BME Design-Fall 2024 - LIA LEJONVARN
Complete Notebook

PDF Version generated by

Xavier Snider

on

Dec 13, 2024 @10:52 PM CST

Table of Contents

Team contact Information

LIA LEJONVARN - Sep 09, 2024, 3:14 PM CDT

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Project description

LIA LEJONVARN - Sep 20, 2024, 11:02 AM CDT

Course Number:

BME 200/300

Project Name:

Microscope Slide Scanner

Short Name:

Scan-a-Slide

Project description/problem statement:

The team has been tasked with finding a more efficient way to scan microscope slides using digital scanning. The client's department already has a scanner, but it can only capture small portions of the slides, and the images are of poor quality. Therefore, we must find a way to enhance the user quality of their digital scanner as well as the images themselves. The department has also asked our team to create software capable of housing the images. This project will hopefully be used for the primate lab and SMPH.

About the client:

Teri Stewart works as a Cytotechnologist in the Wisconsin State Laboratory of Hygiene

2024/09/13 - First Client Meeting

AMANDA KOTHE - Sep 13, 2024, 1:02 PM CDT

Title: First Client Meeting

Date: 9/13/24

Content by: Amanda and Lia

Present: All

Goals: Learn more about the project and what the client wants us to accomplish.

Content:

Questions

- What is the budget
- What are the materials being provided for us
- Describe your current system and what changes you want to make
- What type of environments will the device be used and how often
- What are the requirements in terms of storing the scans
    - How many images will need to be stored? Do they need to be sorted at all?
- What are the requirements for the performance of the scanner
- What are the new scanners and programs that they already looked into and didn't work?

Notes

- Lika CS2 (current scanner)
    - Takes 15/20 minutes to take pictures of a plane
    - Can only get 10 slides a day
- Need better virtual slides for students to work virtually
- 9 MegaPixel or better camera
- 1 circle of cells is 400 images
- SVS Files can't be used easily (can't even be downloaded)
- Want to have a digital file like a JPEG
- Photoshop might work with digital stitching
- UW hospital has a handheld device?
- If wanting to use the scanner instead of stitching images together, we should come in and have a cytotec show us the scanning process
- Picks a focal point and finds the best Z adjustment for each focal point (why it takes so long to get an image)
- 2 options: update the old scanner or find a way to stitch images from a microscope
- Companies to look at:
    - Morphle, Hamamatsu, leica

- HOLOGIC makes scanner that they can’t access
- Some parts of more 3D objects can be out of focus
- Trying to make an arm to go back and forth on microscope to scan it
- Images aren’t as bright on old scanner
- Used by pathology residents
- They have the old scanner they can maybe provide us
- They have plenty of resources in terms of microscopes and stuff
- It will be widely used across campus for research
- Digital imaging pathology
- Stuck stitching photos together and becoming a big problem
- Need these images to diagnose cancer so they have to be more clear
- They can probably buy software and equipment under 5 grand
- It chooses a bunch of focal points which can miss some cells, but the HOLOGIC device is better at finding where it needs to focus
- Specimens come in fluid, goes into centrifuge, then onto slide
- CS2 scanner was originally designed for scanning tissue which is one dimension but they’re using it to scan 3D groups of cells
- The nucleus is very important for determining if cells are cancerous
- They can buy a server for us if needed
- If you capture everything a tech sees you can capture a pretty good picture of the slide
- Increase the speed to a couple of minutes or so
- HOLOGIC uses AI driven software that selects images to focus on based on whether they might be benign or not
- Capital - Morphle, Hammamatsu, Leica
- Send student number and the numbers on the back for building access
- Available 8-5 to show us the scanner and slides in person

Conclusions/action items:

After meeting with the client, it is clear more research needs to be done into the microscope slide scanners. There are 2 possible directions we can go: improving the old scanner, or using a microscope with a better camera and finding a way to stitch images together. More research should be done on both of these possible ways. We also need to set up an in person meeting with our client to see the current scanner and how it works, as well as seeing the slides.

2024/09/16 - Lab Tour

LIA LEJONVARN - Sep 20, 2024, 11:34 AM CDT

Title: Lab Tour

Date: 9/16/24

Content by: Lia

Present: Lia, Amanda, Xavier

Goals: See the scanning process and learn more about what the scanner is used for

Content:

We had the opportunity to tour the lab where our client works and look at the equipment they use. We saw a lot of slides through the microscope and noticed the quality was clearer than what you see on a slide that's been scanned by their CS2 machine. In the scanned photos, you could also see the blurriness around cell cluster edges that she mentioned. She offered to give us their old CS1 machine that they don't use in case we wanted to take the approach of trying to modify their scanner. She will also give us access to the site where they have all of their scans uploaded as well as access to the lab itself which will be very helpful if we ever need to see the scanner or microscope again. From this meeting it looks like there are four routes we can take.

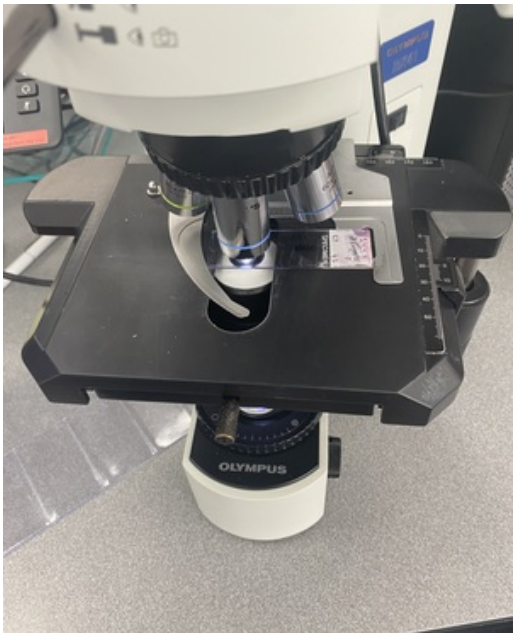
1. We can try and use their old machine to come up with a way to improve their current one
2. We can look into a way to more conveniently stitch the slide pictures together
3. We can follow HOLOGIC's example and try to incorporate the use of AI to better determine what z axis points give the pictures the most clarity
4. We can take a mechanical approach and set up a camera on the microscope with a way to mechanically push the slides through to take pictures since the camera attachment does have a lot of clarity

I took photos of their current equipment including the scanner and their microscope which can be seen below.

Conclusions/action items:

Right now, we just have to continue to work on our PDS and do some research into the mechanisms behind the CS2 scanner and the HOLOGIC scanner. Our client will also send us a HIPPA training that we should complete. We will also send her our wiscard info to get access to the building and find a time to pick up the CS1 scanner. We should also talk with our advisor about where we think the client wants to go and what he thinks is a viable path.

LIA LEJONVARN - Sep 20, 2024, 11:31 AM CDT



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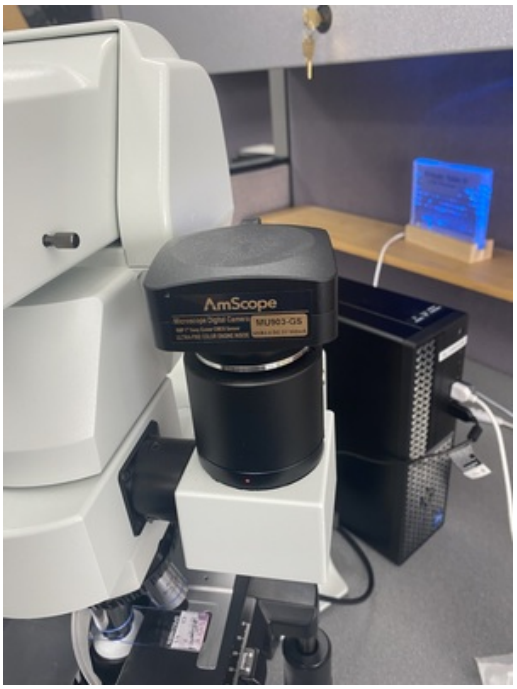
LIA LEJONVARN - Sep 20, 2024, 11:31 AM CDT



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LIA LEJONVARN - Sep 20, 2024, 11:31 AM CDT

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LIA LEJONVARN - Sep 20, 2024, 11:32 AM CDT

LIA LEJONVARN - Sep 20, 2024, 11:32 AM CDT

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IMG_6407.jpg (2.53 MB)

LIA LEJONVARN - Sep 20, 2024, 11:32 AM CDT

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IMG_6406.jpg (2.28 MB)

10/23 Receiving Old Scanner

AMANDA KOTHE - Oct 25, 2024, 12:08 PM CDT

Title: Receiving Old Scanner

Date: 10/23

Content by: Amanda

Present: Amanda, Hamad, Lia

Goals: Receive old scanner from client

Content: This meeting was very brief and was only with Josh (not primary client), however we were able to properly receive the old scanner from the client and move it to ECB so we will be able to investigate the mechanics of the machine.

Conclusions/action items: We will need to have a team meeting to properly investigate the mechanics of the old scanner.

2024/09/13 - Advisor meeting notes

Xavier Snider - Sep 15, 2024, 2:50 PM CDT

Title: First Advisor Meeting

Date: 09/13/24

Content by: Xavier Snider

Present: Lia, Amanda, Hamad, Xavier

Goals: meet advisor and introduce ourselves, understand expectations and resources we'd have, plan for how we will move ahead with the project.

Content: We explained what we knew about our project to our advisor. He gave us advice on how to better understand our project and schedule another meeting. He shared his background and experience with slide scanners and was open to our questions on flattening images and understanding more about scanners in general

Conclusions/action items: we have to schedule another meeting with our client to better understand our project. We have another meeting with our advisor next week to understand expectations and notebook requirements .

2024/09/20 - Design Ideas

LIA LEJONVARN - Sep 27, 2024, 1:20 PM CDT

Title: Design Ideas

Date: 9/20/2024

Content by: Lia

Present: All

Goals: Try to figure out what our client wants from us and what approach we should take to get there.

Content:

Second Advisor Meeting:

Our advisor met with our client and it sounds like they are fine with whatever can improve their current system. We could . . .

- Make something about their scanning process better, but there isn't really a good approach to this
- They do a lot of education so they have pics at different z depths and there might be a way to combine and "flatten" those
- Might be a way to create similar images as HOLOGIC and stitch together images of a different focal length that can be used for educational purposes (software problem)
- There might be a way to speed up their current process with more of a mechanical approach

Software project approach

- How do you take a stack of Z images and turn them into an image that has an expandable focal plan
- How do we take their data and get it into a format that's more useful
- Might have to use ImageJ

What he thinks they're trying to achieve

- They have a way to take pics at multiple Z depths but not a way to combine them which is where we could improve their system
- Deconvolution would help this process
- There is a deconvolution program built into imageJ
- Get images and run them through a deconvolution algorithm through ImageJ
- It would be a slow process but at least the quality would be improved

Conclusions/action items:

From this information, it seems like the most feasible option is to take a software approach. As a team, our next course of action is to use the ideas our advisor gave us to figure out design ideas and fill out our design matrix. From what he said, it seems like deconvolution is a good approach which would involve the use of ImageJ. We could also try and figure out a more mechanical idea as well just to see what we could come up with.

2024/09/27 - Design Matrix

LIA LEJONVARN - Sep 28, 2024, 3:40 PM CDT

Title: Design Matrix Meeting

Date: 9/27/2024

Content by: Lia

Present: All

Goals: Discuss Design Matrix

Content:

- If our client doesn't like the direction we're going in, then we don't have to change our whole presentation.

- The optics are often what's limiting the image quality of the microscope not necessarily the microscope itself.

- Adding a motorized stage to the microscope won't necessarily solve the problem

- Right our design matrix is laid out where each design solves a different problem since our client gave us such a wide range of problems for us to focus on. Therefore, our next course of action is to talk to our client about our winning design but also check in that the problem it's solving is the most pressing one for them.

- As we make our presentation, if we come across information that we don't know yet, then we should create a list of basically questions or things we need from our client to complete our preliminary presentation. This can then guide our project more accurately as it will help us get a better idea of what we need from our client.

- If we wanted to add pictures to our design matrix, we could create almost a flow chart for the algorithm-based designs to show how we would go about implemented them. For the mechanical solution, we can draw up a rough sketch of what it might look like when fitted to their current microscope. However, since this is not our winning design it should not be our main priority.

Microscope Lesson:

- The objective lens should be the limitation for the system and the focal plane should be relatively small

- Objective lenses are rated for the field of view (larger focal plane) but could be tradeoffs with magnification and the z depth

- Lense factors: z depth, magnification, focal plane

- If their limitation is the z depth than the problem has to do with the objective lens

- lower resolution image with larger focal depth on their slide scanner might solve their problem

- Is their limitation just the stitching

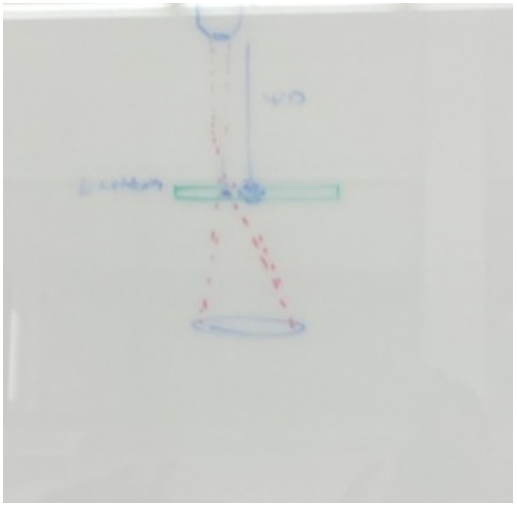
- One solution might be with changing the objective lens in the slide scanner with a wider z focal plane but keeps the properties the same so it works with existing software

Shown below is a rough sketch of how a microscope works courtesy of our advisor

Conclusions/action items:

Our next goal is to figure out what their main problem is in terms of speed, image quality, etc. If it happens that the current problem our winning preliminary design addresses isn't the one they want to focus on, then we will have to refocus our efforts. Therefore, we should speak with our client relatively soon so that we can get a better idea of what our project will focus especially for the prelim presentation. For now, we should work on and practice our presentation and start to research our winning design, deconvolution, and think about how we want to implement it.

LIA LEJONVARN - Sep 28, 2024, 3:40 PM CDT



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IMG_6443.jpg (886 kB)

2024/10/18 - Ideas for Testing

AMANDA KOTHE - Oct 25, 2024, 12:06 PM CDT

Title: Client Expectations and Testing Ideas

Date: 10/17

Content by: Amanda Kothe

Present: Amanda, Lia, Hamad

Goals: Try to narrow down the goals of the project for the semester, as well as discuss prototyping

Content: During this meeting we discusses some fabrication ideas with our advisor. This included discuss the pros and cons for potential motors that we may use for our project. Additionally, we discussed the scope of our project for the semester. This included what are expectations are for completing the mechanical stage and the software portion of the project, and it was agreed that we must meet with our client to discuss proper expectations for the project. We also discussed how this project may be more testing focused than prototyping, which is ok as long as we properly discuss this with our client.

Conclusions/action items: After this meeting, it was agreed that we need to discuss expectations with our client. The group also needs to begin ordering materials, as well as come up with ideas for testing what parameters are needed for this project.

2024/11/01 - Show and Tell

LIA LEJONVARN - Nov 15, 2024, 5:46 PM CST

Title: Show and Tell

Date: 11/01/2024

Content by: Lia

Present: All

Goals: Get advice on current design idea

Content:

People recommended the use of gears for moving the stage controls. They didn't have much advice on the software portion of the project, but it is dealing with programs that none of them seemed to be familiar with so this will be something to ask our advisor. Overall, they seemed to think we had a very good idea and had made significant progress so far.

Conclusions/action items:

We should do more research into gear ratios and how that can play a part in getting smaller movements if needed. However, I think based on the feedback we received, that we are going in a very good direction with the project. Now we just need to gather materials and actually start prototyping to see where we are getting stuck. We should also ask our advisor about connecting amscope to micromanager.

11/26/2024 Discussing Materials List

AMANDA KOTHE - Nov 26, 2024, 10:08 AM CST

Title: Discussing Materials List

Date: 11/26

Content by: Amanda

Present: Amanda and Lia

Goals: Discuss final materials list and plan out final week of work

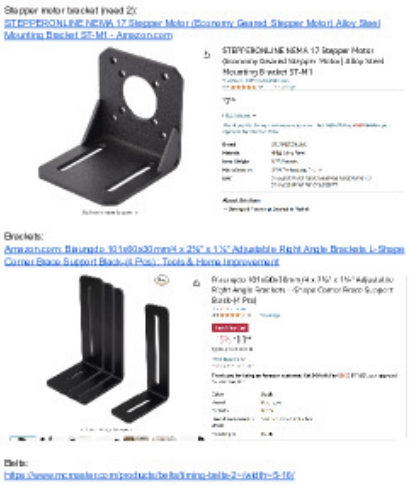
Content:

The final materials list was created and sent to the client for ordering. Additionally, the final report and presentation were created. The second materials list is attached.

Conclusions/action items:

The final report and presentation need to be completed. Additionally, final fabrication needs to be completed with the new ordered materials.

AMANDA KOTHE - Nov 26, 2024, 10:09 AM CST



Download

Materials_List_2.pdf (2.18 MB)

Material List

HAMAD ALDHAHERI - Dec 13, 2024, 8:05 PM CST

Title: material list

Date: 11/24/2024

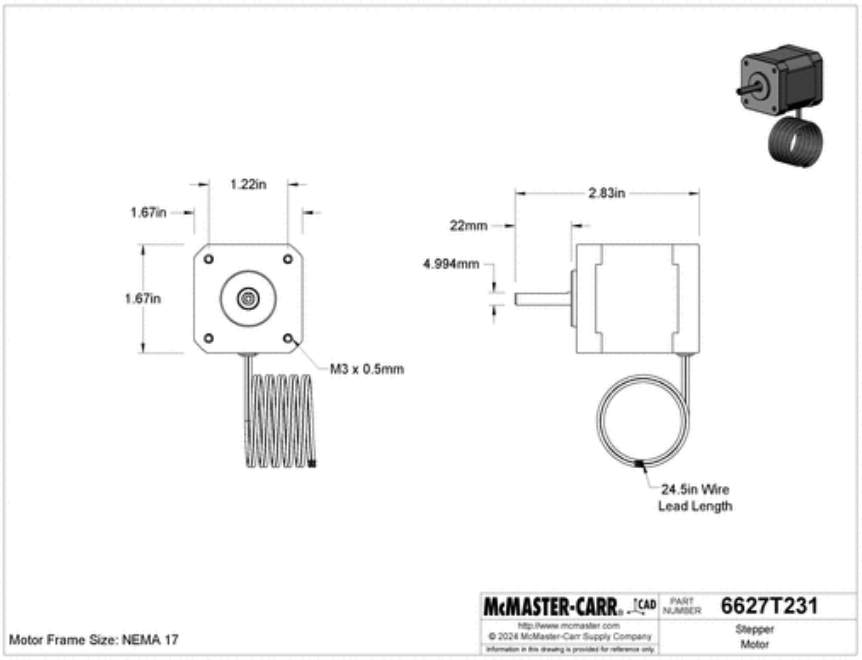
Content by: Hamad ALDhaheri

Present: All

Goals: to list the material we will be using

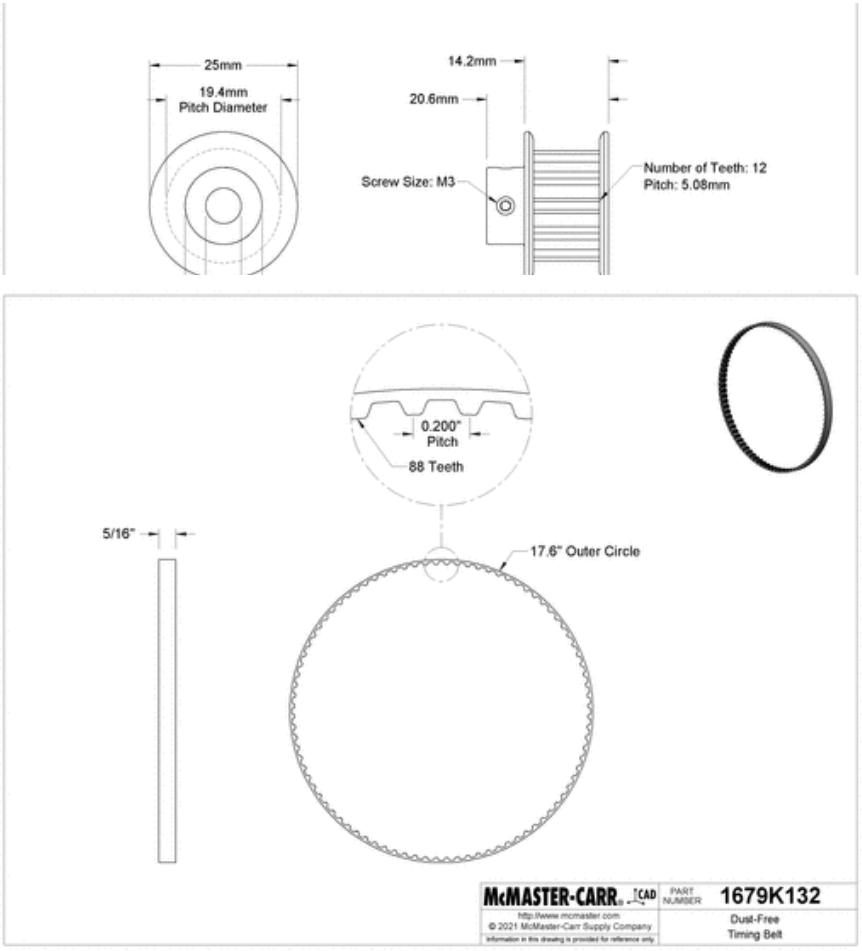
Content:

2x Stepper Motors; Stepper Motor, with Square Body, NEMA 17, 62.3 in.-oz. Maximum Holding Torque | McMaster-Carr:



Price: $87.41 Each

2x Belt Pulley; Corrosion-Resistant Timing Belt Pulley, XL Series, Hub, 2 Flanges, 9.5mm Maximum Belt Width, 25mm OD | McMaster-Carr:



Price: $4-$9 Each

Conclusions/action items:

Order these materials and decide if we need to use more material or if we need to change the dimensions of the materials

Final Material List

HAMAD ALDHAHERI - Dec 13, 2024, 7:27 PM CST

Title: Material List

Date: 12/13/2024

Content by: Hamad ALDhaheri

Present: All

Goals: Present the Materials of our design

Content:

item	description	manufacturer	Vendor	Date	Cost	#	total	link
Motor	Stepper motor with full step increment of 0.9 degrees and shaft radius of 4.994mm	Nema	Mcmaster	11/18/2024	$87.41	2	$174.82	Link
Pulley	Corrosion-resistant Timing Belt Pulley with a trapezoidal teeth shape and a diameter of 25mm as well as shaft diameter of 6mm	lily-bearing	Mcmaster	11/18/2024	$13.67	2	$27.34	Link
Belt	A belt with trapezoidal teeth big enough to encase the microscope moving mechanism as well as the belt pulley	Mcmaster	Mcmaster	11/18/2024	$8.40	2	$16.80	Link
Duct Tape	General tape	Rugged Blue	Walmart	11/25/2024	$4.45	1	$4.45	Link
L-shape Brackets	An L shape bracket with dimensions of 101x60x30mm (Corner base)	Biaungdo	Amazon	11/25/2024	$11.85	3	$35.55	Link
motor Brackets	Motor Brackets specifically made for our nema stepper motor made of alloy steel	OSM Technology Co.Ltd	Amazon	11/25/2024	$7.26	2	$14.52	Link
Bolts	Nylon bolts used to attach the brackets together 3/8 inches-16 thread size	Biaungdo	Amazon	11/25/2024	$8.49	4	$8.49	Link
Endstops	Endstops with operating V=300 Volts and current rating of 2Amps plugs in with our board	AlMOCN	Amazon	11/25/2024	$8.99	6	$8.99	Link
Stepper motor drivers	The A4988 stepper motor driver carrier is a breakout board for Allegro's A4988 microstepping bipolar stepper motor driver. It has adjustable current limit and five different microstep (1/16-step) operates with 8-35V up to 1A.	Pololu	Pololu Robotics and electronics	11/25/2024	$4.49	2	$8.98	Link
Arduino Uno Board	Arduino Uno REV3 CPU speed 16MHz Memory storage 32KB Ram Memory 0.2MB	Arduino	Amazon	11/25/2024	$27.60	1	$27.60	Link
						total	$327.54	

Conclusions/action items:

The total cost of all materials bought is $335.04. However not all bought materials were used in constructing our design some were bought as upgrades to the design that team didn't have time to implement.

2024/11/29 - RAMPS Board Set-up

LIA LEJONVARN - Dec 13, 2024, 4:48 PM CST

Title: RAMPS Board Set-Up

Date: 11/29/2024

Content by: Lia

Present: All

Goals: Prepare stepper motors for RAMPS board and the code for the board

Content:

The stepper motor wires were soldered to female connectors in the green room at ECB. This allows the stepper motors to connect the required drivers on the board. The team found code online that allows the ramps board to control the stepper motors. However, the team tried multiple times to edit and upload the code but the LCD screen would not turn on.

Conclusions/action items:

The team has decided to forgo the RAMPS board idea and instead connect the stepper motors to the drivers off of the ramps board via a breadboard. They will then use an Arduino UNO to control the movement of the motors. Right now the team has to set up the new circuit idea as well as the code.

2024/12/03 - Breadboard set up

LIA LEJONVARN - Dec 13, 2024, 4:51 PM CST

Title: Breadboard Set Up

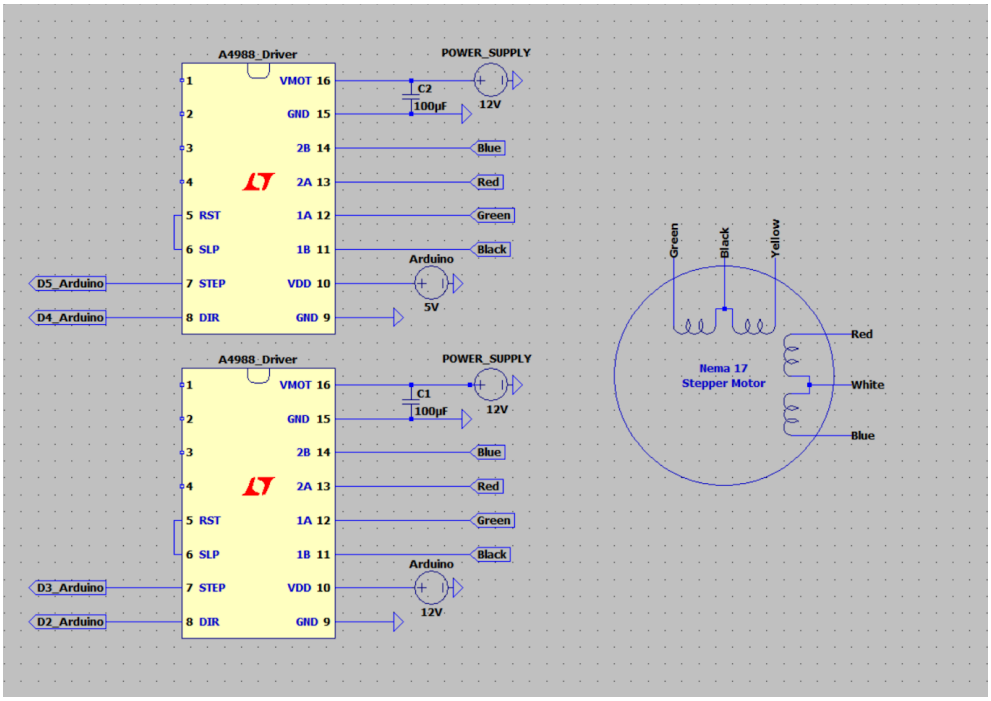
Date: 12/03/2024

Content by: Lia

Present: All

Goals: Create a new circuit to control the stepper motors using the drivers from the RAMPS board

Content:



Conclusions/action items:

The final circuit setup can be seen above. There is a 100 uF capacitor between the 12V and ground rails in order to reduce LC voltage spikes. The drivers were then connected to different pins on the Arduino UNO. The team now has to develop Arduino IDE code that will control the movement of the motors.

2024/12/04 - Arduino IDE setup

LIA LEJONVARN - Dec 13, 2024, 4:56 PM CST

Title: Arduino IDE Setup

Date: 12/04/2024

Content by: Lia

Present: All

Goals: Create Arduino IDE code that will allow the motors to move the microscope stage

Content:

Code:

```
// Adapted from https://www.makerguides.com/a4988-stepper-motor-driver-arduino-tutorial/
// Define stepper motor connections and steps per revolution:
#define dirPin_x 2
#define stepPin_x 3
#define stepsPerRevolution 200
#define dirPin_y 4
#define stepPin_y 5

void setup() {
  // Declare pins as output:
  pinMode(stepPin_x, OUTPUT);
  pinMode(dirPin_x, OUTPUT);
  pinMode(stepPin_y, OUTPUT);
  pinMode(dirPin_y, OUTPUT);
}


void loop() {
//Complete cycle 11 times
for (int i=0; i<11; i++) {

//Move microscope slide across 25 times

for (int i=0; i < 25; i++) {
   // Set the spinning direction counterclockwise:
  digitalWrite(dirPin_x, LOW);
```

```
  // Spin the stepper motor 1/6 revolution quickly:
  for (int i = 0; i < stepsPerRevolution/6; i++) {
    // These four lines result in 1 step:
    digitalWrite(stepPin_x, HIGH);
    delayMicroseconds(1000);
    digitalWrite(stepPin_x, LOW);
    delayMicroseconds(1000);
  }

  delay(1000);

}
delay (1000);

//Move microscope slide down 1 time

//Set the spinning direction clockwise:
digitalWrite(dirPin_y, HIGH);

// Spin the stepper motor 1/6 revolution quickly:
for (int i=0; i < stepsPerRevolution/6; i++) {
   digitalWrite(stepPin_y, HIGH);
   delayMicroseconds(1000);
   digitalWrite(stepPin_y, LOW);
   delayMicroseconds(1000);
  }

delay(1000);

//Move microscope slide across 25 times

for (int i=0; i < 25; i++) {
   // Set the spinning direction clockwise:
  digitalWrite(dirPin_x, HIGH);

  // Spin the stepper motor 1/6 revolution quickly:
  for (int i = 0; i < stepsPerRevolution/6; i++) {
```

```
    // These four lines result in 1 step:
    digitalWrite(stepPin_x, HIGH);
    delayMicroseconds(1000);
    digitalWrite(stepPin_x, LOW);
    delayMicroseconds(1000);
  }
  delay(1000);
}

delay (1000);

//Move microscope slide down 1 time

//Set the spinning direction clockwise:
digitalWrite(dirPin_y, HIGH);

// Spin the stepper motor 1/6 revolution quickly:
for (int i=0; i < stepsPerRevolution/6; i++) {
   digitalWrite(stepPin_y, HIGH);
   delayMicroseconds(1000);
   digitalWrite(stepPin_y, LOW);
   delayMicroseconds(1000);
  }

delay(1000);
}
exit(0);
}
```

How the code works is it moves the microscope stage 1/6th of a revolution for 25 steps across then turns off the x axis motors and turns on the y-axis motor to move the stage down once. The x-axis motors is the turned back on and moves the stage across the other direction for another 25 steps before the stage is moved down once more. This then continues on for 11 iterations which equates to around 22 steps down which should cover the entire microscope slide.

Conclusions/action items:

The team now has to take pictures when the stage is moving to see what kind of overlap is present between photo sections. ImageJ should also be utilized to test how the pictures stitch together.

2024/12/13 - Bracket and stepper motor set up

Xavier Snider - Dec 13, 2024, 6:02 PM CST

Title: Bracket and stepper motor set up

Date: 11/13/2024

Content by: Hamad ALDhaheri

Present: All

Goals: Describe how to set up the Bracket and stepper motor.

Content:

How to set up the Bracket and motor:

1- Adjust the L-Bracket length according to which side of the base it will be placed upon, the y-axis higher while x-axis lower or the opposite if the movement rods are switched to where y-axis control is lower and x-axis control is higher.

2- Place the L-Bracket on the same side as the desired rod and as far away as possible ensuring maximum tension between the pulley and the rod.

3- Attach the L-Bracket using bolts and drills; in this case it is a temporary placement or before drilling into the base use tape to hold it in place.

4- To ensure stability of the L-bracket place a stabilizing rod between the L-bracket and the control rod on the base.

5- Attach the stepper motor to the stepper motor bracket using 2 Nylon bolts/nuts.

6- Using the Bolts attach the stepper motor bracket with the stepper motor to the L-bracket that is stabilized on the base.

7- Ensure that everything is stable and moving properly then attach the wires to their designated boards.

Conclusions/action items:

The team now has to test the movement of the motors and the stability of the overall design.

2024/11/15 - Protocol for Connecting AmScope to Micro-Manager

LIA LEJONVARN - Nov 15, 2024, 5:41 PM CST

Title: Protocol for Connecting AmScope to Micro-Manager

Date: 11/15/2024

Content by: Lia

Present: All, Dr. Trevathan

Goals: set up the camera connection between micro-manager and the amscope camera already on the microscopes

Content:

Download drivers from ToupTek:

1. Go to downloads in ToupTek
2. Go to drivers, download UvcSamSetup
3. Go to windows, download Toupview

Connect drivers to Micro-Manager

1. Go to ToupView in program files
2. Go to 64 and copy all dll files
3. Go to micro-manager in program files and past dll files

Set up configuration

1. Go into Micro-Manager and select Hardware Configuration as None
2. Go to Devices -> Hardware Configuration Wizard
3. Setup new hardware configuration and select Amscope from list of cameras
4. New configuration should be created

Conclusions/action items:

Our advisor, Dr. Trevathan, helped us set up the connection between micro-manager and the amscope camera. He found that the dll files need to connect micro-manager to the driver were no longer available for download through the amscope sight, but they were through ToupTek. He then copied the dll files from ToupTek into micro-manager which worked. As a team, we now need to play around with the configuration settings to make sure we get the clearest picture possible. This will require more research into the settings people have used in the past when using micro-manager.

2024/10/23 - ImageJ Testing

LIA LEJONVARN - Nov 15, 2024, 5:31 PM CST

Title: Image J Testing

Date: 10/23/2024

Content by: Lia

Present: All

Goals: Test stitching together manually cropped images using ImageJ

Content:

Test 1: Stitching with overlap (10 - 15 pixels)

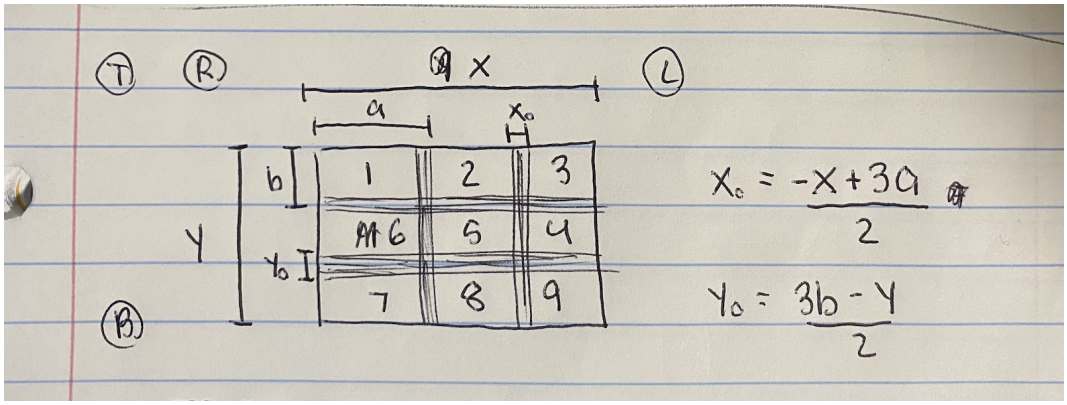
Photo 1

Process:

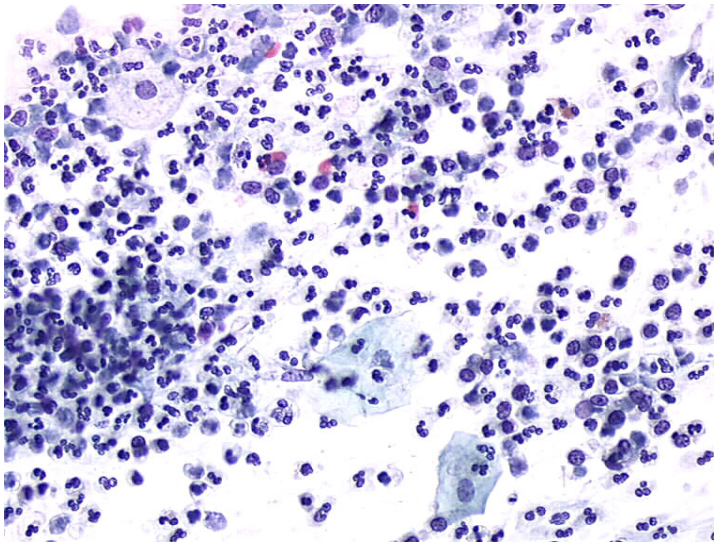
1. Download Fiji (an updated version of ImageJ)
2. Find a picture of a cytology slide online, then crop it into 9 photos using the layout and pixel dimensions as a guide
3. Save each cropped photo using the same name with a different number according to where it lies in layout 1
4. In Fiji, go to Plugins -> Stitching -> Grid/Collection stitching
5. Set type as Grid: snake by rows and order as Right & Down then press ok
6. Set Grid size x and Grid size y as 3, select fusion method as linear blending and select compute overlap then press ok
7. Fused image should be displayed, go back to Fiji and save image
8. Run matlab similarity code to evaluate effectiveness of stitching (1 = greatest similarity)

Link: Image Stitching (imagej.net)

Layout 1:

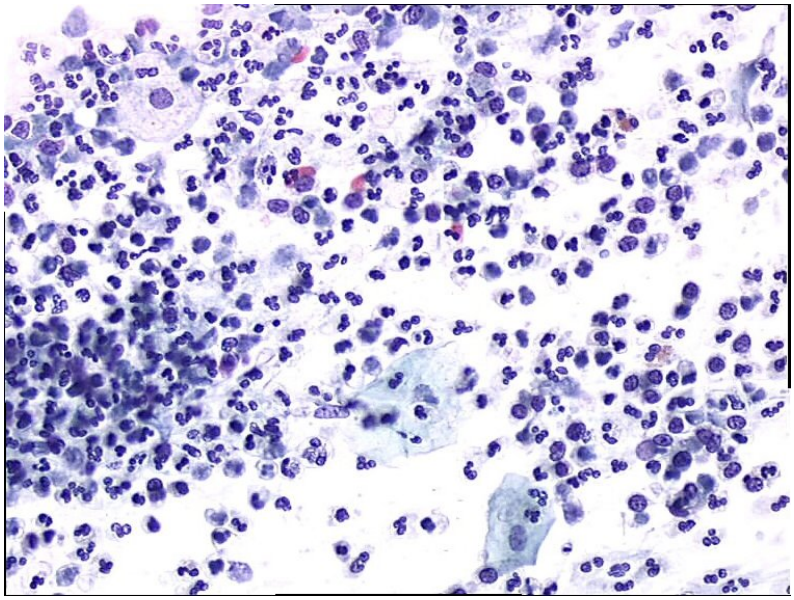


Original photo:



Link: Cytopathology of the uterine cervix - digital atlas (iarc.fr)

Fused photo:



Similarity Score: 0.7740

Overlap: 12 pixels in the x dimension and 15 pixels in the y dimension

Discussion:

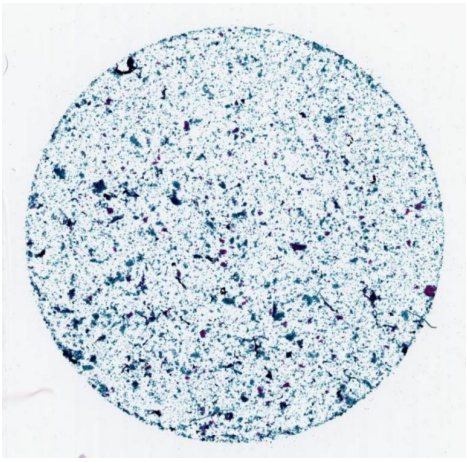
When comparing photos, the code requires they be the same size. The stitched photo was one pixel larger in the x dimension and was cropped on the left hand side before calculating similarity. The overlapped photos also lined up too far in some parts causing the images to be shifted slightly off center. This is what's causing the disjointed outline of the picture.This could possibly be fixed with either different settings or smaller overlap. One option might be to use pairwise stitching on the photos one at a time which might negate any errors or show where errors are occurring. However, this would take too much time for the actual project application.

Photo 2

Process:

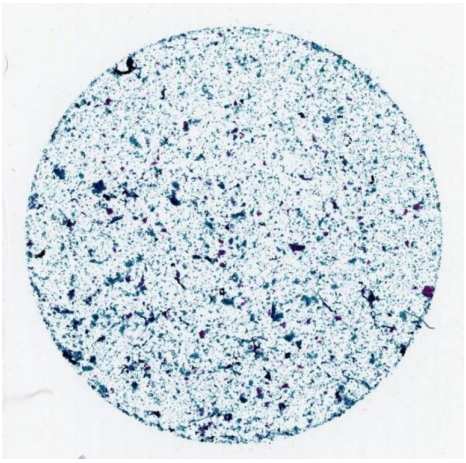
**Same as above using different photo

Original:



Link: pap smear two - Huron Digital Pathology

Fused:



Similarity Score: 0.9928

Overlap: 21 pixels in the x dimension and 14 pixels in the y dimension

Discussion:

Since there were problems with the edges of the previous photo, I attempted the same process using a cytology scan typical of what the client's current scanner outputs with the slide shown as a circle with a white outline. The similarity score was much higher than the previous one. This could be due to the change in outline or possible errors in the first cropping process. To further analyze the differences seen, both photos will continue to be used for the other tests.

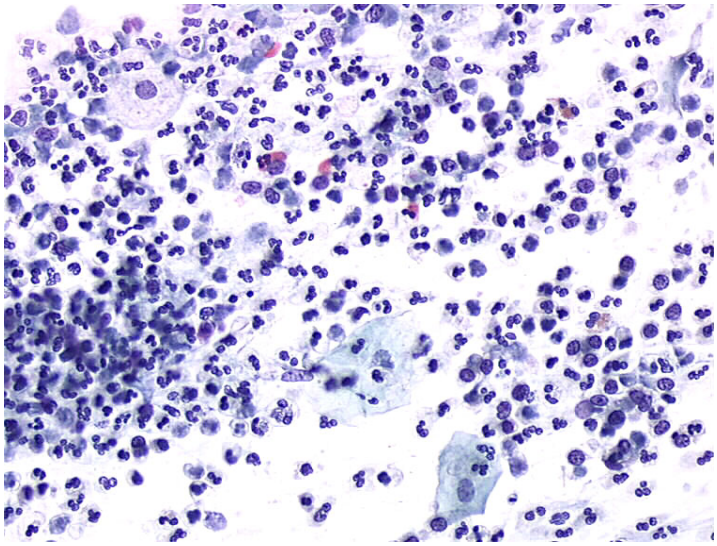
Test 2: Stitching with lots of overlap (>30 pixels)

Photo 1

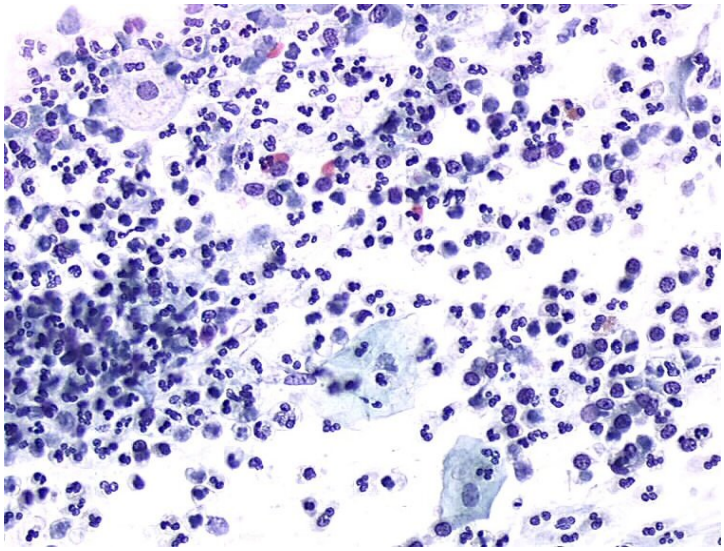
Process:

**Same as above with greater Xo and Yo

Original photo:



Fused photo:



Similarity Score: 0.9722

Overlap: 42 pixels in the x dimension and 45 pixels in the y dimension

Discussion:

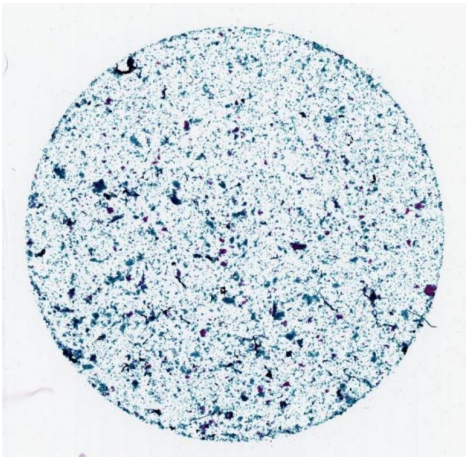
The similarity was greatly increased from trial 1. This seems to be due to the increase in overlap, however, performing this trial with the second photo will show whether it is the overlap itself or a lack of errors in the cropping process compared to the first trial.

Photo 2

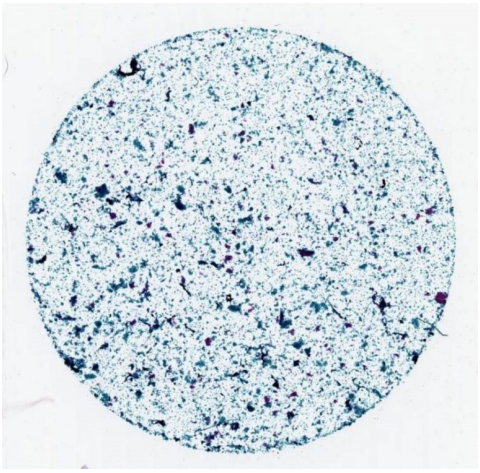
Process:

**Same as above with greater Xo and Yo

Original:



Fused photo:



Similarity Score: 0.9931

Overlap: 51 pixels in the x dimension and 43.5 pixels in the y dimension

Discussion:

The similarity score was increased by only 0.03% when cropped with greater overlap. It seems that once the right amount of overlap is achieved to stitch the photos together properly, increasing this value does not increase the accuracy by much. However, it seems large overlaps will help with accuracy instead of impeding it. This means our automated stage does not have to achieve high accuracy in terms of where pictures are taken as long as there is enough overlap to stitch them together.

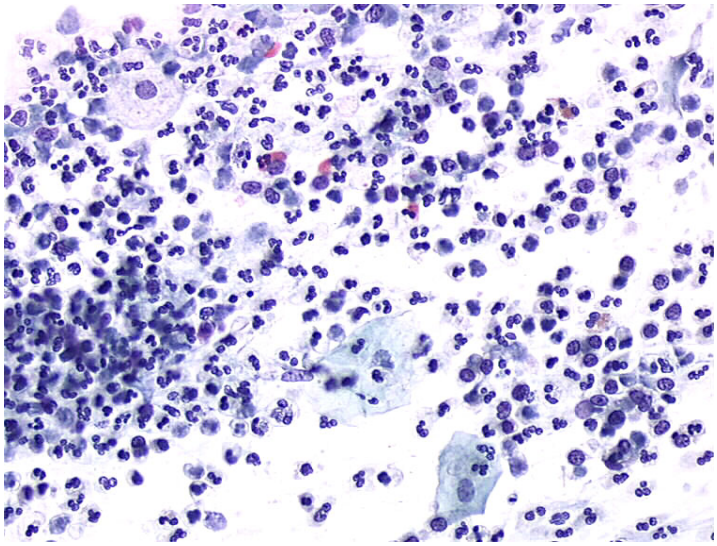
Test 3: Stitching with no overlap

Photo 1

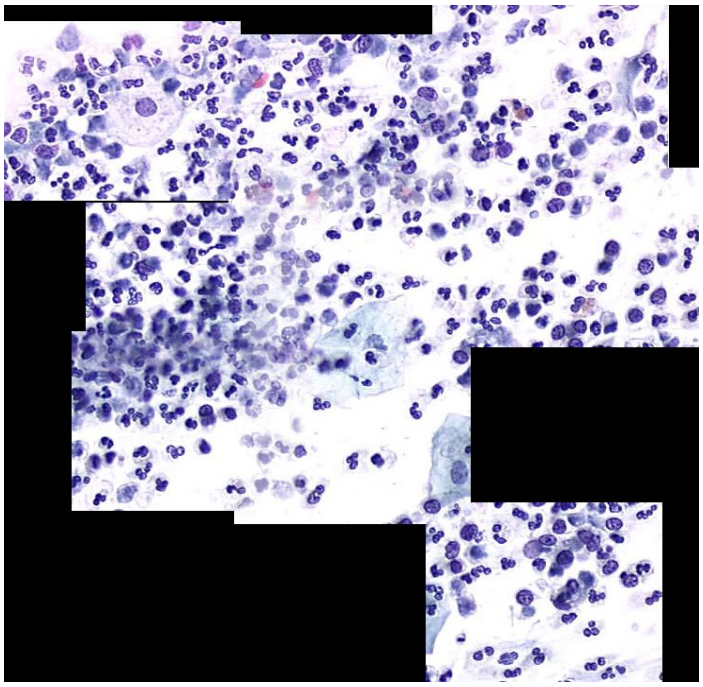
Process:

**Same as above with no overlap (Xo and Yo are 0)

Original photo:



Fused photo:



Similarity Score: N/A

Overlap: 0

Discussion:

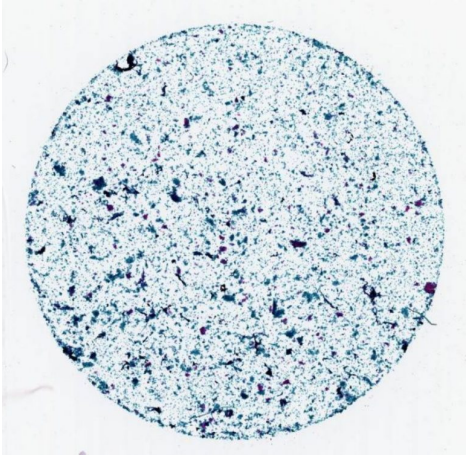
A similarity score was not calculated for this trial due to the vast difference in the picture sizes. It is also very clear from looking at the photos that the pictures were not stitched together with any accuracy. It seems that some level of overlap is needed in order to know where the pictures place relative to each other. Performing this same trial with the second photo will make it clear whether the lack of an outline on this photo is causing less accuracy in the stitching process.

Photo 2

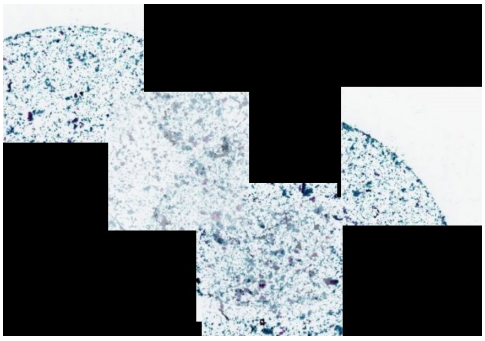
Process:

**Same as above with no overlap (Xo and Yo are 0)

Original:



Fused:



Similarity Score: N/A

Overlap: 0

Discussion:

This outcome matches that of the first photo. Once again finding the similarity between photos is not possible due to the difference in sizes, however, you can clearly see that the pictures did not stitch together correctly. This further shows that overlap is necessary for the algorithm to correctly place where the photos are supposed to be stitched together. This will affect how our automated stage moves and where the photos are cropped.

**MATLAB Code for Calculating Simularity

```
%Cyto Test Simularity Analysis
%References:https://www.mathworks.com/matlabcentral/answers/584714-how-do-i-compare-two-images-and-find-the-similarity-percentage

%Load in images with A being the fused photo and ref being the original
A = imread("C:\Users\liale\OneDrive\Desktop\BME300\cyto_test2.5\pap2_fused.jpg");
ref = imread("C:\Users\liale\OneDrive\Desktop\BME300\cyto_test2.5\pap_original.jpg");

%Calculate similarity score
```

```
ssimval = ssim(A,ref)
```

Conclusions/action items:

We saw from testing that when the images have a good amount of overlap, they stitch together much better than when they don't. One thing we should be cautious of is if too much overlap will start to decrease image quality. Right now, that doesn't seem to be the case, but more testing might be required to see if a significant amount of overlap decreases the MATLAB similarity score between the photos. This is good news for us, however, since it shows we don't have to be so specific with positioning the slide since we want there to be overlap.

2024/09/12 - Progress Report 1

LIA LEJONVARN - Sep 11, 2024, 4:25 PM CDT

Microscope Slide Scanner

Date: 9/12/24

Client: Teri Stewart
Advisor: Dr. James Trevathan
Team: Lia Lejonvarn (Team Leader)
Amanda Kothe (Communicator and BSAC)
Hamad AlDhaheri (BPAG)
Xavier Snider (BWIG)

Problem statement

The team has been tasked with finding a more efficient way to scan microscope slides using digital scanning. The client's department already has a scanner but it can only capture small portions of the slides and the images are of poor quality. Therefore, we must find a way to enhance the user quality of their digital scanner as well as the images themselves. The department has also asked our team to create software capable of housing the images. This project will hopefully be used for the primate lab and SMPH.

Brief status update

The team assigned team roles and contacted our client and advisor. Additionally, we set up a meeting with our client to discuss the project.

Difficulties / advice requests

The team is having difficulty understanding the actual scope of the project and what needs to be accomplished. This should be fixed by meeting with the client.

Current design

Materials and expenses

Item	Description	Manufac-turer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
Category 1										
									$0.00	
									$0.00	
Category 2										
									$0.00	
									$0.00	
								TOTAL:	**$0.00**	

Major team goals for the next week

1. Do preliminary research on microscope scanners and sorting software
2. Create PDS for project
3. Meet with client to further understand the goals for the project

Next week's individual goals

- Amanda:
  - Continue communicating with client and advisor about project
  - Start work on researching microscope scanners
  - Work on designated sections of PDS
- Lia:
  - Continue working on creating questions for the client
  - Start work on the PDS
  - Research digital scanning
- Xavier:
  - Attend client meeting
  - Research other slide scanners
- Hamad:
  - Research possible solutions for the clients request and determine a possible course of action
  - Develop a financial plan with the clients parameters

Timeline

Task	Sep			Oct				Nov					Dec	
	13	20	27	4	11	18	25	1	8	15	22	29	6	11
Project R&D														
Empathize														
Background…														
Prototyping														
Testings														
Deliverables														
Progress Reports														
Prelim presentation														
Final Poster														
Meetings														
Client														
Advisor														
Website														
Update														

Filled boxes = projected timeline

X = task was worked on or completed

Previous week's goals and accomplishments

- Amanda
  - Communicated with client and advisor about project
  - Helped complete first progress report
- Lia:

    - Set up our team notebook
    - Established a team google drive
    - Helped make the first progress report
- Xavier
    - I set up the team website
    - Labeled each members role
    - Lowered the resolution of team photo
- Hamad
    - Statered research about microscopic scanners

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Amanda	9/11	We met as a team	1	1	1
Lia	9/11	We met as a team	1	1	1
Xavier	9/11	We met as a team	1	1	1
Hamad	9/11	We met as a team	1	1	1

2024/09/19 - Progress Report 2

LIA LEJONVARN - Sep 20, 2024, 11:06 AM CDT

Microscope Slide Scanner

Date: 9/19/24

Client: Teri Stewart
Advisor: Dr. James Trevathan
Team: Lia Lejonvarn (Team Leader)
Amanda Kothe (Communicator and BSAC)
Hamad AlDhaheri (BPAG)
Xavier Snider (BWIG)

Problem statement

The team has been tasked with finding a more efficient way to scan microscope slides using digital scanning. The client's department already has a scanner but it takes a while to scan one slide and the images are not of the best quality. Therefore, we must find a way to enhance the user quality of their digital scanner as well as the images themselves. The department has also asked our team to create software capable of housing the images. This project will benefit multiple labs who send in slides for processing including the primate lab and SMPH.

Brief status update

The team met with our client twice and got a tour of the lab. The team also completed a PDS for the project and completed some initial research.

Difficulties / advice requests

The team is still having difficulty understanding the actual scope of the project and what is expected of them. The team's advisor will meet with the client to help solve this.

Current design

Materials and expenses

Item	Description	Manufac-turer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
Category 1										
									$0.00	
									$0.00	
Category 2										
									$0.00	
									$0.00	
								TOTAL:	**$0.00**	

Major team goals for the next week

1. Do preliminary research on microscope scanners and sorting software
2. Start thinking about preliminary designs for the project
3. Create and fill out a design matrix for the preliminary designs

Next week's individual goals

- Amanda:
  - Start on preliminary designs
  - Continue researching
  - Continue communicating with client to better understand her needs
- Lia:
  - Finish PDS
  - Start working on preliminary designs
  - Continue researching
- Xavier:
  -
- Hamad:
  - Develop a preliminary design
  - Continue researching

Timeline

Task	Sep			Oct				Nov				Dec		
	13	20	27	4	11	18	25	1	8	15	22	29	6	11
Project R&D														
Empathize														
Background…														
Prototyping														
Testings														
Deliverables														
Progress Reports	X													
Prelim presentation														
Final Poster														
Meetings														
Client	X													
Advisor	X													
Website														
Update														

Filled boxes = projected timeline

X = task was worked on or completed

Previous week's goals and accomplishments

- Amanda
  - Communicated with client and advisor about project
  - Helped complete first progress report
- Lia:
  - Set up our team notebook

    - Established a team google drive
    - Helped make the first progress report
- Xavier
    - I set up the team website
    - Labeled each members role
    - Lowered the resolution of team photo
- Hamad
    - Started research about microscopic scanners

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Amanda	9/16	Got a tour of client's lab	1	1	2
Lia	9/16	Got a tour of client's lab	1	1	2
Xavier	9/16	Got a tour of client's lab	1	1	2
Hamad					1

2024/09/26 - Progress Report 3

LIA LEJONVARN - Sep 27, 2024, 1:15 PM CDT

Microscope Slide Scanner

Date: 9/27/24

Client: Teri Stewart
Advisor: Dr. James Trevathan
Team: Lia Lejonvarn (Team Leader)
Amanda Kothe (Communicator and BSAC)
Hamad AlDhaheri (BPAG)
Xavier Snider (BWIG)

Problem statement

The team has been tasked with finding a more efficient way to scan microscope slides using digital scanning. The client's department already has a scanner but it takes a while to scan one slide and the images are not of the best quality. Therefore, we must find a way to enhance the user quality of their digital scanner as well as the images themselves. The department has also asked our team to create software capable of housing the images. This project will benefit multiple labs who send in slides for processing including the primate lab and SMPH.

Brief status update

The team has come up with three preliminary designs and evaluated them to come up with a final design that they will pursue. The design matrix with all three designs is attached at the end of this report.

Difficulties / advice requests

The team is having difficulties fully understanding what the use of deconvolution would look like. This can be solved by continuing to research the topic.

Current design

Materials and expenses

Item	Description	Manufac-turer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
Category 1										
									$0.00	
									$0.00	
Category 2										
									$0.00	
									$0.00	
								TOTAL:	**$0.00**	

Major team goals for the next week

1. Create preliminary presentation
2. Practice presentation
3. Continue researching the current design

Next week’s individual goals

- Amanda:
  - Continue doing more research on deconvolution
  - Work on the preliminary presentation
- Lia:
  - Start working on the preliminary presentation
  - Continue researching deconvolution
  - Practice presentation
- Xavier:
  - Begin work on prelim presentation
  - Practice Prelim
- Hamad:
  - Working on preliminary presentation
  - Researching more regarding the deconvolution design
  - Research more regarding the microscope slide scanner’s imaging criteria

Timeline

Task	Sep			Oct				Nov				Dec		
	13	20	27	4	11	18	25	1	8	15	22	29	6	11
Project R&D														
Empathize														
Background…														
Prototyping														
Testings														
Deliverables														
Progress Reports	X	X	X											
Prelim presentation														
Final Poster														
Meetings														
Client	X	X												
Advisor	X	X												
Website														
Update	X	X												

Filled boxes = projected timeline

X = task was worked on or completed

Previous week’s goals and accomplishments

- Amanda
  - Started on preliminary designs
  - Continued researching
  - Continued communicating with client to better understand her needs

- Lia:
  - Finished PDS
  - Started working on preliminary designs
  - Continued researching
- Xavier:
  - Finish PDS
  - Upload to website and canvas
  - Continued researching
- Hamad:
  - Developed a preliminary design
  - Continued researching

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Amanda	9/26/2024	Design matrix Meeting with advisor	2	2	4
Lia	9/26/2024	Design matrix Meeting with advisor	2	2	4
Xavier	9/26/2024	Design matrix Meeting with advisor	2	2	4
Hamad	9/26/2024	Design matrix Meeting with advisor	2	2	3

Microscope Slide Scanner Design Matrix

Design Criteria	Design #1: Automatic Slide Glider		Design #2: Deconvolution		Design #3: AI Image Improvement	
Accuracy (30)	3/5	18	4/5	24	4/5	24
Feasibility (25)	4/5	20	4/5	20	2/5	10
Useability (20)	4/5	16	4/5	16	3/5	12
Speed (10)	3/5	6	2/5	4	3/5	6
Cost (10)	3/5	6	5/5	10	5/5	10
Manufacturability (5)	4/5	4	5/5	10	4/5	8
Total (100)	70		84		70	

Criteria:

Accuracy: This criteria refers to the accuracy of the finished product. This is the most important criteria as the client wants the slide image to be improved as much as possible.

Feasibility: The design must be feasible to make during the semester, and must be able to be used in the clients lab.

Useability: The finished design needs to be easy for the client to use and understand.

Speed: The client mentioned that they would like the speed of the scans to be improved if possible, however it was not the most important improvement that needs to be made.

Cost: The client has given a budget for the project.

Manufacturability: The design must be able to be replicated.

Design #1: Automatic Slide Glider

This design scored in the mid range for accuracy due to the need to stitch many photos together, leaving room for error. It received a higher score for feasibility due to our previous and existing knowledge of the skills and techniques required to build the required mechanism. As well as this, we believe that this would benefit the clients needs by perfecting a method she herself has previously tried. Useability also scored higher because while the slide will move and have photos taken, someone must be responsible for properly changing, focusing, and running the scans. Speed received a middle range score as well as the mechanism wouldn't be able to quickly take photos. Cost received a middle range rating due to the materials/motor required to move the slide around, compared to fully algorithmic options. Lastly it scored highly in manufacturability due to its small, simple design that could be mass produced and recreated exactly the same every time.

Design #2: Deconvolution

This design scored the highest in accuracy and tied for first in feasibility and useability. Therefore, it was scored as our winning design. We gave it a higher score in the aforementioned areas because there are highly developed programs out there that have been successful in improving the image quality of cytology scans. This also makes it feasible to produce since our task will be utilizing these programs in an easier to use interface for our client. This design did score low on speed, however, since it requires the use of different z axis images which takes a while to collect and for the algorithm to process. This would also be a very low cost option earning it the highest score in that category since the only materials needed would be storage. It is also a very easy to reproduce product since it is all software based.

Design #3: AI Image Improvement

This design was thought of to be a competing design however after taking a look at it through different lenses in our design criteria it did not score the highest amongst our project ideas. Despite its strong accuracy to our clients needs, it has the negative aspect of slow processing and continuous use that could hinder our overall clients experience with the finished product. Additionally it was not feasible for the group to make since the level of knowledge regarding programming AI is missing.

2024/09/20 - Digital Cytology

LIA LEJONVARN - Sep 22, 2024, 10:56 AM CDT

Title: Digital Cytology

Date: 9/22/2024

Content by: Lia

Present: N/A

Goals: Learn more about the process of digitizing slides

Search Term: Scanning Slides

Citation:

Link: Digital Cytology - ScienceDirect

Content:

- There are a variety of terms describing digital pathology: telepathology, telecytology, telecytodiagnosis, digital microscopy, virtual microscopy

- A previous version of digital cytology involved using microscope cameras or smart phones to take static photos. Whole slide imaging has become the preferred method, however, and uses a machine to scan and convert a glass slide into a digital image.

- Digital cytology offers many benefits including rapid evaluation of slides via pathologists through the use of digital scans performed in clinics.

- One limitation the article mentioned matched that of one of the problems the client has with her current scans. Digital scanning sometimes has the inability to focus through different focal planes preventing someone from seeing multiple features of a specimen. This has been improved with Z stacking and z-axis videos.

Whole Slide Imaging

- more common for tissue sections

- considered superior to static images and other methods of digital pathology

- Most use a tiling system where multiple high-res images are aligned to create a single image

- Most scanners with 20x lens have res of 0.5 um/pixel and those with 40x lens have 0.25 um/pixel

- z-axis scanning involves taking multiple scans at various planes of focus. This can result in larger image files

- The computer software used to view the scans have functions such as a light microscope and users can change magnification, pan through the image, and focus Z stacking

- Advantages: static images only capture portions of slides and virtual slides are easy to annotate

- Disadvantages: cytologic slides can be harder since there are multiple Z axis points that have better focus which can result in longer scan times. However, using z stacking can take a lot of time and storage. There is a "region of interest" technique where certain areas are digitized at high resolution instead of the whole slide which can lower scan time.

Static imaging

- involves the use of a camera to capture scans through the microscope

- Advantages: low cost option, quick process

- disadvantages: parts of the slide could be left out and there isn't an option to change the z axis. However, there has been some success with taking video while adjusting the z axis manually.

Taking pictures with smartphones

- make sure everything is clean of oil

- for dry slides the condenser should be close to the stage with the diaphragm open

- for wet slides the condenser should be dropped or the diaphragm should be closed

Conclusions/action items:

This article was very helpful for comparing the different methods for scanning slides. It seems like we could go the static imaging route, however, we would have to spend a lot of time figuring out a mechanical solution to automate the process somewhat so that consistent results can be attained. This doesn't seem feasible in a semester, however, so I think we agreed to go the digital route and focus on making a program that will implement z stacking. However, after reading this article I really want to look into the region of interest method as one of our main concerns was the increased time the z stacking would require to scan slides.

2024/11/07 - ImageJ/Fiji Stitching Process

LIA LEJONVARN - Dec 13, 2024, 6:56 PM CST

Title: ImageJ/Fiji Stitching Process

Date: 11/07/2024

Content by: Lia

Present: N/A

Citation:

[1] “Image Stitching,” *ImageJ Wiki*. https://imagej.net/plugins/image-stitching

Link: Image Stitching

Goals: Learn how to use ImageJ/Fiji software to stitch photos together

Content:

This document provides a very good overview of how to stitch together photos and the different settings. It mentions that the Fiji version of ImageJ already has the stitching plugin included. It then describes that there are two different stitching processes, pairwise and grid stitching. The pairwise is only for two photos at a time whereas for the grid process you can do multiple. For the grid stitching, you have to choose which orientation the pictures were taken in as well as how many there are, where the pictures are location, the relative names, and the number specifying the first picture. There are some additional settings you can set, however, for our purposes this article provided a very detailed overview of how to get started with using the stitching software.

Conclusions/action items:

Next steps including testing the software to see if it can properly stitch together photos of a cytology scan since they tend to be more complex. To complete this, I plan on acquiring photos offline and cropping them then stitching them back together. It would be helpful to change the amount of overlap between photo sections in order to determine how imageJ responds since this will affect how the microscope stage moves in our project.

2024/09/20 - CS2 Scanner

LIA LEJONVARN - Oct 03, 2024, 3:32 PM CDT

Title: CS2 Scanner

Date: 9/20/2024

Content by: Lia

Present: N/A

Goals: Learn more about their current scanner

Search Term: CS2 Scanner

Citation:

"APERIOCS2 Highly Reliable, Desktop Digital Pathology Scanner." Accessed: Oct. 03, 2024. [Online]. Available: https://www.leicabiosystems.com/sites/default/files/media_product-download/2023-03/Brochure_-_Aperio_CS2_Desktop_Scanner_-_EN%20_95.14550_Rev._A.pdf

Link: Brochure_-_Aperio_CS2_Desktop_Scanner_-_EN _95.14550_Rev._A.pdf (leicabiosystems.com)

Content:

- The scanner uses Line Scanning (look up what that is)

- The objective lens is Olympus UPLXAPO and has 40x scanning

- It produces scans with a resolution of 20x: 0.50 uM/pixel and 40x: 0.25 uM/pixel

- It can only load 5 slides at a time which the client has mentioned is a problem since it takes so long to scan those 5

- One thing that was interesting to me was the brochure mentioned that it was for research use only, and not for diagnostic procedures

Conclusions/action items:

I want to do some digging into some of the components of the scanner such as the objective lens and the method of scanning (line scanning). I also want to try and compare some of the specs with other scanners that the client was looking at such as the HOLOGIC one. The comment on the brochure about it only being used for research purposes makes a lot of sense for the quality compared to when looking at scans through a microscope. I know the client is interested in eventually being a part of the digitization of slides for diagnostic purposes, however it is very clear that their equipment is not meant for that purpose. I do not think we can help them fully reach that point in only a semester but I hope our product can at least get them further to a more useful form of scanning.

2014/12/13 - A4988 and Nema 17 Circuit and Code

LIA LEJONVARN - Dec 13, 2024, 6:45 PM CST

Title: A4988 and Nema 17 Circuit and Code

Date: 12/13/2024

Content by: Lia

Present: N/A

Citation:

[1] A. B. de Bakker, “A4988 Stepper Motor Driver with Arduino Tutorial (4 Examples),” *Makerguides.com*, Feb. 11, 2019. https://www.makerguides.com/a4988-stepper-motor-driver-arduino-tutorial/

Link: A4988 Stepper Motor Driver with Arduino Tutorial (4 Examples)

Goals: Research how to connect the A4988 drivers to the stepper motors

Content:

This article gave an example circuit and explained the function of each component. They added in a 100uF capacitor to reduce LC voltage spikes. They also showed which wires from the stepper motors should be connected to which pins as well as how the driver should be connected to the Arduino. The article then provided example code for turning the motor with comments about what each parameter controlled.

Conclusions/action items:

I am going to take their example circuit and adapt it so that two stepper motors and drivers can be set up. I will keep in the 100 uF capacitor as it will be very useful. I also need to take their example code and adapt it to our uses by adding in the right amount of iterations, the correct direction the motor has to turn, add in additional parameters for the y-axis motor, etc.

2024/12/03 - Circuit Design

LIA LEJONVARN - Dec 13, 2024, 4:42 PM CST

Title: Circuit Design

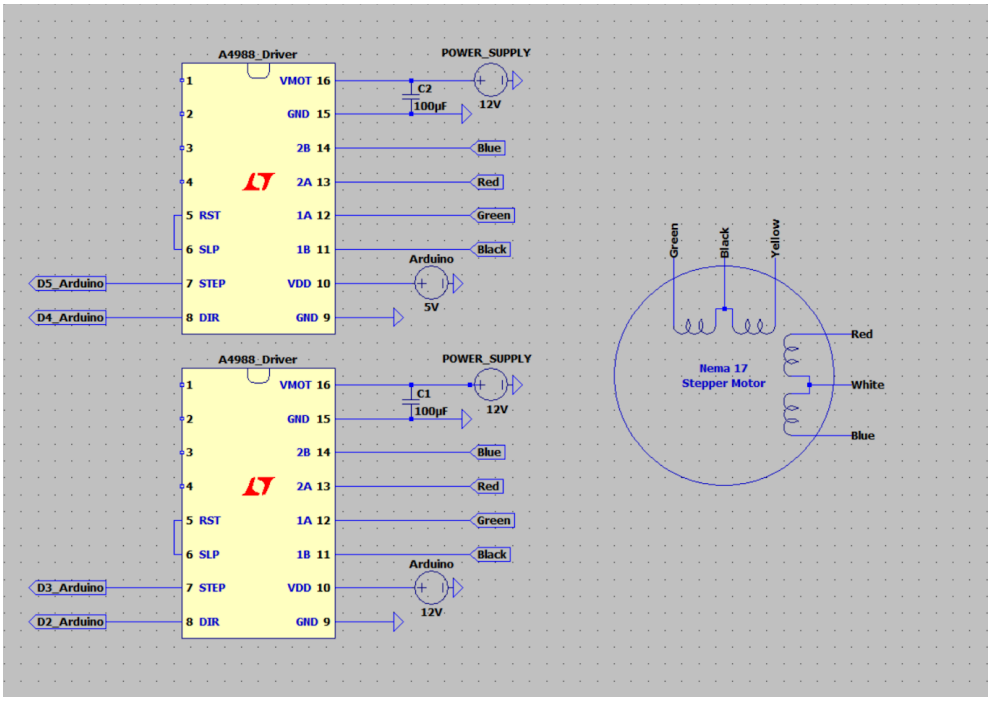
Date: 12/03/2024

Content by: Lia

Present: N/A

Goals: Create a circuit to control the stepper motors

Content:



Conclusions/action items:

The two drivers will be set up on the same breadboard and there will be a 100 uF capacitor between the 12V power rail and ground rail in order to reduce LC spikes voltage spikes. The drivers will then connect to different pins on the arduino board so all that's left to do is to code the arduino to control the movement of the motors via the stepper motor drivers.

BME Career Prep - 9/11/24

LIA LEJONVARN - Sep 11, 2024, 2:08 PM CDT

Title: BME Career prep

Date: 9/11/24

Content by: Lia

Present: N/A

Goals: Get ready for the career fair and job searching

Content:

Job Search Tips:

- make an ECS tracking sheet (ecs.wisc.edu/resources)

- use quality sites such as Handshake, LinkedIn, Indeed

- Applying is step 1 by you should follow up within 2-3 weeks

- Try connecting before you are a candidate

Resume Tips

- make quick changes to tailor resume to position

- show a balanced picture of your experience

- resume should be: MS word, no columns charts or colors, design projects without years or semesters, technical skills and coursework, jobs with organization + location position title + dates

Cover Letter Tips

- custom to each job

- showcase your greatest selling points

Career fair advice for BMEs

- try to find a purpose not just an internship

- research the employer

- make a why you statement

- highlight the overlapping with other majors

Additional tips

- don't get caught up in job posting titles

- look at BME, ME, and EE columns on the career fair sheets

Conclusions/action items:

There were a lot of tips that I wish I knew last year especially the point about seeking out employers who didn't specifically list BME. There is so much overlap with other majors and I forget that employers often don't know that. I do have a co-op for this spring and summer, so I do not think it will be useful for me to attend the upcoming career fair. However, I can use these tips for future job searches. I can also use this lecture to help re-write my resume as it's always useful to have an up-to-date resume on hand.

2024/09/18 - Exploring Your Leadership Style

LIA LEJONVARN - Sep 18, 2024, 1:59 PM CDT

Title: Exploring Your Leadership Style

Date: 9/18/24

Content by: Lia

Present: N/A

Goals: learn about different leadership styles

Content:

Some qualities the room thought described leadership were confidence, communication, organization, motivational, and more

Anatomy of a good leader:

- self-awareness (understanding weaknesses and strengths)
- vision (provide direction)
- transparent (clear processes)
- communication (articulate goals)
- decision-making
- empathy

Leadership styles

- Power model: leadership = power, idea that certain people are born to lead, outdated, hierarchy, authority, command
- servant: being of service to others, sharing power, listening and understanding, empathetic, empowering, shared decision making
- authentic: building self-esteem and self-awareness, creating authentic relationships, emotional intelligence, transparency, honesty

Other leadership styles

- People-oriented: glue that holds the team together, relationship building skills
- process-oriented: set pace for team, work alongside everyone, efficiency focused
- thought-oriented: sees big picture and thinks ahead
- impact-oriented: sets the bar high, inspire people to follow your cause and mission

Leadership doesn't require a particular job title. You can develop your leadership skills regardless of your position. Leading others starts with leading yourself.

Explore leadership styles

- self-assess: what you enjoy, what you're good at
- observe and reflect: what are the things that give you a sense of accomplishment? How do you get in your own way?
- Seek our feedback: others can identify strengths and areas for growth you're not actively aware of

Goal setting

- Start small, slow down
- focus on one element to practice
- look for mentors
- ask questions, partner with others
- consider tracking your progress

Conclusions/action items:

Some goals I want to enact after learning about leadership styles are:

- Team goal: I want us to be motivated to complete the project together instead of having us fall behind in some areas or procrastinate a lot. I can help enact this be leading by example and reminding the team of due dates and trying to be more proactive about things.
- Self goal: I want to gain more confidence in my leadership skills through this course by getting out of my comfort zone and testing out leadership skills I haven't had a lot of experience in before.

I also want to seek out some assessments and learn more about my leadership style as I feel that can help put me on the right track when leading my design team this semester. Overall, this lecture was very helpful for learning more about what it's like to lead and for reminding me that not everyone leads the same.

2024/09/25 - Post Grad Planning

LIA LEJONVARN - Sep 25, 2024, 2:08 PM CDT

Title: Post Grad Planning

Date: 9/25/2024

Content by: Lia

Present: N/A

Goals: Learn more about Post Grad Planning!

Content:

- Use your undergrad experience to "build a story": gain experience while you can, time them together, research

- Do your homework: what does your ideal career look like? What programs have the opportunities you're looking for?

- Think about references early on: 3 strong ones

- if taking MCAT or GRE prepare the summer before senior year

- avoid statements like . . . legos -> engineer -> cancer -> BME

- be more specific about what you want to do in the company

writing your story

- start with a thesis on what you want to do

- personal statement: show what you will achieve, what you want to do after, name the faculty who are in your field of interest

- defend your plan with your life experiences

- CV to some extent in paragraph form (be specific)

Graduate school options:

- Masters, MS: stepping stone, industry focused, generally one year

- Doctoral, PhD: desire to be an independent researcher, write research grants, work in academia, lead projects in industry, startups, and consulting

MS as stepping stone

- MS will make your more desirable

- fill gaps in resume, higher level of skills, more experiences

- powerful if you add in industry experience

- reasons: opens doors, higher starting salary, another opportunity for summer internships, can co-op during MS as well, time to find the dream job

Three MS options within BME
- Research (1.5-2 years): for those continuing on for a PhD here, thesis required, can be funded as RA/TA/PA (tuition remission and stipend)

- Accelerated program (1 year): coursework only, independent study allowed, funding (TA only) stipend only (no tuition remission)

- Biomedical Innovation, Design and Entrepreneurship (1 year): project based (project required), partnership with business school, funding (TA only) stipend only

Applying for Accelerated MS Programs

- Apply online, pay fee and submit - fall and spring start available

- Special for UW BME BS students: no letters of rec, still need to input email addresses

- easy to meet deadline of 12/15 (some flexibility)

- application is reviewed separately, special consideration to BME undergrads, need at least 3.0 overall / 3.0 in last 60 credits

Masters Elsewhere

- MEng, MS in global health, MS in other engineering dept (takes longer), MBA (industry pays for credits or evening options)

- Duke has similar program (do your homework on it)

- you can often go from masters program to PhD program

PhD additional advice

- follow your passion, who is working in that area?

- build your resume/CV: research is a must, REU (summer)

- External funding NSF - GRFP (funds four years of your PhD wherever you want to go)

PhD application

- apply early and list names

- generally need 3.5

- highly sought after candidates are invited for "visit weekends"

MD or other pre-health field advice

- check requirements early

- special requirements for most medical schools

- clinical engineer is an option!!! - helping with implantation of devices in the medical field

Beyond classroom

- research is required

- volunteer

- shadow physicians

- patient contact time

- build relationships - write letters

- use your design experiences

- requirements vary be degree

Conclusions/action items:

This lecture was very helpful in terms of learning more about getting an MS. I had no idea there are multiple options for an MS degree here at Madison. I thought I was decided on going into the industry after school, however, I think getting an MS could be an option. For now, I should do more research into MS programs or possibly some of the research options. I have always wanted to go abroad at some point too, so I should look into options that would involve traveling if there are any (REU??).

2024/10/02 - Near Peer Mentoring

LIA LEJONVARN - Oct 02, 2024, 2:03 PM CDT

Title: Near Peer Mentoring

Date: 10/02/2024

Content by: Lia

Present: N/A

Goals: Learn more about mentoring

Content:

Why are we mentoring?

- additional instruction and emotional support
- peer mentors are more approachable; mentees are willing to ask questions
- share experiences
- increases belonging
- mutual benefits

Transferrable skills

- leadership
- communication skills
- active listening
- study practices
- self-awareness
- interpersonal skills

General benefits of mentoring

- increased self-esteem and confidence
- increased patience
- build positive habits
- Foster personal growth
- help identify gaps in your own knowledge

What does it mean to be a good mentor?

- building trust
- psychological safety
- reliability
- support/enthusiasm
- being available
- transparent
- humanizing their challenges: Be the coach
- good listening

Listening effectively

- get rid of distractions
- stop talking
- act like you're interested
- look at the other person
- get the main idea
- ask questions
- check for understanding
- react to ideas, not to the person
- avoid hasty judgements

What do you wish you knew in BME 200

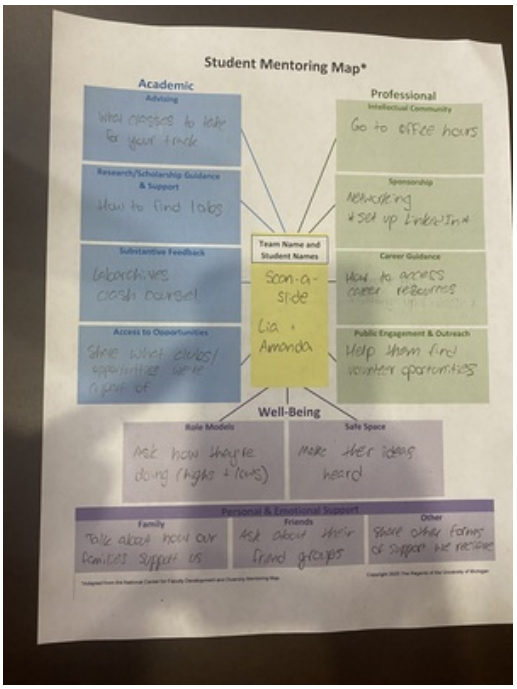
- getting ready for the career fair and applying to internships

- how to be ok with not knowing everything
- time management
- labarchives stuff
- how to ask for help

Conclusions/action items:

This lecture was very helpful for coming up with ways to better help our mentees. Me and Amanda are going to integrate these action items into our team meetings so that we can better help our Sophomores succeed. One thing I really want to do is a Labarchives crash course. I feel like they don't know much about how to write good entries or about the importance of putting everything into our notebooks. Overall I feel like I learned some new ways I can help them through BME and also better connect with them so that this semester runs very smoothly.

LIA LEJONVARN - Oct 02, 2024, 1:59 PM CDT



Download

IMG_6451.jpg (2.73 MB)

2024/10/09 - Sustainable Engineering

LIA LEJONVARN - Oct 09, 2024, 1:58 PM CDT

Title: Sustainable Engineering

Date: 10/09/2024

Content by: Lia

Present: N/A

Goals: Learn about sustainable engineering!

Content:

- Sustainability is defined as: "meeting the needs of the present without compromising that ability of future generations to meet their own needs"
- The health care industry has a lot of environmental impacts which in turn causes health impacts
- Circular economy: keeping materials out of waste streams so we can reuse them
- Life cycle assessment: you look at the environmental impact of products throughout their lifetimes
- Sustainability can also be about resiliency

How does sustainability fit into our projects?

- We should make our microscope platform long lasting
- It should be able to be recycled at the end of its life
- Make it so other labs can use it to (universal design) so that different versions don't have to be made

Conclusions/action items:

This lecture was helpful for learning about how sustainability applies to the field of medicine. I also learned more about what sustainability means. Our team will try and implement ways we can make our product more sustainable. One of these would be making our design more universal for the other labs on campus.

2024/10/16 - Introduction to WARF, IP, Disclosing, and Licensing

LIA LEJONVARN - Oct 16, 2024, 2:06 PM CDT

Title: Introduction to WARF, IF, Disclosing and Licensing

Date: 10/16/2024

Content by: Lia

Present: N/A

Goals: Learn more about patenting and licensing and WARF

Content:

WARF

- support university research by providing financial report, actively managing assets, and moving innovations to marketplace
- Technology transfer: moving research results from campus onto the market
    - examples: intellectual property licenses, industry sponsored research, consulting arrangements, fee for service
    - WARF at this to facilitate securing IP rights and commercial licenses

Intellectual Property

- four common types: patents, copyrights, trademarks, trade secrets
- other, WARF IP: biomaterials, technique and know how, data

Non-patent IP

- copyrights
    - protection for creative works that are expressed in tangible medium
    - a wide range of subject matter
- trademarks
    - protection for names, marks, logos, dress, etc
    - requires use in commerce
    - source-identifying function
- trade secrets
    - can be used to protect anything of value
    - protection is good so long as the concept is not generally known

patents

- patents are property rights granted by a governmental agency
- patent holder has right to exclude others from making, using, selling, or importing the claimed invention
- three different types of US patents
    - design (ornamental features, 15-year term)
    - plant (20-year term)
    - utility (provisional is a 1-year place holder, non-provisional is a 20-year term)
- Utility (non-provisional)
    - issued for invention of a new and useful process, machine, manufacture, or composition of matter
    - a quid pro quo with the USPTO and the public
    - often takes 2-5 years to issue after filing
    - cost on average $30K
    - 90% of patents issued by USPTO
- requirements
    - 101 - eligible: cannot be a product of nature, abstract idea, or natural phenomenon
    - 102 - novel: it must be new
    - 103 - non-obvious: it cannot be simple modification or combination of existing concepts
    - 112 - enable and described: must provide enough detail to teach others how to make or use the invention
    - patent examiners are scientists hired and trained by the USPTO to review applications for these requirements

Disclosing an innovation to WARF

- Disclosing:
    - describe the innovation

    - identify advantages and potential applications
    - name contributors
    - provide finding and public disclosure details
- meeting with WARF
    - discuss the innovation in detail
    - ask questions about WARF and patenting process
    - discuss next steps

Assessing university inventions

- IP considerations: type, strength of IP protection, public disclosure, stage of development
- licensing considerations: applications, likelihood of identifying a commercial partner, likely return from licensing

Marketing and Licensing

- market analysis
    - market status - established, emerging, new
    - side and type
    - potential licensees
- license negotiation
    - types and terms
    - consideration
- ongoing: technology development, enforcement, amendment, termination

Value of Licensing

- Benefits to company: reduced R&D costs, improved time to market, opportunity to enter new markets, new features or products provide additional revenue opportunities
- Determining the value: technology application, key selling points, technology trends, market size, industry standards/historical deals

AI and IP

- Patents
    - can AI invent? No
    - limited to US? No
    - Can AI assist in inventing? evolving but likely yes under Pannu Factors
- Copyrights
    - original works of human authorship
    - AI must be incidental to conception and creation
    - original conception by human master mind
    - combinations of derivative works requires more than de minimis contribution from human
    - traditional elements of authorship generated by AI? No

Conclusions/action items:

This was very helpful for learning more about possible options for the products we develop in these design classes. I do not think our project would ever reach this point since it is very much geared towards our client's specific issues with her scanner. However, this will be a helpful reference for future design courses.

2024/10/23 - Do I Need An IRB

LIA LEJONVARN - Oct 23, 2024, 2:03 PM CDT

Title: Do I Need an IRB

Date: 10/23/2024

Content by: Lia

Present: N/A

Goals: learn more about IRBs and what they mean for our projects

Content:

IRB:

- Institutional Review Board
- committee that conducts ethical and regulatory review of research involving human participants

Why do IRBs exist and what is their role?

- in response to unethical research such as the Nazi prisoner experiments which led to the 1947 Nuremberg Code
- The Tuskegee Syphilis Study led to the 1974 National Research Act
- Belmont principles: Respect for Persons, Beneficence, Justice
- Regulations for protection of human "subjects": DHHS aka "common rule", FDA

IRBs

- Instituted by Common Rule and FDA regulations
- review research studies to ensure they meet regulatory and ethical standards, follow policies, and protect participant's rights and welfare
- two IRBs at UW Madison
    - Minimal Risk Research IRB (MRR IRB): biomedical, education, and social/behavioral sciences research, secondary analysis of data, survey research, etc.
    - Health sciences IRB (HS IRB): biomedical, interventional, and risk level, all RDA regulated and VA regulated research

Do I need an IRB

- Is it research under the common rule? research means a systematic investigation including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge
- Does it involve human subjects?
    - human subject means a living individual about whom an investigator conducting research obtains information or biospecimens through intervention or interaction and obtains, uses, studies, or analyzes identifiable private information or identifiable biospecimens
- Is it human research under FDA device regs?
    - Device = intended for use in diagnosis, treatment, or prevention of disease, or that affects structure or function of body
    - research/clinical investigation = involves one or more subjects to determine device safety or effectiveness
    - subject = individual on whom or on whose specimen an investigational device is used or as a control in an investigation

Preparing for IRB review

- Complete required training for researchers through CITI: human subjects protection training, conflict of interest training, good clinical practice training, HIPAA privacy and research training
- Complete annual outside activities report
- Develop research plan

What IRB application type will you need?

- All use UW Madison's electronic submission system, ARROW
- Basic types: protocol-based and non-protocol based

Conclusions/action items:

This lecture was helpful in learning more about IRB's and when to decide if you need one. Our project does involve the use of biospecimens in the form of cytology slides. However, the slides are de-identified and there is no interaction with human subjects. Our project is also very specific to our

client's needs and does not necessarily contribute to general knowledge. Therefore, we do not need and IRB for our project and since it is just for our client's use at this stage, I do not think it will be necessary after the semester as well.

2024/10/30 - Navigating FDA Device Requirements

LIA LEJONVARN - Oct 30, 2024, 2:08 PM CDT

Title: Navigating FDA Device Requirements

Date: 10/30

Content by: Lia

Present: N/A

Goals: learn about FDA requirements for medical devices

Content:

What is a medical device?

- Anything that's intended to improve health but not through chemical or biological action
- non-traditional: laboratory tests, software, medical apps (apple watch), mouth wash
- software as a medical device (SaMD): intended for one or more medical uses that may run on operating systems of in virtual environments. Software run on a hardware medical device is a SaMD when not part of intended use of the hardware medical device

Device Classification Overview

- There are three main classes (1, 2, and 3)
- Three risks (low, moderate, highest)
- marketing: exempt from premarket approval, 510(k) showing substantial evidence, premarket approval

Regulatory Controls Key Elements

- General controls: registration and listing, adverse event reporting, labeling, manufacturing practice
- special controls: performance, post-market surveillance, data requirements
- premarket approval: data to show safety and effectiveness

Class 1

- Risk level: low
- regulatory requirements: mostly exempt from premarket notification and QS requirements, most follow certain general controls
- approval process: self-registration and listing with the FDA

Class 2

- risk level: moderate risk
- regulatory requirements: must follow general and special controls
- approval process: submission of a 510(k) application to show substantial evidence; may be exempt

Class 3

- risk level: high
- regulatory requirements: must follow general controls and additional stringent requirements, such as clinical trials to demonstrate safety and efficacy
- approval process: PMA submission, involves a comprehensive FDA review of safety and effectiveness of data before marketing

Market submission types

- 510(k) exempt: registration and listing only
- 510(k)-premarket notification: substantial equivalence
- PMA-premarket approval: full safety and effectiveness submission, manufacturing details
- De Novo Classification: Novel medical devices, no legally marketed predicate

How to classify a medical device

- FDA has a bunch of data bases you can look through to find similar devices (product classification panel)
- Product code: device definition and classification, submission type, GMP requirements, recognized consensus standards

Key points for classification

- Intended use: general purpose
- Indications for use: specify specific conditions, populations, or situations where device is intended to be used

Conclusions/action items:

Our team should further look into whether what we make is considered a medical device. I think it does classify but the only way it could directly affect the health of others is through diagnosis however our client is mainly intending to use the scans for teaching purposes. However, we should further research similar devices and which classification our device falls under. This can help us keep in mind some requirements we would need to follow if this would become a commercial product.

2024/11/06 - Regulatory Strategy

LIA LEJONVARN - Nov 06, 2024, 2:05 PM CST

Title: Regulatory Strategy

Date: 11/06/2024

Content by: Lia

Present: N/A

Goals: Learn more about the framework guiding advanced therapeutic product development

Content:

FDA structure and Advanced Therapies

- Examples: Gene Delivery, Genome editing, cell therapy
- Subcomponents: Device (CDRH): PMA, 510(k), IDE; Drug (CDER): NDA, IND; Biologic (CBER): BLA, IND

Human cells, tissues and cellular and tissue-based products

- 361 (minimal manipulated) products: don't have to go through whole process of showing that the product is safe
- 351: product is regulated like traditional biologic, it is not minimally manipulated

Product development life cycle

- each stage faces its own risks and challenges
- proper management of these risks is vital for successful commercialization
- extremely important to be able to distinguish between studies that are "on the critical path" vs. "good research projects"

A target product profile is your product vision

- When to use it, why to use it, how to use it?
- Patient identification: Indication
- Patient benefits: Efficacy profile
- Patient risks: Safety profile
- is it medically and commercially compelling

Considerations when developing a 351-regulated CGT

- Start with non-GLP nonclinical studies and pilot tox studies
- pivotal GOP Tox studies
- CMC development
- demonstrate manufacturing consistency
- phase I/II/III trials
- ready to launch product

Quality management system implementation

- A system that documents policies, processes, internal rules, procedures, and other records to ensure consistent quality

Career options

- Characterization and Analytics: cell characterization, in-process controls
- Manufacturing development: GMP compliance, documentation
- process development: design space, CPPs for CQAs, device design
- gene delivery: Vector design/optimization, large scale production

Conclusions/action items:

This lecture was helpful for knowing the regulatory process for drugs and biologics. This does not apply to our current design project; however, it could apply to future projects. The lecture also went over good research practices which is helpful to know since I work in a lab this semester. The career options looked interesting too, and I think device design under process development applies most to what I want to do.

2024/11/13 - Medical Device Innovation

LIA LEJONVARN - Nov 13, 2024, 2:10 PM CST

Title: Medical Device Innovation

Date: 11/13/2024

Content by: Lia

Present: N/A

Goals: Learn about the process from prototyping devices to commercial clinical use

Content:

- regulatory process takes time so plan ahead, double calculation estimate

breakthrough devices program

- timely access to medical devices for life-threatening or irreversible conditions

process at a glance

- innovation idea and development
- human testing data acquisition with IRB oversight
- FDA regulatory process
- reimbursement or financial incentive
- sales

ecosystem

- medical device needs to follow rules of physician's departments
- examples: IDN, GPO, HER, IT, JIT

general steps

- clinical studies
- FDA approval
- CPT codes
- CMS national insurance decisions
- standards of practices
- national regional buying groups
- regional/local IDNs, hospitals
- hospital/IDN value analytics groups
- product evaluations
- regional/just in time distribution
- product implementation

workflow

- think about what the physician is doing
- how is the activity done without your device
- where is your opportunity for improvement
- are you improving the physician or the patient experience
- look at whole pathway when it enters to when it leaves

stakeholders

- who are they for your medical device
- examples: administration, national clinical oversight, patient point of care, national/regional buying groups, standard orgs, national and regional payment/reimbursement

trickle-down influence

1. national policy, standards of practice and clinical practice guidelines
2. health system and provider

3. payor

hospital new product adoption product

- find clinical champion
- find out review process (value analysis and technology assessment)
- think about opportunities for trials and evaluations

who buys, pays and gets reimbursed

- Key terms to uncover payments
  - CMS
  - DRG
    CPT
  - ICD 10
  - GPO
  - IDN
  - Payer Mix (% private, capitated, Medicare)
- Existence of codes do not equal financially favorable

Conclusions/action items:

It's very helpful learning about the endgame even though we are at the very beginning of the process. This can help guide our decisions in our design process in terms of regulations and also stakeholders. This will also be helpful later on when we hopefully have the opportunity to get farther along the process. The speaker also mentioned that it is very helpful to talk to people such as the clinician or anyone who is part of the process.

2024/11/20 - How New Product Development Works in the Medical Device Industry

LIA LEJONVARN - Nov 20, 2024, 2:05 PM CST

Title: How New Product Development Works in the Medical Device Industry

Date: 11/20/2024

Content by: Lia

Present: N/A

Goals: Learn about new product development

Content:

NPD in the medical industry is:

- highly regulated: FDA and other regulatory bodies have an impact
- expensive: requirement for verification and validation is a cost multiplier
- resource intense:
- competitive

Selecting and prioritizing projects:

1. corporate business strategy
2. product portfolio review
3. project review
4. budgeting and resource allocation

Types of NPD projects

- line extensions
- product improvements
- new-to-company
- new-to-world

Managing NPD: Stage-gate process

- Stage 0: ideation
- Stage 1: exploration
- Stage 2: concept development (can kill projects at this stage)
- Stage 3: design development
- Stage 4: design confirmation (design freeze)
- Stage 5: design transfer and commercialization (launch)
- Post-market surveillance

Defining the Problem

- most important step of the process!

Design Development

- move to prototype
- continue design process
- confirm regulatory pathway
- begin formal design control documentation

Design control

- mandatory for FDA class 2 and 3 and almost all EMA devices
- includes documentation of customer needs, design requirements, design inputs/outputs, testing, and design reviews
- tightly aligned with risk management

Design confirmation

- conduct extensive verification and testing

- finalize product and component drawings/models
- accelerate manufacturing process development along with plans for quality control
- "freeze" design at the end of this stage
- submit regulatory documentation

Design transfer and commercialization

- complete remaining testing
- make final design changes
- build models, assembly/test equipment
- create instructions for use (IFU) and user manuals
- develop service plan and resources
- finalize go-to-market strategy and start limited release (if applicable)

Conclusions/action items:

There are a lot more steps with creating new products than I originally thought. I had no idea it was such an involved process though it makes sense when considering the application of most of these products. It's interesting to hear about how the original idea is developed and how important it is to hear about existing problems in the area of interest and how important it is to get a good idea of the problem. That was one step we had trouble within our design project, the problem was not clearly defined by our clients, so we had to pick a struggle that they had and continue down that path.

9/13/24 Microscope Scanner Research

AMANDA KOTHE - Sep 13, 2024, 9:13 AM CDT

Title: Microscope Scanner Research

Date: 9/13/24

Content by: Amanda Kothe

Present: N/A

Goals: Learn about the basics of how microscope scanners function

Content:

- Images generated by microscope slide scanners are stitched together by software during the slide scanning process

- The final result is a single digital file in full resolution

- Many slide scanning systems consist of box systems with fixed instrument configurations (like a dedicated objective and one imaging mode)

-Microscope scanners are integrated into research microscopes

- While the microscope moves in small steps around the entire slide, individual images are taken and then all the images are stitched together

Citation:

> *Whole Slide Scanner: MMI Cell Scanner*. Molecular Machines & Industries. (2024, August 12). https://www.molecular-machines.com/products/whole-slide-scanner

Conclusions/action items: In this research I learned about the basics of microscope slide scanners and how they work in order to have some questions ready for the client. These questions include:

- What type of slide scanner and software are they currently using?

- What new software have they tried?

- Do they want us to add to the old machine, or build a whole new slide scanner?

- Budget?

- Any dimension limitations on how big microscope can be?

- How many slides do they scan a day? How many images will need to be housed in the software?

- More specifics about software (how should images be sorted, should they be split into groups/labs and projects? Just need more details)

9/26/24 Deconvolution Research

AMANDA KOTHE - Sep 27, 2024, 12:39 PM CDT

Title: Deconvolution Research

Date: 9/26/24

Content by: Amanda Kothe

Present: N/A

Goals: Learn more about deconvolution of images

Content:

PSF (point spread function): makes image intensity information non-quantitative. The PSF is the image of a point source of light as imaged through a lens, and it is the function describing the diffraction of light in optical system. The PSF helps to verify no abnormalities are present.

Microscope lenses kill more and more contrast of smaller features, up to the resolution limit, after which there is no contrast (and thus no resolution). This means large features are bright but small features appear less contrasted and dimmer than they should be.

Deconvolution corrects the systemic error of contrast loss (it tries to reverse the effects of blur in the image).

Diffraction-PSF-3D plugin in ImageJ generates a Z stack of the theoretical PSF.

Iterative Deconvolution #D plugin uses a PSF image z-stack to correct image contrast vs feature size.

Resources:

“Deconvolution,” ImageJ Wiki, https://imagej.net/imaging/deconvolution (accessed Sep. 26, 2024).

Conclusions/action items:

Once we as a group get access to the Z-Stack images from the labs current scanner, we can try to use both types of Image J deconvolution (diffraction and iterative) to see which improves the images the best. From there, we can try to determine how we can make an automated process for the lab to use this software to improve their images.

10/17 Image Stitching Software

AMANDA KOTHE - Oct 18, 2024, 12:23 PM CDT

Title: Image Stitching Software

Date: 10/17

Content by: Amanda Kothe

Present: N/A

Goals: Learn about possible software's we can use for image stitching

Content:

Image J is able to do Grid/Collection stitching of images. This can be done row by row, column by column, or snake by rows/columns (probably most relevant for our project). This would allow us to give the software the orientation of the images, and then it would be able to stitch them together for us.

Conclusions/action items:

The website says we would be able to use an "arbitrary" number of images, meaning more research and testing would need to be done to determine if it is possible to use this software with the number of images we will have.

9/20/24 Patents and Standards Research

AMANDA KOTHE - Sep 27, 2024, 12:25 PM CDT

Title: Patents and Standards Research

Date: 9/20/24

Content by: Amanda Kothe

Present: N/A

Goals: Learn more about the patents and standards related to slide scanning in labs.

Content:

eCFR 493.1274 Standard: Cytology clarifies that when cytology labs are using automated and semi-automated screening or scanning devices, the laboratory must follow the manufacturer's instructions for the machine [1]. It also specifies that labs must have written policies and control procedures in place for scanning slides.

Additionally, eCFR Standard 1254.80 specifies that when using a slide scanner, slides must be checked after scanning to ensure that no damage occurs when the slide is in the scanner. Automatic feeder devices on flatbed scanners are prohibited. Light sources in the scanner must not raise the surface temperature of the slide being scanned. Finally, no part of the equipment may come in contact with the slides in a way that will cause friction, abrasion, or any damage to the slides [2]. There are also many more random specifications, such that the platens or copy boards must not be smaller than the records (the slides cannot hang over the board they are on), and drum scanners cannot be used.

Resources:

[1] “§ 493.1274 Standard: Cytology.” *Ecfr.gov*, 2024. https://www.ecfr.gov/current/title-42/chapter-IV/subchapter-G/part-493/subpart-K/subject-group-ECFRc96daead380f6ed/section-493.1274 (accessed Sep. 19, 2024).

[2] “§ 1254.80 Does NARA allow me to use scanners or other personal copying equipment?” *Ecfr.gov*, 2024. https://www.ecfr.gov/current/title-36/chapter-XII/subchapter-C/part-1254/subpart-C/subject-group-ECFRd4513c4b260d6b4/section-1254.80 (accessed Sep. 19, 2024).

Conclusions/action items:

This research essentially clarified that slide scanners used in labs must not impact the slides in any way. This means that for whatever method we take for the project, we must be very careful that the slides remain the same as when they started. We also must document the methods we are using for the lab to have access to.

9/11 - BME Career Prep

AMANDA KOTHE - Sep 11, 2024, 2:07 PM CDT

Title: BME Career Prep

Date: 9/11/2024

Content by: Amanda Kothe

Present: N/A

Goals: Get ready for the career fair and for "job searching"

Content:

Job Search Tips

- Keep track of what you do

- Quality of source matters

- Connect BEFORE you are a candidate

- Applying is step 1

- Think beyond the title (focus on skills, industry, and exposure)

- It takes time

- Don't let perfect be the enemy of good

ECS.wisc.edu/resources for excel tracker sheet

Resume Tips

- Tailor your resume to the position - quick changes

- Create balance (show a full picture of your experience)

- "Flawless" product (ATS proofed resume is do-able) : MS Word, no columns/charts/colors, design projects without years or semesters, technical skills and coursework, jobs-organization + location, position title + dates

- Lots of ECS help still available before the fair

Career Advice for BME

- Identify your purpose: more than just an internship

- Looking beyond the obvious: overlap with other disciplines

- Research the employer: feedback from our partners

- Develop your "value added" statement: why you?

Conclusions/action items: I will use the tips explained today when at the career fair. This includes all of the advice given about resumes, how to stand out, and what to look for in companies at the career fair.

9/18/2024 Lecture Notes

AMANDA KOTHE - Sep 18, 2024, 2:03 PM CDT

Title: Exploring your Leadership Style

Date: 9/18/2024

Content by: Amanda Kothe

Present: N/A

Goals: Learn more about leadership styles and try to determine what mine is.

Content:

What are important qualities in a leader? Organized, understanding, confident, communication, empathetic, open minded, respectful, and more

Anatomy of a good leader: Self-awareness, vision, transparent, communication, decision-making, empathy

Leadership Styes (3 examples)

Power Model: "Someone has to take control here, and it should be me". "Great Man Theory" & Trait Theory - only certain people are born to lead, being in control is the most important thing. Has hierarchy, authority, and command.

Servant: "It's not about me and my needs, the needs of my followers is most important. Being of service to others, sharing power, and listening and understanding. Empathetic, empowering, shared decision making.

Authentic: "By being genuine self, I will gain and build trust." Building self esteem and self-awareness, emotional intelligence, creating authentic relationships. Transparency, genuineness, honesty.

Four quadrants of leadership stye:

People : The glue that holds the team together: gets to know everyone as individuals

Process: Sets the pace for the team, willing to work alongside everyone

Thought - Sees the big picture and anticipates the future

Impact - You set the bar high and push for excellent performance

Leadership doesn't require a particular job title: leading other starts with leading yourself.

Explore and define how you want to lead:

- Self asses (motivations, strengths, and values)

- Observe and Reflect (what gives you a sense of accomplishment, where do you show up well, how do you get in your own way?)

- Seek out feedback (others may be able to identify strengths and areas of growth you're not actively aware of)

Goal Setting

- start small, slow down

- focus on one element to practice

- look for mentors

- ask questions, partner with others

Conclusions/action items:

Team Goal: I would like my design team to be able to function well together and be able to openly talk to each other and bounce ideas off of each other without conflict. In order to do this, I believe it would be good for me to be a people-oriented leader. In order to do this, I should get to know all of my team members, and try to make as inclusive of an environment as I possibly can.

Self Goal: I would like to learn more about being a leader in general. As a person, I think I normally tend to want to fade into the background a bit, so it will be good practice for me to try and be more in the forefront for my project this semester. Success would look like playing a bigger role in my team project this semester, and hopefully feeling like a leader to my teammates (especially the sophomores).

9/25 Fall Post Grad Planning

AMANDA KOTHE - Sep 30, 2024, 11:58 AM CDT

Title: Fall Post Grad Planning

Date: 9/25 (notes taken on 9/30, per permission by Dr. P)

Content by: Amanda Kothe

Present: N/A

Goals: Learn more about what to do post grad

Content:

- Use your undergraduate experience to "build a story" (gain experience while you can, tie them together, research)

- Do your homework

- Think about letter writers of references early (3 strong ones)

- School: Prepare for the MCAT or GRE (summer before senior year)

- MS is typically a stepping stone for further education, and will make you more desirable (really powerful for industry experience)

- 3 MS options in BME at UW

- Can also do a MS in global health, in other engineering dept, or get MBA (though industry generally pays for credits or evening options)

- It is important to balance classwork and research and experiences for what is important for your future, after these leadership and extracurricular activities

Conclusions/action items:

After watching this lecture, I am sure that I am more focused on going into industry post grad than anything else. Although I am still considering a masters, I am more interested in going straight into industry than that. I am also considering an MBA, however that would be something to look into post grad, as many companies help to pay for that.

Email from Dr.P excusing the late entry:

John Puccinelli

To: AMANDA ROSE KOTHE

Wed 9/18/2024 5:48 PM

Hi Amanda,
That's a great opportunity, yes, you can go. Please email me after the lecture and I can send you the recording so you can put in your notes (along with this email) for attendance.
Well wishes,
-Dr.P

John P. Puccinelli, PhD (he/him)
Associate Chair of the Undergraduate Program
BME Design Curriculum Coordinator
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1550 Engineering Drive
Madison, WI 53706-1609
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Department of Biomedical Engineering

10/2 Near Peer Mentoring

AMANDA KOTHE - Oct 02, 2024, 2:08 PM CDT

Title: Near Peer Mentoring

Date: 10/2

Content by: Amanda Kothe

Present: N/A

Goals: Learn more about peer mentoring

Content:

Why are we mentoring BME 200 students?

- Additional instructional and emotional support for students

- Peer mentors are more approachable, mentees are more willing to ask questions

- Share experiences

- Increases belonging

- Mutual Benefits (transferable skills)

Transferrable Skills: Leadership, communication, active listening, study practices, self awareness, interpersonal skills

General Benefits of Mentoring: Increased self esteem/ confidence, increased patience, build positive habits, foster personal growth, help identify gaps in your own knowledge, sense of accomplishment

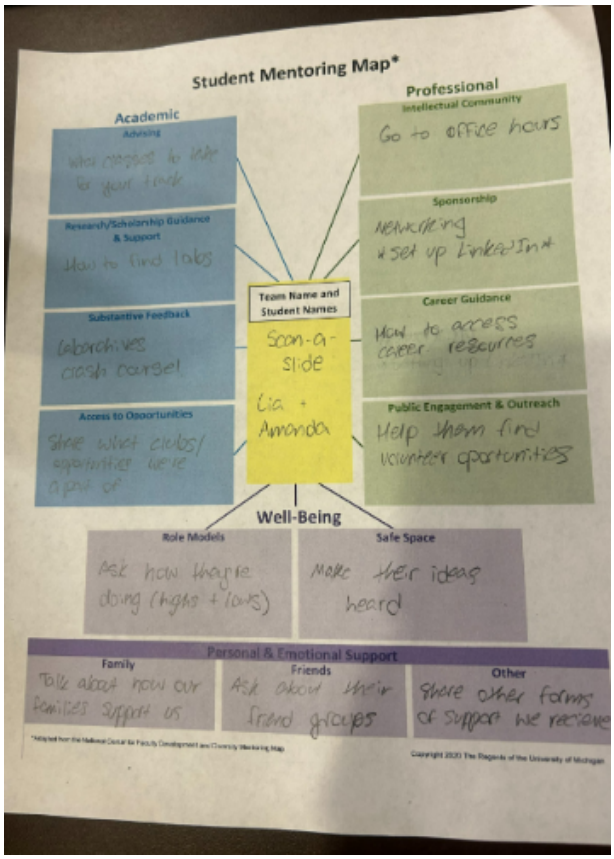
What does it mean to be a "good mentor"?

- Building trust
- Psychological Safety (share w/o fear)
- Reliability
- Support/Enthusiasm
- Being available
- Transparent (open and honest)
- Humanizing their challenges (be the coach)
- Good listening

Listening Effectively: get rid of distractions, stop talking, act like you're interested, look at the other person, get the main idea, ask questions, check for understanding, react to ideas and not the person, avoid hasty judgements

What do you wish you knew in BME 200?

- more access to example documents
- preparing for the career fair and applying to internships
- how to be ok with not knowing everything and be ok with asking questions
- Crash Course in Lab Archives



Conclusions/action items: After this lecture, I really understand the importance of trying to be a good mentor for my BME 200s. I will try to integrate the advice and things that I learned into my leadership this semester to make my sophomores as successful as possible. Lia and I will also try to use the items in our action plan to help our sophomores.

10/9 Sustainable Engineering

AMANDA KOTHE - Oct 09, 2024, 2:02 PM CDT

Title: Sustainable Engineering

Date: 10/9/2024

Content by: Amanda Kothe

Present: N/A

Goals: Learn more about sustainable engineering

Content:

In 1987, United Nations Brundtland Commission defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

A Life cycle assessment is how you get a carbon footprint. It is circular from resources - processing - manufacturing - distribution - use - end of life - back to resources.

We then discussed how sustainability fits into BME projects and medicine.

How does sustainability fit into our project:

- We need to make our product as long lasting as possible so our clients don't have to "consume" more

- Should be recyclable at end of us

- Trying to make product other labs can also use (universal design) so other labs can also consume less

Conclusions/action items:

I will try to use the information I learned today about sustainable engineering where it pertains in my project. I will also keep this in mind in my future endeavors in work, as this is a very important topic especially in med device.

10/16 Intro to WARF, IP, Disclosing and Licensing

AMANDA KOTHE - Oct 16, 2024, 2:07 PM CDT

Title: Introduction to WARF, IP, Disclosing and Licensing

Date: 10/16

Content by: Amanda Kothe

Present: N/A

Goals: Learn more about WARF and patenting and licensing

Content:

- WARF supports scientific research within the UW-Madison community by providing financial support, actively managing assets, and moving innovations to the marketplace for a financial return and global impact
- Technology Transfer: moving research results from campus out into the market. WARF works at this interface to facilitate securing IP rights and commercial licenses
    - intellectual property licenses
    - industry sponsored research
    - consulting arrangements
    - fee for service
    - A
- Four common types of IP
    - patents: a property right granted by a governmental agency (each country has it's own patent agency), patent holder has right to exclude others from making, using, selling, or importing the claimed invention
        - 3 types of us patents:
            - Design (15 years, limited to ornamental features)
            - Plant (new variety, 20-year term, asexually reproducing, non-tuber)
            - Utility (provisional is effectively a 1 year placeholder, non-provisional is 20-year term and can claim priority to a provisional)
        - Issued for the invention of new and useful process, machine, manufacture, or composition of matter
        - Often takes 2-5 to issue after filing
        - costs, on average, 30k
        - Statutory requirements include: eligible, novel, non-obvious, and enabled and described
        - Patent examiners are scientists hired and trained by the USPTO to review patent applications
    - copyrights: protection for creative works that are expressed in a tangible medium, a wide range of subject matter, including software code
    - trademarks: protection for names, marks, logos, dress, etc. Requires use in commerce, source-identifying function
    - trade secrets: can be used to protect anything of value, protection is good so long as the concept is not generally known
    - other, WARF IP: biomaterials, technique and know how (akin in some ways to trade secretes), data
- WARF receives ~400 new innovation disclosures each year
- Disclosing:
    - describe the innovation
    - identify its advantages and potential applications
    - name contributors

    - Provide funding and public disclosure details
- Meeting with WARF
    - discuss the innovation in more detail
    - ask questions about WARF and patenting process
    - discuss next steps
- IP Considerations
    - type of IP protection
    - Potential breadth and strength of IP protection
    - Public disclosure (past and planned)
    - Stage of development
- Licensing Considerations:
    - Applications
    - Likelihood of identifying a commercial partner
    - Likely return from licensing
- Market Analysis
    - Market Status - established, emerging, new
    - Size and type: e.g., large and growing, medium and contracting, etc.
    - Potential licenses - companies in the market
- License Negotiation
    - Type and terms - e.g. exclusive and field limited, sublicensing, etc.
    - Consideration - e.g., upfront payment, royalties, reimbursement
- Ongoing
    - Technology development, enforcement, amendment, termination
- AI is a lot more complicated when it comes to patents and copyright

Conclusions/action items:

Today I was able to learn more about the patent protection process. The information that I learned today is something that I can keep in mind when continuing to work on BME projects, and projects during my career that might require patents.

10/23

AMANDA KOTHE - Oct 23, 2024, 2:10 PM CDT

Title: Do I need an IRB

Date: 10/23

Content by: Amanda

Present: N/A

Goals: Why do IRBs exist and what is their role? IRBs at UW-Madison. What requires IRB review and approval? Preparing an IRB application. IRB Review Process.

Content:

IRB = Institutional Review Board

- Committee that conducts ethical and regulatory review research

Unethical research -> ethical principles -> human research regulations

Belmont Principles: Respect for Persons | Beneficence | Justice

Institutional Review Boards...

- Instituted by Common Rule and FDA regulations
- Review research studies to ensure they meet regulatory and ethical standards

UW Madison IRBs

- Minimal Risk Research IRB (MRR IRB)
  - Biomedical, education, and social/behavioral sciences research
  - Secondary analysis of data, survey research, behavioral health interventions, evaluations of educational practice
- Health Sciences IRB (HS IRB)
  - Biomedical, interventional, any risk level
  - All FDA regulated and VA regulated research
- They serve UW-Madison, UW Health affiliates, Madison VA Hospital
- May "cede" oversight to other institutions or independent IRBs
  - multi-site studies required to use single IRBs

Is it research under the Common Rule?

- Research means a systematic investigation including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge

Does it involve human subjects?

- Human subject means a living individual about whom an investigator conducting research:
  - obtains information or biospecimens through intervention or interaction, and uses, studies, or analyzes the information or biospecimens; or
  - obtains, uses, studies, analyzes, or generates identifiable private information or identifiable biospecimens

Is it human research under FDA device regs?

- Device = intended for use in diagnosis, treatment, or prevention of disease, or that affects structure or function of the body
- Research / clinical investigation = involves one or more subjects to determine device safety or effectiveness
- Subject = individual on whom or on whose specimen an investigational device is used or as a control in an investigation

Researcher Responsibilities

- Complete required training for researchers through CITI
- Complete annual Outside Activities Reports

Basic Types of IRB applications: Protocol-based and Non-Protocol Based

Post-approval responsibilities

- Obtain all required approvals before beginning research
- Follow approved protocol precisely
- Use only IRB-approved materials (protocol, recruitment materials, consent forms, assessment tools)
- Submit change of protocol application for IRB approval before implementing any changes

Conclusions/action items:

Today I was able to learn more about IRBs, especially those on campus. Although not relevant to my current project, this could be relevant to projects in the future, so I will keep this information in mind then.

10/30/2024 Navigating FDA Device Requirements

AMANDA KOTHE - Oct 30, 2024, 2:10 PM CDT

Title: Navigating FDA Device Requirements

Date: 10/30/2024

Content by: Amanda Kothe

Present: N/A

Goals: Learn about the FDA regulated Research Oversight Program and ICTR IND/IDE consultation service

Content:

What is a Medical Device?

- An instrument, apparatus, implement, machine, contrivance, implant, in vitro reagent, or other similar or related article, including a component part, or accessory
- Ex: MRI machines, drug infusers, syringes, gauze, etc.
- Non traditional med devices: laboratory developed tests, software, apple watch (due to EKGS and FDA 510k clearance), some mouthwash

Software as a Medical Device (SaMD)

- Software intended for one or more medial uses that may run on different operating systems or in virtual environments. Software run on a hardware medical device is a SaMD when not part of the intended use of the hardware medical device. Software is not SaMD if it drives or controls the hardware medical device.

Device Classification Overview

- Class 1 - low risk, exempt from pre-market approval, ex: band-aids, floss, tongue depressor
- Class 2 - moderate risk, 510(k) showing substantial equivalence, ex: BP cuffs, sutures, catheters
- Class 3 - highest risk, premarket approval, ex: pacemakers, vascular stents
- Note: other countries have different classes and clearances

Regulatory Controls Key Elements

- General Controls: registration and listing, adverse event reporting, general labeling, GMP
- Special Controls: performance standards, special labeling requirements, post-market surveillance, potential data requirements
- Premarket approval: data to show safety and effectiveness

Market Submission Types

- 510(k) Exempt: Registration and Listing only
- 510(k) - Premarket Notification : Substantial Equivalence
- PMA - Premarket Approval: Full Safety and Effectiveness Submission, Manufacturing Details
- De Novo Classification : novel medical devices, no legally marketed predicate

Conclusions/action items:

FDA requirements will be very relevant to my future career, as I want to work in industry. Over the summer during my internship I learned more about 510(k) clearances and working with the FDA, especially when it comes to audits. Thus, I know how some of the content learned today will be used in my future. However, it was helpful to get a more extensive background on the specifics of the FDA and medical devices.

11/6/2024

AMANDA KOTHE - Nov 06, 2024, 2:07 PM CST

Title: Regulatory Strategy

Date: 11/6/2024

Content by: Amanda Kothe

Present: N/A

Goals: Learn more about the framework guiding advanced therapeutic product development

Content:

FDA Structure and Types of Advanced Therapies: Device:CDRH (PMA, 510(k), IDE), Drug : CDER (NDA, IND), Biologic : CBER (BLA, IND)

- Examples: Genome Editing, Gene Delivery, Cell Therapy

Developing CGT Products for Hemophilia: U.S Laws made by congress -> Regulations made by FDA -> FDA Guidelines

Human cells, tissues, and cellular and tissue-based products are markedly different in terms of the time, effort, and expense required to bring a product. Basically, 351 products are regulated as drugs and/or biologics, while 361 products, comparatively, are largely unregulated.

Product Development Life Cycle: "Each stage of the product development cycle faces its own risks and challenges, and proper management of these risks is vital for successful commercialization." It is extremely important to be able to distinguish between studies that are "on the critical path" vs. "good research projects"

A target product profile (TPP) is your product vision. When to use it? Why to use it? How to use it? Is it medically and commercially compelling?

- Patient identification: indication
- Patient Benefits: Efficacy Profile
- Patient Risks: Safety Profile

Quality Management System Implementation: A system that documents policies, processes, internal rules, procedures, and other records to ensure consistent quality.

Career Options within a Regulated Environment: Chemistry, Manufacturing, Controls

- Quality and Regulatory Support
    - Characterization and Analytics
    - Manufacturing Development
    - Process Development
    - Gene Delivery

Conclusions/action items:

Today, I was able to learn about the different processes and framework behind advanced therapeutic product development. This included learning about the FDA, TPPs, and quality management systems. Although I am more interested in devices than therapeutic product development, a lot of the ideas behind these are similar, so I will keep what I learned in mind once I get into industry.

11/13 Medical Device Innovation

AMANDA KOTHE - Nov 13, 2024, 2:11 PM CST

Title: Medical Device Innovation: From Prototype to Commercial Clinical Use

Date: 10/13

Content by: Amanda Kothe

Present: N/A

Goals: Learn more about the path of medical device innovation

Content:

Medical Device Process at a Glance:

1. Innovation Idea and Development
2. Human Testing Data Acquisition with IRB oversight
3. FDA Regulatory Process
4. Reimbursement or Financial Incentive
5. Sales

Breakthrough Devices Program

- Formerly expedited access program
- Timely access to medical devices for life-threatening or irreversibly debilitating diseases / conditions

New Medical Technology Ecosystem

- Physicians, other clinical professionals, nursing clinicians, pharmacy, patient safety, informatics health it, biomed, materials/supply
- GPO/IDN Distribution/ JIT, International Clinical / research societies, EHR/IT Systems Suppliers, GPO/IDN Clinical Standards

General Steps from Approval to Adoption: Clinical Studies -> FDA Approval -> CPT Codes -> CMS National Insurance Decisions -> Standards of Practice -> National Regional Buying Groups ->

Regional/Local IDNS, Hospitals -> Hospital/IDN Value Analytics Groups -> Product Evaluations -> Regional/Just in time distribution -> Product Implementation

Trickle-Down Influence for New Technology: National Policy, Standards of Practice and Clinical Guidelines -> Health System and Provider -> Payor

Value Drivers to Discover: Economic, Clinical, Mission Impact

- Evidence more compelling than "hand-waving" benefit assumptions

Who buys, pays, and gets reimbursed depends (EXISTENCE OF CODES DO NOT EQUAL FINANCIALLY FAVORABLE)

Discover Through Research and Interviews

- Start with a detailed patient (or diagnosis) Flow/Care Pathway
- Explore pain points (OF COURSE) and gain creators (naturally)
- expand your knowledge of the procedure or diagnosis payment
- examine about how products or therapies are adopted locally and nationally
- understand the impact of outside organizations

Conclusions/action items:

Today I was able to learn more about the path from developing a med device to sales. This is extremely relevant to me as I want to work in R&D, so I will take the information I learned today and try to apply it when I work in industry.

11/15/2024 Tong Lecture

AMANDA KOTHE - Nov 15, 2024, 12:29 PM CST

Title: Tong Lecture

Date: 11/15/2024

Content by: Amanda

Present: All

Goals: Learn about the founders of Tasso

Content:

Both founders have unconventional backgrounds

Law and Entrepreneurship Clinic really helped them start the company and helped with initial patenting

Get scrappy with funding opportunities - SBIR grants

Evolution of the technology: Make a better product, kill your product when needed

Finding a key customer (champion) is very important - developing the technology for the costumer, early adopter with ownership in the technology

Conclusions/action items:

11/20 How NPD Works in Industry

AMANDA KOTHE - Nov 20, 2024, 2:07 PM CST

Title: How NPD Works in Industry

Date: 11/20

Content by: Amanda Kothe

Present: N/A

Goals: Learn about how new product development works in the medical device industry.

Content:

Intro

- NPD in the med device industry is
  - Highly regulated: FDA and other regulatory bodies have a significant impact
  - Expensive: Requirement for verification and validation (e.g. clinical testing) is a cost multiplier
  - Resource Intense: Involves sizeable teams to execute projects
  - Competitive:

Selecting and Prioritizing Projects: Corporate Business Strategy -> Product Portfolio Review -> Project Review -> Budgeting and Resource Allocation

Types of NPD Projects (from least to highest risk)

- Line Extensions: Addition of additional sizes and configurations
- Product Improvements: Existing product change due to market feedback and/pr new customer needs
- New - to - company: Product line that is not new to market but is new for the company
- New - to - world: Innovative products that create completely new markets

Managing NPD : Stage - Gate Process

- Stage 0 : Ideation
- Stage 1 : Exploration
- Stage 2 : Concept Development
- Stage 3 : Design Development
- Stage 4 : Design Confirmation (Verification and Validation)
- Stage 5 : Design Transfer and Commercialization
- "Stage 6" : Post Market Surveillance after Launch
- Includes "Gate reviews" with upper management about continuing project

Conclusions/action items:

Everything learned about today is very relevant to what I will be working on in industry. As I will be working in Research and Development at a med device company next semester, much of this information will be relevant to me. Thus, I will try to use what I learned today about the process when working at my Co-Op to further understand the work I am doing.

Resources regarding Microscope slide scanners

HAMAD ALDHAHERI - Dec 13, 2024, 7:30 PM CST

Title: Resources regarding Microscope slide scanners

Date: 11/24/2024

Content by: Hamad AlDhaheri

Present: N/A

Goals: To gain more understanding of Microscope slide scanners

Content:

https://www.molecular-machines.com/glossary/whole-slide-imaging#:~:text=Whole%20Slide%20Imaging%20is%20a,a%20single%20digital%20image%20file.

https://www.3dhistech.com/3-steps-to-ensure-superior-image-quality-with-digital-slide-scanning/

https://www.grundium.com/blog/should-pathologist-choose-a-microscope-or-a-slide-scanner/

https://www.olympus-lifescience.com/en/landing/objectives/research/slide-scanner/

https://www.microscopesinternational.com/support/kb/article/nsc1175.aspx

Conclusions/action items:

Based on the information gathered we can determine that in order to improve the existing microscope slide scanner we will need to incorporate improved software.

Research Regarding software to use in our design

HAMAD ALDHAHERI - Dec 13, 2024, 8:01 F

Title: Research Regarding software in our designs

Date: 11/24/2024

Content by: Hamad AlDhaheri

Present: N/A

Goals: To gain understanding regarding the software mainly deconvolution and AI image improvements

Content:

https://www.sciencedirect.com/topics/engineering/image-enhancement

https://www.laserfocusworld.com/detectors-imaging/article/55056066/deep-learning-methods-enable-image-enhancement-advances

https://medium.com/@patrishaanneestrada/the-art-of-image-enhancement-enhancing-image-quality-with-visual-transformation-techniques-3af789aa878

https://www.geeksforgeeks.org/image-enhancement-techniques-using-opencv-python/

https://onlinelibrary.wiley.com/doi/10.1155/2021/6612471#:~:text=Retinex%20algorithm%20%5B18%E2%80%9320%5D,do%20with%20the%20surrounding%20enviro

https://www.activeloop.ai/resources/image-enhancement-in-machine-learning-the-ultimate-guide/

https://www.pre-scient.com/knowledge-center/image-processing/image-processing-algorithms/

https://www.mathworks.com/discovery/image-enhancement.html

https://medium.com/image-processing-with-python/image-enhancement-with-python-d3040a39e394

Conclusions/action items:

based on this information determine the type and what kind of software to use in our designs.

Design Idea for Base 2

HAMAD ALDHAHERI - Dec 13, 2024, 7:00 PM CST

Title: Design Idea for Base 2

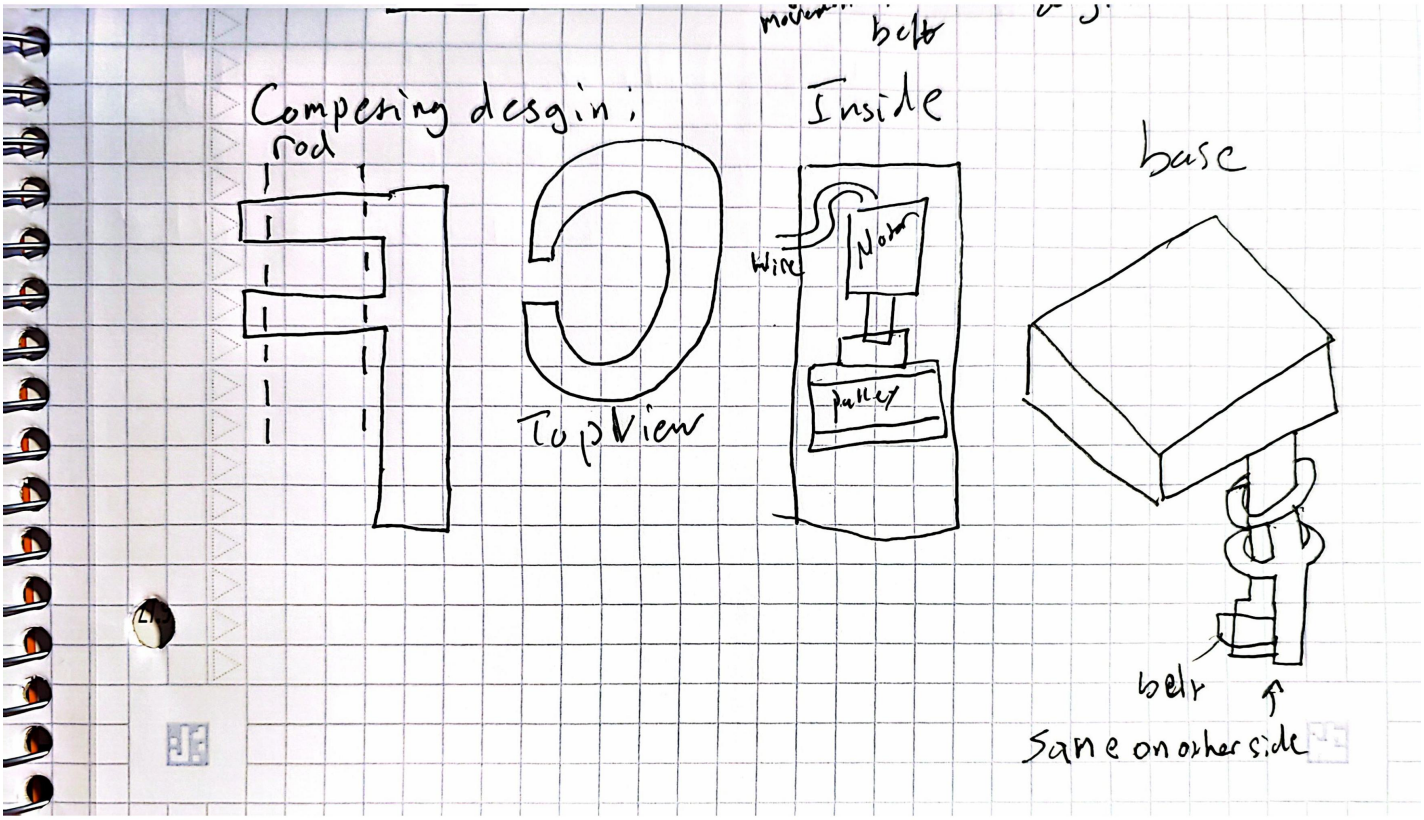
Date: 11/14/2024

Content by: Hamad ALDhaheri

Present: N/A

Goals: Propose a Design for how we are going to attach our design to the base

Content:



Conclusions/action items:

Discuss with the team which design are we going to use.

Design Idea for Base 1

HAMAD ALDHAHERI - Dec 13, 2024, 7:08 PM CST

Title: Design Idea for Base 1

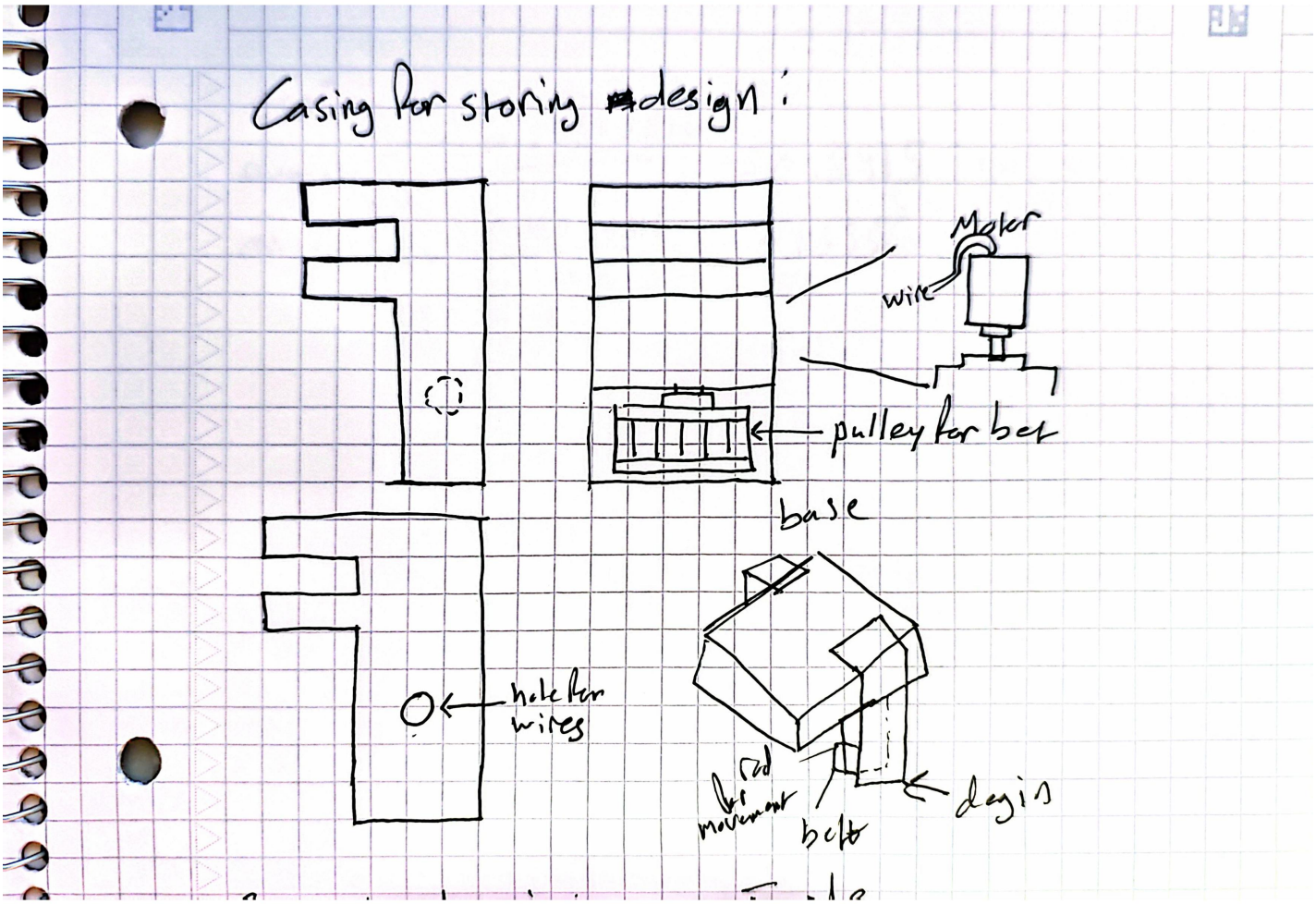
Date: 11/14/2024

Content by: Hamad AlDhaheri

Present: N/A

Goals: To Propose a Design for the base

Content:



Conclusions/action items:

Discuss with the team which Design to use to attach our project to the existing base.

Design Flowchart for Deconvolution

HAMAD ALDHAHERI - Dec 13, 2024, 7:13 PM CST

Title: Design Flowchart for Deconvolution

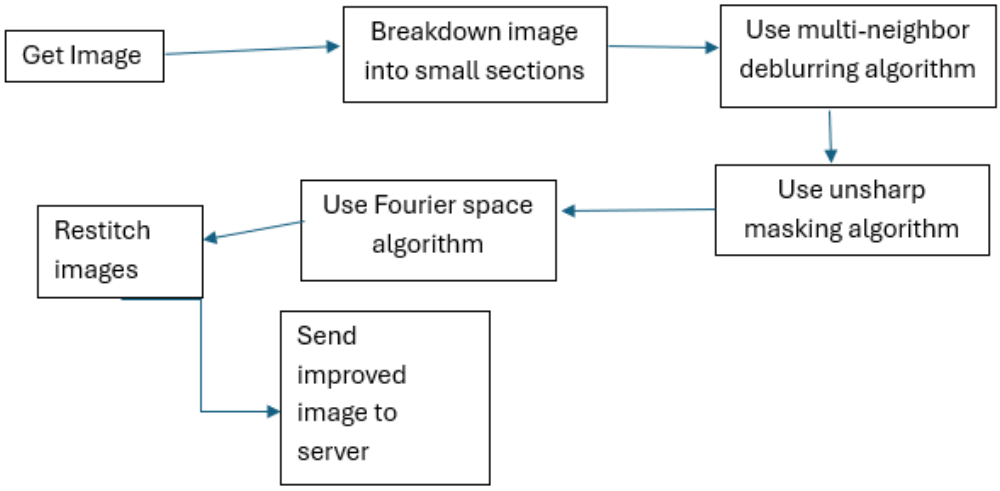
Date: 11/14/2024

Content by: Hamad AlDhaheri

Present: All

Goals: To showcase how the deconvolution software we proposed works

Content:



Conclusions/action items:

Discuss and review the design criteria to determine which design out of the three designs that we should be doing.

Design Flowchart for AI Image Improvement

HAMAD ALDHAHERI - Dec 13, 2024, 7:16 PM CST

Title: Design Flowchart for AI Image Improvement

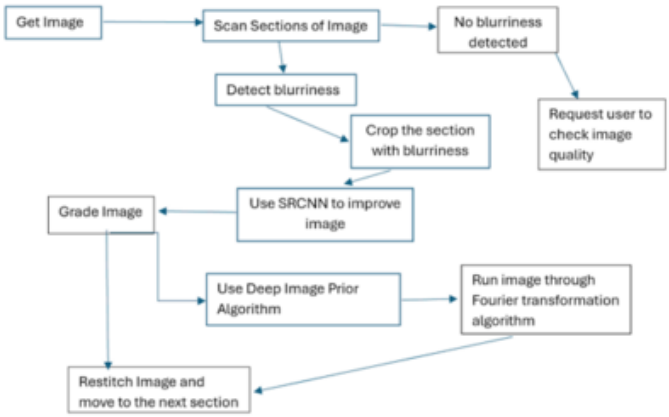
Date: 11/14/2024

Content by: Hamad AlDhaheri

Present: All

Goals: To showcase how the AI Image improvement software is going to work

Content:



Conclusions/action items:

Discuss with the team on which of the three propose design we should do based on the design criteria.

Research on movable stages / motors

Title: Research on movable stages / motors

Date: 10/25/24

Content by: Xavier Snider

Present: none

Goals: Fully take apart slide scanner, understand workings, take measurements.

Content: After fully deconstructing the slide scanner and seeing the workings, I researched different products similar (or suimilar ideas) for a m for movable x y axis pieces and stepper motors. I Found that we should probably go another rotue from making our own stage and lean towards for motors and potential parts but what i mainly got out of this personal research session was that we cannot build our own and understanding t

Products: https://www.googleadservices.com/pagead/aclk?sa=L&ai=DChcSEwicsbDat6qJAxW-Sv8BHc7gMvIYABABGgJtZA&co=1&ase=2&gclid=CjwKCAjwg-24BhB_Ei3ciML_kV3kizqYEG5TKu5NrL8n8Zj69YhWrcFYhoCwuMQAvD_BwE&ohost=www.google.com&cid=CAESVuD2jg_sFt5SwQKf6MdjjikiCppPRrnMW0uxEIl7jtAfLpSxHfoPrcG079aq8k_KvemfkN6Hurmw&q&nis=4&adurl&ved=2ahUKEwjWnarat6qJAxXvj4kEHSfNKzAQ0Qx6BAgIEAM

https://us.openbuilds.com/c-beam-linear-actuator-bundle/?srsltid=AfmBOopNWM_PO4rrCUdH2NCpQ__VDnBFAVvKBNbNZLIhdjLJD_ng7PFm

https://www.newport.com/p/M-406?xcid=goog-pla-M-406&gad_source=1&gclid=CjwKCAjwg-24BhB_EiwA1ZOx8qR00dr4m7qj95VUC4U3ZvI1lsjPtKqLnhPNhRoTEpHB3

https://www.sainsmart.com/products/sainsmart-genmitsu-cnc-router-3018-pro-diy-kit?srsltid=AfmBOoo3j-pCHAu7YPvoF9pu2FhBvmbXu9LGEttx74nVZlmRAwtYZ5sl

https://www.sainsmart.com/products/sainsmart-genmitsu-cnc-router-3018-prover-kit?srsltid=AfmBOopMcyvLfSWWPSNJgOO3h6IBpxV3-rrRgXUkf1w_Zq5f2OUXw-oS

https://www.newport.com/p/MT-XY?xcid=goog-pla-MT-XY&gad_source=1&gclid=CjwKCAjwg-24BhB_EiwA1ZOx8mCpCyaS0lHswSHRVfLe6TJr4PB7Lvi-fabeua2KyXceE

https://www.edmundoptics.com/p/Linear-Motor-XY-Microscope-Stage-Insert-Nikon-Inverted-Microscope/53521 **

Conclusions/action items: Figure out how to utilize pre-existing stage for microscope.

motor/pulley/gear potential purchases

Xavier Snider - Nov 15, 2024, 8:25 PM CST

Title: motor/pulley/gear potential purchases

Date: 11/15/24

Content by: Xavier Snider

Present: No one

Goals: Just housing some links

Content: https://www.amazon.com/gp/product/B00PNEQKC0/ref=ox_sc_act_title_4?smid=AWQBCGWISS7BL&psc=1

https://www.amazon.com/gp/product/B0CQNZYZPW/ref=ox_sc_act_title_3?smid=AK64CGABQOWCO&th=1

Conclusions/action items: We can order from the suyggested source we learned in our meeting. I belive a nema 17 is a good motor and we should proeceed with that.

The Slide Glider

Xavier Snider - Nov 15, 2024, 8:39 PM CST

Title: my design idea slide glider

Date: 10/20/24

Content by: Xavier Snider

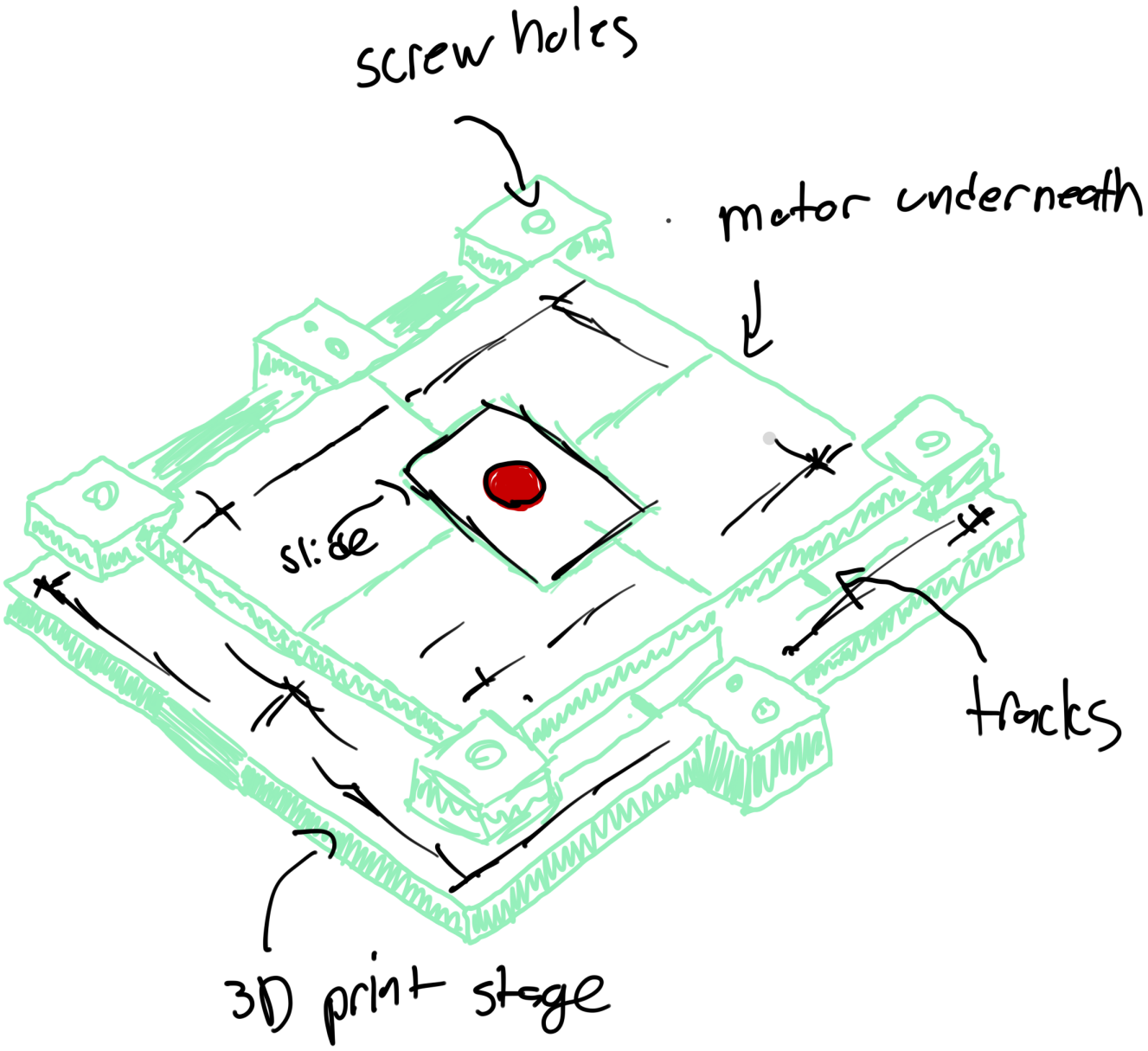
Present: Xavier

Goals: Make a design for a mechanical application to our clients issue.

Content:

Here is the design I made. While the specifics are not perfect or guaranteed, this is the general idea that our client liked and asked us to focus on. It features an integrated design that will replace the current stage with a movable xy axis that

will be controlled by two motors and the 3d printed shell will be made of a durable, strong plastic.



Conclusions/action items: Need to test is microscope stage can be removed. Get our client to FINALLY give us our microscope. Lastly we need to figure out how to get a motor with hyper specific movements for tiny movements for the design.

Final Design for movable stage

Xavier Snider - Nov 15, 2024, 6:48 PM CST

Title: Final stage design

Date: 10/30/24

Content by: Xavier Snider

Present: Hamad, Lia, Amanda

Goals: Design final stage usinbg premade parts from Olympus

Content: I figured out how to change around the gear so there can be isolated controls for the x and why axis on each side. I disconnected gearing and then attached to the right. It seems its designed for a left handed person, so if we get a secoind handle, the second set of gears on that wioll be disconnected giving us the freedom to turn, rotate, and change direction indepentdently. Everythings set up for this to work and I helped assemble so we will order or ask for the parts we need.

Conclusions/action items: Need to receive a new handle fore the x axis movment. Email the client to see for spare. Talk to Olympus and then order motors.

Mounting Idea

Xavier Snider - Dec 13, 2024, 7:52 PM CST

Title: L bracket mounting idea design

Date: 11/19/24

Content by: Xavier S.

Present: none

Goals: How to attach stepper motors?

Content: L shaped beam to attach the stepper motors onto. I think this would work because the L beam would have an adjustable height and would be strong enough to hold necessary weight. Nema 17 designed brackets can hold the motors and use belts to turn the knobs. This approach is temporary and much easier than other methods we have discussed.

Conclusions/action items: Make materials list. Order parts. Finish project before poster presentations Friday.

2024/10/25 Slide Show won't upload to website

Xavier Snider - Oct 25, 2024, 12:18 PM CDT

Title: Documenting the issue

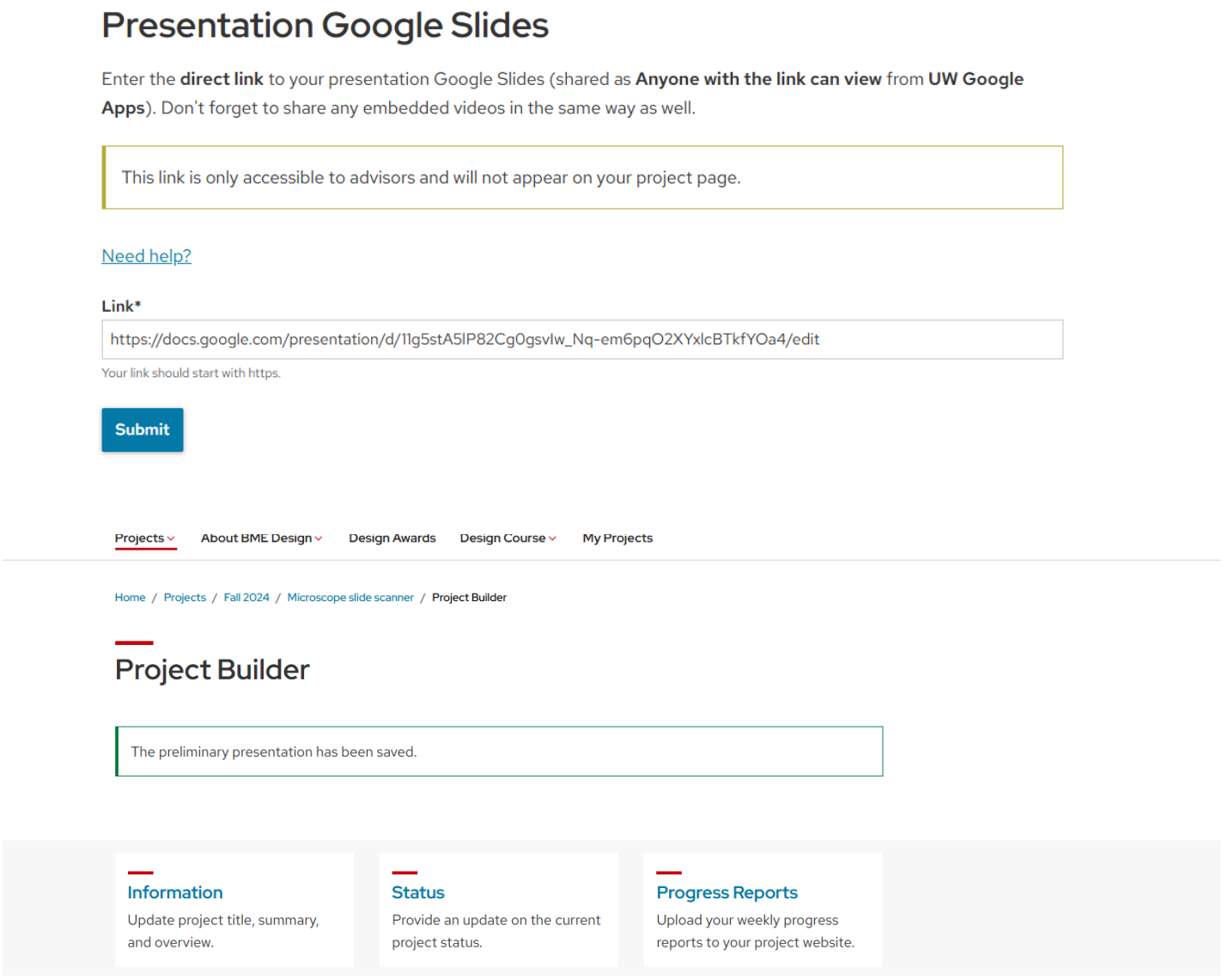
Date: 2024/10/25

Content by: Xavier Snider

Present: none

Goals: demonstrate problem

Content: After following instructions, it says "saved" but does not appear on our presentation. I am not sure why it does not appear on the slides.



Conclusions/action items:

I will share this with who it concerns and show the issues I am having here.

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

LIA LEJONVARN - Sep 11, 2024, 1:18 PM CDT

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items: