mm.
- Micromanager can control multiple apps.
    - Could have it doing one thing with the nikon and another with arduino

Conclusions/action items: The team will use this information to integrate our gears and motors with the Nikon software to enable stitching of images.

2/4/2022 - Meeting 1

Siddharth Kulkarni - Feb 04, 2022, 12:43 PM CST

Title: Advisor Meeting 1

Date: 2/4/2021

Content by: Sid, Mark, Nate, Corey

Present: Sid, Mark, Nate, Corey

Goals: Meet with advisor and discuss future plans

Content:

- Go to ecb to see the microscope and preliminary design
- Make updates to the PDS
    - Does that make sense at this phase
    - Defining a testing method - make improvements to it?
    - Integrate the software with the designed components
- Does the device allow for the stitching of the images placed under the microscope?

Conclusions/action items:

Make updates to the PDS and take about updates from last semester's prototypes.

2/11/2022 - Meeting 2

Siddharth Kulkarni - Feb 27, 2022, 7:30 PM CST

Title: Advisor Meeting 2

Date: 2/11/2021

Content by: Siddharth Kulkarni

Present: Group

Goals: The goal is t discuss future plans for the semester

Content:

- Discuss project overview
- Setting up meeting with the Nikon Guy
- Gaining access to the bioinstrumentation room for testing
- Possible Cheap materials to use for fabrication

Conclusions/action items:

We must begin thinking about design ideas as well as how to conduct the testing process towards the end of the semester.

2/18/2022 - Meeting 3

MARK NEMCEK - Feb 27, 2022, 7:30 PM CST

Title: Advisor Meeting 3

Date: 2/18/2022

Content by: Siddharth Kulkarni

Present: Nate, Sid, Mark, Corey

Goals: The goal is to meet with our advisor and discuss plans for the future.

Content:

- looked over progress report ad design matrix
- talked about perhaps getting dr. P to buy a new rail completely
    - Does one rail cause tipping?
    - Is there more stability when using two rails?
    - Design that allows the motor to freely slides with minimal friction\
- 80/20 and McMaster-Carr => sliding motor rail system
    - T-slided railing

Conclusions/action items:

Begin working on preliminary deliverables (reports, presentations, notebooks).

3/4/2022 - Meeting 4

Siddharth Kulkarni - Mar 04, 2022, 12:39 PM CST

Title: Meeting 4

Date: 3/4/202

Content by: Siddharth Kulkarni

Present: Group

Goals: Talk about future semester plans

Content:

- Presentations
  - talked about improvements
  - explain design ideas better
    - talk more about the microscope and what was done last semester
  - focus on the big picture and the broad overview
    - details are a lot harder to understand for the audience
- 3D Printing SolidWorks Design

Conclusions/action items:

3D Print the final design and work on the testing protocols.

4/15/2022 - Meeting 5

Siddharth Kulkarni - Apr 19, 2022, 6:02 PM CDT

Title: Advisor Meeting 5

Date: 4/15/2022

Content by: Siddharth Kulkarni

Present: Sid, Mark, Corey, Nate

Goals: The goal is to discuss future plans for the rest of the semester.

Content:

- Poster Presentations Next Week

- Begin Testing this week (Tuesday and Friday if needed)

- Print the new attachment

- Begin working in poster and finalize the Executive Summary

Conclusions/action items:

- Keep up to date on lab archives and finish testing.

Design Matrix 2/18/22

MARK NEMCEK - Feb 27, 2022, 7:48 PM CST

Title: Design Matrix

Date: 2/18/22

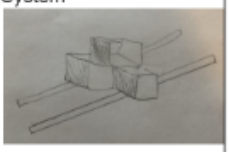
Content by: Mark Nemcek

Present: Mark, Corey, Nate, Sid

Goals: To create a design matrix to analyze our different options for a stabilizing device.

Content:

Attachment Stabilizer 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**

- 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.

Conclusions/action items: The team will move forward with the two-rail system and try to start fabricating.

Team Design Meeting - 3/23/2022

Siddharth Kulkarni - Mar 23, 2022, 7:15 PM CDT

Title: Team Meeting

Date: 3/23/2022

Content by: Siddharth Kulkarni

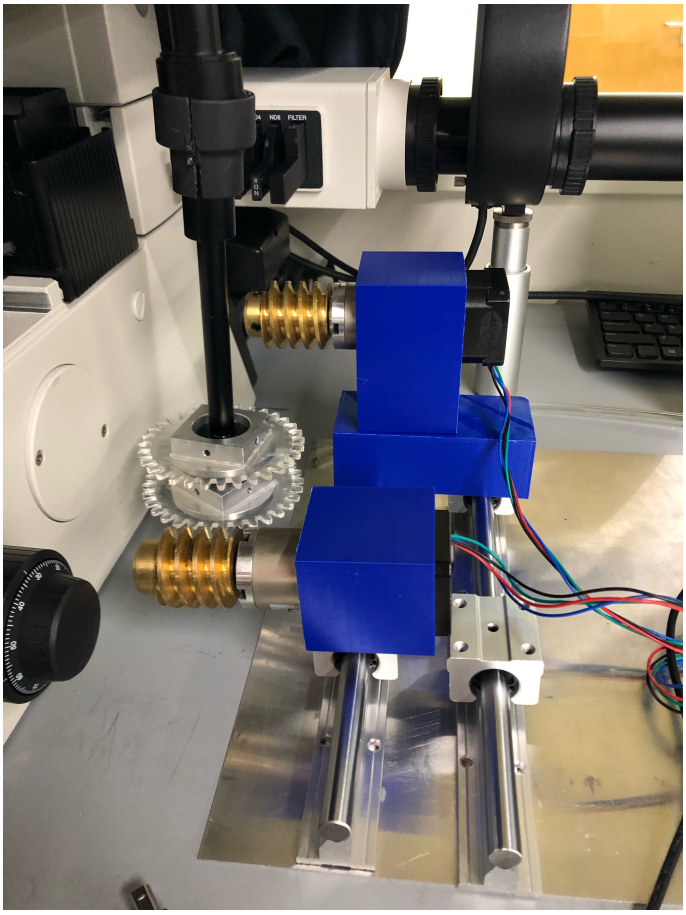
Present: Team

Goals: The goal is to test how our device works with the microscope.

Content:

- Test how the device attaches to the microscope motors
  - Are the 3D printed sizes correct?
  - Is there tipping still involved?
  - Is tape/glue going to be used in any way?

Picture of the device connected to the microscope..



Conclusions/action items:

We need to prepare for the show and tell as well as start developing some testing protocols.

2022/03/25 Show and Tell

COREY STEINHAUSER - Mar 25, 2022, 1:20 PM CDT

Title: Show and Tell suggestions

Date: 3/25/22

Content by: Corey

Present: Entire design group

Goals: Figure out how to hold motors to gears

Content:

- Bar and rubber band

- Slit in both boxes with bars in between

- Bar in between, screw to tighten (Wrench idea)

- Bar on top

- Spring in between with the bar

- Size specific external slit, hinge to hold in place

- Magnet on support bar in between

- Hole in the support structures, glue in magnets on both, metal bar in between them

- Removeable joint

- Bar with bent ends, brackets on each of the support structures

- Flexible (rubber) fixed bar

- Cap to fit on top

- Clamp

- Hand clamp

- Pneumatics

- Bungee cord with hook

link for potential cheap magnets https://www.grainger.com/product/31LU26?ef_id=Cj0KCQjw0PWRBhDKARIsAPKHFGgNTa1eDZR88MurZCWm-I9ozpn8fSIHa0K-8tFEt1SoZlX01YRqcuIaAvaIEALw_wcB:G:s&s_kwcid=AL!2966!3!264955915895!!!g!439505055028!&gucid=N:N:PS:Paid:GGL:CSM-2295:4P7A1P:20501231&gclid=Cj0KCQjw0PWRBhDKARIsAPKHFGgNTa1eDZR88MurZCWm-I9ozpn8fSIHa0K-8tFEt1SoZlX01YRqcuIaAvaIEALw_wcB&gclsrc=aw.ds

Conclusions/action items:

5/1/22 Final Expenses Sheet

MARK NEMCEK - May 01, 2022, 10:41 AM CDT

Title: Final Expenses Sheet

Date: 5/1/22

Content by: Mark Nemcek

Present: Mark, Corey, Nate, Sid

Goals: To fill out the final expenses sheet over the entire 4 semester period of this project.

Content:

Item	Quantity	Price
Previous Group	1	$129.85
2X SBR12 Linear Rail Guide	1	$30.74
AllPoints 26-4004 – GEAR, BRASS WORM - MAIN SHAFT BRASS WORM GEAR.	2	$16.08
Analog 2-axis Thumb Joystick with Select Button + Breakout Board	1	$16.72
3D Printing Makerspace	14	$26.88
	Total:	$220.27

Conclusions/action items: Use this information for future reference if this process is to be repeated or improved upon.

5/1/22 SolidWorks of Final Design

MARK NEMCEK - May 01, 2022, 11:39 AM CDT

Title: SolidWorks of Final Design

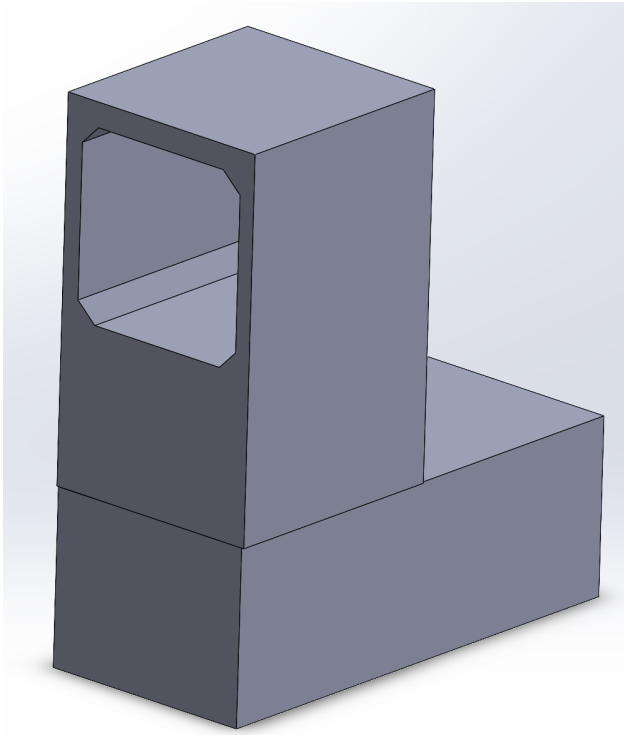
Date: 5/1/22

Content by: Mark Nemcek

Present: Mark, Corey, Nate, Sid

Goals: To create SolidWorks Drawings for our 3D printed pieces.

Content:

- Motor Stabilizers
  - 
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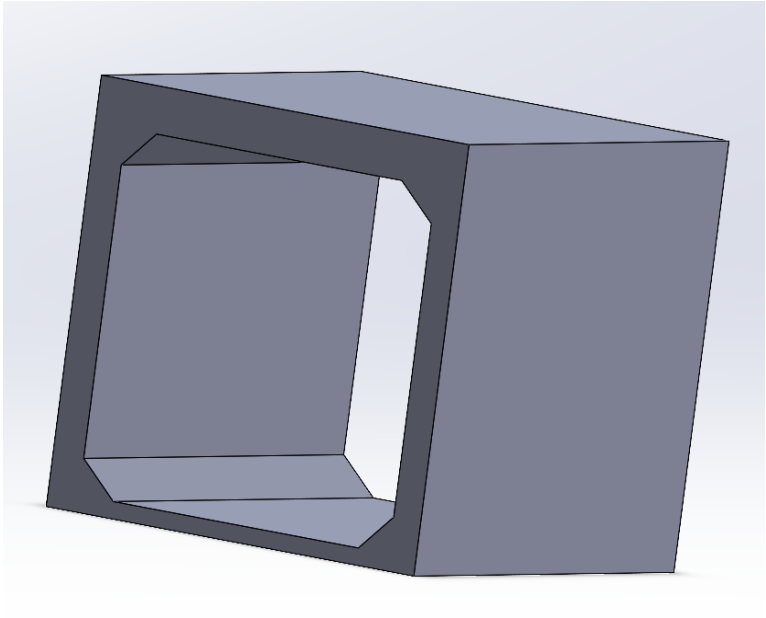
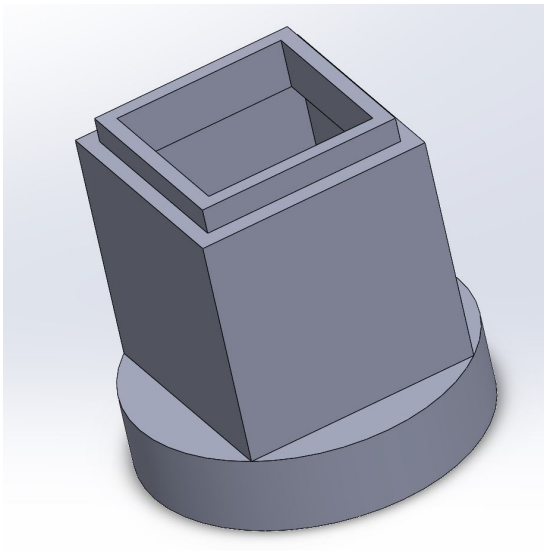
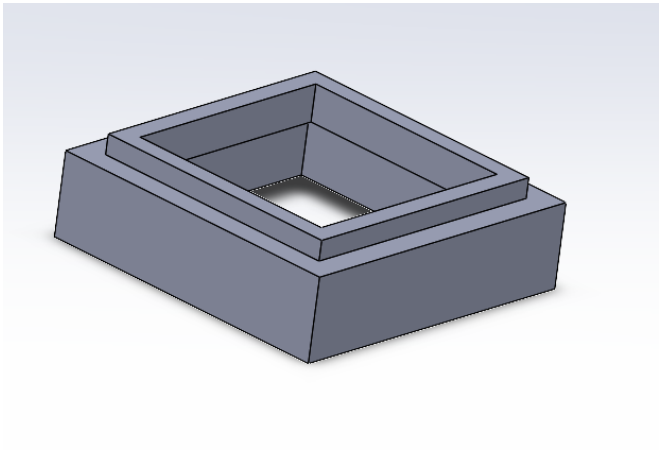


- Manual Control Knob Stabilizer





Conclusions/action items: This information was used to create our 3D printed pieces, it gives a good depiction of how the prototype was made and how it could be recreated in the future.

5/1/22 Final Design

MARK NEMCEK - May 01, 2022, 11:43 AM CDT

Title: Final Design

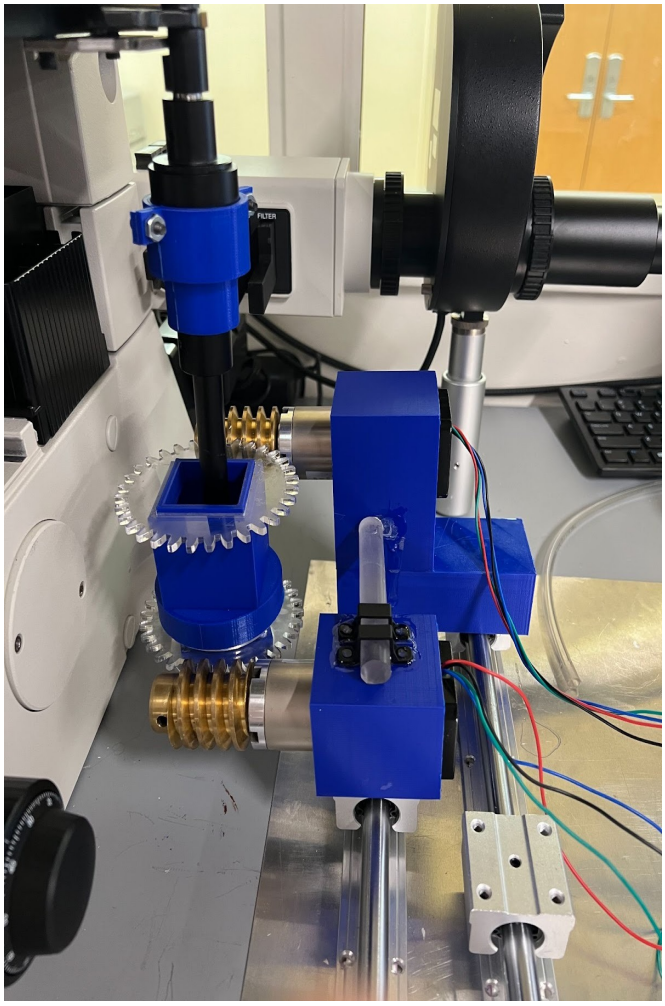
Date: 5/1/22

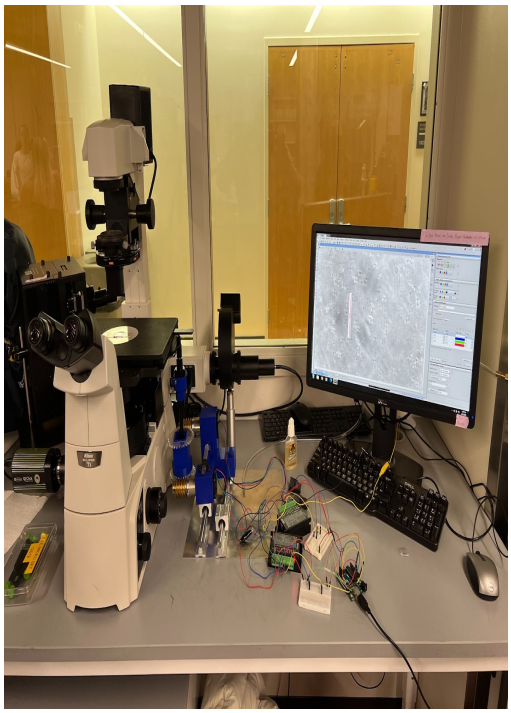
Content by: Mark Nemcek

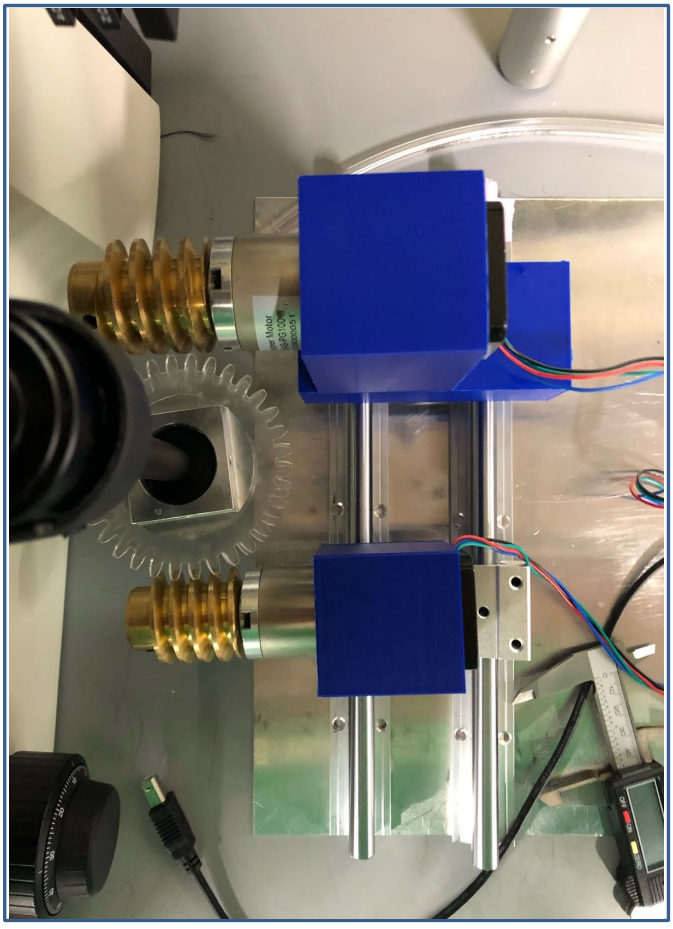
Present: Mark, Corey, Nate, Sid

Goals: To document images of our final prototype design put together.

Content:

- Images of final design:
  - 
  -





Conclusions/action items: Use this information to help visualize how the final prototype was assembled and the overall function of the device.

5/1/22 Final Testing protocols

MARK NEMCEK - May 01, 2022, 11:39 AM CDT

Title: Final Testing Protocols.

Date: 5/1/22

Content by: Mark Nemcek

Present: Mark, Corey, Nate, Sid

Goals: To layout the entire testing protocols that were used in this experiment.

Content:

- Speed Determination Testing
  - To test for the accuracy of distance traveled, the speed that the stage moved in each direction had to be determined. To test for the speed a photograph of the sample with 6µm dots was taken at one position. Then, the motor was set to a constant speed for 2.5 seconds but until another photograph was taken of the sample at position 2. The two images were imported into ImageJ to calculate the distance traveled of one dot on the slide. Based on the distance traveled, the speed in each direction was determined.
- Accuracy of Distance Traveled Testing
  - After the speed was determined, code was developed to set the motors to move 100µm. The slide with the 6µm dots was photographed before and after the motor movement. The two images were imported into ImageJ and the actual distance traveled of one dot on the slide was determined. Three tests were run in each direction and the difference between the projected and actual distance traveled was noted.

Conclusions/action items: This information was used for testing and could be used for reference in future semesters.

5/1/22 Final Testing Data

MARK NEMCEK - May 01, 2022, 11:39 AM CDT

Title: Final Testing Data

Date: 5/1/22

Content by: Mark Nemcek

Present: Mark, Corey, Nate, Sid

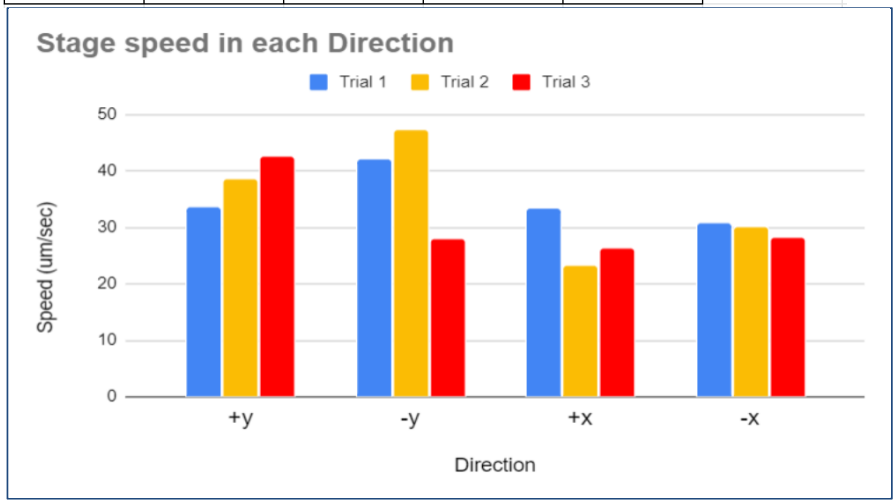
Goals: To test our prototype on collect testing data.

Content:

- Speed Determination Testing

	Seconds	Distance	Test Trial	Speed	Average
Shift Up	2.5	84.11	1	33.644	38.224
	2.5	96.34	2	38.536	
	2.5	106.23	3	42.492	
Shift Down	2.5	104.93	1	41.972	39.044
	2.5	118.22	2	47.288	
	2.5	69.68	3	27.872	
Shift Left	2.5	77.08	1	30.832	29.714
	2.5	75.223	2	30.0892	
	2.5	70.552	3	28.2208	
Shift Right	2.5	83.556	1	33.4224	27.66426667
	2.5	58.002	2	23.2008	
	2.5	65.924	3	26.3696	

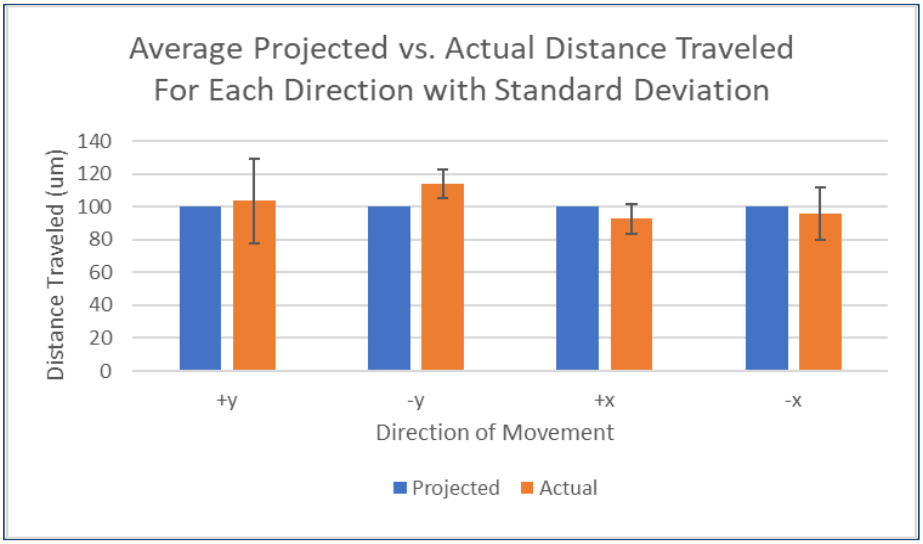
	+y	-y	+x	-x
Trial 1	33.644	41.972	33.4224	30.832
Trial 2	38.536	47.288	23.2008	30.0892
Trial 3	42.492	27.872	26.3696	28.2208



- Accuracy of Distance Traveled Testing

Accuracy Data

	Mean (µm)	Standard Deviation (µm)	Percent Error
+y	103.56	25.86	**3.56%**
-y	113.85	8.44	**13.85%**
+x	92.69	16.09	**7.31%**
-x	95.65	9.02	**4.35%**



Conclusions/action items: This information was used in the final poster and is a measure of how much the project has improved over the semester. Could be used as a reference point for future semesters.

Product Design Specifications 2/11/22

MARK NEMCEK - Feb 27, 2022, 7:48 PM CST

Title: Design Matrix

Date: 2/18/22

Content by: Mark Nemcek

Present: Mark, Corey, Nate, Sid

Goals: To create a PDS to assess and define the desires of our client and to get a better understanding of the problem at hand

Content:

- Link to PDS
  - https://docs.google.com/document/d/1WUYBZThDulTpILexVbO6AxSnzJBfvW1uXf0aZFAYtvE/edit?usp=sharing
- Also attached below
- This is the PDS as it currently stands, it will be updated as the semester goes on as needed.

Conclusions/action items: Use the PDS to create a design that fulfills the clients wishes.

MARK NEMCEK - Feb 27, 2022, 7:47 PM CST

Microscope Low-Cost Motorized Stage Product Design Specifications

February 11th 2022

Client: Dr. John Puccinelli
Advisor: Dr. Colleen Witzenburg

Team Members:
Mark Nemcek (Team Leader) mjnemcek@wisc.edu
Nate Burkard (Communicator) njburkard@wisc.edu
Corey Steinhauser (BWIG and BSAC) steinhauser2@wisc.edu
Siddharth Kulkarni (BPAC) sskulkarni4@wisc.edu

Function:

Inverted fluorescence microscopes are currently controlled using manual translational control knobs. These manual control knobs do not allow for automated imaging and automated stitching of images. Our goal is to design, program, and fabricate an attachment to motorize a stage to be used for inverted fluorescent microscopes to allow for automated imaging and automated stitching that can be integrated with the Nikon Elements imaging software. This attachment must cost less than $100 and the resolution of the stages' movement should be around 1 um.

Client Requirements:

- The movements of the stage should be able to be controlled by joystick or computer software.
- The program should be able to perform automated imaging and stitch images together.
- Team must create a motorized mechanism that moves and controls the stage.
- The movements of the stage should be within a resolution of 1-10 microns in x and y direction.

Download

Product_Design_Specifications_1_.pdf (198 kB)

Preliminary Presentation 2/25/22

MARK NEMCEK - Feb 27, 2022, 7:56 PM CST

Title: Preliminary Presentation

Date: 2/25/22

Content by: Mark Nemcek

Present: Mark, Corey, Nate, Sid

Goals: To create a presentation that illustrates what our project is about and how we plan to accomplish the goals of the client going forward this semester.

Content:

- Link to preliminary presentation
  - https://docs.google.com/presentation/d/1vGltg7l-LCW22SmuK9Eau0jlFPhFMfM9OG3u3ldstCo/edit?usp=sharing
- Also attached below

Conclusions/action items: Going forward the team will finish our preliminary report.

MARK NEMCEK - Feb 27, 2022, 7:56 PM CST

Download

301_Preliminary_Presentation.pptx (10.5 MB)

Preliminary Report 3/2/22

MARK NEMCEK - Mar 02, 2022, 9:20 AM CST

Title: Preliminary Report

Date: 3/2/22

Content by: Mark Nemcek

Present: Mark, Corey, Nate, Sid

Goals: To create a Preliminary report to explain what we have done thus far in the semester as well as where we are going in the future with the project

Content:

- Link to Preliminary report
  - https://docs.google.com/document/d/1AU9KyZVEVX-j8904NhHxAsY96HX4t3VLLblinAuKIuY/edit?usp=sharing
- Also attached below

Conclusions/action items: Start fabricating our designs and implementing our software with the microscope.

MARK NEMCEK - Mar 02, 2022, 9:21 AM CST

Download

Spring_2022_Preliminary_Report.pdf (1.07 MB)

Final Poster 5/1/22

MARK NEMCEK - May 01, 2022, 11:40 AM CDT

Title: Final Poster

Date: 5/1/22

Content by: Mark Nemcek

Present: Mark, Corey, Nate, Sid

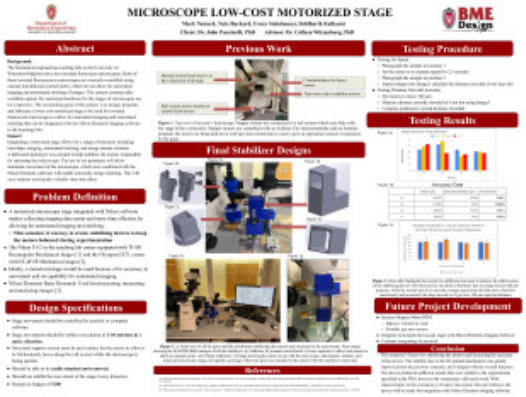
Goals: To create a poster that explains the overarching goal of the project and shows the progress and accomplishments the team has made this semester.

Content:

- Link to Final Poster
  - https://docs.google.com/presentation/d/1aYJC1Dxeu8OVx0uUXayHcsSxDSOGu93Z/edit?usp=sharing&ouid=115969766352188250979&rtpof=true&sd=true
- Also attached below

Conclusions/action items: Use this information in future semesters of the project.

MARK NEMCEK - May 01, 2022, 10:39 AM CDT



Download

Low-Cost_Motorized_Microscope_Stage_Poster.pptx_2_.pdf (1.97 MB)

Final Report 5/3/2021

Siddharth Kulkarni - May 03, 2022, 1:38 PM CDT

Title: Final Report

Date: 5/3/2022

Content by: Team

Present: Sid, Corey, Nate, Mark

Goals: The goal is to present our final report.

Content:

Conclusions/action items:

We must discuss if we want to continue this project next semester.

Siddharth Kulkarni - May 04, 2022, 11:35 AM CDT

Microscope Low-Cost Motorized Stage

Biomedical Engineering 301: Biomedical Engineering Design

Date: May 3rd, 2022

Client: Dr. John Puccinelli, PhD, Department of Biomedical Engineering, UW-Madison

Advisor: Dr. Colleen Witzenburg, PhD, Department of Biomedical Engineering, UW-Madison

Team Members: Mark Nemcek - Team Leader, Nate Burkard - Communicator, Corey Steinhauser - BWIG and BSAC, Siddharth Kulkarni - BPAG

Download

Spring_2022_Final_Report.pdf (3.46 MB)

2/6/22- Inverted Fluorescence Research

MARK NEMCEK - Feb 07, 2022, 12:04 AM CST

Title: Inverted Fluorescence Research

Date: 2/6/22

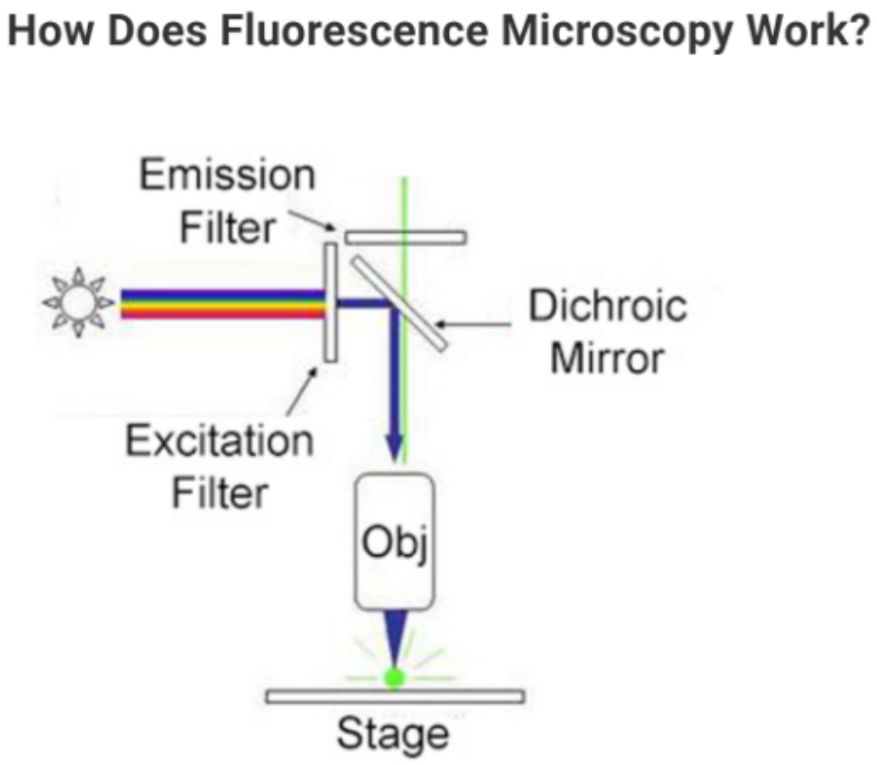
Content by: Mark Nemcek

Present: Mark Nemcek

Goals: To learn more about inverted fluorescence and how it is used.

Content:

- https://ibidi.com/content/212-inverted-and-upright-microscopy
  - Inverted microscopes are used because cells sink to the bottom and onto the coverslip for adherence
  - Ability to access sample from the top
  - No contact between the objective and sample, so increased sterility
  - Cells have access to larger amount of medium
- https://microscopeinternational.com/fluorescence-microscopy/
  - Fluorescence Microscopy uses a high-intensity light source to excite a fluorescent molecule in sample
  - Used to study samples that are complex and cannot be examined under a conventional microscope
  - Helps to identify cells and sub-microscopic cellular components



Conclusions/action items: Use this knowledge of inverted fluorescence to gain a better understanding of the project.

9/14/21 Patent Research

MARK NEMCEK - Sep 16, 2021, 9:31 AM CDT

Title: Patent Research

Date: 9/14/21

Content by: Mark Nemcek

Present:

Goals:

To document any findings about products on the market that are similar to the project which we are currently working on.

Content:

- Personal interface device for positioning of a microscope stage.
  - This patent is for an controller for positioning of the motorized stage.
  - The patent expired in 2014.
  - https://patents.google.com/patent/US5557456A/en?q=motorized+microscope+stage&oq=motorized+microscope+stage

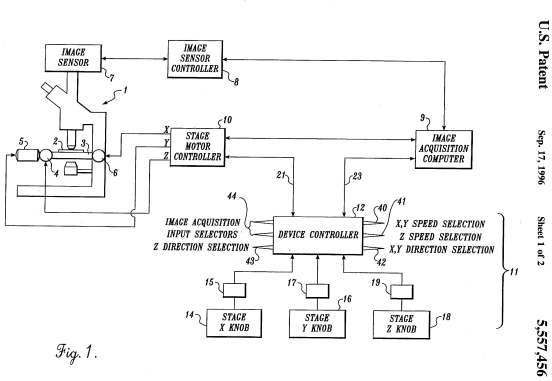
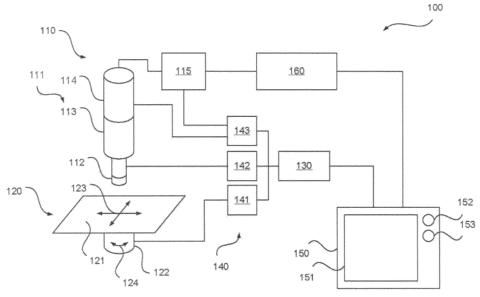


Fig. 1.

- Microscope Having a touch screen.
  - Patent relates to the microscope having a touch screen that is associated with a control device and an operating method.
  - The patent is currently active.
  - https://patents.google.com/patent/US9329375B2/en?q=motorized+microscope+stage&oq=motorized+microscope+stage



- Integrated, automated system for the study of cell and tissue function

- https://patents.google.com/patent/WO2010022391A2/en?q=motorized+microscope+stage&oq=motorized+microscope+stage
- Patent relates to the full automated framework for cell analysis and manipulation using various automated technology.

Conclusions/action items: Use the research found today as possible inspiration, while being cautious of possible patents as well as being too reliant on one single solution.

9/14/21 Products on Market Research

Title: Products on the Market Research

Date: 9/14/21

Content by: Mark Nemcek

Present:

Goals:

To document any findings about products on the market that are similar to the project which we are currently working on.

Content:

- https://www.prior.com/product-category/motorized-stages?gclid=Cj0KCQjw1ouKBhC5ARIsAHXNMI9_AsBqKR83FdP0QIOnJo6ztnDI9AJOTtT2zUPyA
  - Prior Scientific provides a wide arrange of motorized stages with various specifications and uses.
  - States the load bearing capabilities and the movement capabilities.
- https://www.zaber.com/products/scanning-microscope-stages?gclid=Cj0KCQjw1ouKBhC5ARIsAHXNMI8xM7fyPfPMtl4Z2PLk3b6S0vbxZQyjxwAC0S
  - Zaber also provides many different motorized stages.
  - States the resolution size, which could be useful.
  - States the software used in the stage.
- https://discover-echo.com/?utm_source=google&utm_medium=search&utm_campaign=11380688541&utm_term=motorized%20microscope%20stage&utm_content=505993872
  GGZ8iVymvGb_l_qPeDi7caAgf1EALw_wcB#headerAnchor
  - Echo provides extremely advances microscopes.
  - Offers a touchscreen.
  - Completely customizable, which is making it hard to find specifications.
- https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=5360
  - Thor labs provides a specs page which provides easy layout for finding the information we need.
  - Provides the motor type, which could be useful for our group.
- https://www.marzhauser.com/en/products/microscope-stages/motorized-microscope-stages.html
  - Offers good insight into the hardware that goes into the motorized stages on the site.

Conclusions/action items: Use the research found today as possible inspiration, while being cautious of possible patents as well as being too reliant on o

9/14/21 Similar Research Projects

MARK NEMCEK - Oct 14, 2021, 12:13 PM CDT

Title: Similar Research Projects

Date: 9/14/21

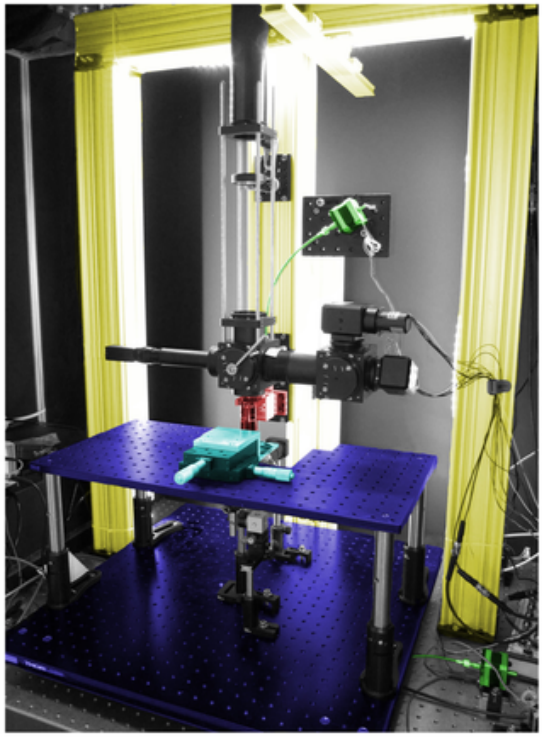
Content by: Mark Nemcek

Present:

Goals:

To document any findings about published research similar to the project which we are currently working on.

Content:

- https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0088977
  - Gives very good insight into the hardware used as well as the results and accuracy obtained by this research group.
  - 
- https://www-sciencedirect-com.ezproxy.library.wisc.edu/science/article/pii/S2468067219300495?via%3Dihub
  - Offers good detail of the hardware and motors.
  - Highlights the low cost of the motorized stage.
- https://www-sciencedirect-com.ezproxy.library.wisc.edu/science/article/pii/S0098300404000615
  - In depth details of how the stage moves and rotates.
  - Also provides great detail on the software used.
  - 
- https://www.sciencedirect.com/science/article/pii/S095656631631106X
  - If we wanted to go the route of 3D printing the stage this article would be extremely useful.
- https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.589.55&rep=rep1&type=pdf

- Another great research article. Provided is data to back up their claims as well as step by step process of the software.

Conclusions/action items: Use the research found today as possible inspiration, while being cautious of possible patents as well as being too reliant on one single solution.

2/6/22- Arduino Joystick Research

Title: Arduino Joystick Research

Date: 2/6/22

Content by: Mark Nemcek

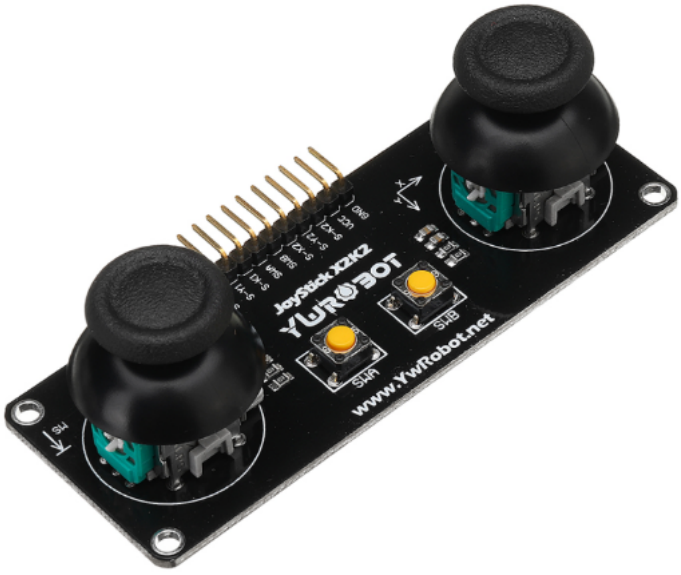
Present: Mark Nemcek

Goals: To research options for an improved alternative Arduino joystick to buy for the project.

Content:

- https://www.adafruit.com/product/3102?gclid=Cj0KCQiAgP6PBhDmARIsAPWMq6kQrjlBZjuSPqNBVxEcUL50ENIErMfZX8-yO1COAfLGIjBC9vGQjEQaAkmPEALw_wcB
  - 10 Kohm resistance value
  - Output smoothness: 0.5% mac
  - X and Y axis range: +/- 25 degrees

- https://alexnld.com/product/ywrobot-joystick-2-channel-ps2-game-rocker-push-button-module-for-arduino-electronic-blocking/?srsltid=AWLEVJyKmolkCiBaeiNrYQWFEuWxZLkJxHjsBH
  - Axis output is two potentiometers. Can read twist angle through AD conversion



- https://www.amazon.com/Acxico-Joystick-Switch-Momentary-Fixing/dp/B083XY33VD/ref=asc_df_B083XY33VD/?tag=hyprod-20&linkCode=df0&hvadid=416948024384&hvpos=&hvnetw=g&hvrand=12446061123998561444&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9018944&hvl

884343326294&psc=1&tag=&ref=&adgrpid=93604211413&hvpone=&hvptwo=&hvadid=416948024384&hvpos=&hvnetw=g&hvrand=12446061123998561444&hvqmt=&hvdev=c&hvdv
884343326294

Conclusions/action items: Use this research to buy a better Arduino Joystick than the one currently owned.

2/27/22- 3D Printing Process Research

MARK NEMCEK - Mar 05, 2022, 2:26 PM CST

Title: 3D Printing Process Research

Date: 2/27/22

Content by: Mark Nemcek

Present: Mark Nemcek

Goals: To research the process of 3D printing at UW Madison so I am prepared for when the team needs to do so.

Content:

- One thing the team will need to do in order to 3D print is pay the materials fee for this semester.
- There is a cost estimator tool on the makerspace website which could be useful.
  - https://making.engr.wisc.edu/3d-printers/
- Process of converting SolidWorks to a printable part as described by the makerspace website:
  - **[1] CAD** (Solidworks, OnShape, etc.) is where the user designs and edits 3D part geometry. At this stage it is good to consider how part will be fabricated by the 3D printer. **[2] STL.** Exporting CAD geometry as a stereolithography file (.STL) file type translates the CAD geometry into triangulated surfaces. At this stage some curved geometry can become noticeably faceted in the final part. **[3] Slicer**. The input of the slicer software is a STL file. The Slicer software allows the users to manipulate perimeters that how printer will print the part. Important parameters to consider are: part orientation, layer height, and infill. **[4] Machine Code.** The slicer creates instructions that the printer will follow; usually gCode. At this stage the user has no ability to effect the final part. **[5] Print time.** 3D printing often takes hours or days to complete. Making choices at the CAD stage and the slicer stage can reduce print times. Long print times gives the printer more opportunity to have an issue; reduce print times when possible. At this stage the user has no ability to effect the final part. **[6] Post Processing** After the part is removed from the printer most parts will require post processing; such as removing support material, or washing and curing.
  - https://making.engr.wisc.edu/3d-printing-the-makerspace/
- Materials guide will also be useful to know.

Conclusions/action items: Use this research to 3D print a part in the future

5/1/22- Micro-manager Research

MARK NEMCEK - May 03, 2022, 1:38 PM CDT

Title: Micro-manager Research

Date: 5/1/22

Content by: Mark Nemcek

Present: Mark Nemcek

Goals: To research micro-manager to better understand where the project could go in the future.

Content:

- Need a software to combine the movements of the stage with the imaging software used on the microscope.
- Micro-manager is an open-source software that can help automate the imaging.
- Works with all four major microscope manufacturers.
- Would allow for computer control of image acquisition.
- Link to micro-manager website: https://micro-manager.org/

Conclusions/action items: Use this research to better understand how the project could be better implemented in the future.

2/12/22- Motor Stabilizer Idea

MARK NEMCEK - Feb 12, 2022, 5:37 PM CST

Title: Motor Stabilizer Idea

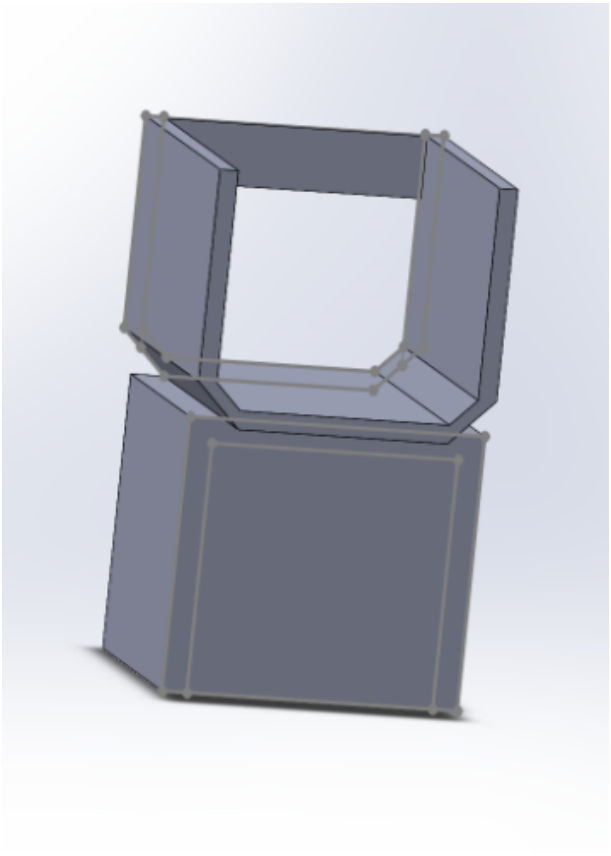
Date: 2/12/22

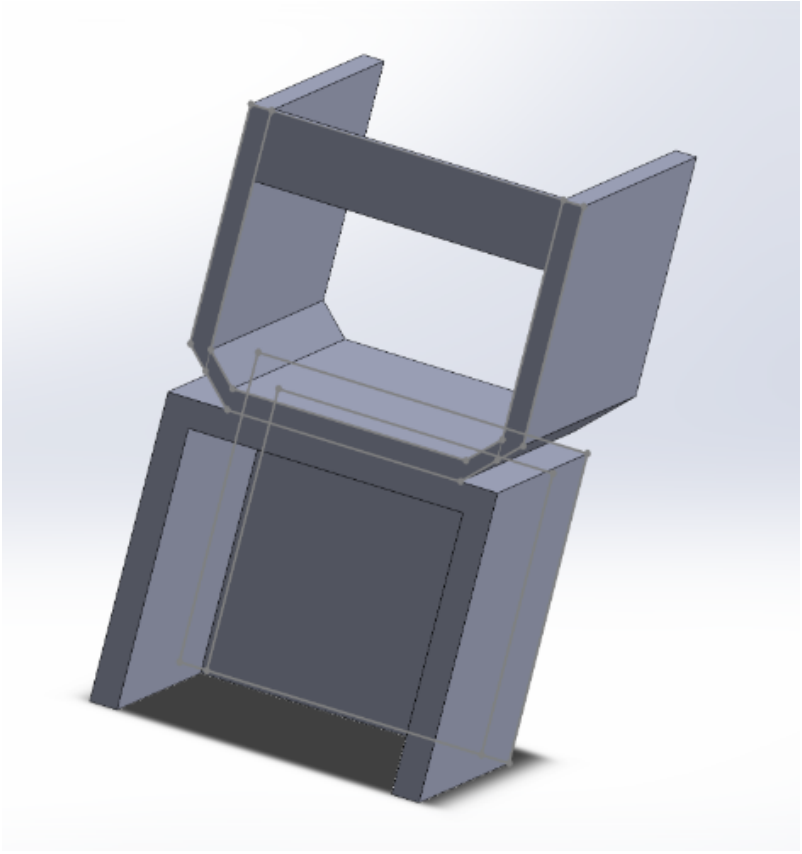
Content by: Mark Nemcek

Present: Mark Nemcek

Goals: To make my idea for a motor stabilizer in SolidWorks so it can be easily expressed.

Content:

- 



- Top part holds the microscope and the bottom slides onto the rail system.

Conclusions/action items: Use this SolidWorks Drawing in our design matrix and possibly incorporate into the project.

5/1/22 SolidWorks of Final Design

MARK NEMCEK - May 01, 2022, 1:37 PM CDT

Title: SolidWorks of Final Design

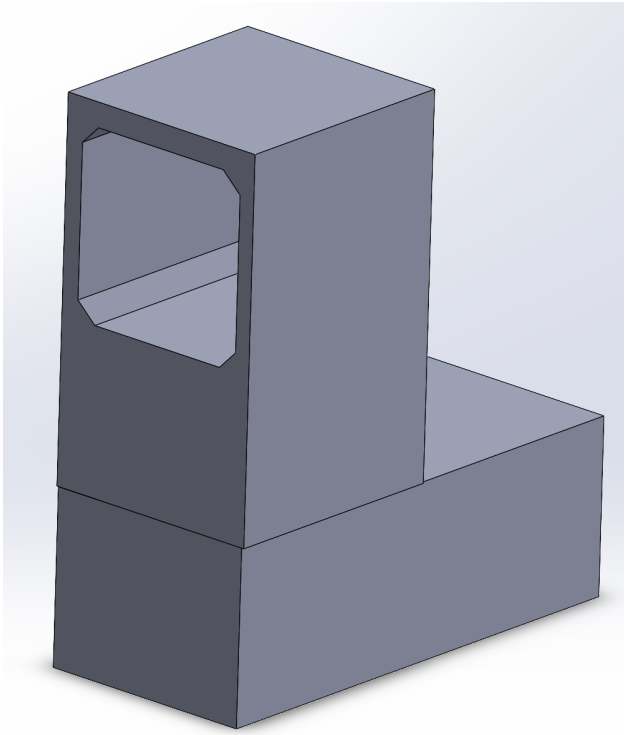
Date: 5/1/22

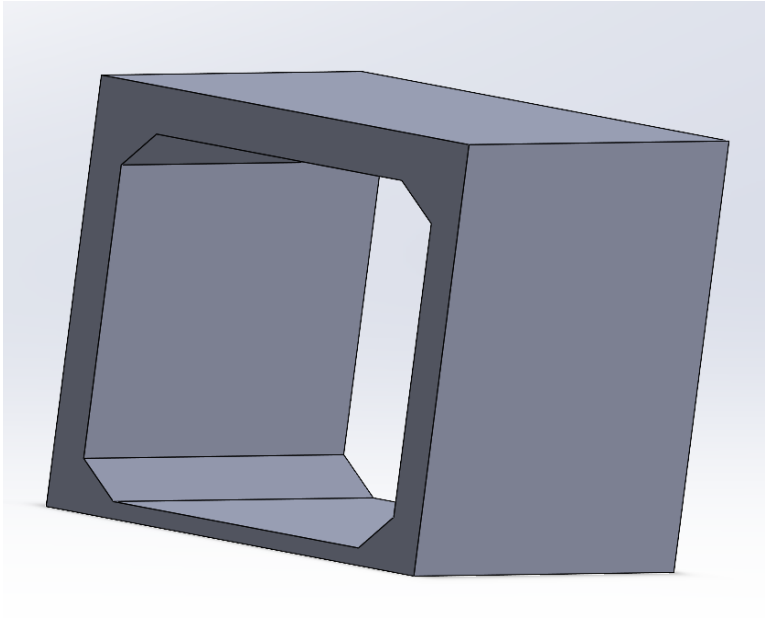
Content by: Mark Nemcek

Present: Mark, Corey

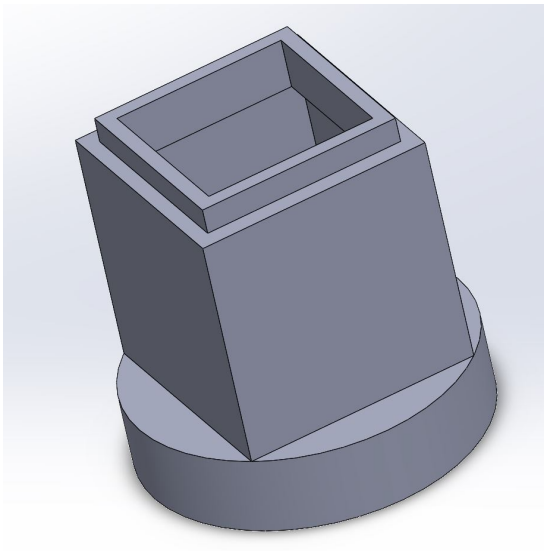
Goals: To create 3D-printable pieces for our design and then print them at the makerspace.

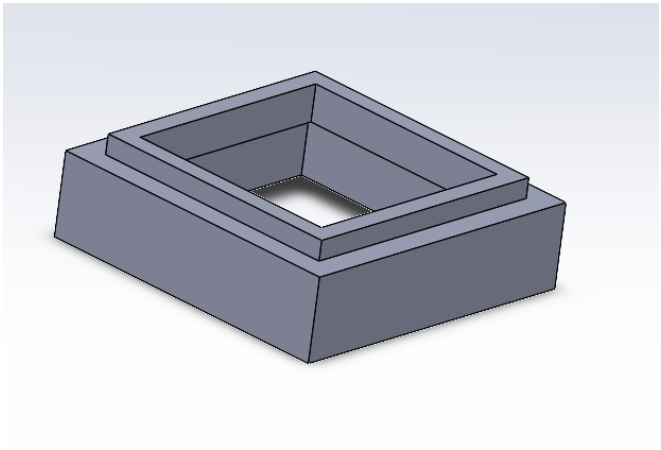
Content:

- Motor Stabilizers
  - 
  -



- Manual Control Knob Stabilizer





Conclusions/action items: This information was used to create our 3D printed pieces, it gives a good depiction of how the prototype was made and how it could be recreated in the future.

MARK NEMCEK - May 01, 2022, 11:48 AM CDT

Download

MotorHolderTopThin.SLDPRT (73.4 kB)

MARK NEMCEK - May 01, 2022, 11:48 AM CDT

Download

MotorHolderTopThick.SLDPRT (70.3 kB)

MARK NEMCEK - May 01, 2022, 11:48 AM CDT

Download

MotorHolderBottom.SLDPRT (74 kB)

MARK NEMCEK - May 01, 2022, 11:48 AM CDT

Download

KnobHolderFixed.SLDPRT (112 kB)

MARK NEMCEK - May 01, 2022, 11:50 AM CDT

Download

LowerGearExtension_1_.SLDPRT (89.1 kB)

MARK NEMCEK - May 01, 2022, 11:50 AM CDT

Download

GearHolderExtension.SLDPRT (117 kB)

2/6/22-Training Documentation

MARK NEMCEK - Feb 06, 2022, 11:28 PM CST

Title: Training Documentation

Date: 2/6/22

Content by: Mark Nemcek

Present: Mark Nemcek

Goals: To record all of my certifications and training documentations

Content:

This certifies that Mark Nemcek has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety 106: Autoclave Use	Biosafety 106: Autoclave Use: Safety and Efficacy - Verification Quiz	3/31/2021	
Biosafety Required Training	Biosafety Required Training Quiz	2/20/2021	
Chemical Safety: Cryogen Safety Training	Part 1 Final Quiz	3/31/2021	
Chemical Safety: Cryogen Safety Training	Part 2 Final Quiz	3/31/2021	
Chemical Safety: Fume Hood Safety Training	Fume Hood Final Quiz	2/20/2021	
Chemical Safety: The OSHA Lab Standard	Final Quiz	2/20/2021	
Disposing of Hazardous Chemicals	Final Quiz	3/31/2021	
Performing a Risk Assessment	Survey	3/1/2021	

Data Last Imported: 06/02/2022 09:50 PM

Conclusions/action items: Use these training documentations wherever possible in the project.

2/6/22-Permit Training Documentation

MARK NEMCEK - Feb 06, 2022, 11:31 PM CST

Title: Training Documentation

Date: 2/6/22

Content by: Mark Nemcek

Present: Mark Nemcek

Goals: To record all of my permit certifications and training documentations

Content:

You have the following permits and upgrades:

Name	Date
Red Permit	02/13/2020
Laser 1	02/20/2020

Conclusions/action items: Use these permit training documentations wherever possible in the project.

3/11/22- WARF Presentation

MARK NEMCEK - Mar 11, 2022, 3:09 PM CST

Title: Warf Presentation

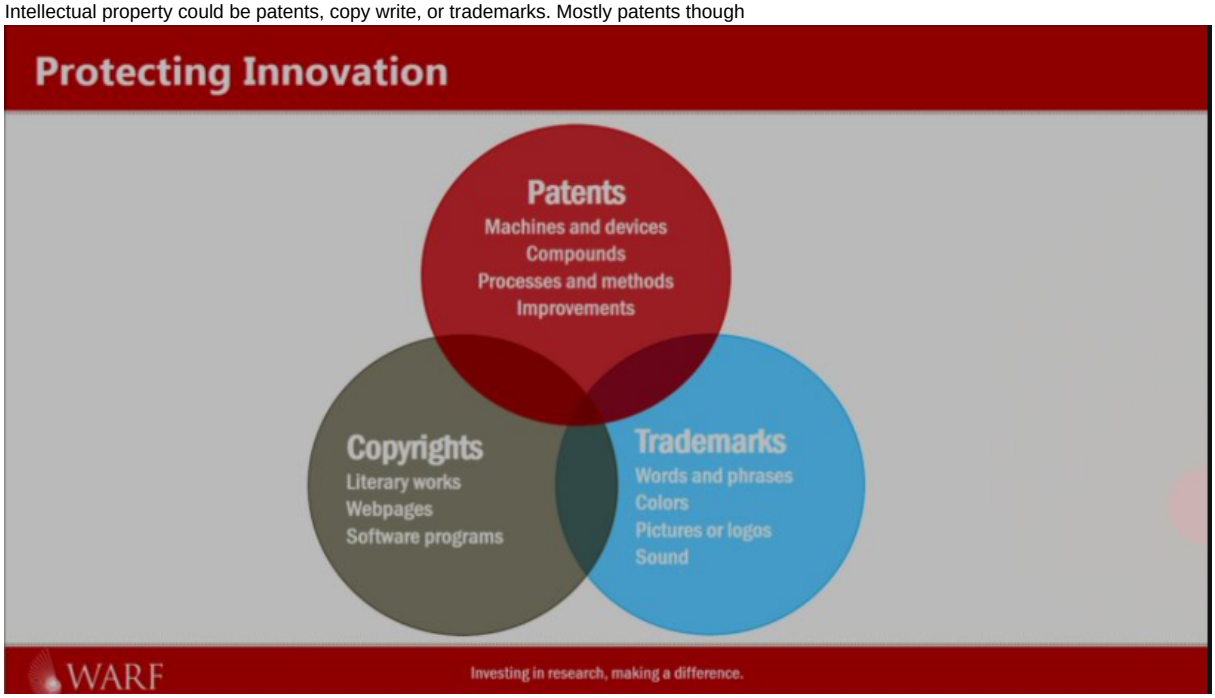
Date: 3/11/22

Content by: Mark Nemcek

Present: Mark Nemcek

Goals: To record a summary of the WARF presentation.

Content:

- General Notes
  - WARF is non-profit, and is separate from the university.
  - Intellectual property could be patents, copy write, or trademarks. Mostly patents though
  - 

- How does my project have intellectual property?
  - I think that our project could have intellectual property with both patents and copyrights. I think that the code we use to automate the movement of the stage could be copyrighted, and the hardware we design could for automating the microscope could be patented.

Conclusions/action items: Use my new knowledge of intellectual property if applicable on my project

2021/10/13 Nikon Ti-U Inverted Fluorescence Microscope

COREY STEINHAUSER - Oct 13, 2021, 10:34 AM CDT

Title: Nikon Ti-U Inverted Fluorescence Microscope

Date: 10/13/21

Content by: Corey

Present:

Goals: Understand the microscope that our device will attach to

Content:

The microscope is equipped with the TI-SR Rectangular Mechanical Stage. The stage knob is connected to the rack which is attached to the stage. The stage knob can control the movement of the stage in both the x and y directions. The knob does not move when changing the x-direction of the stage, but it does move with the stage when controlling the y-direction.

https://eliceirilab.org/sites/default/files/2016-09/Nikon%20Eclipse%20Ti-U%20Manual.pdf

Conclusions/action items:

Create a device that can control both the x and y directions using the stage knob already on the microscope. It must follow the movement of the knob in the y direction.

2021/10/19 Olympus IX71 Inverted Fluorescence Microscope

COREY STEINHAUSER - Oct 19, 2021, 9:29 PM CDT

Title: Olympus IX71 Inverted Fluorescence Microscope

Date: 10/19/21

Content by: Corey

Present:

Goals: Understand one of the microscopes in the BME teaching labs that will use our device

Content:

The Olympus IX71 inverted fluorescence microscope used the IX-MVR mechanical stage and can be controlled laterally in the x and y directions using the stage knob.

“Instructions IX71/IX51 - University College Cork.” [Online]. Available: https://www.ucc.ie/en/media/academic/anatomy/imagingcentre/icdocuments/OLYMPUSIX71_manual.pdf. [Accessed: 20-Oct-2021].

Conclusions/action items:

2021/10/19 Fluorescence Microscopy

COREY STEINHAUSER - Oct 20, 2021, 12:34 AM CDT

Title: Fluorescence Microscopy

Date: 10/19/21

Content by: Corey

Present:

Goals:

Content:

Fluorescence microscopy is important in biology. The microscope send light at cells with fluorescence and they emit some light back, making them able to be viewed and studied. Fluorescent labels can be placed on cells that are not naturally fluorescent. These labels can be either fluorescent proteins or antibodies. Fluorescence microscopy is useful because it allows a single or a few cells to be studied, which can be difficult to do with other methods.

K. Thorn, “A quick guide to light microscopy in cell biology,” *Molecular biology of the cell*, 15-Jan-2016. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4713126/. [Accessed: 20-Oct-2021].

Conclusions/action items:

2021/12/14 Stepper motor

COREY STEINHAUSER - Dec 14, 2021, 9:57 AM CST

Title: Stepper Motor

Date: 12/14/21

Content by: Corey

Present:

Goals: Understand stepper motors in order to use them in the design

Content:

Stepper motors work by receiving impulses. The frequency of these impulses determines the rate at which the motor will turn. There is a magnet in the shaft that responds to electricity going through the two coils, making them act as magnets. With the two coils turning on and off, it will spin the shaft. Because we have bipolar stepper motors, we must use drivers in order to reverse the polarity of the coils. Microstepping is the word used to describe how far the shaft should turn with each "step," or impulse received by the stepper motor. This allows for more accuracy with the stepper motor.

DroneBot Workshop, “Stepper motors with Arduino – Bipolar & Unipolar,” *DroneBot Workshop*, 28-Sep-2021. [Online]. Available: https://dronebotworkshop.com/stepper-motors-with-arduino/. [Accessed: 14-Dec-2021].

Conclusions/action items:

The arduino will need to be programmed to send impulses to the driver at a determined rate to keep the accuracy of the design in the required range. Also, the driver will need to be set to a reasonable microstepping setting to again ensure the accuracy.

2022/02/27 uManager

COREY STEINHAUSER - Mar 01, 2022, 5:15 PM CST

Title: uManager

Date: 2/27/22

Content by: Corey

Present:

Goals: Learn about the uManager software

Content:

uManager is a software used for microscope automation and control. uManager also boasts a large list of microscope-related devices that it can control along with the microscope. Arduino is on that list. uManager would allow the control of the microscope and Arduino in tandem. It is still unclear if uManager has the capability to take pictures automatically through Nikon Elements and stitch them together, making the entire process automated.

Micro-Manager. [Online]. Available: https://micro-manager.org/. [Accessed: 01-Mar-2022].

Conclusions/action items:

uManager could be the key to connecting the microscope, the Arduino, and the Nikon Elements. However, more research will need to be conducted as well as some tinkering around with uManager and Nikon Elements before we can be certain this is the solution.

2022/03/01 One Rail Design

COREY STEINHAUSER - Mar 01, 2022, 6:40 PM CST

Title: One Rail Design

Date: 3/1/22

Content by: Corey

Present:

Goals: Explain the first preliminary design

Content:

The bottom portion of the design would clamp onto a bearing on the linear rail. The top half of the design would hold tightly onto the stepper motors.

Conclusions/action items:

2022/03/01 Two Rail Design

COREY STEINHAUSER - Mar 01, 2022, 6:45 PM CST

Title: Two Rail Design

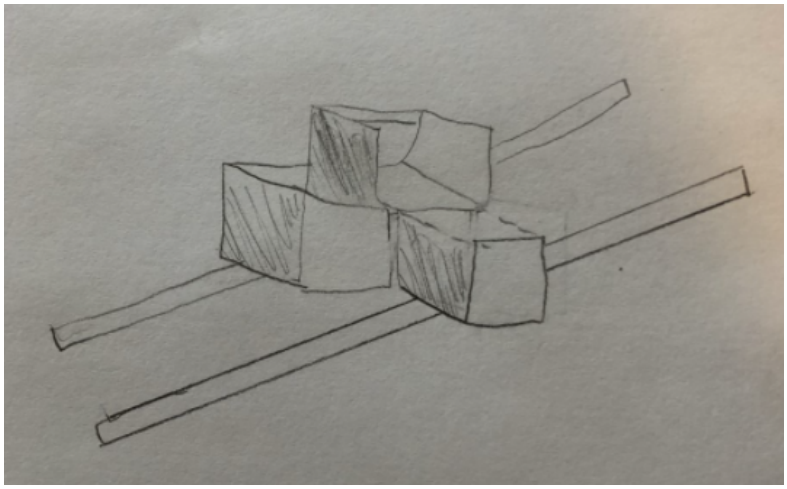
Date: 3/1/22

Content by: Corey

Present:

Goals: Explain the second preliminary design

Content:



This design has two lower portions, each would clamp onto a bearing on parallel rails. The top would house the motor, preventing it from tipping.

Conclusions/action items:

2022/03/01 Tarp Design

COREY STEINHAUSER - Mar 01, 2022, 6:35 PM CST

Title: Tarp Design

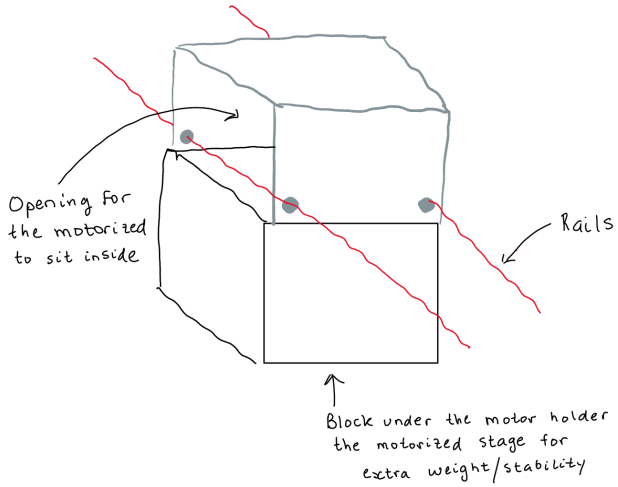
Date: 3/1/22

Content by: Corey

Present:

Goals: Explain the third preliminary design

Content:



The tarp design works be having a block underneath the motors to keep them stabilized. The rails would go through the tarp portion, which would also house the motors.

Conclusions/action items:

2022/05/03 Speed Testing Arduino Code

COREY STEINHAUSER - May 03, 2022, 1:34 PM CDT

Title: Speed Testing Arduino Code

Date: 5/3/22

Content by: Corey

Present:

Goals: Create a working code to test the speed of the microscope stage

Content:

```
// Define pins


int driverY_PUL = 7;    // PUL- pin
int driverY_DIR = 6;    // DIR- pin
int driverX_PUL = 5;    // PUL- pin
int driverX_DIR = 4;    // DIR- pin


void setup() {


  // Set all digital pins to output
  pinMode(driverY_PUL, OUTPUT);
  pinMode(driverY_DIR, OUTPUT);
  pinMode(driverX_PUL, OUTPUT);
  pinMode(driverX_DIR, OUTPUT);
}


void loop() {

  digitalWrite(driverY_DIR, HIGH); // Controls the direction on the motor being used


  // 2273 iterations at .0011 sec/iteration = 2.5 sec
  for (int i = 0; i < 2273; i++){
    digitalWrite(driverY_PUL, HIGH);
    delayMicroseconds(550);
    digitalWrite(driverY_PUL, LOW);
    delayMicroseconds(550);
  }
```

```
  delay(2000); // delay to take picture and see how far it traveled
}
```

Conclusions/action items:

2022/05/03 Distance Testing Arduino Code

COREY STEINHAUSER - May 03, 2022, 1:36 PM CDT

Title: Distance Testing Arduino Code

Date: 5/3/22

Content by: Corey

Present:

Goals: Have working code to test the accuracy of our device when given a specific distance to travel

Content:

```
// Speed in the up direction = 38.2 um/sec
// Speed in the down direction = 39.0 um/sec
// Speed in the right direction = 27.7 um/sec
// Speed in left direction = 29.7 um/sec




// Define pins
int driverX_PUL = 7;
int driverX_DIR = 6;
int driverY_PUL = 5;
int driverY_DIR = 4;


void setup() {


  // Set all digital pins to output
  pinMode(driverY_PUL, OUTPUT);
  pinMode(driverY_DIR, OUTPUT);
  pinMode(driverX_PUL, OUTPUT);
  pinMode(driverX_DIR, OUTPUT);

}


void loop() {


  // This loop is 100 um STAGE RIGHT
  digitalWrite(driverX_DIR, HIGH);
  for(int i = 0; i < 3282; i++) { // 100 (um) / 27.7 (um/sec) / 0.0011 (sec) = 3282 iterations
    digitalWrite(driverX_PUL, HIGH);
```

```
    delayMicroseconds(650);
    digitalWrite(driverX_PUL, LOW);
    delayMicroseconds(650);
   }



   // This loop is 100 um STAGE DOWN
   digitalWrite(driverY_DIR, LOW);
   for(int i = 0; i < 2331; i++) { // 100 (um) / 39.0 (um/sec) / 0.0011 (sec) = 2331 iterations
    digitalWrite(driverY_PUL, HIGH);
    delayMicroseconds(550);
    digitalWrite(driverY_PUL, LOW);
    delayMicroseconds(550);
   }



   // This loop is 100 um STAGE LEFT
   digitalWrite(driverX_DIR, LOW);
   for(int i = 0; i < 3061; i++) { // 100 (um) / 29.7 (um/sec) / 0.0011 (sec) = 3061 iterations
    digitalWrite(driverX_PUL, HIGH);
    delayMicroseconds(550);
    digitalWrite(driverX_PUL, LOW);
    delayMicroseconds(550);
   }



    // This loop is 100 um STAGE UP
   digitalWrite(driverY_DIR, HIGH); // 100 (um) / 38.2 (um/sec) / 0.0011 (sec) = 2380 iterations
   for(int i = 0; i < 2380; i++) {
    digitalWrite(driverY_PUL, HIGH);
    delayMicroseconds(550);
    digitalWrite(driverY_PUL, LOW);
    delayMicroseconds(550);
   }



   delay(1000);
}
```

Conclusions/action items:

2022/03/21 WARF Presentation

COREY STEINHAUSER - Mar 21, 2022, 10:12 AM CDT

Title: WARF Presentation

Date: 3/21/22

Content by: Corey

Present:

Goals:

Content:

WARFs mission is to support research and innovation

Cycle of innovation

- UW Research and Discovery
- IP Protection (mainly patents)
- Licensing and Startups
- Funding to Support Research and Discovery

3 types of intellectual properties:

- Patents
- Trademarks
- Copyrights

Patents:

- Machines and devices
- Compounds
- Processes
- Improvements

Prior Art

- Anything in the world prior to the new idea

Requirements for Patentability:

- Eligible
- Useful
- Enabled
- Described- C
- Novel
- Non-obvious

Factors to consider in starting a company:

- Technology
- Market
- Management
- Capital requirements

Start-up resources

- DP
- Entrepreneurons
- Innovation Roadmap Series
- UpStart Program for Minority and Women's Entrepreneurship
- Law and Business Entrepreneurship

Conclusions/action items:

I think our device is intellectual property and could be patented because it is a device/machine.

1/31/2021 - Fluorescent Microscopes Imaging

Siddharth Kulkarni - Jan 31, 2022, 2:22 PM CST

Title: Fluorescent Microscope Imaging Introduction

Date: 1/31/2021

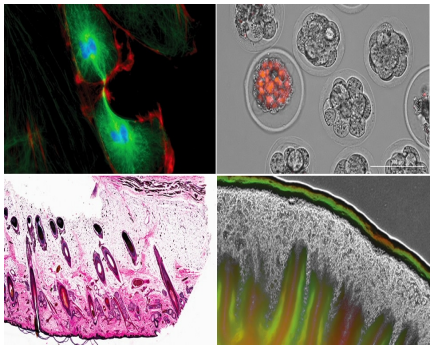
Content by: Siddharth Kulkarni

Present: Siddharth Kulkarni

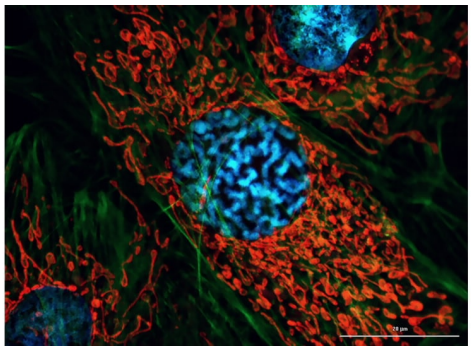
Goals: The goal is to understand basic fluorescent microscope imaging

Content:

- Several options support kinetic live cell assays including an environmental cover to maintain temperature and gas levels, dual reagent injector, and a unique humidity chamber. Flexible, fast, and stable assays produce increased lab efficiency
- Label-free cell counting is fast and easy with the available high contrast bright field option. Gen5 software automates cell counting and characterization of cell proliferation in kinetic studies, saving time in data analysis
- Four imaging modes with multiple imaging processes
    - With bright field, color bright field, phase contrast and fluorescence imaging in four channels, and nearly 20 available filter/LED cubes,
    - Imaging processes through z-stacking to z-projection, montage collection to stitching and digital phase contrast to analysis, all on one hardware and software platform



- Automated Digital Microscopy up to 100x
    - Lionheart FX with Augmented Microscopy automates your imaging workflow to yield amazing images and powerful data.
    - Automated image capture starts with image-based and laser autofocus, plus auto LED and exposure.
    - Automated image preprocessing optimizes images for downstream analysis, from cell counting to characterization of subcellular details



Source: “Real-Time, Live Cell Analysis, Agilent Cell Analysis | Agilent,” *www.agilent.com*. https://www.agilent.com/en/product/cell-analysis (accessed Jan. 31, 2022).

Conclusions/action items:

Automating the imaging process will allow imaging with a click of a button. Computer software and motors that control the stage can take images and stitch them together creating a large image of the entire sample, while still being able to zoom in on particular parts of the sample to see them in full focus. W

1/31/2021 - Components of Microscope

Siddharth Kulkarni - Jan 31, 2022, 2:40 PM CST

Title: Components of Microscope

Date: 1/31/2021

Content by: Siddharth Kulkarni

Present: Siddharth Kulkarni

Goals: The goal is to understand the different components of a microscope

Content:

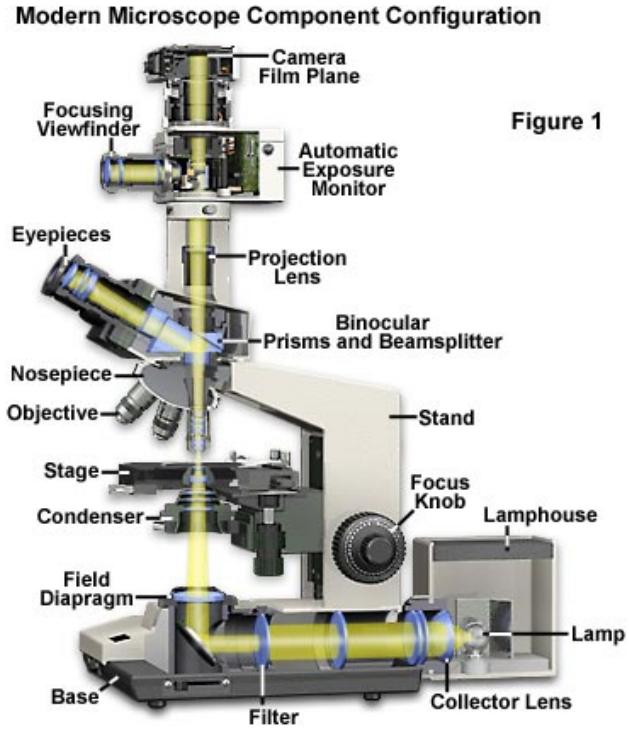


Figure 1

Source: "Microscope Optical Components - Introduction | Olympus LS," *www.olympus-lifescience.com*. https://www.olympus-lifescience.com/en/microscope-resource/primer/anatomy/components/#:~:text=The%20microscope%20optical%20train%20typically.

- Illumination is provided by a tungsten-halogen lamp positioned in the lamphouse, which emits light that first passes through a collector lens and then into an optical pathway in the microscope base.
- Also stationed in the microscope base is a series of filters that condition the light emitted by the incandescent lamp before it is reflected by a mirror and passed through the field diaphragm and into the substage condenser.
- The condenser forms a cone of illumination that bathes the specimen, located on the microscope stage, and subsequently enters the objective.

Conclusions/action items:

Modern compound microscopes have become quite developed in order for it to capture images in both 2D and 3D configurations. Our project is to make a stage that can help in the process of capturing more accurately stationed images.

2/27/2021 - NIKON Laser Elements

Siddharth Kulkarni - Feb 27, 2022, 6:49 PM CST

Title: NIKON Laser Elements

Date: 2/27/2021

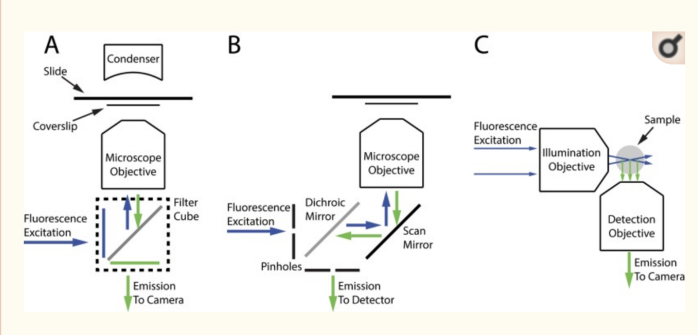
Content by: Siddharth Kulkarni

Present: Siddharth Kulkarni

Goals: The goal is to understand elements of the NIKON microscope

Content:

- Fluorescence microscopy is ideal for imaging samples in biology labs because it allows the imaging of targeted, single cells using a naturally fluorescent protein or antibody as a fluorescence tag
- The Nikon Ti-U comes equipped with TI-SR Rectangular Mechanical Stages and the Olympus IX71 comes with IX-MVR Mechanical stages
- Both stages can be controlled manually using the stage knobs in the x and y directions
- Ideally, a motorized stage would be used because of its accuracy in movement and its capability for automated imaging.
- Obtaining a motorized microscope stage can be very expensive



Source: K. Thorn, "A quick guide to light microscopy in cell biology," *Molecular Biology of the Cell*, vol. 27, no. 2, pp. 219–222, Jan. 2016, doi: 10.1091/mbc.e15-02-0088.

Conclusions/action items:

I need to conduct research on the software that will be used to stitch the different images taken by the microscope together. Additionally, refinement of the code from last semester must be made in order to make testing run smoothly.

2/27/2021 - Cheap 3D Printing Materials

Siddharth Kulkarni - Feb 27, 2022, 7:02 PM CST

Title: Cheap 3D Printing Materials

Date: 2/27/2021

Content by: Siddharth Kulkarni

Present: Siddharth Kulkarni

Goals: The goal is to research cheap materials to 3D print the final prototype with

Content:

- Metal 3D Printing
  - Direct metal laser sintering (DMLS) uses a fiber laser system that draws onto a surface of atomized metal powder, welding the powder into fully dense metal parts
- Stereolithography (SLA)
  - Stereolithography (SLA) uses an ultraviolet laser that draws on the surface of liquid thermoset resin to create thousands of thin layers until final parts are formed
- Selective Laser (SLA)
  - Selective laser sintering (SLS) uses a CO_2 laser that fuses nylon-based powder, layer by layer until final thermoplastic parts are built
- Carbon DLS
  - Carbon DLS uses digital light projection, oxygen permeable optics, and programmable liquid resins to produce plastic parts with excellent mechanical properties and surface finish
- PolyJet
  - PolyJet uses a jetting process where small droplets of liquid photopolymer are sprayed from multiple jets onto a build platform and cured in layers that form elastomeric parts
- Multi Jet Fusion (MJF)
  - Multi Jet Fusion selectively applies fusing and detailing agents across a bed of nylon powder, which are fused in thousands of layers by heating elements into a solid functional component

Source: “3D Printing Service | Instant 3D Printing Quote | Order 3D Prints,” *www.protolabs.com*. https://www.protolabs.com/services/3d-printing/?utm_campaign=us-3dp&utm_source=google&utm_medium=cpc&utm_term=3d%20printing&IDA_Search&gclid=Cj0KCQiA3-yQBhD3ARIsAHuHT64NKVX4A2B9Wkumy0k0tcXo6JkZNYjkzwEC1n-DFRXLvaiXTThpACEaAqZcEALw_wcB (accessed Feb. 28, 2022).

Conclusions/action items:

One of the main criteria of this project is the create a prototype that is cheap and low cost. This entry goes through different cheap materials and ways to print the final prototype at the Makerspace lab.

5/3/2022 - Micromanager and Stiching Images

Siddharth Kulkarni - May 03, 2022, 1:36 PM CDT

Title: Operation of Micromanager and Stitching images together

Date: 5/3/2022

Content by: Siddharth Kulkarni

Present: Siddharth Kulkarni

Goals: The goal is understand how to incorporate micromanager into our project

Content:

General components of micro manager

- Starting Micro-Manager will also start ImageJ
- Both ImageJ and Micro-Manager have their own menus
- Unless specified differently, menu commands in this manual will refer to the Micro-Manager menu.
- The Micro-Manager and ImageJ windows appear differently on different computer systems; examples from multiple systems are used in this manual.

Snapping Singles Images

- To obtain a single image from the camera, press the “Snap” button
- A display window will pop up with the acquired still image.
- At the bottom of the window there are shortcut buttons to save the image, enter live mode or send images to album.

Acquiring a series of images

- With the “Album” button, you can collect a series of still images (snaps) in an image series window.
- The first time you click the “Album” button, a new series window will open, with a fresh image obtained from the camera.
- Every time you click the “Album” button thereafter, a new image will be added to the series. \
- Click the “Save” button to write all images in the series window to disk.

Purpose of the Gamma Function

- The gamma function allows you to change the relation between pixel value in the image and display from linear to hyperbolic.
- This gamma correction makes it possible to visualize both bright and dark objects in an image simultaneously, which can be beneficial, especially with cameras that have higher dynamic range than the display

Source: “Micro-Manager,” *micro-manager.org*. https://micro-manager.org (accessed May 03, 2022).

Conclusions/action items:

I will need to talk with the rest of the group and decide if we want to continue this project and try to incorporate micromanager into the microscope

1/31/2021 - ZABER Motorized Stage

Siddharth Kulkarni - Jan 31, 2022, 2:22 PM CST

Title: Zaber Motorized Stage

Date: 1/31/2021

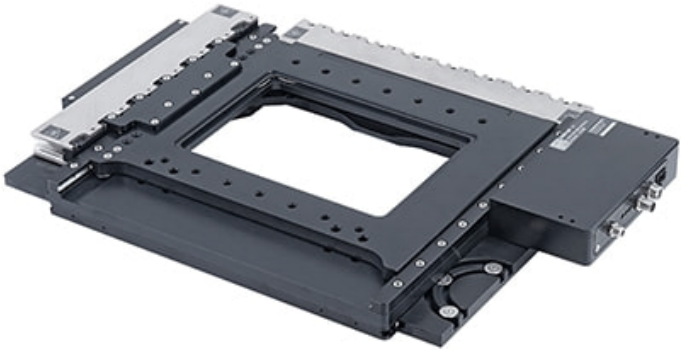
Content by: Siddharth Kulkarni

Present: Siddharth Kulkarni

Goals: Research competing products

Content:

- With the optional built-in controller, a motorized microscope stage can share a single power supply with up to 3 devices and daisy-chain data with up to 99 devices
- Optional motor encoders provide slip/stall detection and recovery; linear encoders add high accuracy, closed loop servo positioning
- 50 mm up to 305 mm travel per axis, up to 5 µm accuracy, 500 nm repeatability, 750 mm/s speed



Source: “Zaber Technologies,” *www.zaber.com*. https://www.zaber.com/products/scanning-microscope-stages?gclid=Cj0KCQiArt6PBhCoARIsAMF5waiCI7bbjqoRQyh7zCiR2WUwkynxQwERW5JZbDrmVlEdf11tzcix2BAaAk_4EALw_wcB (accessed Jan. 31, 2022).

Conclusions/action items:

A motorized microscope stage, also referred to as an XY stage, holds and accurately positions samples along the two horizontal axes while restricting vertical movement to ensure samples stay in focus as they are moved. Zaber offers a selection of standard and customized motorized microscope stage products. Although designed for scanning microscope applications, these stages can be used for many other automated XY positioning tasks. Products are available with optional built-in controllers and encoders.

2/27/2022 - 8MTF Motorized XY Scanning Stage

Siddharth Kulkarni - Feb 27, 2022, 6:37 PM CST

Title: 8MTF - Motorized XY Scanning Stage

Date: 2/27/2021

Content by: Siddharth Kulkarni

Present: Siddharth Kulkarni

Goals: The goal is to present another competing motorized stage design

Content:

Source: “Motorized XY Scanning Stage - Motorized Positioners & Controllers - Catalog - Opto-Mechanical Products - Standa,” *www.standa.lt*. https://www.standa.lt/products/catalog/motorised_positioners?item=311 (accessed Feb. 28, 2022).

- The Motorized scanning stages 8MTF are designed for applications where high accuracy and repeatability is required
- Microscopy is the most common application for such devices. All scanning stages require a motion controller to operate
- Travel Range 75x75 mm (3") or 102x102 mm (4")
- Accepts linear encoders
- USB or RS232 control
- Custom support brackets available for various microscope types
- Suitable for major brand microscopes and macroviewers
- Excellent for imaging analysis, precision scanning, multi axis system

Conclusions/action items: I must continue to do research into other competing designs as well as continue researching components/materials that need to be ordered before testing begins.

2/27/2022 - The Tarp Design

Siddharth Kulkarni - Feb 27, 2022, 4:30 PM CST

Title: The Tarp Design

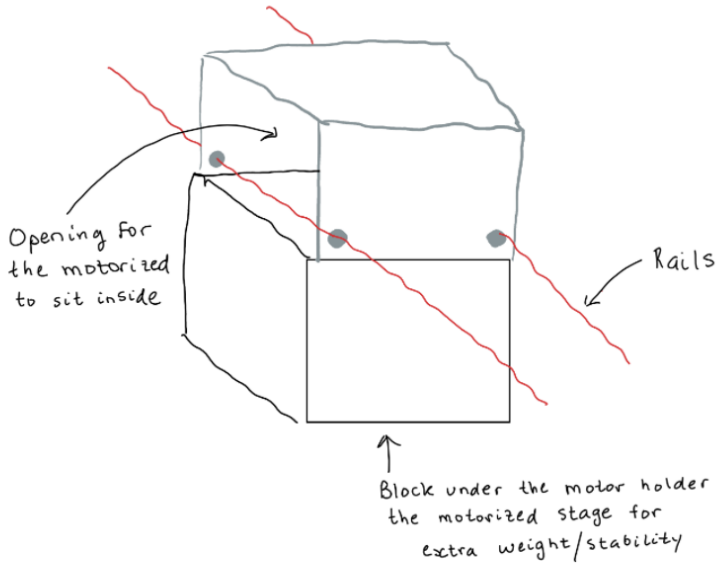
Date: 2/27/2022

Content by: Siddharth Kulkarni

Present: Siddharth Kulkarni

Goals: The goal is to present my design idea for the stabilizing device.

Content:



The third and final design is called the Tarp Design. This design is meant to implement some aspects of the one rails and two rail designs shown above. Similar to the one rail design, the Tarp design has a little nested opening that the motor can slide into and effortlessly move along the frictionless rails upon operation of the microscope. Unlike the one rail and two rail designs, however, the two rails in which the device will be operating on are meant to go through the “tarp” part of the device in order to add balance and prevent the possibility of tipping and falling of the motor upon movement on the rails. The support box located underneath the two rails is also meant to add to this stability in order to, first, prevent tipping of the device, and, second, prevent any bending of the material holding the motor up.

-

Conclusions/action items:

The group needs to analyze all the other design ideas that were created and decide upon a final prototype to fabricate for testing.

2/22/2021 - Biosafety, Chemical Safety, HIPPA training documentation

Siddharth Kulkarni - Feb 27, 2022, 6:22 PM CST

Title: Biosafety, Chemical Safety, and HIPPA training documentation

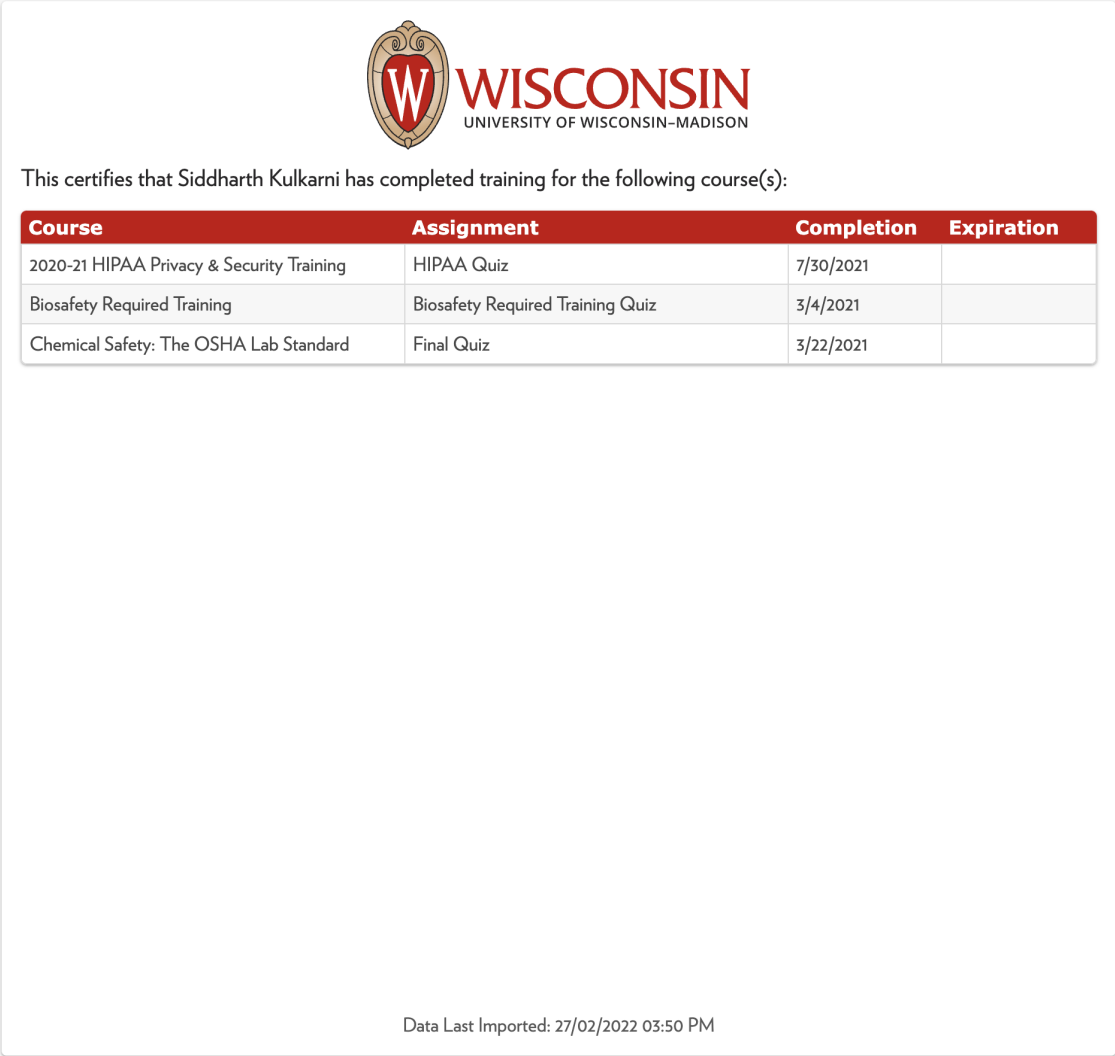
Date: 2/27/2021

Content by: Siddharth Kulkarni

Present: Siddharth Kulkarni

Goals: The goal is to present my biosafety, chemical safety, and HIPPA training documentation

Content:



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This certifies that Siddharth Kulkarni has completed training for the following course(s):

Course	Assignment	Completion	Expiration
2020-21 HIPAA Privacy & Security Training	HIPAA Quiz	7/30/2021	
Biosafety Required Training	Biosafety Required Training Quiz	3/4/2021	
Chemical Safety: The OSHA Lab Standard	Final Quiz	3/22/2021	

Data Last Imported: 27/02/2022 03:50 PM

Conclusions/action items:

I must continue with general research as well as other possible supplies needed before testing begins.

3/10/2021 - WARF Presentation

Siddharth Kulkarni - Mar 10, 2022, 11:15 AM CST

Title: WARF Presentation

Date: 3/10/2021

Content by: Siddharth Kulkarni

Present: Siddharth Kulkarni

Goals: The goal is take notes on the WARF lecture and think about intellectual property

Content:

- Prior Art
  - references created before a specific date
    - By the inventor > over 1 year before the filling date of the patent application
    - By another: before the filling date of the patent application
- Requirements for Patentability
  - Eligible, Useful, Enabled, Described, Novel, Non-obvious
- Licensing Considerations for New Disclosures
  - Chance of Licensing
  - Timeline for Licensing
  - Licensing Strategy
  - Plan for the next year
  - Revenue Projections
- Licensing Innovation
  - WARF provides exclusive or non-exclusive rights to make, use, sell, or import
  - Licensee Provides
    - Develop and commercialize
    - Reasonable Fees: Upfront, royalties, milestones, etc.
    - Fulfill obligations under Bahy-Dole
  - Timeline
    - Varies from moths to years
    - Depends on technology and market readiness
- Factors to consider in starting a company
  - Technology, Market, Management

Conclusions/action items:

I think our stabilizer device could have some intellectual property if a patent was filed, preventing any other outside companies/organizations from gaining rights to the design. I do not think that trademark, franchises, or trade secrets would apply as well to our project.

Microscope Overview

Nate Burkard - Mar 01, 2022, 11:40 PM CST

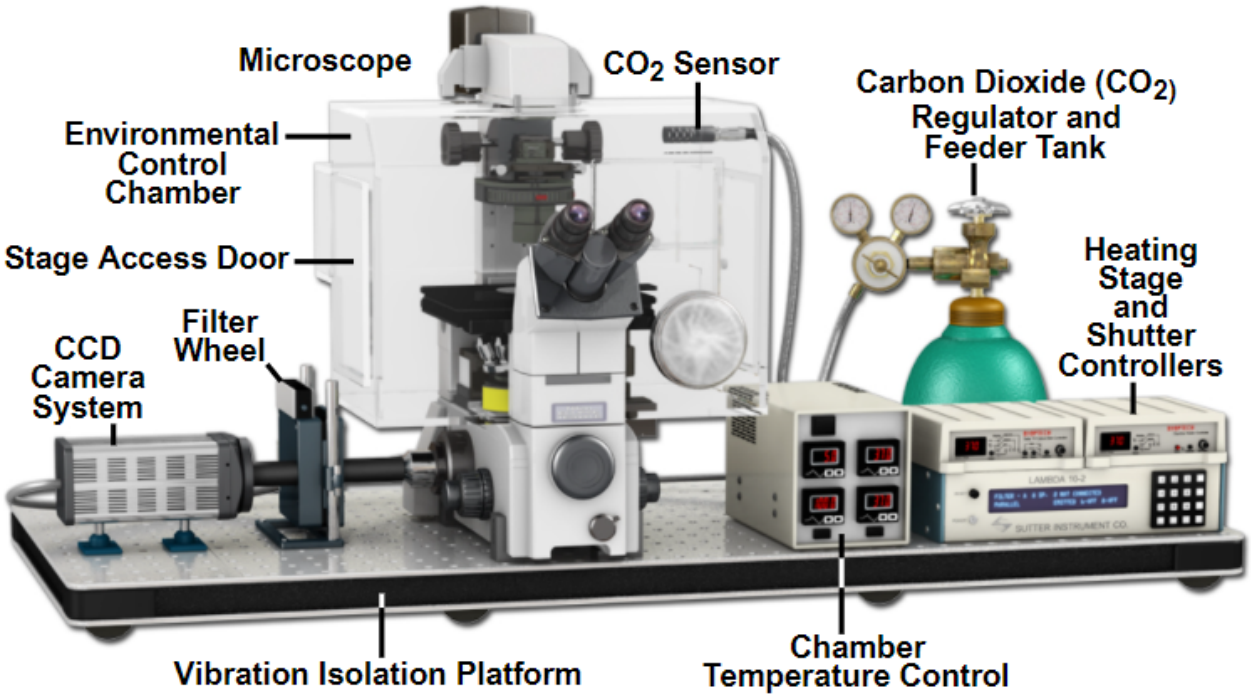
Title: The Automatic Microscope

Date: 1/30/22

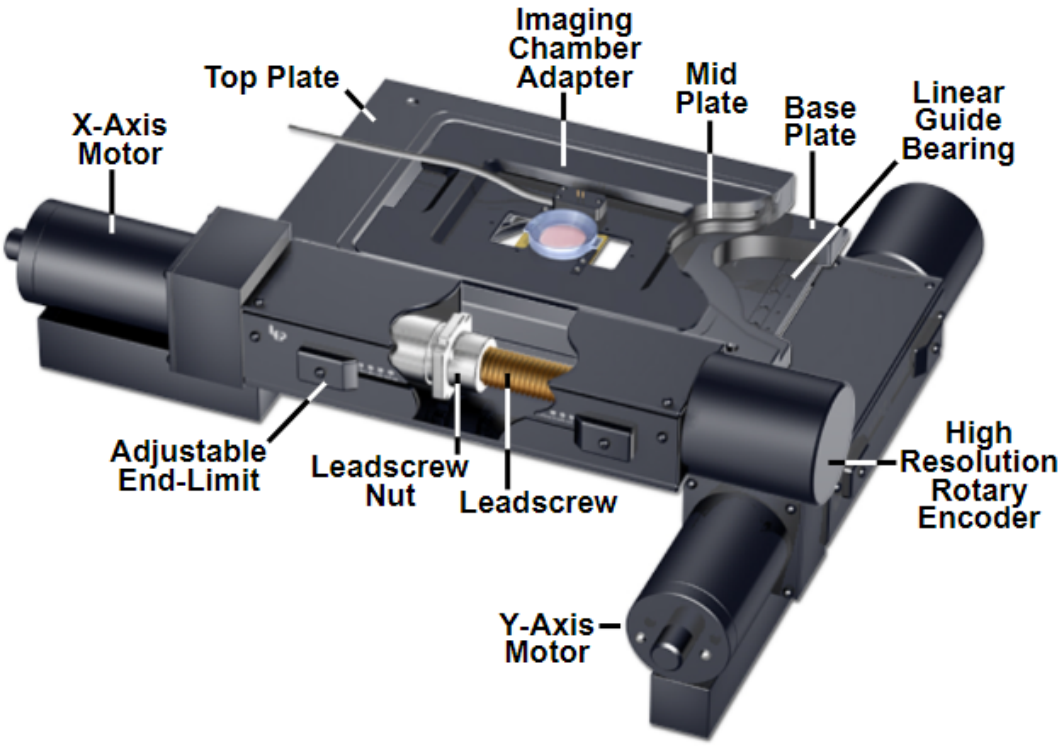
Content by: Nate Burkard

Goals: To learn about fluorescence imaging microscopy

Content:



Goes through the setup of a microscope capable of fluorescence imaging microscopy.



This stage is the set up of how their stage looked, and how it controlled the movement of the x and y axis, as well as where all the other parts of the stage.

Conclusions/action items:

This mostly goes through the different parts of the setup and all the parts that go into it. The only helpful part includes the stage that they use. Their stage would correspond to a replaceable stage for us, since the stage has built in motors for automatically moving it.

https://www.microscopyu.com/applications/live-cell-imaging/the-automatic-microscope

MIST: Microscopy Image Stitching Tool

Nate Burkard - Mar 01, 2022, 11:41 PM CST

Title: MIST: Microscopy Image Stitching Tool

Date: 2/22/22

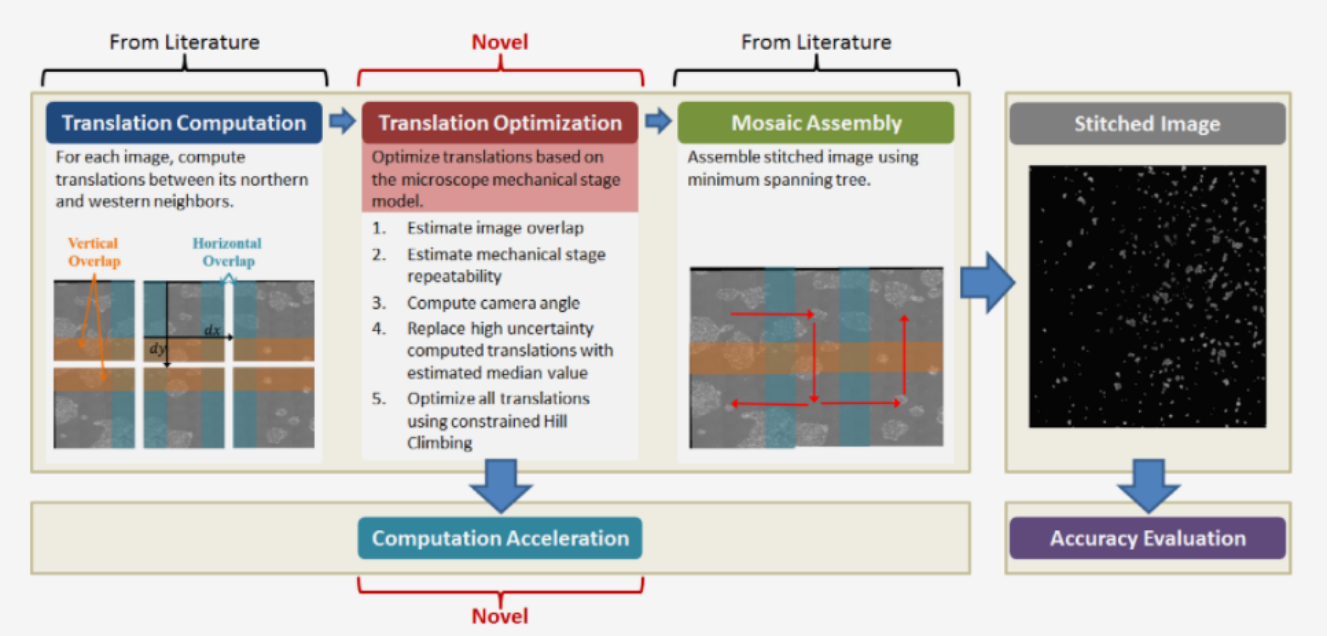
Content by: Nate Burkard

Goals: Learn about an image stitching program used.

Content:

Microscopy Image Stitching Tool (MIST), is a stitching tool for 2D grids of images. MIST estimates the stage mechanical model (actuator backlash, stage repeatability 'r', etc.) from computed pairwise translations and then minimizes stitching errors by optimizing the translations within a (4r)^2 square area. This minimizes the maximum uncertainty related to the translation computation for any pair of images.

With new microscope technologies, scientists are acquiring terabyte-sized datasets to cover large area of their experiments. An automated optical microscope acquires images of a cell cultures specimen. The microscope acquires a grid of partially overlapping images because the microscope field of view is much smaller than the dimensions of the specimen being imaged. This process generates hundreds of thousands of images that need to be stitched into a large mosaic to derive meaningful information. Some of these large mosaics are sparse, mainly at the beginning of an experiment before cells grow and cover more areas. This creates overlapping areas with no foreground pixel intensities to compute the translations between tiles, which increases the translation computation uncertainty for the entire mosaic. Moreover, stitching such large image mosaic is computationally taxing; this becomes overwhelming for live cell experiments.



Conclusions/action items:

This is an option for which stitching tool to integrate into our design.

ImageXpress Pico Automated Cell Imaging System

Title: ImageXpress Pico Automated Cell Imaging System

Date: 2/22/22

Content by: Nate Burkard

Goals: Find competing designs.

Content:

This machine does high powered imaging, and image analysis. Operates in colorimetric, bright field, fluorescence, or Digital Confocal 2D on-the-fly image
CellReporterXpress software. Easily generate heatmaps, scatter plots, and bar charts from analyzed image data in just a few clicks. This machine says it c

Conclusions/action items:

Costs way too much money, they advertise under $50,000. Not sure if there is image stitching to create one large image. Does way more than what we ne

https://www.moleculardevices.com/en/assets/promotion/dd/img/imagexpress-pico?cmp=7010g000000nNGE&utm_source=AdWords&utm_medium=cpc&ut
{adgroup}&utm_location=9018948&utm_keyword=automated%20imaging&utm_device=c&utm_devicemodel=&utm_placement=&utm_adpostion=&utm_tar
oO5QkcnaKSBEaDzNCylvh9PTYaAqcOEALw_wcB

Echo Bioco Company

Title: The Automated Microscope for Life Science Research

Date: 2/22/22

Content by: Nate Burkard

Goals: Research a competing design.

Content:

Build:

Microsoft Surface Studio
28" PixelSense TM Touch Display
4500 x 3000 (192 PPI) Resolution

Multi Dimensional Imaging:
Time Lapse, Multi-Point, Mosaic, Multi-Channel, Z-Stack

Motorized Epi-Fluorescence:
5 Channels - Mercury Free LED illumination with
50,000 hour lifespan

Objectives:
Olympus 1.25x-100x Plan Achromat, Fluorite, and Apochromat
Intelligent Nosepiece

Cameras:
Brightfield: 5MP CMOS Color (2048 x 1536 : 3.45um pixels)
Fluorescence: 5MP sCMOS Mono (2048 x 1536 : 3.45um pixels)

Cost: $69,950.

Live Cell Imaging:

View and capture live samples with automated time-lapse microscopy.

Stage Top Incubator:

Ensures optimal conditions for maintaining specimen viability.

Multi-Channel:

Capture and overlay multiple wavelengths in Fluorescence.

Multi-Point:

Set multiple aquisition points to view and revisit over time.

Image Stitching:

Capture and stitch to form large FOV high resolution images.

Z - Stack:

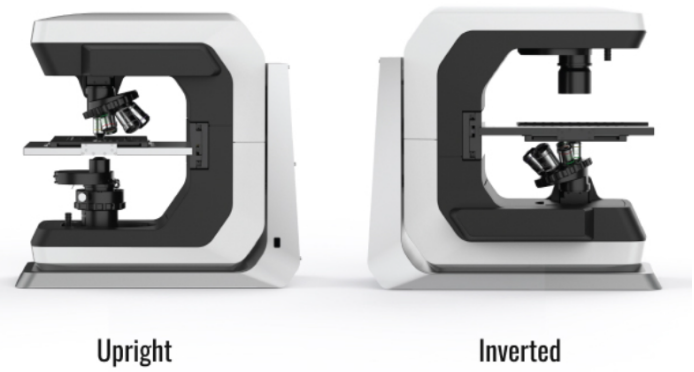
Acquire and stack images at multiple focal planes.

Auto Focus:

Automatically find and track best Z-plane(s) for focus.

Hyperscan:

High-speed image stitching.



Conclusions/action items:

It costs way too much, it is not feasible at all. Has a lot of the features we want, including the imaging, and image stitching.

https://discover-echo.com/revolution?utm_source=google&utm_medium=search&utm_campaign=11736234910&utm_term=image%20stitching%20microscope&utm_content=506118732912&g

Prior Scientific

Nate Burkard - Mar 01, 2022, 11:44 PM CST

Title: Prior Scientific

Date: 2/22/22

Content by: Nate Burkard

Goals: Research Another Competing Design

Content:

Prior Scientific produces a wide range of motorized stages, for use with a wide range of applications including live cell imaging. Prior stages offer Ultra high precision scanning and processing for multiple samples. They have several different kinds of stages that can be used while imaging.

One Example:

Image	Part Number	Travel (x)mm	Travel (y)mm	Drive	Applications	Encoders	Max Load kg
	HLD117	120	72	Linear Motor	Ultra high precision scanning and processing	Yes	6

Conclusions/action items:

The company Prior Scientific has plenty of replaceable stage designs for creating automatic motorized stages. This is an option for what to do with the microscopes here, we just need to add a software connected to it to automatically image and stitch images.

MicroManager

Nate Burkard - Feb 26, 2022, 1:19 PM CST

Title: MicroManager

Date: 2/26/22

Content by: Nate

Goals: Figure out what micromanager is about and if we can use it for our project.

Content:

Micromanager is an open source software that can be used for control and automation of the microscope.

Micromanager is compatible with Arduino

Micromanager was designed in order for interactive work to take place at the microscope as well as unattended completely automated processes.

It can integrate multiple programs to help assist with the microscope.

Conclusions/action items:

We may be able to use Micromanager to switch back and forth between Arduino and Nikon Elements to move the stage with Arduino, and then take a picture with Nikon Elements and stitch it.

The Two-Rail System

Nate Burkard - Mar 01, 2022, 11:38 PM CST

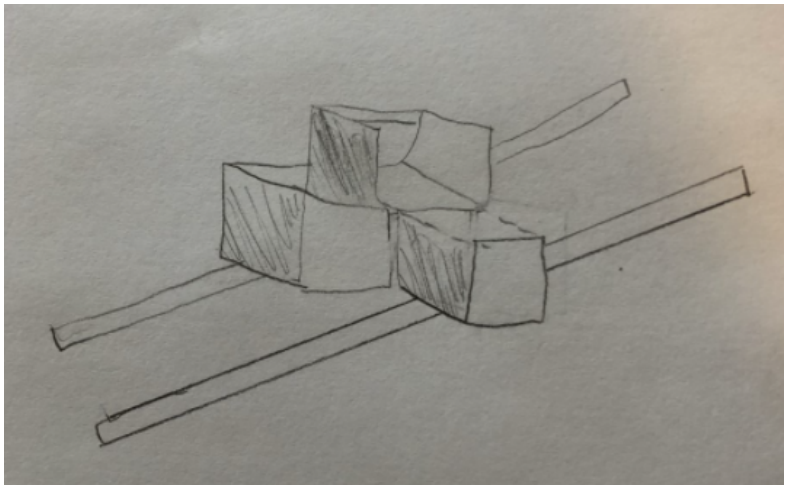
Title: Two-Rail System Design

Date: 2/28/22

Content by: Nate Burkard

Goals: Brainstorm a second design to stabilize the motors.

Content:



The Two-Rail Design consists of two linear rails that contain bearings on each of them. A 3D printed part will clamp around one bearing on either rail. Between the bearing clamps will be a motor casing that connects the two clamps on top, that is designed to hold the motor in place, while being stabilized and shifted by the two rails.

Conclusions/action items:

This design provides increased stability, as it includes two rails that can stabilize the motors. However, it is a little bulkier which can be harder to attach and detach, as well as add to the cost.

3/10/22 WARF Presentation

Nate Burkard - Mar 11, 2022, 6:57 AM CST

Title: WARF Presentation

Date: 3/10/22

Content by: Nate Burkard

Goals: Think about if our design might have intellectual property.

Content:

To protect innovation:

- Patents
  - Machines and devices
  - Compounds
  - Processes and Methods
  - Improvements
- Copyrights
  - Literary works
  - Webpages
  - Software Programs
- Trademarks
  - Words and phrases
  - Colors
  - Pictures or logos
  - Sound

Prior Art: References created before a specific date

- By the inventor: >1 year before the filing date of the patent application
- By another: before the filling date of the patent application

Requirements for Patentability:

- Eligible
- Useful
- Enabled
- Described
- Novel
- Non-obvious

Conclusions/action items:

For our project, a patent is the best way to protect our invention, as creating an automated microscope stage with an automatic imaging and stitching falls under machines and devices.

2014/11/03-Entry guidelines

John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity, subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

Title: Descriptive title (i.e. Client Meeting)

Date: 9/5/2016

Content by: The one person who wrote the content

Present: Names of those present if more than just you (not necessary for individual work)

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Contains clear and organized notes (also includes any references used)

Conclusions/action items:

Recap only the most significant findings and/or action items resulting from the entry.

2014/11/03-Template

Nate Burkard - Mar 11, 2022, 6:42 AM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items:

PDF of Notebook

MARK NEMCEK - Jan 28, 2022, 1:18 PM CST

BME Design-Fall 2021 - MARK NEMCEK
Complete Notebook

PDF Version generated by
Nate Burkard
on
Dec 16, 2021 @ 12:41 PM CST

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