BME Design-Fall 2018 - JAMISON MILLER
Complete Notebook

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JAMISON MILLER

on

Dec 12, 2018 @01:06 PM CST

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Team contact Information

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▪ ALEXUS EDWARDS ▪ Oct 10, 2018 @12:08 PM CDT

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Project description

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▪ JAMISON MILLER ▪ Sep 20, 2018 @09:00 PM CDT

Course Number:

BME 200/300

Project Name:

Rodent rotation and translation stage

Short Name:

(RRaTS)

Project description/problem statement:

While doing research on photoreceptors in the retina of an eye, images are frequently viewed through a stationary device. In order to view all of the photoreceptor cells, the eye or viewing device needs to rotate with 5 degrees of freedom. The team's objective is to create a stage to hold a human eye or rodent which allows translational and rotational movements while keeping the viewing device focused on the pupil.

About the client:

Dr. Jeremy D. Rogers is an assistant professor at the University of Wisconsin-Madison and works in the Laboratory for Optical and Computational Instrumentation along with Medical Physics and the UW Eye Research Institute.

13-Sep-2018 Initial Meeting

revisions print • Cory Beek • Sep 20, 2018 @12:59 PM CDT

Title: Initial Client Meeting

Date: 13-Sep-2018

Content by: Cory Van Beek

Present: Dr. Rogers, Jamison, Cory, Lexi, Kevin, Aaron

Goals: Introductions with team and client. Get a better idea of the requirements for the project so we can come up with a problem statement, write our PDS, and begin brainstorming design ideas.

Content: Questions for the client with their answers.

<u>Device</u>

- What is the current device you use?
  - U-shaped bed with a bite bar
    - Lots of duct tape
    - Not used by our client, but he's seen this setup before
- What are the main issues with the device?
  - Needs a mount that adjusts and keeps the pupil of the eye in the center
- Could we see the current set up?
  - The client does not have the current device
- How precise do device movements need to be?
  - Not very - people currently do it by hand
    - ~100 microns for translational motion
  - Want to have smooth movements for rotation
- What process do you use to sanitize the current device (ethanol, autoclave, etc.)?
  - Have the ability to wipe it down. - Hard plastics or metal. -Avoid sharp corners or geometry that is hard to clean.
- How is the head of the animal currently secured?
  - Bite bar
  - What about the rest of the animal?
    - Lays in trough
- Is there any sort of breathing apparatus like intubation tubing for the animal that will affect the placement of the animal?
  - Warmer would be helpful -research temperatures
  - Squirrel used a nose cone
- What sorts of biology and physiology is important to understand for the scope of the project?
  - The angle of an eye to the body on different rodents.

    - Dimensions of a human eye
- Are there any specific needs for viewing the eye that may be different than the rest of the animal?
    - Possible swappable holder for viewing different objects, e.g. mouse, squirrel, or detached human eye.
- What sort of movements do you typically make when examining an animal under the microscope?
    - Pitch and roll for animal axis - eyes are closer to orthogonal to the body of a rodent
    - Research gimble mount
- You mentioned 5 degrees of motion, is there one that you'd like left out?
    - roll not required but could be helpful
- Does the new stage have to communicate electronically with microscope software?
    - No, simpler the better. Stick to mechanical movements for now.
- How much weight should the new stage hold?
    - < 10 lbs
- Will the general "table" sit horizontally?
    - The imaging device will be looking at it horizontally

<u>Possible Future Improvements:</u>

- Autoclavable
- Electronic movement

<u>Administrative Questions</u>

- When are you available during the week for possible future meetings?
    - Thursday mornings could work pending travel.
- What is our budget for this project?
    - $250 - possibly more
- Would you like to receive the weekly progress reports?
    - Up to us. He may not read it.
- Do you have lab space where we can test prototypes in the future?
    - Yes
    - What type of training is required to work in your lab (if any)?
        - We didn't make it to the last two questions before running out of time
    - What safety training must be completed to work in your lab (particularly with rodents)?

Conclusions/action items: After meeting with Dr. Rogers, we have a better understanding of the problem we will fix this semester. He helped establish basic requirements that we can use in our PDS. For other aspects of the device, we will need to come up

18-October-2018

revisions print ▪ ALEXUS EDWARDS ▪ Dec 11, 2018 @10:32 PM CST

Title: Client Meeting

Date: 10/18/2018

Content by: Alexus

Present: Aaron, Kevin, Jamison, Alexus

Goals: Our goals were to update Dr.Rogers on the deisgn that was choosen and get feedback on design..

Content:

Majority of the meeting was discussing different design and how to modify the chosen design so that it fits Dr.Rogers' lab work.

Suggested Ideas to Modifications of the designs

- Gimbal compas
- Width/height
    - Those are considered soft constraints
    - Make sure that is compac
- The lack of the need for percison- if it easy to design something complexity can be very simple
- Keep in mind our percision is not that great, and making sure that you have the right degrees of freedom and the lining up of the center of axis
- When you add a gearing- you add cost and fabrication and it breaks
- Think about the duration of the whole device when considering 3D printing
- Think about is their a simplier way to accomplish something
- How much access will the microscope have to the eye
    - Basically make it somewhat compact laterally and something taller.
    - Micoscope need to get close
- Estimated for printing
- Discussed creating an account with the makerspace in order to 3D print everything.

Conclusions/action items:

In conclusion, as a group we should consider simplifying our design more so that it fits the desired tasks of Dr.Rogers. Dr. Rodgers emphasis that the decice can be maintained over a long period of time and would perfer something more simple in order to get that longevity. Also we should consider the grears and their functionality and maybe finding a subsitiute for them because that was a big concern of his.

Advisor meeting 09/21/2018

revisions print ▪ ALEXUS EDWARDS ▪ Sep 23, 2018 @07:21 PM CDT

Title: First Advisor Meeting

Date: 09/21/2018

Content by: Alexus Edwards

Present: Aaron Siminski, Cory Van Beek, Jamison Miller, Alexus Edwards, Kevin Koester, Aaron Patterson

Goals: To obtain a standard of practice within each meeting, along with outlining the expectations throughout this semester.

Content:

Good Job website!!!!

Good PDS!!!!!

Lots of potential for this project!!!!!

New This Semester

- Putting more emphasis on PDS this year
    - Look into sterilization-could make that more specific

Expectations

- Following the schedule on the websites
- Quantifiable, testable specification-specific details, identify how things are going to be tested
- Preliminary
    - Evaluation forms-look at the different forms use them as guides
    - Assessment evaluation
    - Report evaluation
- Feedback
    - If you want on one feedback feel free to ask
    - Notebook
        - Documentation is better to start now.
- Project
    - Think about making the design so that it can fit a broad scope of people
    - Think about a broader audience-Ask him
    - Thinking about the preliminary report, the preliminary presentation
    - Design matrix
        - Important to tell the reader what the specific criteria means for the project itself
        - Describe the design matrix-then underneath describe what each of those criteria means and then why did you choose the numbers.
- Ideas
    - Transitional stages height builds pretty quickly

  - Limiting factors cheap and sturdy materials
  - Encourage 3D printing at the start

Conclusions/action items: We as a group have been doing a great job so far. Stay ahead and continue striving. Look into the preliminary presentation and report. Also start considering ideas for the design matrix.

Advisor meeting 09/28/2018

revisions print ▪ Aaron Patterson ▪ Sep 28, 2018 @12:45 PM CDT

Title: Second Advisor Meeting

Date: 09/28/2018

Content by: Aaron Patterson

Present: Dr. Aaron Suminski, Cory Van Beek, Jamison Miller, Alexus Edwards, Kevin Koester, Aaron Patterson

Goals: Show Dr. Suminski our design matrix and preliminary designs to get feedback

Content:

General Notes

- "Off to a great start on design matrix, designs, and PDS"
- Hollow design: need to figure out how to translate the animal to match the eye or different animals
- Gear design: center of rotation is known, could translate on top of it to reach the correct position, you can make the table as wide as you need it.
- Think about height specification and how different movements will add height
- Hollow design: ellipsoidal with a higher focal point which is more desirable, how do you get the sample to be at the center, could be able to lock rotational/translational separately
- Preliminary Presentation: next week, preparatory materials posted on this weeks page for course handout, pay attention to upload directions, google slides (share with Dr. Suminski) make sure videos/sound are shared if we have them

To do

- Keep thinking about ways to modify the Hollow Design
- Go back to PDS and define precision and rotation in design specifications to make the two relatable and more specific

Conclusions/action items: Prepare for Preliminary presentation next week keeping in mind the specific requirements and everything that we need in the presentation.

Advisor Meeting 10/12/2018

revisions print • Aaron Patterson • Oct 12, 2018 @12:38 PM CDT

Title: Advisor Meeting

Date: 10/12/2018

Content by: Aaron

Present: Jamison, Cory, Kevin, Aaron, Alexus at BPAG meeting

Goals: Get preliminary design presentation feedback and more feedback on design

Content:

Dr. Suminski's Feedback on presentation:

- Presentation was good.
- Could have improved clarity on some design explanations.
- Answered questions well.

Going forward:

- Pick materials to order for design prototype
- Refine designs to make it work
- Next deliverable: 11/9 - show and tell sessions - short pitch of design in a minute or two
- Building up details on design
- make sure to look at naming conventions for peer evaluation and other file deliverables

Current problems:

- When rotating one the other one binds and you can no longer move the other one in the required direction

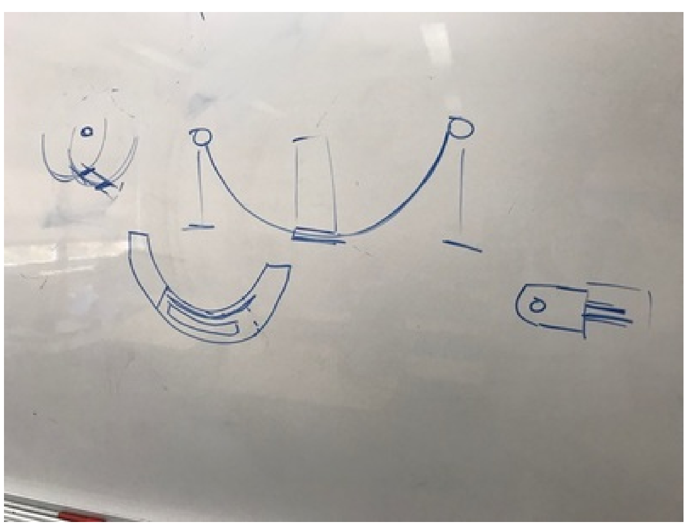
Solutions:

- We could add a pivot, like a gyroscope, so the bottom would lock allowing the other side to rotate
- Decouple one of the degrees of freedom from the base, for example removing a pair of the supporting bases. Then would have to figure out how to hold the stage.
- Try to make the design out of cardboard in order to visualize how our device works.
- Linear gear to move it along the degree of freedom on only one of the arcs
- Plan a time to go and visit Dr. Suminskis lab

Conclusions/action items:

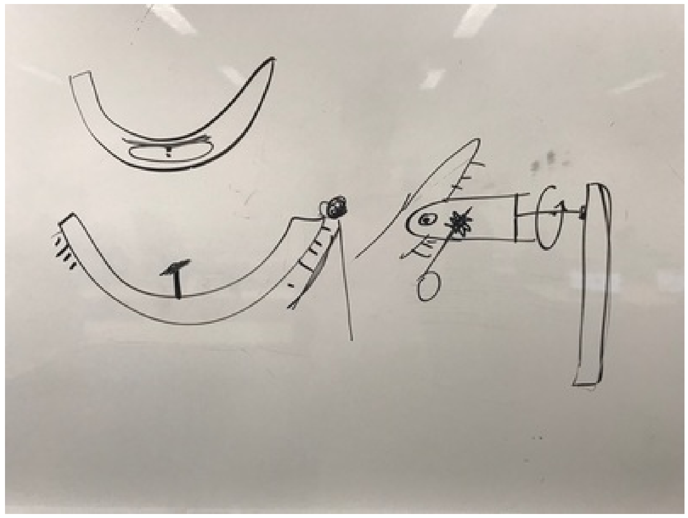
Send Dr. Suminski an email to see what time that we could meet to go to his lab.

revisions print • Aaron Patterson • Oct 12, 2018 @12:33 PM CDT



Dr._Suminski_Design_Idea.jpg(43.3 KB) - download

revisions print ▪ Aaron Patterson ▪ Oct 12, 2018 @12:34 PM CDT



Jamison_s_design_sketch.jpg(44 KB) - download

Advisor Meeting 10/19/2018

revisions print ▪ Aaron Patterson ▪ Dec 10, 2018 @08:52 PM CST

Title: Advisor Meeting for Refining Design

Date: 10/19/2018

Content by: Aaron

Present: Jamison, Cory, Kevin, Alexus, Aaron

Goals: Get more feedback on our design and see where to go next

Content:

Feedback:

-Notebook and Preliminary Report grades sometime later this week

Ideas for Modular Part: Magnets, Holes and screws,

Most important degrees of freedom: rotation about z-axis, and about x-axis

Suggestions:

-Shaft could go through and then screw to hold all together and then use friction to keep rotation in place

Things to Think About:

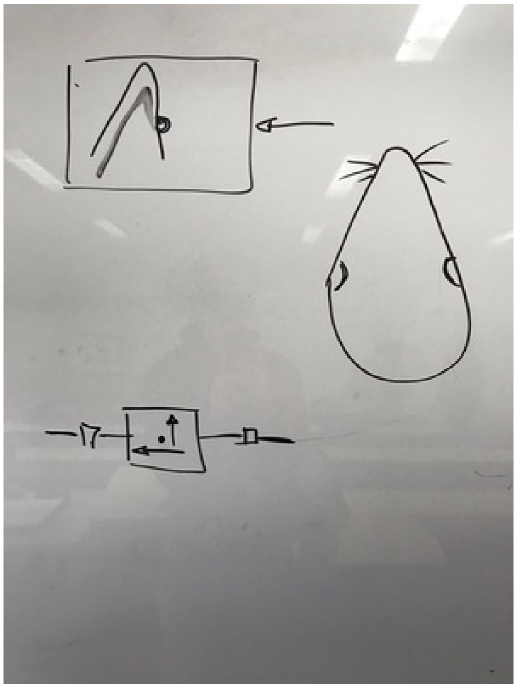
-How much motion do we need? If we could limit the amount of rotation, it could be a solution to our height problem.

-What are the most important degrees of freedom for our clients application? Can you eliminate other degrees of freedom to make the device more modular and more general for other applications? How do we need to iterate our design to accommodate the most important degrees of freedom.

-How do you ensure that the eye is at the center of rotation with a variety of subjects?

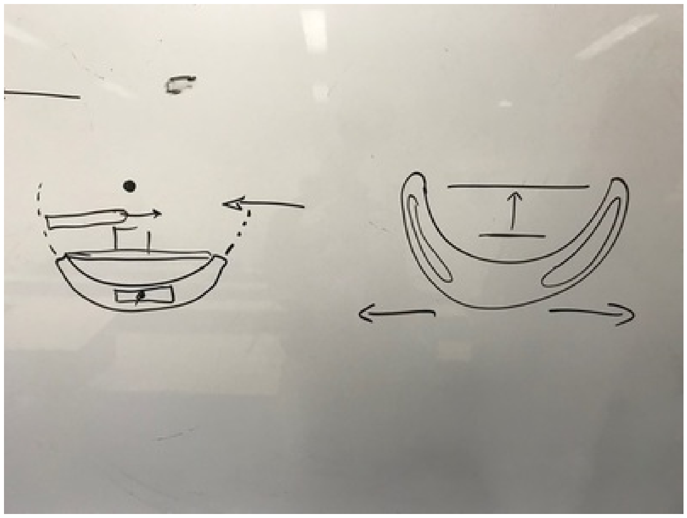
Use a spark fun stepping motor.

revisions print ▪ Aaron Patterson ▪ Oct 19, 2018 @12:51 PM CDT



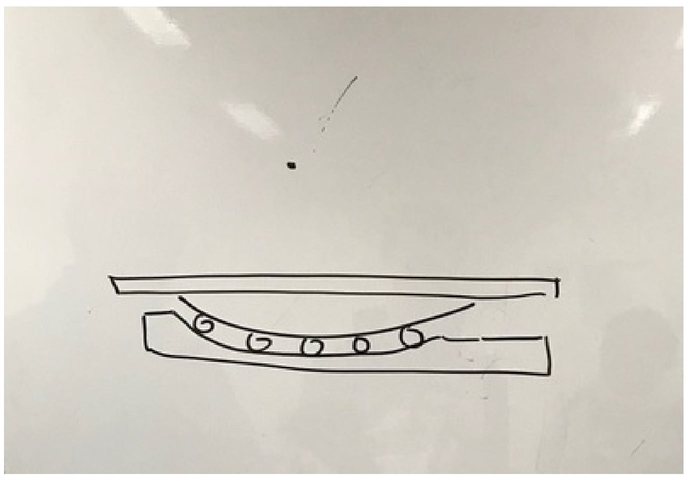
Dr._Suminski_s_sketches.jpg(68.3 KB) - download

revisions print ▪ Aaron Patterson ▪ Oct 19, 2018 @12:51 PM CDT



Sketches_from_team_meeting.jpg(36.9 KB) - download

revisions print ▪ Aaron Patterson ▪ Oct 19, 2018 @12:52 PM CDT



Dr._Suminski_s_design_idea.jpg(38.8 KB) - download

revisions print ▪ Aaron Patterson ▪ Dec 10, 2018 @08:52 PM CST

Conclusions/action items:

-Work to simplify our design in order to accommodate the MOST important degrees of freedom

Advisor Meeting 11/30/2018

revisions print ▪ Aaron Patterson ▪ Nov 30, 2018 @12:31 PM CST

Title: Advisor Meeting

Date: 11/30/2018

Content by: Aaron

Present: All

Goals: See what work we still have to do

Content:

Next week is the poster presentation:

-Follow the instructions for uploading etc.

-He will look at it for feedback if we finish it early or if we have it half-complete

-The SolidWorks drawing can be the center of the poster

Poster priorities

-should have an abstract

-problem definition: background, competing products, why they are unsatisfactory

-one column for background / one column for results, main results in the middle

-main part of the poster is the center and eye level portion: linear flows are more efficient

-most important parts of poster: how we came to the design that we chose. The design itself. The design choices we made. The testing

Final deliverables are due on the 12th

Super glue will break the plastic which would take days for it to settle

-look for more conventional ways to make more complicated pieces of our prototype easier for us to fabricate our prototype

-we could use a smaller screw on the bottom.

Ideas for Testing

-minimum translation movement of 100 micron, come up with ideas to meet that specification if that test fails

-how to measure 100 micron movement, under a microscope, add a teflon film to make moving magnet easier on bottom of subject holder, we can use Dr. Suminski microscopes for testing

-for destruction tests we could put in our deliverables and just ignore tests

Priorities

-Final deliverables, testing, final poster

-Focus on tests that are functional, (ex. 5 degrees of freedom test, translational test)

Conclusions/action items:

-Start the poster

-Finish some of the poster so we can submit to Dr. Suminski for feedback

-Test to specifications that we came up with in our PDS

2018/09/21 - Team Brainstorming and Design Discussion

revisions print • JAMISON MILLER • Sep 23, 2018 @08:09 PM CDT

Title: Design Idea Meeting

Date: 09/21/2018

Content by: Jamison Miller

Present: The whole team is present

Goals: Brainstorm effective design ideas.

Content:

Translational

- There are already many existing devices on the market for translational movement and we expect the design for such to be relatively simple/similar to existing designs.

Rotational

- Hypothesis #1
    - Geared approach with center of rotational in the middle of the sphere.

Holding device

- Bite bar will account for the position of the head (translation in the x,y,z).

Conclusions/action items:

The team will continue to think of new design ideas, draw up some ideas in solidworks and present ideas to the group in our Sunday meeting.

2018/09/23 - Team Brainstorming and Solidworks

revisions print • JAMISON MILLER • Sep 23, 2018 @08:08 PM CDT

Title: Team Brainstorming Meeting

Date: September 23, 2018

Content by: Jamison Miller

Present: All team members except Aaron

Goals:

- Determine good times to meet
- Discuss Design ideas
- Decide which design ideas to add to the matrix

Content:

Meeting times

- Sunday Meetings at 9 PM
- Friday Meetings after discussion with adviser

Design Ideas

- Curved Gear design
- Separated translation and rotation stages
- Tripod design
    - Use long lever arms to force precision on each of the rotations.
- Grooved for sliding track and hollow bottom.

Conclusions/action items:

Begin designs in Solidworks, format and make a design matrix, and continue to brainstorm design ideas.

Preliminary Design Matrix

revisions print • Aaron Patterson • Dec 10, 2018 @08:59 PM CST

Title: Preliminary Design Matrix

Date: 10/7/2018

Content by: Aaron

Present: all

Goals: Come up with preliminary design criteria to evaluate our three design ideas

Content:

Design Aspect	Weight	**Design 1: The Park Rank (1-5)**	Weighted Rate	**Design 2: The Rigamortis Rank (1-5)**	Weighted Rate	**Design 3: The Rocking Chair Rank (1-5)**	Weighted Rate
Precision	35	3	21	4	28	4	28
Usability	25	3	15	5	25	2	10
Height	15	4	12	2	6	2	6
Amount of Rotation	10	2	4	3	6	1	2
Ease of Build	5	3	3	3	3	3	3
Cost	5	4	4	5	5	5	5
Safety	5	5	5	5	5	5	5
Total:	**100**		**64**		**78**		**59**

Our design matrix, shown above, was used to evaluate our three preliminary designs: The Park, The Rigamortis, and The Rocking Chair. Before fully grading each of our designs, our design specifications were ranked from highest to lowest importance. The design specifications were defined as follows:

Precision: Precision is defined as how accurately the device keeps the center of rotation during rotations. While this was originally defined in the product design specifications as a measurement in microns, an accurate reading would not fully be determined for each device until they were fabricated. The precision ranked for each device was thus determined based on the ability to keep the eye at the center of rotation.

Usability: Usability can be defined as how easily you can adjust the rotational and translational movements of the device. The rotational precision has to be less than a degree.

Height: Height is defined by the requirement that the device is less than 15 cm. Shorter devices will score higher in this category because they allow for more workable room under a microscope if image subjects are viewed from above.

Amount of Rotation: The amount of rotation indicates the degree a device can rotate around the focal point in comparison to two different axes (e.g. pitch and roll). This criterion was based upon rotational dimensions of each design provided.

Ease of build: Ease of build is defined as how easy it is to produce a prototype and how easy it would be for someone else to fabricate and manufacture the device.

Cost: The cost is defined by a budget of $250. Devices which cost less to produce and test will score higher in this category. This price reflects the allowable budget for fabrication, testing, and product development.

Safety: Safety is defined as how well the device limits harm to the user(s). This criterion entails safety for both the mice who are acting within the holding device and the researchers are operating the anesthetic and imaging procedure.

As shown (from top to bottom), the aspects of our design that were of most importance were: precision, usability, and height (weights 35, 25, 15, respectively). These three were followed closely by amount of rotation, ease of build, cost, and safety (weighted 10, 5, 5, 5, respectively). The specifications were then distributed by weight, with the aspect of greatest importance having the highest weight and the one of least importance with the lowest weight. Then, as a group, we ranked each design from one to five by design aspect.

Designs 2 and 3 scored highest in the precision category because the focal points remain constant for all device rotations. Design 2 scored highest in the usability category because its gear design provides the highest and most user-friendly degree of rotational control and the best method of rotation. This is due to the fact that the gear ratios can be adjusted to allow for both fine and coarse adjustment of rotation. Design 1 scored highest in the height category because the tripod base can be adjusted to a lower height than the other designs. Design 2 scored highest in the amount of rotation category because it allows between 45 degrees of rotation. Designs 2 and 3 scored highest in the cost category because they include all 3D printed parts, which keep them well below the $250 budget. All three designs scored five out of five for safety because all gears are contained, there are no sharp edges, the devices are inflammable, and there are no other significant sources of danger. Therefore, Design 2: The Rigamortis, finished with the highest score of 78 when ranked against the other two designs. Based on its score in the design matrix, and after discussing further with the team, we decided that The Rigamortis was best suited to be our proposed final design.

Conclusions/action items:

Now that we picked our design, we can now begin fabrication plans and refining the Rigamortis on SolidWorks.

2018/10/12 - Team Cardboard Design Meeting

revisions print • Aaron Patterson • Oct 12, 2018 @12:54 PM CDT

Title: Design Cardboard Prototype

Date: 10/12/2018

Content by: Aaron

Present: Jamison, Cory, Kevin, Alexus, Aaron

Goals: To make a preliminary prototype out of cardboard

Content:

revisions print • Aaron Patterson • Oct 12, 2018 @12:57 PM CDT

Cardboard_from_Union_South.jpg(141.7 KB) - download Cardboard that we got from Union South. We are using this to come up with a simple prototype, as recommended by Dr. Suminski.

revisions print • Aaron Patterson • Oct 14, 2018 @12:59 PM CDT

Conclusions/action items: Continue building a cardboard prototype to visualize the movement of our device.

2018/10/14 - Team Cardboard Design Day 2

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:50 PM CST

Title: Cardboard Design Meeting 2

Date: 2018/10/14

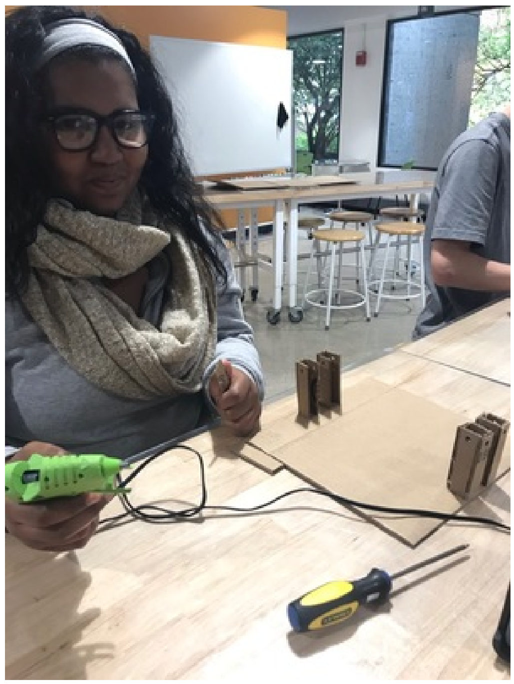
Content by: Aaron

Present: Jamison, Cory, Alexus, Aaron

Goals: To continue and possibly finish our cardboard design

Content:

revisions print ▪ Aaron Patterson ▪ Oct 14, 2018 @01:39 PM CDT



Progress_in_forming_our_base.jpg(158.6 KB) - download Here is Lexi hot gluing our cardboard base to our two rotational towers.

revisions print ▪ Aaron Patterson ▪ Oct 14, 2018 @01:46 PM CDT

Our_rotatation_component.jpg(165.6 KB) - download Here are Cory and Jamison attempting to connect our cardboard arc and gear to our towers. Our joints are made from sanded down pencils and stuck through our hole punched cardboard.

revisions print ▪ Aaron Patterson ▪ Oct 14, 2018 @01:43 PM CDT

Functional_movement_.mov(6.6 MB) - download Here is a video of Jamison demonstrating the primary rotation of our device with success!

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:50 PM CST

Conclusions/action items:

Get ready to report our current progress to Dr. Rodgers.

2018/11/11 - Team Z-translation

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:18 PM CST

Title: Z-translation

Date: 2018/11/11

Content by: Aaron

Present: Jamison, Cory, Lexi, and Aaron

Goals: To come up with a solution for Z-translation

Content:

Conclusions/action items:

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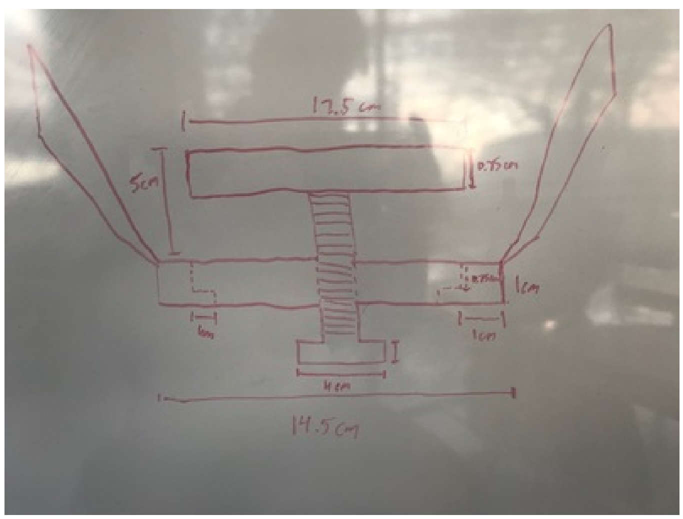
Cory_and_Jamison_Looking_for_Bolts.jpg(82.5 KB) - download Here is a picture of two friends looking for potential bolts to help with our z-translation device.

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:23 PM CST

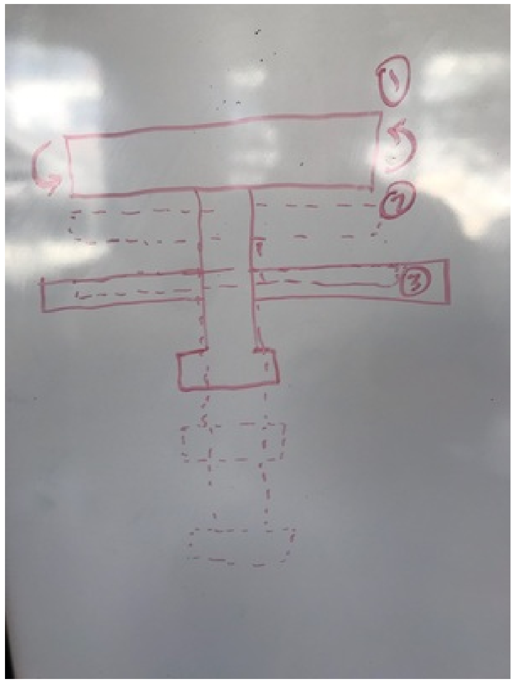
Potential_Bolts.jpg(151.6 KB) - download Here are our bolts that we decided would be strong enough to hold our new translation table while also easy to move for the user because they are big enough. Our next task would be to measure the bolts and see which bolt would be easiest to integrate into our design.

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:32 PM CST



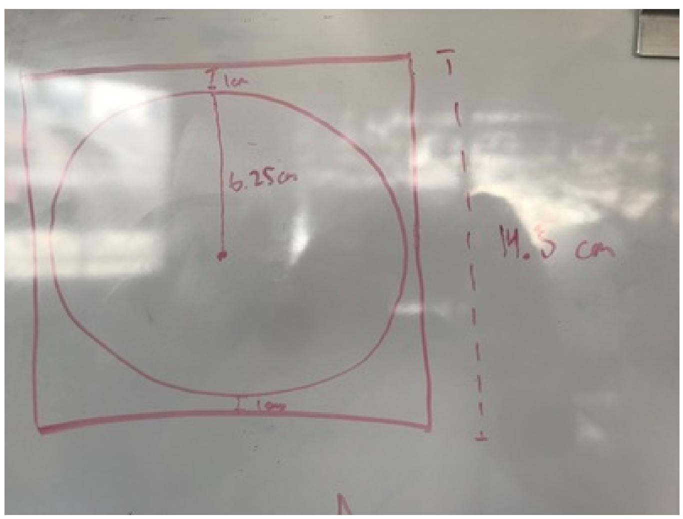
Whiteboard_drawing_.jpg(40.6 KB) - download Here is a diagram of the primary idea for z-translation. The user would turn the top of the table. and the stage would move up and down at the users liking. This would allow for maximum precision and ease of motion for the user.

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:26 PM CST



Whiteboard_design_.jpg(61.7 KB) - download Here is a picture of a diagram of the movement that the z-device would have. The z-translation would move with a turning motion by the user. This would allow for easy and precise movement in the z-direction to place the subject at the center of rotation.

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:29 PM CST



Whiteboard_design.jpg(37.4 KB) - download This is a drawing with dimensions from a birds-eye view of the table. The total length of the table is 14.5 cm long so we decided that our inner circle would have a 12.5 cm diameter to give enough strength for the holding device while also allowing for the maximum amount of movement on the table.

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:21 PM CST

Here are some of our concerns about changing the top of our table:

-we may need to change the thickness (0.25 cm is not strong enough to hold weight when at maximum height)

-What are the relative heights of the holding devices?

BPAG primary meeting

revisions print

▪ Aaron Patterson ▪ Oct 12, 2018 @12:49 PM CDT

Title: BPAG primary meeting

Date: 2018/10/12

Content by: Aaron

Present: Jamison, Cory, Kevin, Alexus, Aaron

Goals: To get information from Alexus about the BPAG meeting

Content:

Kevin should email Dr. Rogers so that we can know how we are planning to pay for the project.

Different options:

- Dr. Rogers can make an account at CoE and he can pay through that
- Personal checks
- Reimbursement
- He can go through Susan a BME accountant

Conclusions/action items:

Email Dr. Rogers about preliminary material orders and business

Materials

revisions print ▪ ALEXUS EDWARDS ▪ Dec 11, 2018 @10:18 PM CST

Title: Material used

Date: 2018/12/11

Content by: Alexus Edwards

Present: Alexus

Goals: To outline all of the materials and the cost of them that were used.

Content:

Materials For RRaTs

Descripton	Supplier	Part/Model #	Link to Part	Qty	Date	Total
Aobbomok Chrome Bearing Steel Round Balls	Amazon	CSbb-3-1000	https://www.amazon.com/Aobbmok-1000pcs-Chrome-Bearing-Balls/dp/B079HPKSJ9/ref=sr_1_18?ie=UTF8&qid=1540575840&sr=8-18&keywords=small+ball+bearing#feature-bullets-btf	1	N/A	$10.99
Needle Roller Bearing	VXB.com	KIT7891	https://www.vxb.com/ProductDetails.asp?ProductCode=Kit7891	1	n/A	$7.70
DIYMAG powerful Neodymium Disc Magnets	Amazon	HLMAG03	https://www.amazon.com/DIYMAG-Powerful-Neodymium-Permanent-Scientific/dp/B06XD2X45M#feature-bullets-btf	1	N/A	$9.49
3D Printed Device	Makerspace	N/A	N/A	1	N/A	$76.03
Super Glue	Makerspace	N/A	N/A	2	N/A	$2.03
Magnet	Makerspace	N/A	N/A	1	N/A	$2.40
						108.64

Figure 1:A summary of all the materials that we used for the device.

Conclusions/action items:

Our total expenses equaled $108.03 which was under our goal of $250.00.

2018/11/13 - First 3D Printing Meeting

revisions print · JAMISON MILLER · Nov 13, 2018 @08:52 PM CST

Title: First 3D Print

Date: November 13, 2018

Content by: Jamison Miller

Present: Cory, Alexus, Kevin

Goals: The goals of this meeting were to revise the current designs of the project, check the status of 3-D printers, transform some of the designs into 3D printing compatible software, and work through expenses.

Content:

We began printing the solid base part of the design. We split the design into two pieces because the design could not fit onto one printer on its own.We added a Rigamortis decal to the base and conferred with shop staff to make sure everything printed successfully.

Conclusions/action items:

The print will take a little over 3 days to complete, so we will begin to print other pieces and adjust some of the current designs while that is in progress.

2018/11/18 - Team 3D Printing Meeting

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:49 PM CST

Title: 3D Printing

Date: 2018/11/18

Content by: Aaron

Present: All

Goals: Begin printing bottom base

Content:

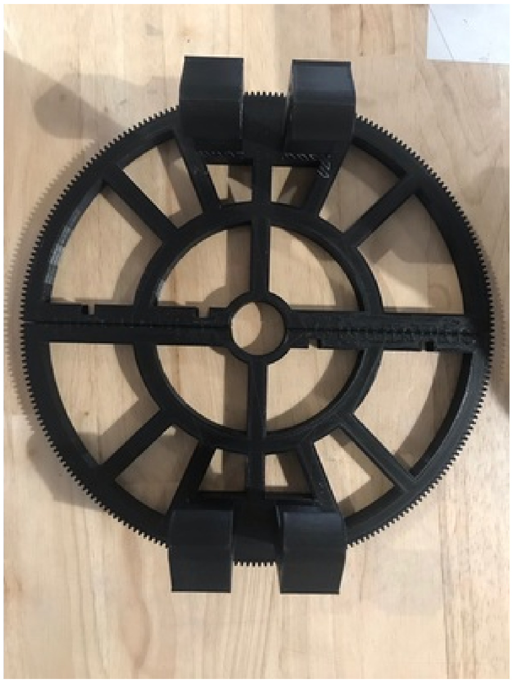
revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @12:56 PM CST

Gear_on_Base.jpg(67.6 KB) - download Our gears on our bottom base turned out very well. This was one of concerns before printing but the teeth on the gear look strong.

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @12:58 PM CST

Side_view_of_base.jpg(67.9 KB) - download Here is a side view of our well printed base. We were very excited that our base turned out so well.

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @12:59 PM CST



Top_view_of_base.jpg(131.9 KB) - download Here is a top view of our first experience with printing our prototype. We were very excited that our print turned out so well. In this image you can see our beautiful cross-sectional design.

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:34 PM CST

Printing_progress.jpg(125.3 KB) - download We have started printing the second part of our base in a slick Badger Red.

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:35 PM CST

Conclusions/action items:

Check back in a couple of hours to check progress on printing.

Eventually come to collect print and start printing gears.

2018/11/20 - 3D Printing Progress

revisions print ▪ Aaron Patterson ▪ Dec 10, 2018 @08:51 PM CST

Title: 3D Printing Progress

Date: November 20, 2018

Content by: Aaron

Present: Jamison, Lexi, Cory, Aaron

Goals: Pick up printed gears and see if the gears printed well. Pick up printed base stage. Begin printing other parts of device.

Content:

Our prints of our base stage and also our gears turned out very well. We were nervous that the gears would not print accurately enough to allow for smooth movement. However, at first glance the gears look very accurate to our SolidWorks drawings. We will have to go through testing to make sure that the gears will move efficiently enough to satisfy our client.

revisions print ▪ Aaron Patterson ▪ Nov 25, 2018 @10:24 AM CST

Base_platform_progress_.jpg(125.3 KB) - download Here is a picture of our base platform being printed in the 3D printer.

revisions print ▪ Aaron Patterson ▪ Nov 25, 2018 @10:22 AM CST

Base_platform.jpg(111.2 KB) - download Our base platform printed out really well! This will hold the whole device and will also have the needle bearing between the bottom base and black main stage holder we printed first.

revisions print ▪ Aaron Patterson ▪ Nov 25, 2018 @10:23 AM CST

Gears_.jpg(117.2 KB) - download Our gears printed out better than we expected. We were worried that the gears would be too small and wouldn't print as accurate but they look great. Now we have to attach them to the device itself.

revisions print ▪ Aaron Patterson ▪ Nov 25, 2018 @10:25 AM CST

Conclusions/action items: Continue to print out our parts so we have a full prototype suitable for testing.

2018/12/05 - Testing Protocol

revisions print · JAMISON MILLER · Dec 05, 2018 @09:41 PM CST

Title: Testing Protocols for Final Design

Date: December 5, 2018

Content by: Jamison Miller

Present: All team members

Goals: Layout a detailed testing protocol.

Content:

Testing Protocol
Ergonomics test

- Using an upright microscope and micron calipers, track the precision that a user can achieve in x and y translation. Prompt the user to move the sample holder with attached magnets on the metal plate 1 mm. Next, try 500 microns, next try 200 microns, and finally see if the user can perform a 100-micron movement. Repeat with multiple users who are both trained in lab techniques and who have no previous microscope or laboratory training.

Angular Test

- We will use a protractor and reference point to determine that the device rotates a specimen 45 degrees.

Height Test

- The device should be able to satisfy a z-translation of 1 mm above and below the center of rotation. We will determine the center of rotation by fixing a string to the top of each of the supports and connecting them in the middle. The middle will be measured out on the top of the table and a t square will be used to determine the middle of the string.

Conclusions/action items:

We will begin testing of the device the day before presentations. In order to evaluate responses will we have people answer survey questions about the device. The survey will inform us of the ergonomic quality of the device. Data from the survey will be analyzed and graphed.

2018/12/11 - Updated Testing Protocol

revisions print

• JAMISON MILLER • Dec 11, 2018 @05:11 PM CST

Title: Testing Protocol

Date: December 11, 2018

Content by: Jamison Miller

Present: N/A

Goals: Create an updated protocol for testing

Content:

Testing Protocol

Translation test

- A needle will be attached to the side of the eye sample holder perpendicular to the metal plate of the table. A hole will be poked with the needle at the start location and the end location. Prompt the user to move the sample holder in the smallest increments possible. Repeat with multiple users who are both trained in lab techniques and who have no previous microscope or laboratory training. Use a micron calipers to measure the distance between start and end holes.

Angular Test

- An angle inclinometer will be set on the table for the x and y axis rotation. The range of rotation and the precision of rotation will be notated for 5 trials. The mean, standard deviation, and t-confidence interval will be determined for each axis.

Height Test

- The device should be able to satisfy a z-translation of 1 mm above and below the center of rotation. We will determine the center of rotation by fixing a string to the top of each of the supports and connecting them in the middle. The middle will be measured out on the top of the table and a t square will be used to determine the middle of the string.

Stress Test

- The weakest element will be determined in SolidWorks using stress analysis. From there the dimensions, ultimate load to be placed on the table, and material properties will be used to determine the max stress the weakest element can hold and a factor of safety will be determined.

Ergonomics Survey

- Post-doctoral researchers, graduate students, and undergraduate students at the Wisconsin Institute of Medical Research will be given an introduction to the device and asked to take a qualitative survey on the functionality and ergonomics of specific features of the device. The survey will prompt users to perform certain translations and rotations and the users will be asked questions with five answer options for each question relating to ease of use or

Conclusions/action items:

The survey will inform us of the ergonomic quality of the device. Data from the survey will be analyzed and graphed. Boxplots will be made from translation and rotation test precision data.

2018/12/6 - Prototype Testing

revisions print ▪ Aaron Patterson ▪ Dec 10, 2018 @08:53 PM CST

Title: Prototype Testing

Date: December 6, 2018

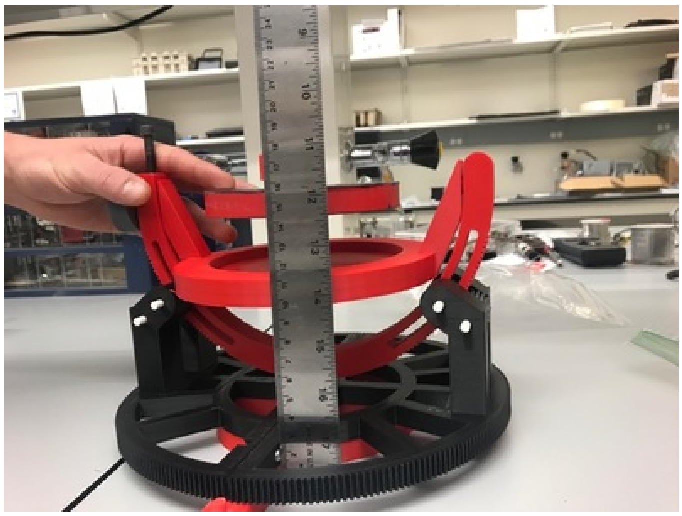
Content by: Aaron

Present: Aaron, Jamison, Cory, Lexi

Goals: To test our prototype using our planned testing protocols

Content:

revisions print ▪ Aaron Patterson ▪ Dec 09, 2018 @04:30 PM CST



HeightTest.jpg(78 KB) - download Here is our height test in progress. We used a basic ruler to mark where our device is at a minimum and maximum. This test was used to know how far our device could move our subject holder in the z-direction.

revisions print ▪ Aaron Patterson ▪ Dec 09, 2018 @04:35 PM CST

AngularTest.jpg(89.2 KB) - download Here is a picture of Cory in the process of completing our angular test. We used an angular inclinometer gage to measure the minimum amount of rotation that the device could move in both the x and y rotation.

Angular Test

Movement	X-axis rotation Angle measurement	Y-axis rotation measurement
1	0.5	0.7
2	0.3	0.6
3	0.2	0.6
4	0.4	0.7
5	0.6	0.6
6	0.6	0.5
7	0.8	0.9
8	0.6	0.5
9	0.4	0.4
10	0.5	0.9
11	0.5	0.4
12	0.4	

Here is the data for our angular test that we eventually used for the calculations shown below.

Data Analysis

Mean

X-Axis Rotation: 0.4769

Y-axis Rotation: 0.6182

T-confidence Interval

X-Axis Rotation: (0.3811, 0.5697)

Y-axis Rotation: (0.5025, 0.7338)

Standard Deviation

X-Axis Rotation: 0.1536

Y-axis Rotation: 0.1722

After our data analysis we concluded that our device passed both of the angular precision tests about both axes. This also satisfied our preliminary design specification of less than one degree of angular precision.

revisions print ▪ Aaron Patterson ▪ Dec 09, 2018 @04:39 PM CST

Translation_test.jpg(169 KB) - download Here is a picture of Aaron completing the x-y translation test. For this test we used a stick and poke method. A sheet of paper was placed over a metal bar to track the increment of translational movement of our modular device. Then we punched holes using pins to track movement precision. Then, A digital caliper was used to measure the distance between pin punches in micrometers.

revisions print ▪ Aaron Patterson ▪ Dec 10, 2018 @09:07 PM CST

Translation Test

Movement	Measurement in Micrometers (um)
1	110
2	120
3	130
4	160
5	210
6	210
7	290
8	320
9	330
10	410

Here is the data for our angular test that we eventually used for the calculations shown below.

Data Analysis

Measurement of X-Y Translation

Mean

239

Standard Deviation

106.2

After completing our data analysis for the translation test, we concluded that our device did not meet our preliminary design specifications. The mean for our data was 239 um which wasn't close to our specification of 100 um translational precision.

revisions print ▪ Aaron Patterson ▪ Dec 09, 2018 @04:40 PM CST

Conclusions/action items:

Use data analysis methods to verify our results and finish the poster.

2018/09/27 - Research Notes

revisions print ▪ JAMISON MILLER ▪ Oct 07, 2018 @10:48 PM CDT

Title: Research Notes

Date: 09/27/2018

Content by: Jamison Miller

Present: N/A

Goals: Define the anatomy/dimensions of subjects that will be relevant in positioning the eye at the center of rotation for each.

Content:

House mouse

- Weight: 12 - 30g
- Distance from neck to eye

Thirteen-lined ground squirrel

- Length: 33 cm on average
- Weight: 227g

Detached human eye

- 2.4 cm diameter
- 7.5 g on average

Conclusions/action items:

We need to accommodate for the relative lengths and weights of each of these specific animals when creating holding devices for their specific anatomy. This will likely happen later on in the project.

References:

1. E. S. Perkins and H. Davson, “Human eye,” Encyclopedia Britannica, 22-Jun-2018. [Online]. Available: https://www.britannica.com/science/human-eye. [Accessed: 21-Sep-2018].
2. E. C. Cleary and S. R. Craven, “Thirteen-lined Ground Squirrels and Their Control,” Internet Center for Wildlife Damage Management. [Online]. Available: http://icwdm.org/handbook/rodents/13linedgroundsquirrel.asp. [Accessed: 21-Sep-2018].
3. L. Ballenger, “Mus musculus (house mouse),” Animal Diversity Web, 1999. [Online]. Available: http://animaldiversity.org/accounts/Mus_musculus/. [Accessed: 21-Sep-2018].

2018/10/08 - Anatomy of the Eye

revisions print • JAMISON MILLER • Oct 09, 2018 @02:00 AM CDT

Title: Anatomy of the Eye

Date: 10/08/2018

Content by: Jamison Miller

Present: N/A

Goals: Outline the different aspects of eye anatomy and how this relates to needed positioning of the eye via our stage design.

Content:

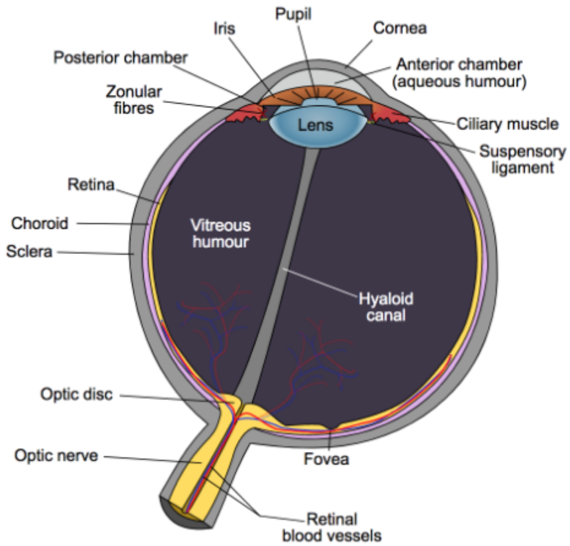


Figure 1. Anatomical Diagram of the eye

<u>Functional aspects of the eye</u>

- Cornea
- Pupil
- Lens
- Zonular Fibers
- Iris
- Optic Nerve
- Ciliary Muscle
- Anterior Chamber
- Retina
- Optic Disc
- Fovea
- Sclera
- Choroid

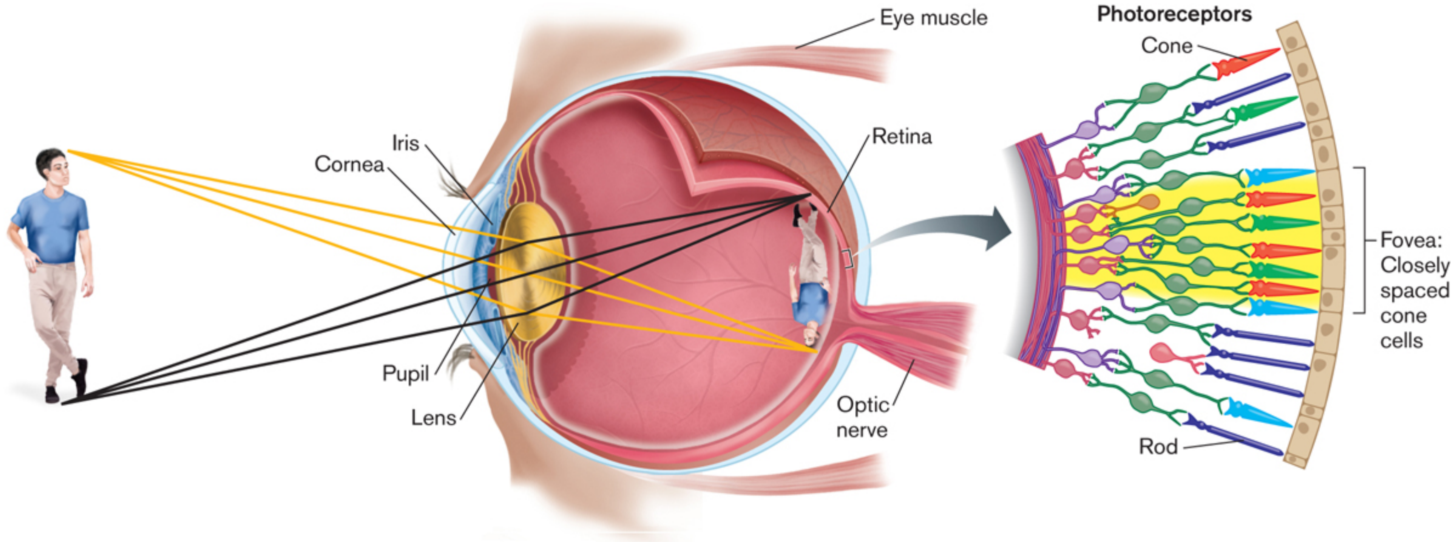


Figure 2. Anatomical Diagram of an eye and how it interprets signal input.

<u>How are photoreceptors involved?</u>

- Photoreceptors which can be either cones or rods receive stimulus in the form of light energy
- The stimulus from light energy creates a graded potential along bipolar cells
- Graded potential from bipolar cells transfers to ganglionic cells in which an action potential is generated
- This action potential is carried from the ganglionic cells to the optic nerve
- The optic nerve carries the signal to the brain which interprets signal into a working image.'

<u>Resolution of the Human Eye and Field of View</u>

- Field of view for the human eye:
  - 95° away from the nose
  - 75° downward
  - 60° toward the nose
  - 60° upward
- Humans have nearly 180-degree forward-facing horizontal field of view, which means light can be processed by the photoreceptors from 180 in the horizontal direction.

Conclusions/action items:

Since the human eye is capable of receiving light stimulus for 180 degrees in the horizontal direction, a microscope will be able to visualize the photoreceptors at the nearly 180 degrees. This will mean that our stage design must allow for the manipulation about the z axis up to 180 degrees. Our device must also be capable of viewing the photoreceptors for 135 degrees in the vertical direction.

Courses.lumenlearning.com. (2018). *The Human Eye | Boundless Physics*. [online] Available at: https://courses.lumenlearning.com/boundless-physics/chapter/the-human-eye/ [Accessed 9 Oct. 2018].

2018/09/20 - Multi-Axis Translation/Rotation Modular Stage Design

revisions print • JAMISON MILLER • Oct 09, 2018 @01:40 AM CDT

Title: Competing Design

Date: 2018/09/20

Content by: Jamison Miller

Present: N/A

Goals: Specify the function and design of the competing patent

Content:

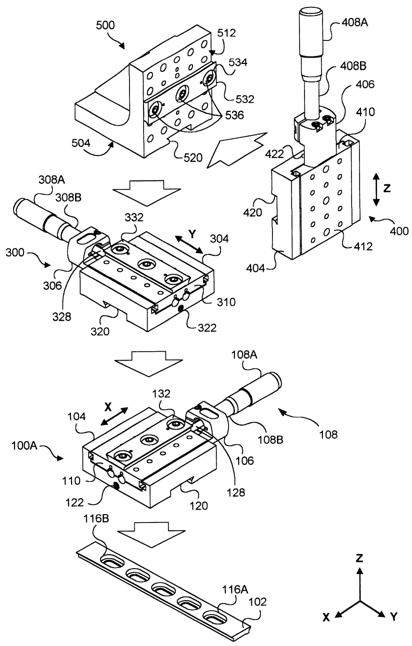


FIG. 4B

Figure 1. The above figure represents the modular attachment of each translational unit

<u>Arrangment 1</u>

- The device in figure 1 allows for modular attachments that provide translational in two axis with one of the pieces used to modify the plane of the mounting surface.
- 102 in figure 1 is the track upon which the bottom-most stage translates.

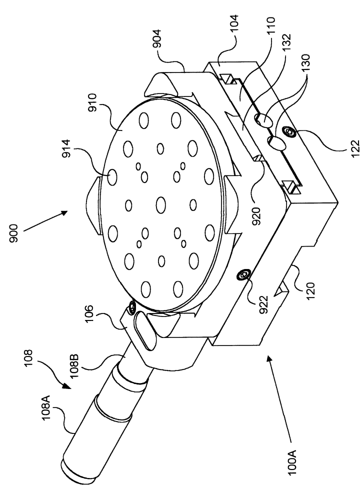


FIG. 9A

Figure 2. The above figure represents the rotational aspect of the design.

Modular Rotational Piece

- The rotational component in figure 2 is fixed upon another stage base via a dove tail attachment.
- 108A points to a micrometer adjustment handle which rotates gears that lie beneath the rotating platform.

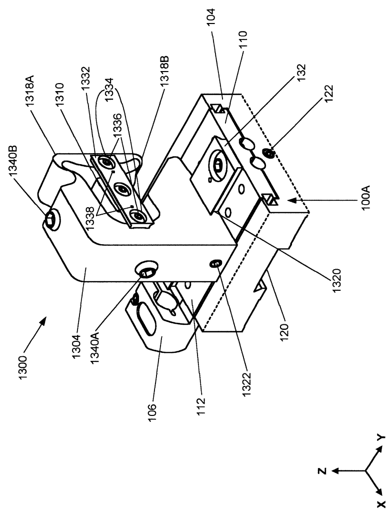


FIG. 13

Figure 3. The above figure represents a multi-axis linear-rotational translation device that is mounted upon another linear uniaxial mount.

Translational Device

- The dove tail connection is a signature style of all of the modular pieces of this design.
    - The dove tail connection allows for the sliding of each modular attachment onto the surface of the stage.
    - The dove tail track is mounted onto the base of the stage with screws
    - A dove tail indentation is present on the bottom of this device to attach to the male dove tail of any other modular stage.
- The device allows for a large amount of adaptability on the users side

Conclusions/action items:

As we develop and refine our own device, we must keep in mind that the unique function our device is to hold the image subject at the center of rotation. The device outlined in this report does not allow for 5-6 degrees of freedom in rotational and translational movement. Using dovetails as a possible source of connection could be useful, but we have to make sure our design is uniquely different from the one presented above.

References:

Ba Do, K. and Arnone, D. (2018). *US6350080B1 - Modular motion stages utilizing interconnecting elements - Google Patents*. [online] Patents.google.com. Available at: https://patents.google.com/patent/US6350080?oq=translation+and+rotation+stage [Accessed 9 Oct. 2018].

2018/09/26 - Modular design

revisions print • JAMISON MILLER • Sep 26, 2018 @12:23 PM CDT

Title: Modular Stage design idea

Date: 09/26/18

Content by: Jamison Miller

Present: N/A

Goals: Display and explain the modular stage design idea

Content:

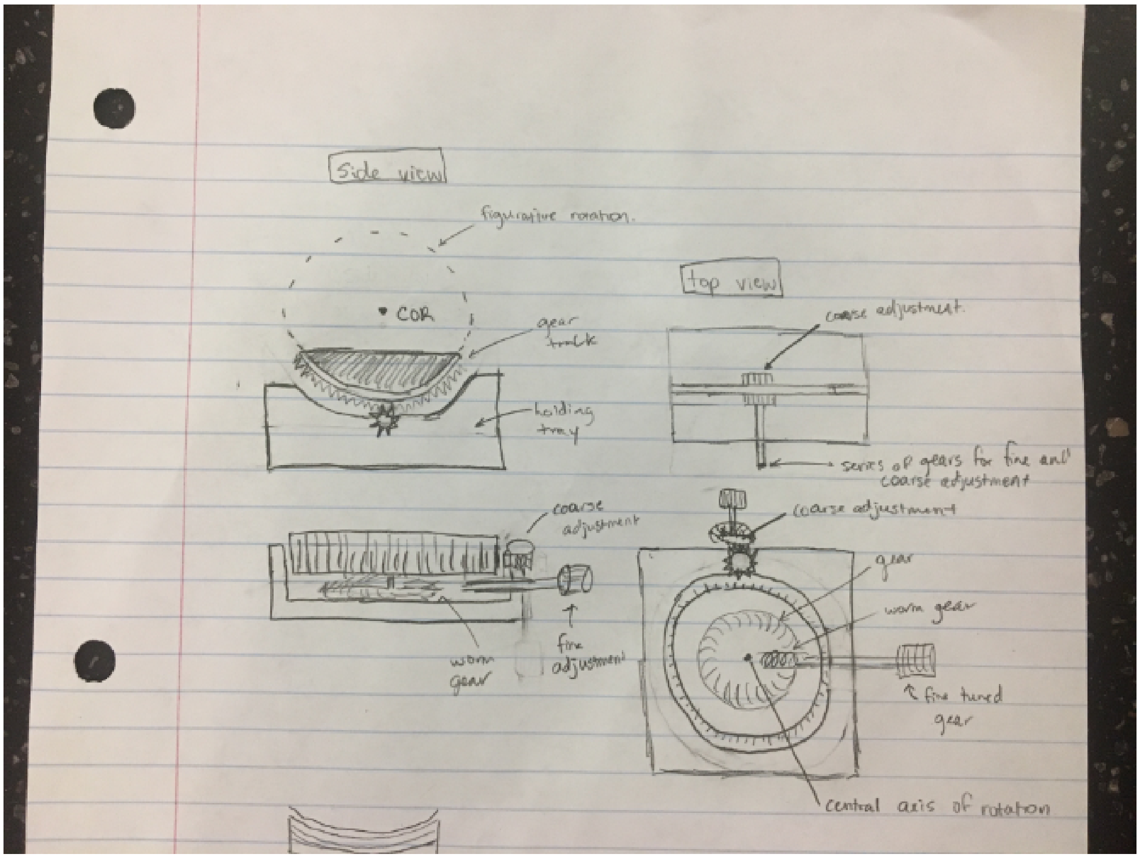


Figure 1. The above figure represents the modular stage design for the roll and yaw motion.

- The diagram in the top left of the figure shows a side view of a stage design that would provide roll motion.
  - This design features a gear track that would span the bottom of a hemisphere that would hold the animal on the top.
  - The gear track shown would rest on the top of another gear that would have fine and coarse adjustment nobs.
  - The center of rotation for this design would lie above the flat surface of the hemisphere to allow for the difference in height from the image subject's neck/chin to the center of their pupil.
- The diagram in the top right of the figure shows a top view of the stage design for roll motion
  - The gear track would be wide enough to support the weight of a subject up to 5 kg and lie on the mid-line of the surface holding the animal.
- The diagram in the bottom left of the figure shows a side view the stage that would enable yaw motion.
  - A simple square platform would lie underneath a wide cylindrical rotating platform.
  - The rotating platform would have find and coarse adjustment using a worm gear and a curved gear at the base of a cylinder connected to the rotating plate.
  - This design would secure to the bottom of the stage design for roll motion and its center of rotation would lie on the same line of action as the center of rotation for the roll motion.
- The diagram in the bottom right of the figure shows a top view of the stage that would enable yaw motion
  - A gear could be implemented on the circumference of the rotating platform to allow for either coarse or fine adjustment.

This design would be placed on top of a platform that would allow for translational movement on x, y, and z axes. While the modular approach of this design would make for simpler fabrication it only allows for five degrees of freedom, where six degrees of freedom is ideal. The element of pitch motion is lacking in this design.

Conclusions/action items:

This design will need to be drawn up in solidworks and brought before the team to compare with other designs in the design matrix. The deadline for drawing up the design in solidworks is the day before the presentation on Friday, October 5th 2018.

2018/09/26 - Six DOF Stage

revisions print • JAMISON MILLER • Sep 27, 2018 @04:07 PM CDT

Title: Spider Leg Design

Date: 09/26/2018

Content by: Jamison Miller

Present: N/A

Goals: Explain and detail the design of the Spider Leg stage.

Content:

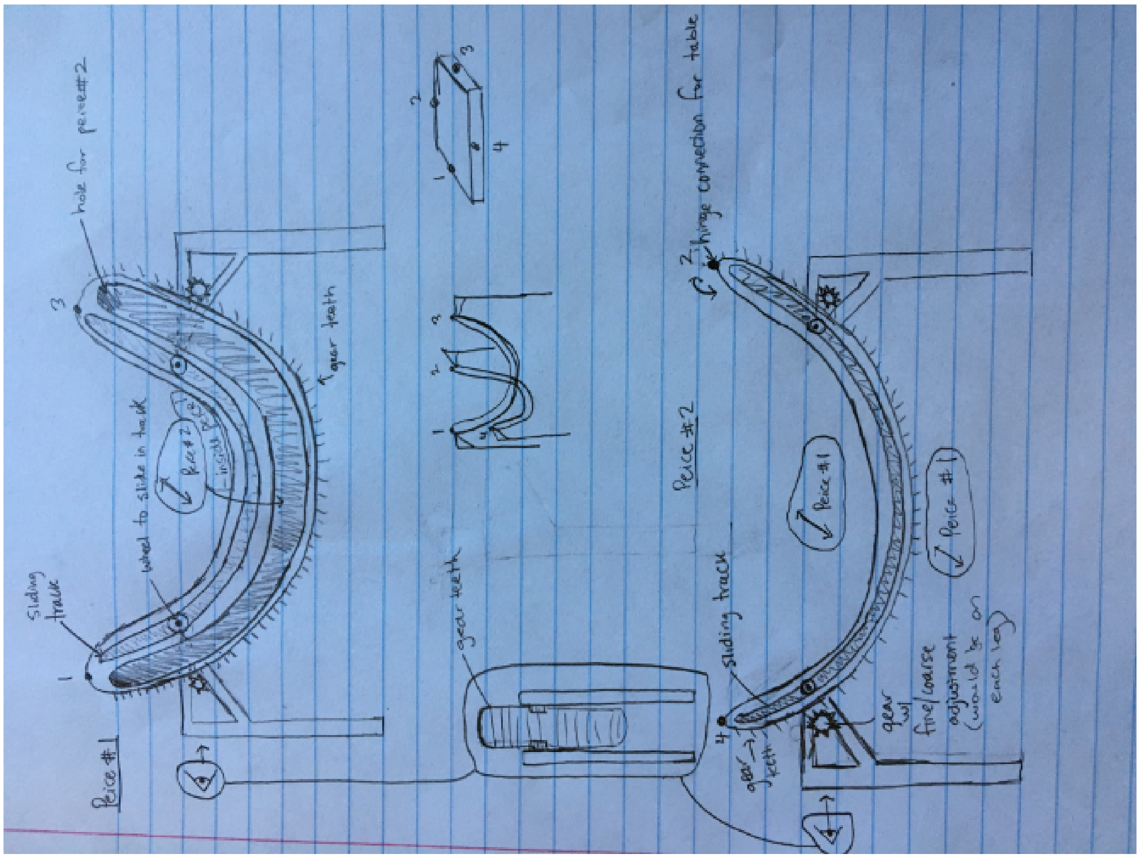


Figure 1. The above figure represents a rough sketch of the spider leg design.

- The Spider Leg Design Concept consists of:
    - Two-sided support legs with slots for the sliding tracks
        - Gears at each support leg with fine and course adjustment knobs
    - Two hollow hemispherical shapes
        - Piece 1
            - Grooves/cuts for insertion of wheels or sliding track
            - Cut with space for insertion of piece 2.
            - Hinge joint at the apex of each hemisphere
            - Gear track lining the bottom surface
        - Piece 2
            - Grooves/cuts for insertion of wheels or sliding track
            - Hinge joint at the apex of each hemisphere
            - Gear track lining the bottom surface

Conclusions/action items:

Begin drawing this idea up in solidworks so that it is ready for the design matrix and preliminary presentation.

2018/10/21 - Solidworks Design of the Animal Holder

revisions print • JAMISON MILLER • Oct 21, 2018 @11:31 PM CDT

Title: Thirteen Lined Ground squirrel holder

Date: October 21, 2018

Content by: Jamison Miller

Present: Aaron was present for about an hour.

Goals: Design a holder for the thirteen lined ground squirrel.

Content:

I worked for 2 hours in the computer lab in ECB 1410. I looked for specific dimensions of the thirteen lined ground squirrel and brainstormed methods of holding the animal given the restrictions of the current table design with Aaron. We determined the subject holder for the thirteen lined ground squirrel should be approximately 30 cm long and in order to account for the table size we made the sample holder curved to avoid the swinging arm. This will still keep the animals eye at the center of rotation. A bite bar was elevated above the surface of the subject holder to account for the displacement of the mouth to the eye and still account for room for the microscope.

Conclusions/action items:

This design will be brought before the team in a virtual conference later this week and we will continue to improve upon the dimensions and overall design.

2018/10/24 - Animal holder Solidworks

revisions print • JAMISON MILLER • Oct 24, 2018 @

Title: Subject Holder SolidWorks

Date: October 24, 2018

Content by: Jamison Miller

Present: Cory van Beek

Goals: Modify the dimensions of the subject holder to accommodate for the dimensions of the animal and the table respectively

Content:

The following images below were used as some visual source data in creating the Solidworks designs

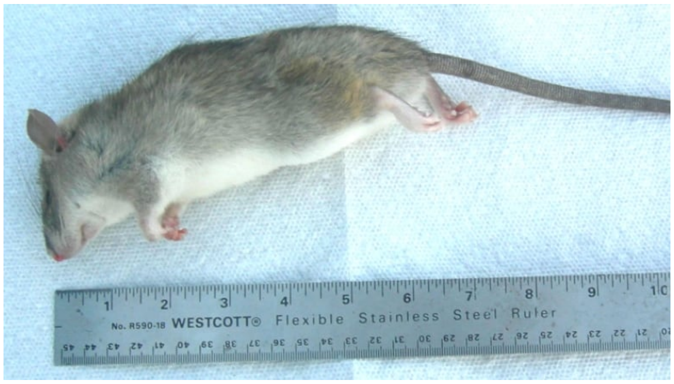


Image can be found at: https://www.google.com/search?q=Ruler+next+to+rodent&rlz=1C1GCEV_enUS820US820&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjbrYKchqDeAhVK54MKHSpRAFIQ_AUIDigB&biw=1920&bih=1089#imgrc=B3h_84H-I

Figure 1. The above figure represents the average size of a mouse that would be used in imaging experiments.

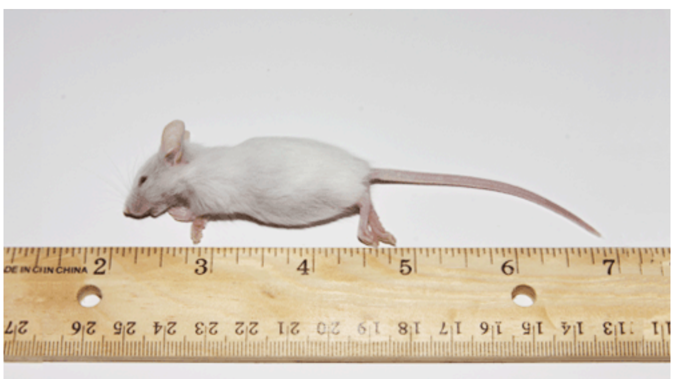


Image can be found at: https://www.google.com/search?q=Ruler+next+to+rodent&rlz=1C1GCEV_enUS820US820&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjbrYKchqDeAhVK54MKHSpRAFIQ_AUIDigB&biw=1920&bih=1089#imgrc=Tvd_SSLs

Figure 2. The above figure represents the length of a white laboratory mouse in both inches and centimeters.

Image can be found at: https://www.google.com/search?q=Ruler+next+to+rodent&rlz=1C1GCEV_enUS820US820&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjbrYKchqDeAhVK54MKHSpRAFIQ_AUIDigB&biw=1920&bih=1089#imgrc=QX4VXP1

Figure 3. The above figure represents the approximate length of a field mouse in centimeters.

Figure 4. The above figure shows the measurement of a thirteen lined ground squirrels skull in cm. This more accurately depicts the distance of the animals eye position relative to front incisors

Reference Dimensions

Radius of Rotation: 7 cm (arc length from the middle)

- This was a limitation provided by the geometry of the current table design which is limited by the size of the 3D printers.

Overall length = 20-30 cm

Displacement from big teeth bite bar to eye: Approximately 2-3 cm

Animal is 6 – 8 cm wide

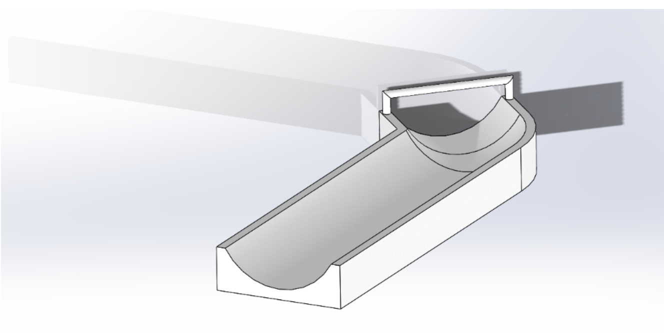


Figure . The above figure represents the modified design of the animal holder with the bite bar included.

- The total length of the outside arc is 30 cm (this is also the maximal length of all subjects to be held on the device.
  - The long part of the subject holder: 20 cm
  - The outside arc length: 7 cm
  - Short straight segment: 3 cm
- The bite bar is 1 cm above the table holder allowing the eye to be more accessible via the microscope.

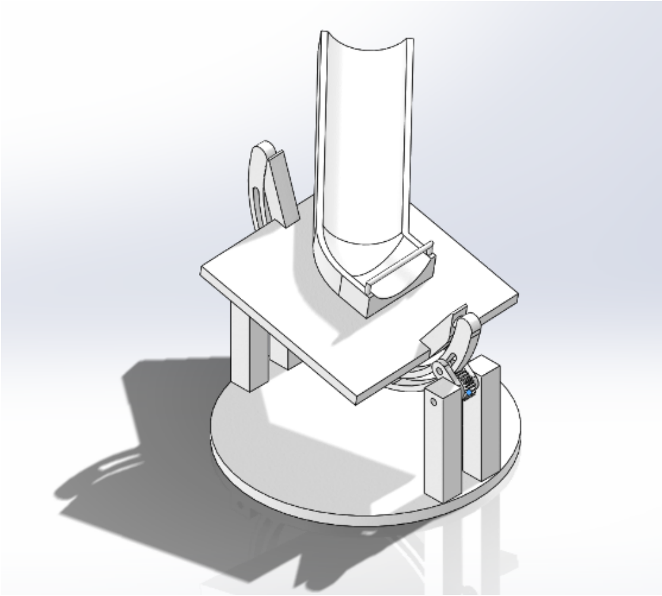


Figure . The above figure represents how the sample holder sits on the rotating table.

- The center of rotation will be kept around the eye where the curve begins after the short segment.
  - An average distance from bite bar to eye was assumed to be 3 cm (this measurement could be changed by +/- 1 cm and still fit appropriately on the table and not collide with the swinging arm.)
- The center of weight for the animal was assumed to lie mostly on the table and the overhanging part was assumed to not support a significant amount of weight.
  - This could be further validated when the method of attachment to the surface of the table is determined and the exact weight distribution of the animals is known
- The height to the eye from the table will be controlled by an added element of z translation on the surface of the table.

Conclusions/action items:

We will continue to research the weight distribution of animals and the usability of this device to determine whether the angled approach for holding the subjects head is appropriate. We will beg methods for translation about the z-axis on the top of the table and adjust the heights of the subject holder and distance of bite bar location to the top of the subject holder.

2018/10/31 - The Underbaser

· JAMISON MILLER · Dec 12, 2018 @12:43 AM CST

Title: The Underbaser

Date: October 31, 2018

Content by: Jamison Miller

Present: Cory van Beek

Goals: Draw up a design in Solidworks that is compatible to the existing base that can attach to the TMC vibration-less table.

Content:

Figure 1. The first iteration of the Underbaser

The design depicted in figure 1 features a groove with dimensions that can be seen in Cory's lab notebook reducing base volume in the ball bearing diagram. The first iteration of the Underbaser has four arms extending from a center circle to stabilize the device and attach to the TMC vibrationless table. The arms of the first iteration of the Underbaser were too long and were not wide enough to account for the countersink of the screw heads and holes for the screw itself.

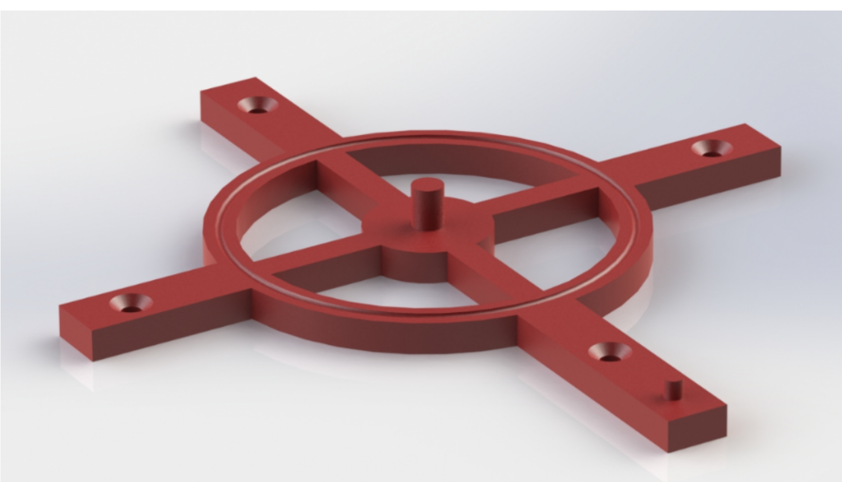


Figure 2. The final Underbaser design with applied red hue.

The design in figure 2 features wider arms from the center circle to contribute to structural integrity and account for the wide countersink of the 1/4" screws. The distance between screws was measured from each other and designed to match the spacing of holes on the TMC vibrationless table.

Conclusions/action items:

The device matches well with the existing base and has the appropriate spacing to match the holes on the TMC vibration less table. We will move forward with the printing process and begin testing with the device once fabrication has completed.

2018/11/28 - Sample Holder Design Modifications

revisions print • JAMISON MILLER • Dec 11, 2018 @04:29 PM CST

Title: Sample Holder Design Modifications

Date: November 28, 2018

Content by: Jamison Miller

Present: N/A

Goals: Overview the iterations and changes that were made to the sample holder over the course of the design process

Content:

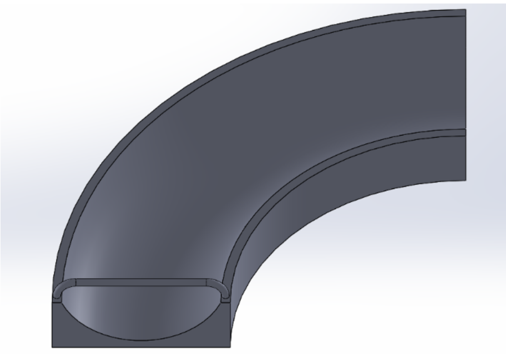


Figure 1. The first iteration of the rodent sample holder with a simple extruded feature.

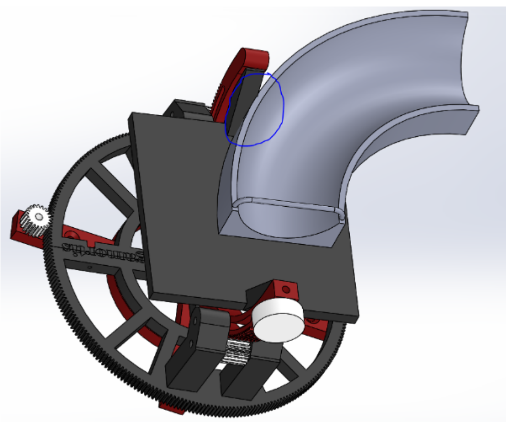


Figure 2. With the sample holder placing the eye at the center of rotation, the table was running into the sample holder.

The problem with the device in figure 1 was that it would run into the side table as indicated by figure 2. A modified sample holder of 45 degrees was needed.

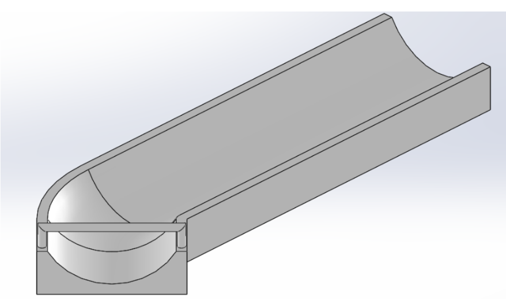


Figure 3. The modified dimensions and partially curved section to account for the table running into the sample holder.

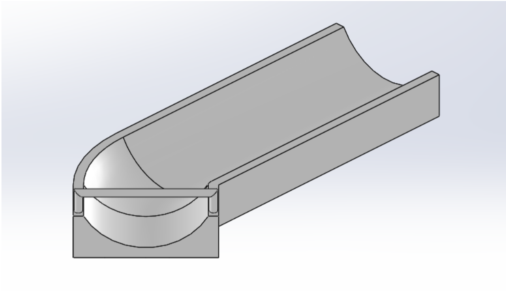


Figure 4. Mouse Sample holder (top)

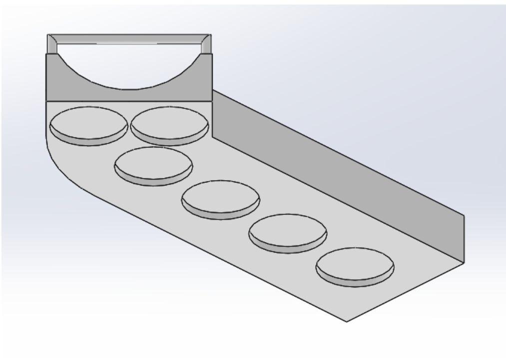


Figure 5. Mouse Sample holder (bottom)

The sample holder length was shortened to only account for mice as seen in figure 4. Magnet indentations were added to the bottom of the sample holder as seen in figure 5 to allow for the x and y axis translation.

Conclusions/action items:

The device should be printed and tested for the translation precision it can achieve. Magnets need to be epoxied to the bottom of the sample holder for accurate testing.

2018/12/04 - Poster Meeting

revisions print • JAMISON MILLER • Dec 11, 2018 @03:14 PM CST

Title: Poster Work Meeting

Date: December 4, 2018

Content by: Jamison Miller

Present: Cory van Beek

Goals: Write a more detailed testing protocol and work on the poster.

Content:

We refined the testing protocol and set up a series of experiments we could perform on the device to test its functionality. We worked on the poster and related figures.

Conclusions/action items:

Continue to work on the poster and test the device, so that it can be implemented in the poster before the presentation.

2018/12/11 - The Impact of Rigamortis

revisions print • JAMISON MILLER • Dec 11, 2018 @04:50 PM CST

Title: Impact of Rigamortis Worldwide

Date: December 11, 2018

Content by: Jamison Miller

Present: N/A

Goals: Understand the ethical, global, economic, and environmental impacts of the Rigamortis rotation and translation device.

Content:

According to the World Health Organization as of October 11, 2017, there were 253 million people living with vision impairment, 36 million of whom were completely blind while the other 217 million had moderate to severe blindness. It is estimated that by 2050 there could be upwards of 115 million people who are blind. This is mostly attributed to a growing population and also an increasing age of the existing population [1]. Scientists are researching the sources of visual impairments by using microscopy and other optical techniques. A device such as the Rigamortis rotation and translation device could greatly assist researchers in their ability to image the photoreceptors of the retina to further understand causes of blindness and diseases that can be detected by viewing the eye. There currently does not exist a product on the market that is capable of translation and rotation to achieve six degrees of freedom. With such freedom to translate and rotate about a sample, cell cultures, 3D models, and other laboratory experiments can be more effectively analyzed. From an economical standpoint, the Rigamortis device could cut down on overall time used to image cells and allow researchers to be more efficient in their image capture. Ethically, the Rigamortis design provides a more stable and safe place for the mouse to rest while being imaged, especially because it could account for the insertion of a warming pad. If the device were to be manufactured on a broader scale, it could have a small negative impact on the environment as metal production has the ability to release varying amounts of greenhouse gases into the environment.

Conclusions/action items:

It is important to understand the ramifications of introducing any sort of new device into either the medical world or the research world. As an engineer, it is our goal to strive to improve the way the world works and understanding the consequences and benefits of introducing new technology into the world. The Rigamortis would ultimately improve the efficiency of those in optical research and possibly research beyond. Environmentally, there are some risks involved with production, but after production, the device would have no net negative impact on the environment. Moving forward with the design process after submitting final deliverables will entail conducting market research to identify a need outside of our client Dr. Rogers to determine whether it is an economical decision to continue improving the device and possibly mass manufacturing the device. If successful feedback is attained from market research, we will continue to do background research to find other devices similar in function and move forward with attempting to secure a patent if none are found.

Tiltable Optical Microscope Stage

revisions print • Cory Beek • Oct 10, 2018 @09:01 AM CDT

Title: Tiltable Optical Microscope Stage

Date: 20-Sep-2018

Content by: Cory

Present: N/A

Goals: Find similar stage devices that allow for both translational and rotational movements.

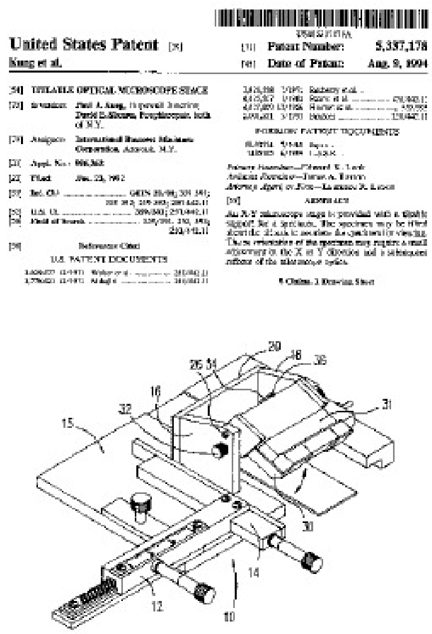
Content:

- This device allows for translational movements in two directions, and rotation about either the x or y-axes (but not both).
    - Due to the simple hinge used for rotation, a similar method would be difficult to use if we wanted to get 3 degrees of freedom for rotation. By stacking hinge joints, the focal points no longer line up since the axes of rotation do not intersect.
    - This device features a compact method of translational movements that could be used in our device without adding much height.

Conclusions/action items:

This device provides possible solutions for translational movements but is limiting in rotation.

revisions print • Cory Beek • Sep 20, 2018 @10:22 PM CDT



United States Patent

Kung et al.

Patent Number: 5,337,178

Date of Patent: Aug. 9, 1994

TILTABLE OPTICAL MICROSCOPE STAGE

References Cited

U.S. PATENT DOCUMENTS

ABSTRACT

US5337178.pdf(476.2 KB) - download

Makerspace 3D Printers

revisions print ▪ Cory Beek ▪ Dec 12, 2018 @12:57 PM CST

Title: MakerSpace 3d Printers

Date: 08-Nov-2018

Content by: Cory

Present: Cory

Goals: Meet with Makerspace staff to ask questions about 3d printing.

Content: I talked with a member of the MakerSpace staff to get answers to the following questions:

- One part we have is slightly bigger than the 3d printer, so we need to print it as two parts. We were thinking of connecting them with screws, but is there a better way?
    - Screws are usually the best way. Fusing can get messy, especially with large parts.
- Does the Makerspace have screws available for purchase, and if so are they limited in sizes?
    - They have the most common screw sizes available, such as 1/4" and 1/2"
- Is there a recommended speed for printing parts like gears which need to be more precise?
    - It is better to just print thinner layers when looking to increase precision.
- Can any holes in our structure that may be filled with supports during the print be drilled out?
    - Yes, that works, but take it slow and be careful.
- Only one of our team members has a shop pass. Can other people start prints or collect them?
    - No, the team member with the pass would need to start all the prints. That person could probably write down the names of other team members who could pick up the finished print.
- Can we slice our own files on Cura, or do they need to be sliced in the MakerSpace?
    - Slicing our own should be okay if we have the software to do it.
- The 3D printers are pretty busy, is there a good time to come in?
    - It's pretty dead on Friday nights. In general, it's pretty busy in the mornings and a little better before close.

Conclusions/action items:

Most of our designs can be printed easily at the MakerSpace but we will need to come often so we can use the printers when one becomes available.

Ball and Socket Joint

revisions print • Cory Beek • Sep 12, 2018 @12:55 PM CDT

Title: Ball and Socket Design Idea

Date: 9/12/2018

Content by: Cory

Goals: Brainstorm design ideas that maximize possible motions

Content:

The mount I have in my car that holds my phone like a GPS contains a simple ball and socket joint that allows me to orient my phone in almost any direction. If the tabletop of our device sat on a joint similar to this, it could potentially have ~120-degree motion in the pitch and roll direction and full 360-degrees in yaw.

This design is limited though in precision, and it needs to be manually anchored in place by tightening the bolt after each adjustment. If our client is seeking electronic controls, this may also be difficult to implement.

Conclusions/action items:

A ball and socket joint could be used to supply all necessary rotational motions to the table, although it is limited in precision. This could be a simple implementation if we do not need to automate the movement of the device.

revisions print • Cory Beek • Sep 12, 2018 @12:54 PM CDT

phoneholder.png(428.1 KB) - download This image shows the ball and socket joint in my phone cradle that allows me to rotate my phone.

Design Fixes from SolidWorks

revisions print • Cory Beek • Oct 10, 2018 @11:51 AM CDT

Title: Solidworks Design Modifications

Date: 10-Oct-2018

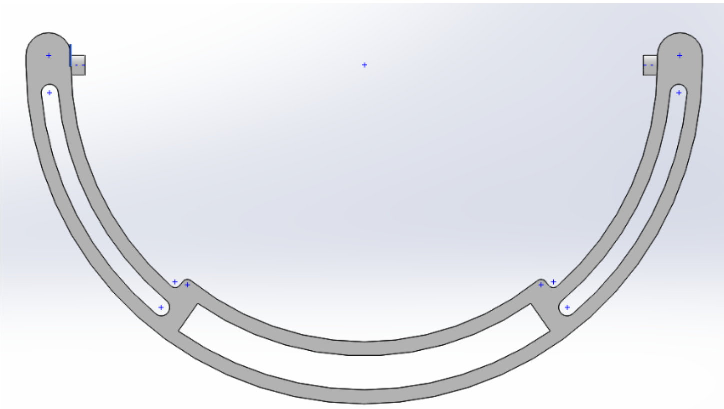
Content by: Cory

Present: N/A

Goals: Make Jamison's Spider Leg Design more efficient.

Content:

- Thinning the guide arms:
    - The original design had two slots stacked on top of each other in the thicker of the two guide arms. One slot was an attachment point for the guide to the arms in the base of the device, and the other slot allowed for the smaller guide arm to slide within it for its independent motions.
    - This caused the larger guide arm to be quite thick (~4-5cm)
        - This increases the height of the overall device
        - Also means the subject table must be smaller
    - Solution: Separate the slots for the attachment point and guide pass-through. The outsides of the large guide contain the slots to attach to the base, and will eventually have the gear teeth necessary to move it. In the middle of the guide is a hole which fits the smaller guide. The smaller guide was thinned down even further in the middle so the hole in the larger guide could be as small as possible.
        - Pros: The thickness is less than half the original size (~2cm). Also, the attachment slots on both of the guides are in the same relative positioning to the base so only one attachment device needs to be made and it will work with both guides.
        - Cons: This limits the amount of possible rotation to about 45 degrees about the x and y-axes. However, this is enough rotation for the research being done by Dr. Rogers.



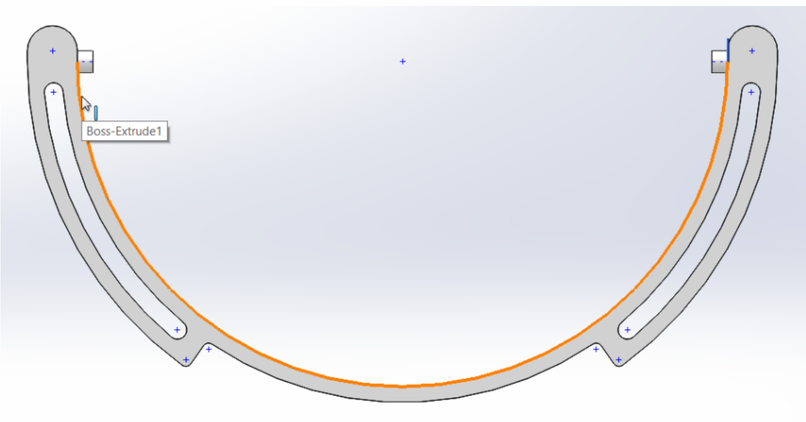
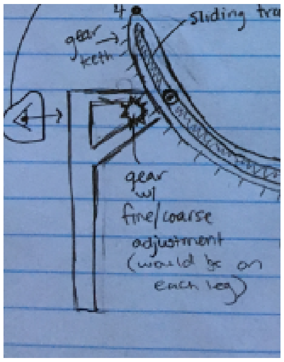


Image1: The new large guide featuring separate attachment and small guide slots. Image 2: The new small guide which is skinnier in the center so the large guide can be shorter. Note that the dimensions on the upper sides of both guides are the same.

- Simplifying the Base Arms
  - The original design attached the guide arms to the base with four complex arms to hold the gears and connect to the slot in the guide. This created an issue where the guide slot pin wasn't always tangent to the edge of the guide, which complicates the positioning of the slot in comparison to the gear teeth on the guide. The originally proposed arm was also skinnier making it more fragile at higher loads on the table.
  - Solution: The base arm was changed to just be two columns with simple rectangular geometry. There is a hole in each column that attaches to two supports with the gear in the middle. The two supports are independent parts which connect at the gear and base arms on one side, and the guide slot on the other. This keeps the pin-point in the guide slot tangent to the edge of the guide, so the guide slot and guide gears will both have the same arc length.
    - Pros: Simplified geometry, more structural support, easier to 3d print.
    - Cons: Introduces a new part (the support) and arguably doesn't look as cool.



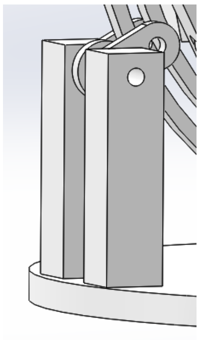


Image 3: Jamison's original attachment arm. Image 4: The new attachment arm and supports. The circular gear which controls movements of the guides can be seen as well in the middle.

- Lowering the table
  - The design initially had the table to hold the subjects even with the axis of rotation. This made it so the focal point was actually slightly below (1/2 the table thickness) the surface of the table.
  - Solution: The table was dropped down so that its top was 5 cm below the focal point of rotation. Arms were added to attach the table to the tops of the curved guides.
    - Pros: The subject can be moved around so the eye is in the focal point which is the main purpose of our design.
    - Cons: Harder to 3d print.

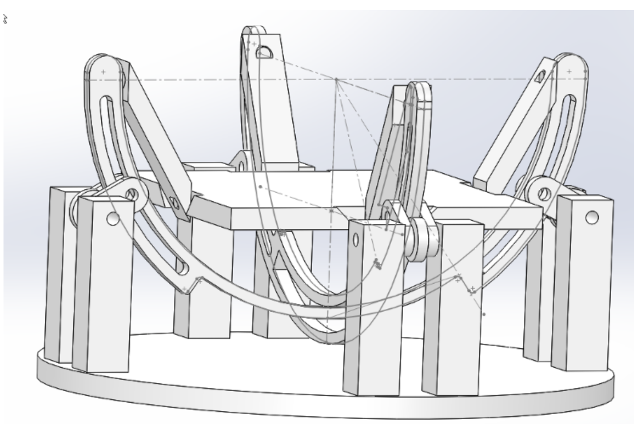


Image 5: This image shows the table dropped below the axes of rotation (viewed in the sketches). It also features the four table arms that connect the table to the guides.

- Unable to rotate in two directions at the same time:
  - One issue with the device currently is that it can only be rotated around one of the x or y-axes at a time. The reason for this is that when the device rotates about the x-axis, the y-axis rotates as well so that it is no longer directly parallel to the base.
  - Solution: We do not currently have a solution for this issue.

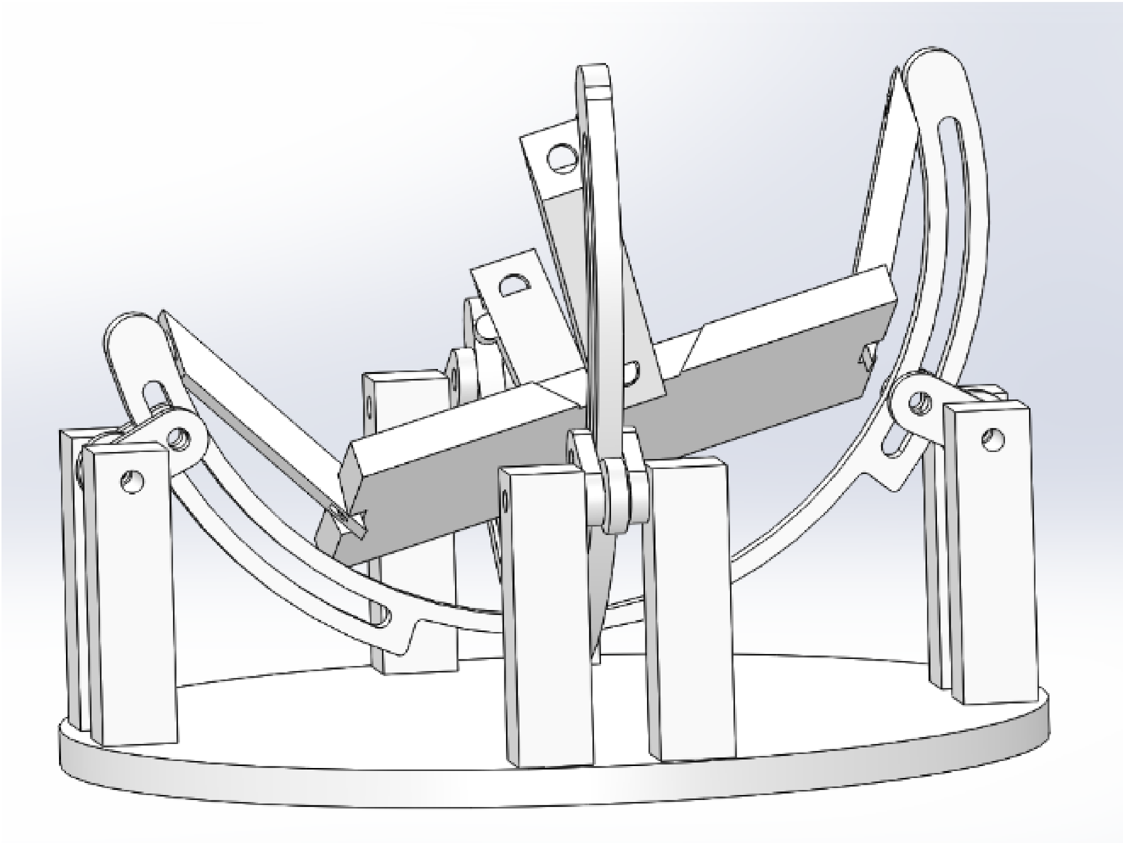


Image 6: This shows that the table arms can no longer attach to the guides if both guides are rotated at the same time.

Conclusions/action items:

Moving forward, the team will try to brainstorm ways to fix the multi-rotational issue. If we can't find a solution, we could remove one of the rotational directions and still meet the requirement for 5 degrees of freedom. We will also need to finish the SolidWorks designs including adding teeth to all the gears.

Removal of Second Curved Support

revisions print ▪ Cory Beek ▪ Dec 11, 2018 @09:38 PM CST

Title: Removal of Second Curved Support

Date: 19-Oct-2018

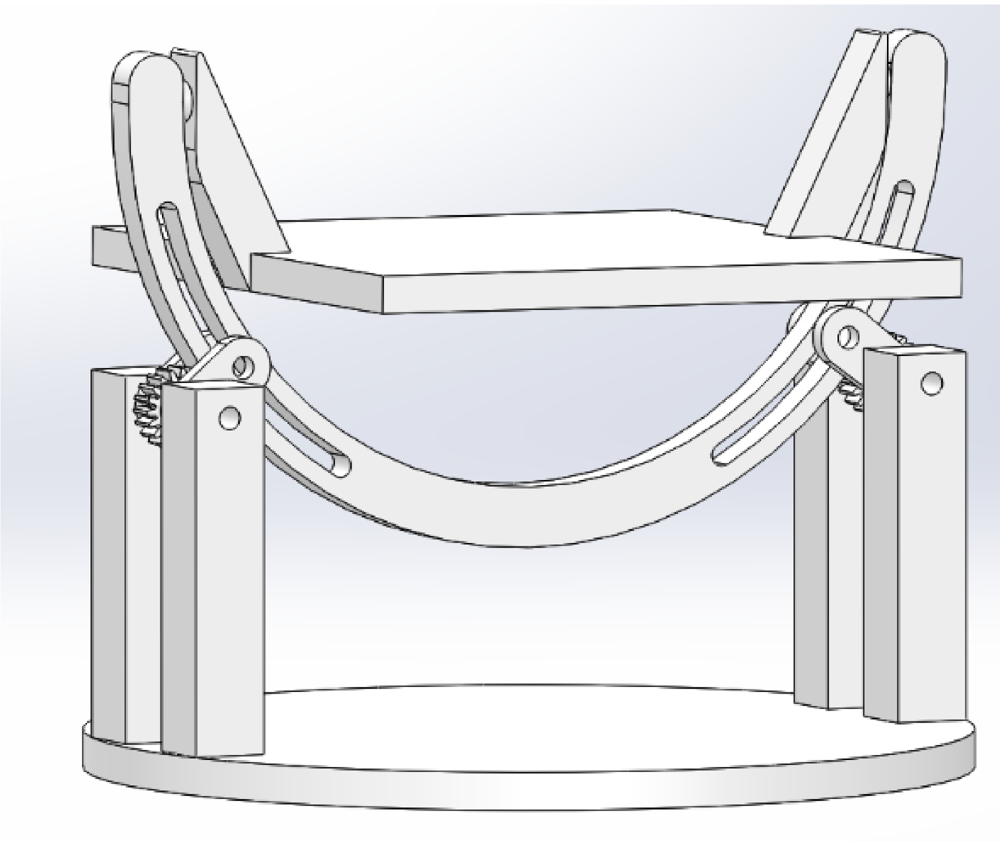
Content by: Cory Van Beek

Present: Cory

Goals: Create a SolidWorks design with only one curved support to fix the multi-rotational locking issue.

Content:

We previously described the issue that due to having two curved support arms, we are only able to rotate the table in one direction at a time. After talking with Jamison and Dr. Suminski, we came up with the idea of removing one of the curved supports and providing the second degree of rotation by creating pivots at the top of the remaining support. Below is a SolidWorks image of our idea:



The picture shows that the table hangs down between the sides of the support and is able to freely rotate around two different pins at the top. It is possible that the rotation could be controlled by gears, but there may be some better mechanism.

Conclusions/action items:

The new method will allow rotations in both x and y directions. Future work will include:

- Brainstorm ways to control the new rotation method.
- Finish adding gears to the SolidWorks model

Reducing Base Volume

revisions print ▪ Cory Beek ▪ Dec 11, 2018 @10:06 PM CST

Title: Removal of Second Curved Support

Date: 24-Oct-2018

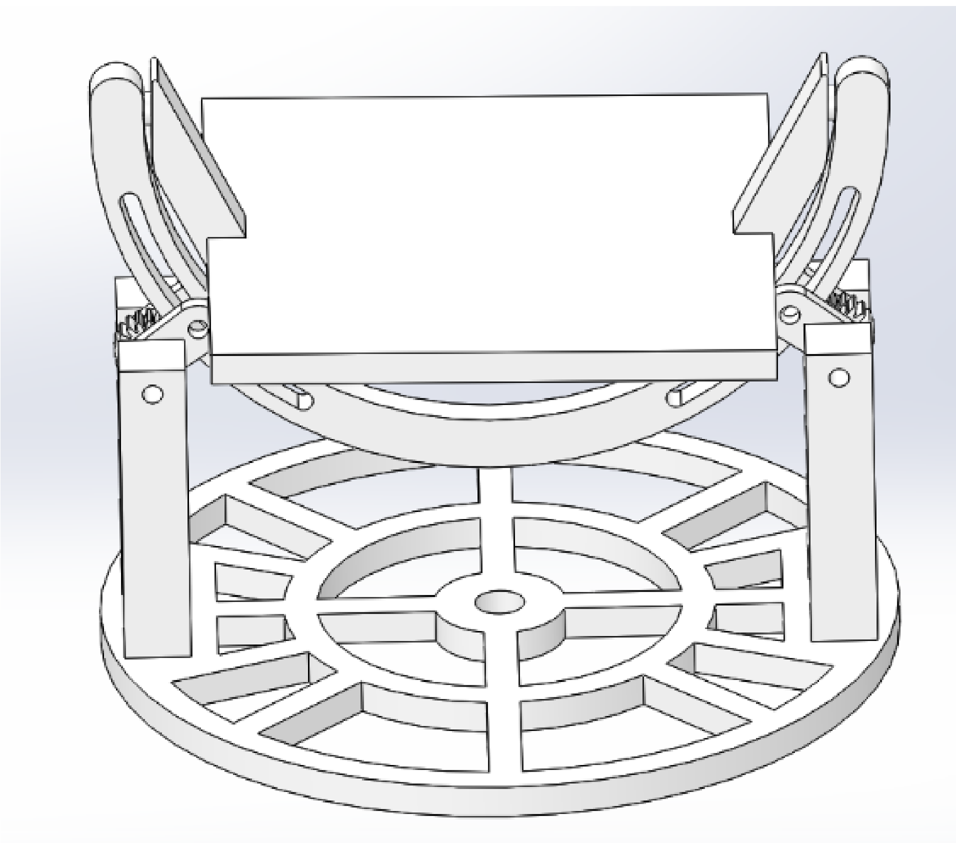
Content by: Cory Van Beek

Present: Cory

Goals: Reduce the volume of the base piece to make it easier to 3D print.

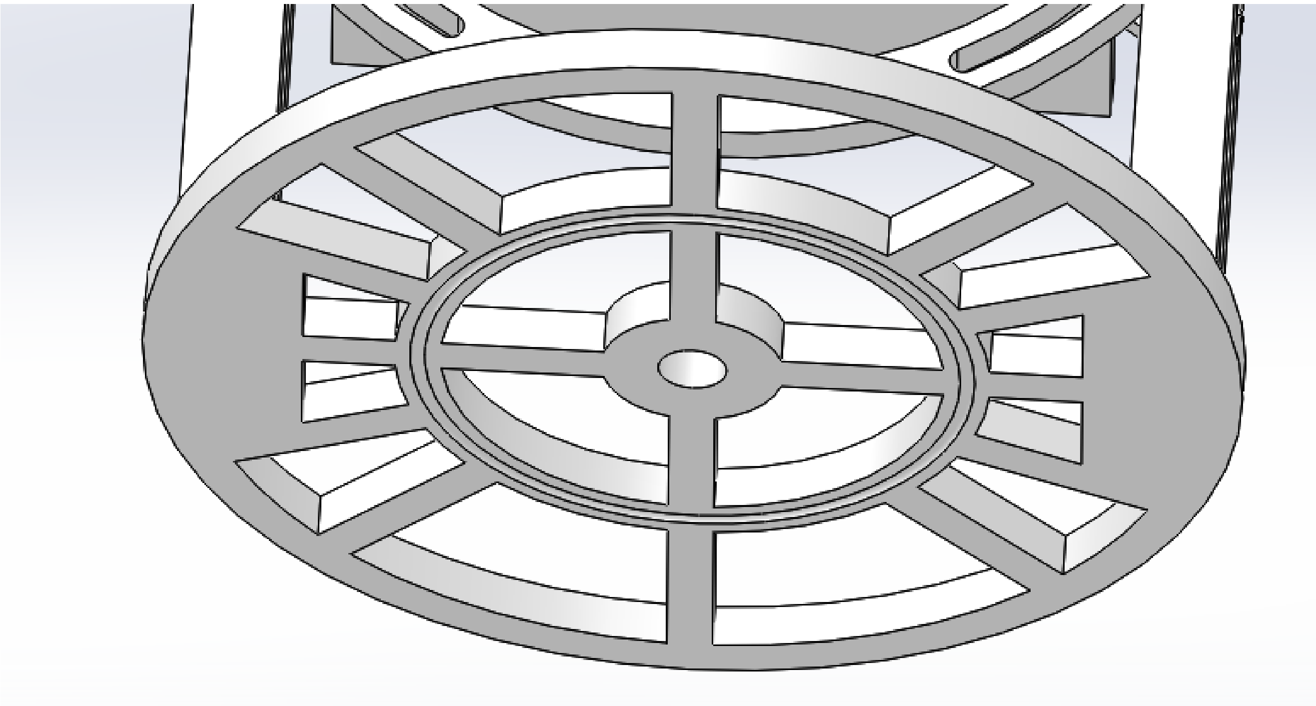
Content:

When 3D printing parts, decreasing the volume will help decrease material costs. In certain areas (such as the base), we can remove sections of the part without making significant changes to the structural integrity of the part. The picture below shows the base with multiple cutouts.



The cutouts vastly reduce the volume of the structure. All parts of the new base are at least 1 cm thick, which is plenty to accommodate the minimal stress the part will be under.

In addition to the cutouts, a circular groove was also cut into the bottom of the part:



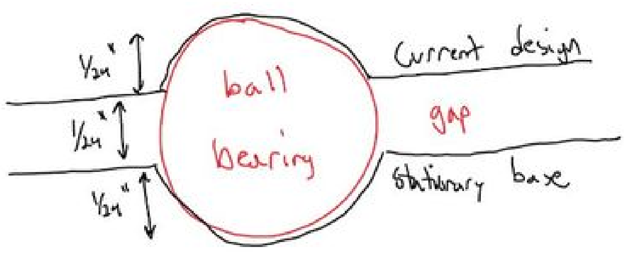
This groove will fit 1/8 inch ball bearings, allowing for smooth rotation around a stationary base. The groove is 1/24" deep as shown in the attached ball bearing diagram.

Conclusions/action items:

The base has decreased volume and therefore decreased cost. Future work includes:

- Designing a base the design can rotate above
- Finish adding gears to the SolidWorks model

revisions print ▪ Cory Beek ▪ Dec 11, 2018 @10:05 PM CST



Ball_Bearing_Diagram.JPEG(18.3 KB) - download

Added Gear Teeth

revisions print

▪ Cory Beek ▪ Dec 11, 2018 @10:21 PM CST

Title: Added Gear Teeth

Date: 25-Oct-2018

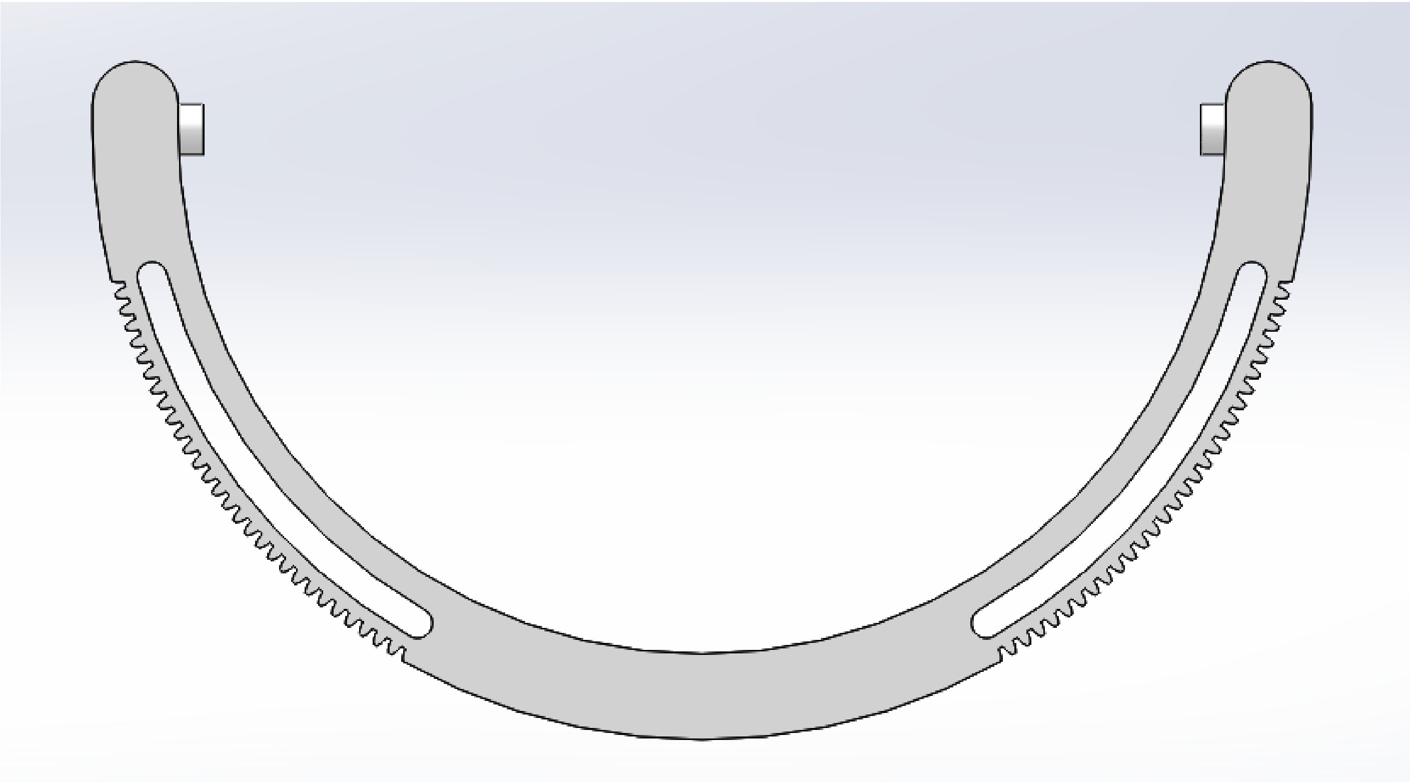
Content by: Cory

Present: NA

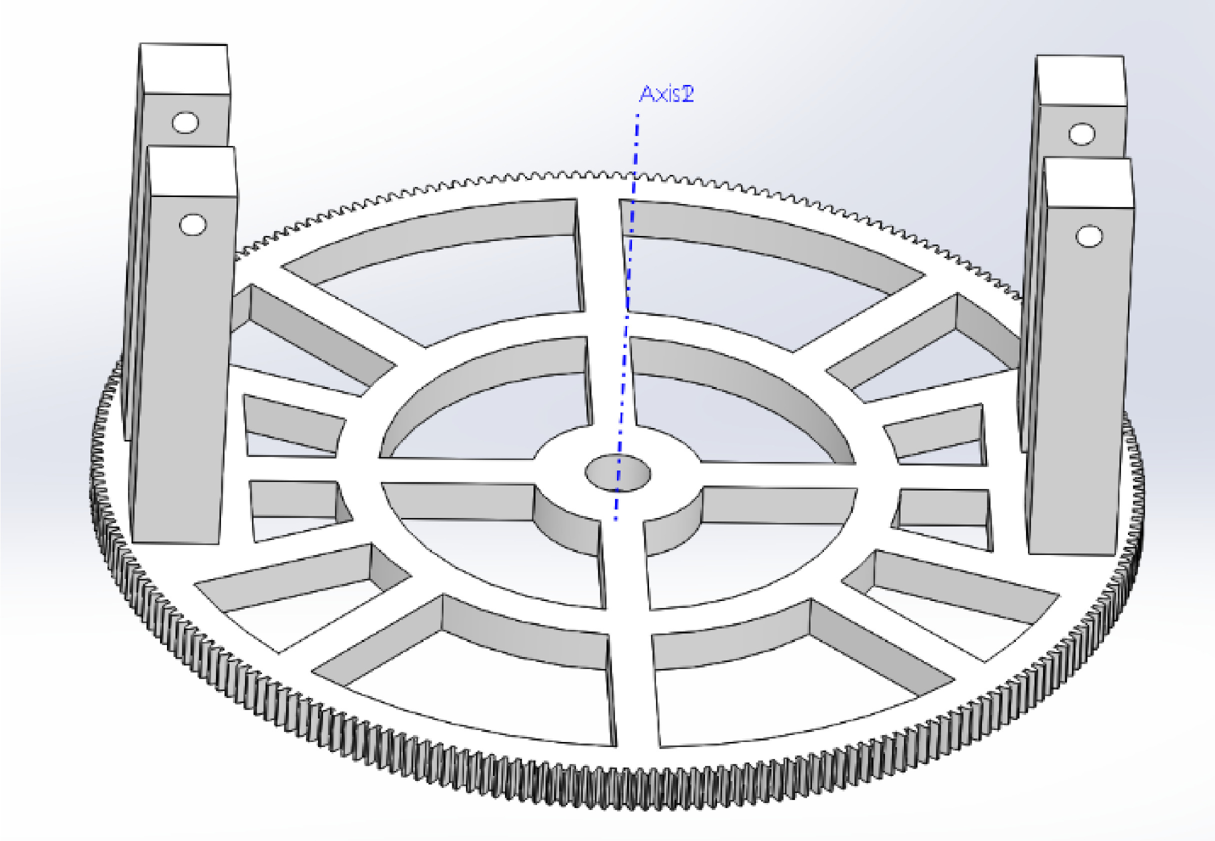
Goals: Add gear teeth to the existing SolidWorks parts

Content:

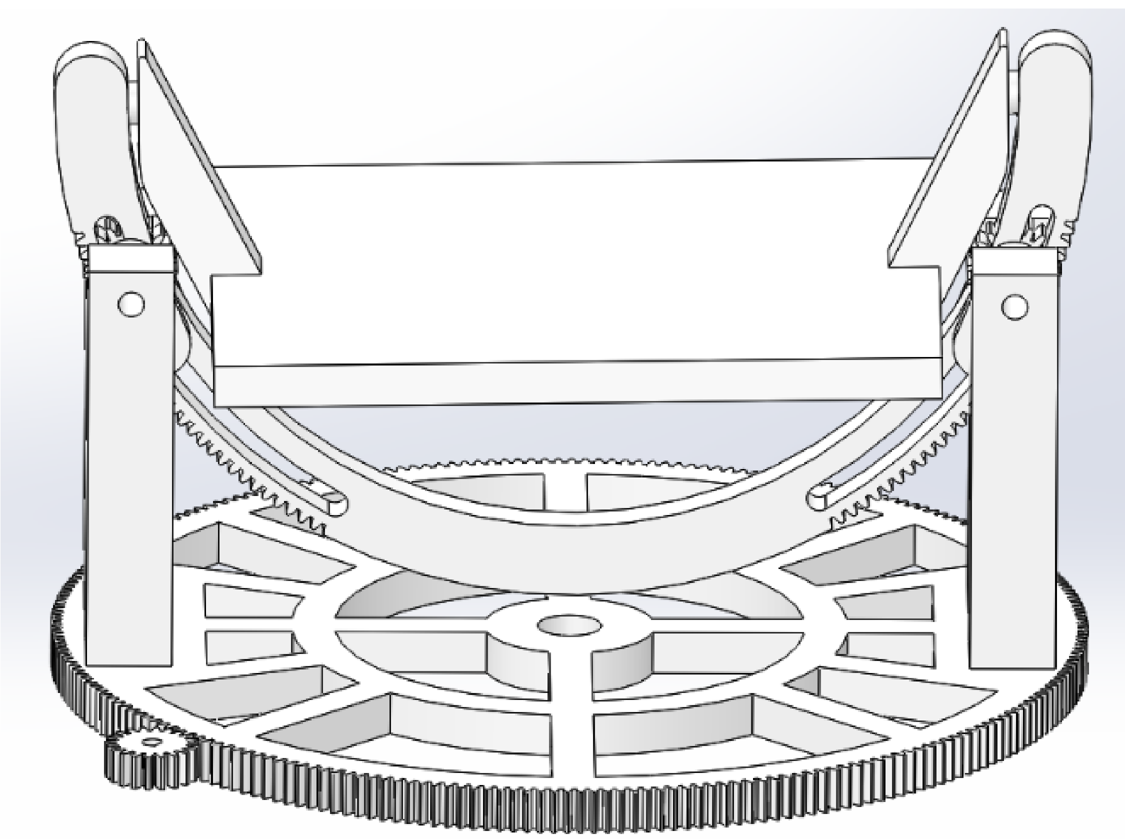
The previous SolidWorks designs did not include gear teeth in multiple components that required them. I've added teeth to the base and curved support pieces. The curved support was a bit more tricky than the previous gears I've made because they started at an angle. That means I had to create my own references that weren't just horizontal or vertical. It was also harder to do the circular pattern since it doesn't go all the way around. Once one side was done though, it was just mirrored across to the other side. Both gears have the same 0.1 (diameter/teeth) module as the gear already created, so they will all line up.



Above is the curved support with its gear teeth.



and above the new base.



It seems that these gears have broken the mates in the assembly, so I will need to fix those later.

Conclusions/action items:

Gears have been added to the base and guide pieces. Future work includes:

- Fixing the mates in the SolidWorks assembly
- Designing a base the design can rotate above

Gears Issue

▪ Cory Beek ▪ Dec 11, 2018 @11:27 PM CST

Title: Gears Issue

Date: 26-Oct-2018

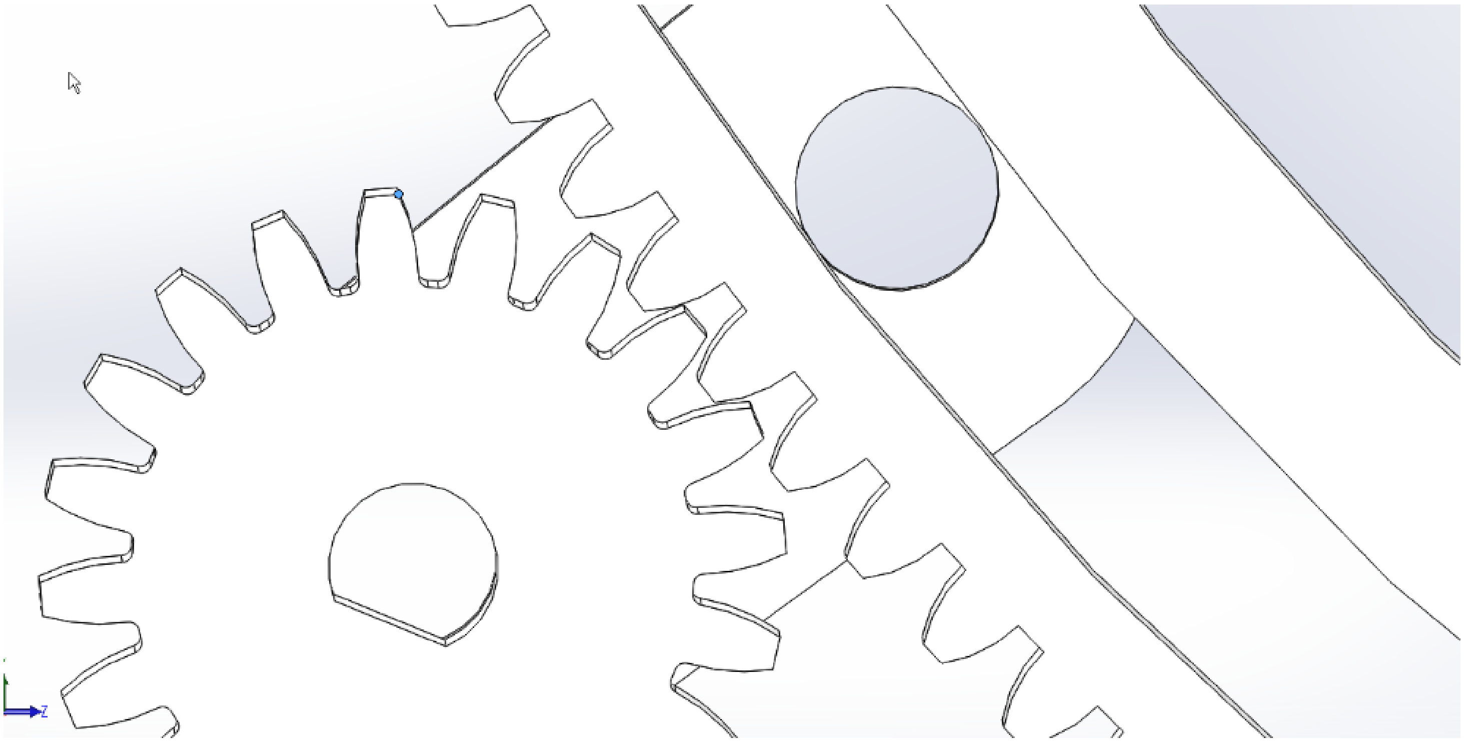
Content by: Cory

Present: Cory, Jamison

Goals: Acknowledge the issue we're having with the gears in the assembly

Content:

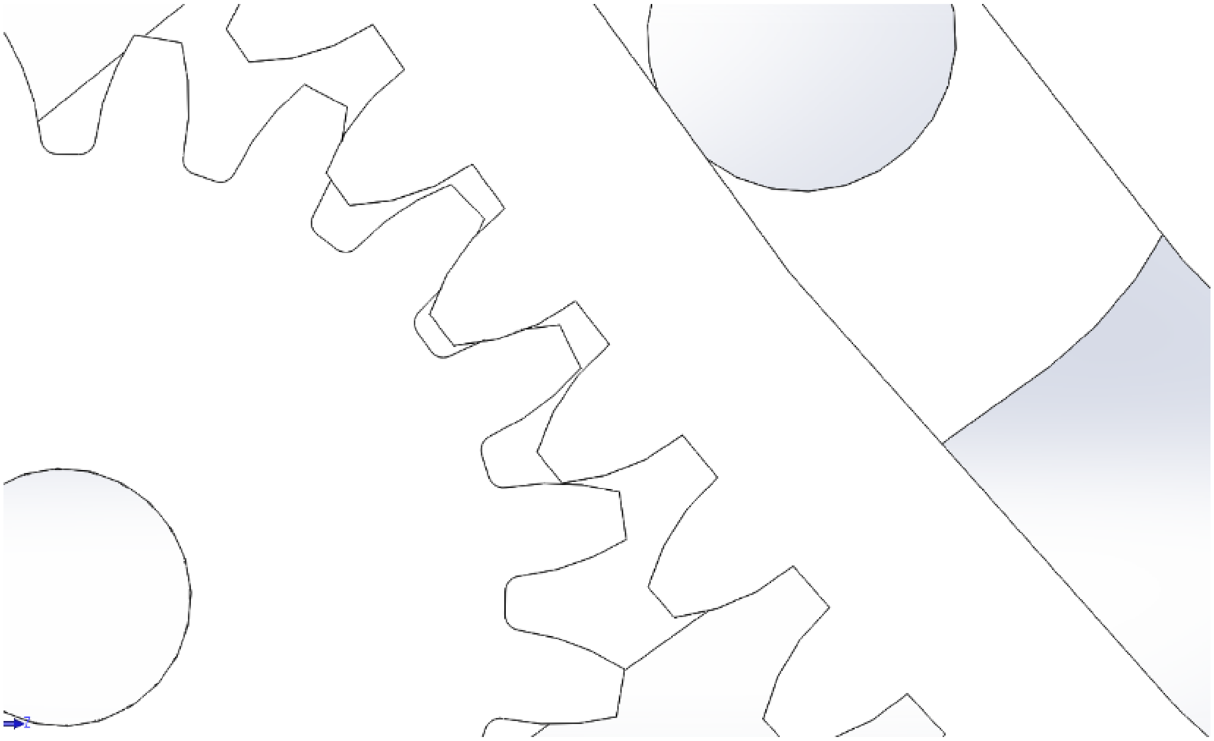
After fixing the SolidWorks assembly, we're having some issues with the gears not matching up with the support guide gears.



It seems that the piece connecting the two gears may be too long, but it also looks like the curved support gear teeth are larger, which is strange since they were made with the same module.

Update: 31-Oct-2018

I've confirmed that the connecting piece was too long. This has been fixed and now the two gears pitch diameter circles are tangent to each other. However, the gears still aren't matching up properly. It still looks like the curved support has bigger gear teeth, and if they are rotated, the small gear's teeth are moving faster than the others. I've rechecked everything I can think of that could be causing this issue, but all the math and angles seem correct. Alexus is planning to her mentor (the ex Harley-Davidson gear master) to see if he can tell what is wrong.



The above figure shows the new interaction with the correct gear spacing, but something is wrong with the teeth size.

Conclusions/action items:

Figure out how to make the gears line up.

Added Underbaser to Assembly

revisions print ▪ Cory Beek ▪ Dec 11, 2018 @11:55 PM CST

Title: Added Underbaser to Assembly

Date: 04-Nov-2018

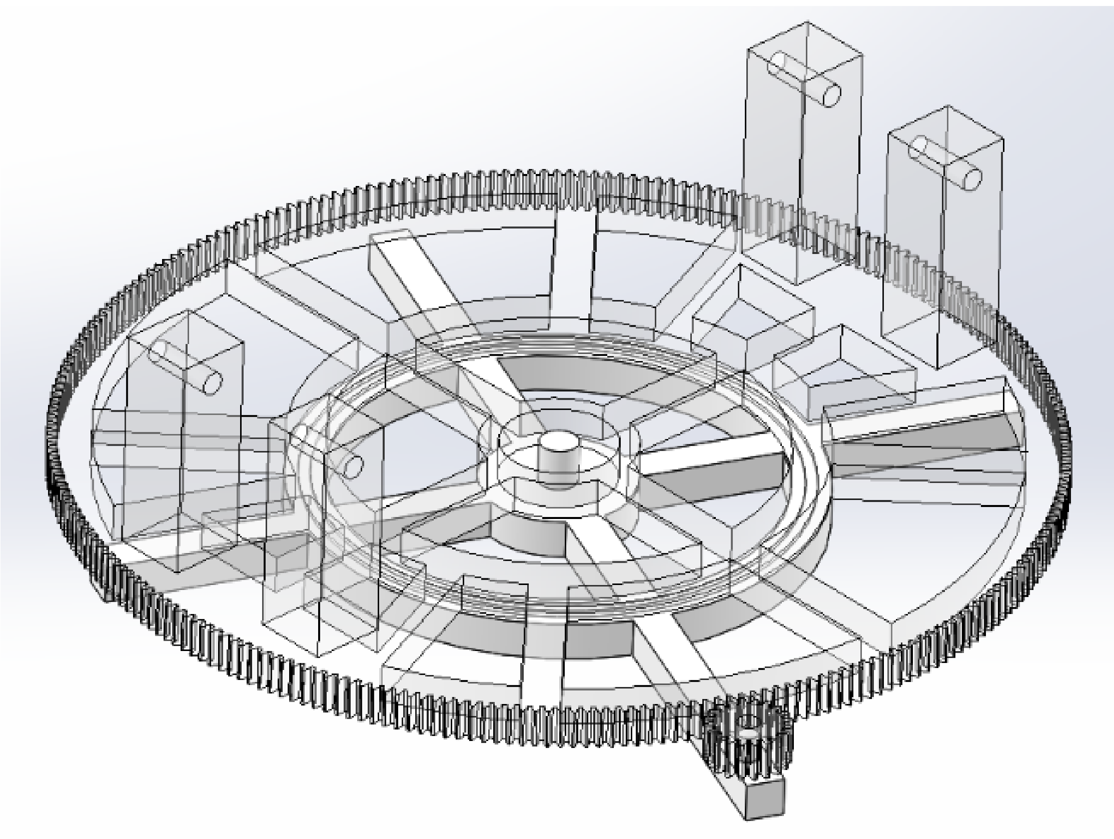
Content by: Cory

Present: Cory, Jamison

Goals: Add Jamison's Underbaser part to the assembly

Content:

The Underbaser that Jamison created was added to the assembly, and the device is able to rotate around it. All of the gear interactions work as expected.



Additionally, the hole in the center of the device was increased in size. We are hoping to find a ball bearing that will fit in between the device and the Underbaser, which will secure the two devices together while still allowing the device to rotate.

Conclusions/action items:

- Find a ball bearing that will fit between the two pieces.

Splitting the Base

revisions print ▪ Cory Beek ▪ Dec 12, 2018 @02:00 AM CST

Title: Splitting the Base

Date: 08-Nov-2018

Content by: Cory

Present: NA

Goals: Figure out a way to print the base piece which is bigger than the 3D printer build plate.

Content:

The base gear piece has a diameter slightly greater than 24 cm, which is bigger than the build plate for the Cura Ultimaker S5 (the largest 3D printer MakerSpace has). In order to print it, I was able to split the part into two identical pieces. These pieces attach to each other with four 1/8" screws and include a cutout to fit a nut to lock the screws in place. With the pieces in half, they will be able to be printed simultaneously on one S5 printer.

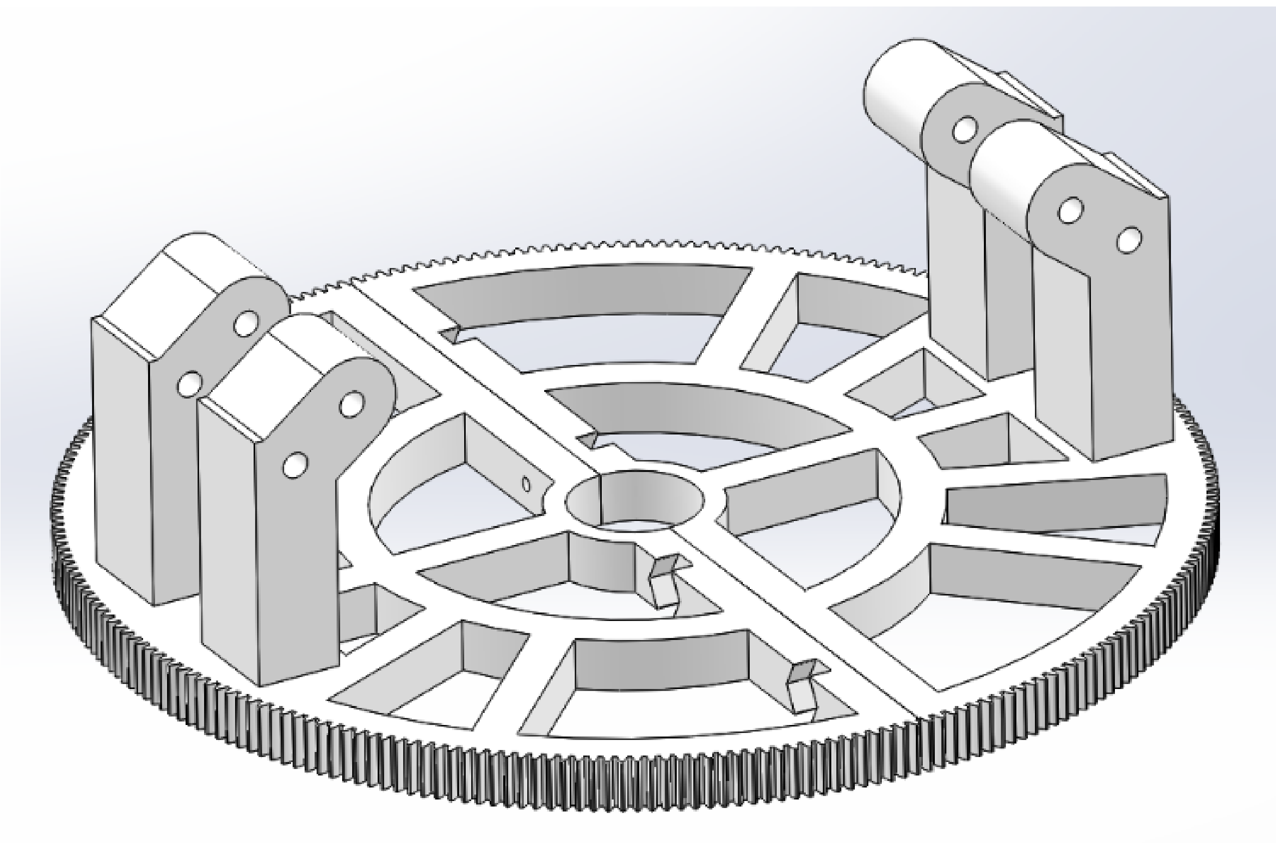


Figure: The two base pieces put together.

Another change that was made which can be seen in this picture is the removal of the pieces that connected the rotational gears to the curved support. They have been replaced by an add-on to the arms of the base, which now feature two holes each. The first hole holds the circular gear, while the second, higher hole goes through the slot in the curved support. Having a separate piece to hold the two gears together was causing the table to sink slightly when under loads, which makes it less precise and harder to rotate. We were able to demonstrate this with our cardboard model of the device.

Conclusions/action items:

The pieces are now able to fit on the 3D printer.

- Action Item: find 1/8" screws in the BME junk hallway.

Gears Issue Resolved!

revisions print ▪ Cory Beek ▪ Dec 12, 2018 @02:06 AM CST

Title: Gears Issue Resolved!

Date: 15-Nov-2018

Content by: Cory

Present: NA

Goals: Fix the issue where the gears aren't lining up.

Content:

After a couple agonizing weeks, I've finally found the problem that was causing the gears to not match up! The issue was in the spacing of the cuts which are used to make the teeth on the curved guide. Unlike the other gears, on the curved guide, they don't go all the way around in a full circle. When I created the circular pattern, I had specified an exact number of copies to make at equal spacing, but I needed to specify exact spacing, and let SolidWorks figure out how many copies to make over that curve. When I made that change it all worked out.

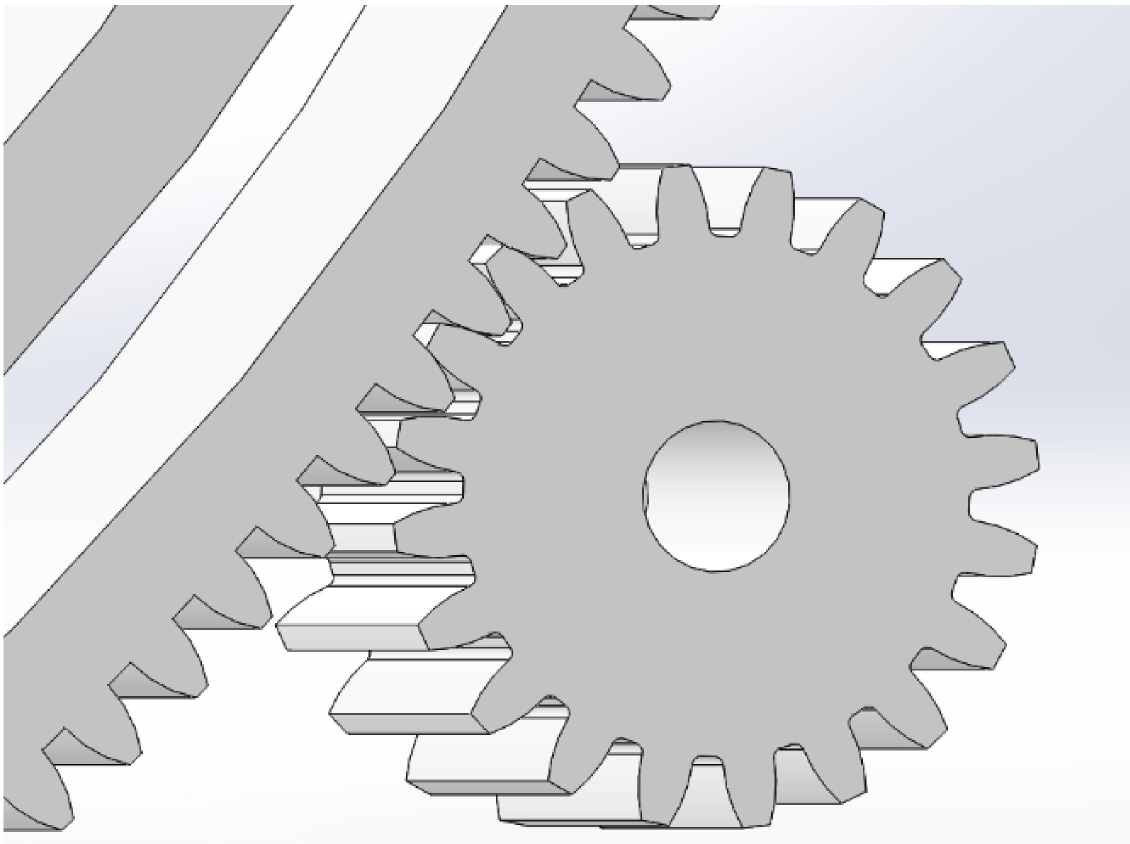


Image: The fixed gears in all their glory.

Conclusions/action items:

The gears are fixed!!!

Rotation via Dial

revisions print ▪ Cory Beek ▪ Dec 12, 2018 @11:03 AM CST

Title: Rotation via Dial

Date: 11-Nov-2018

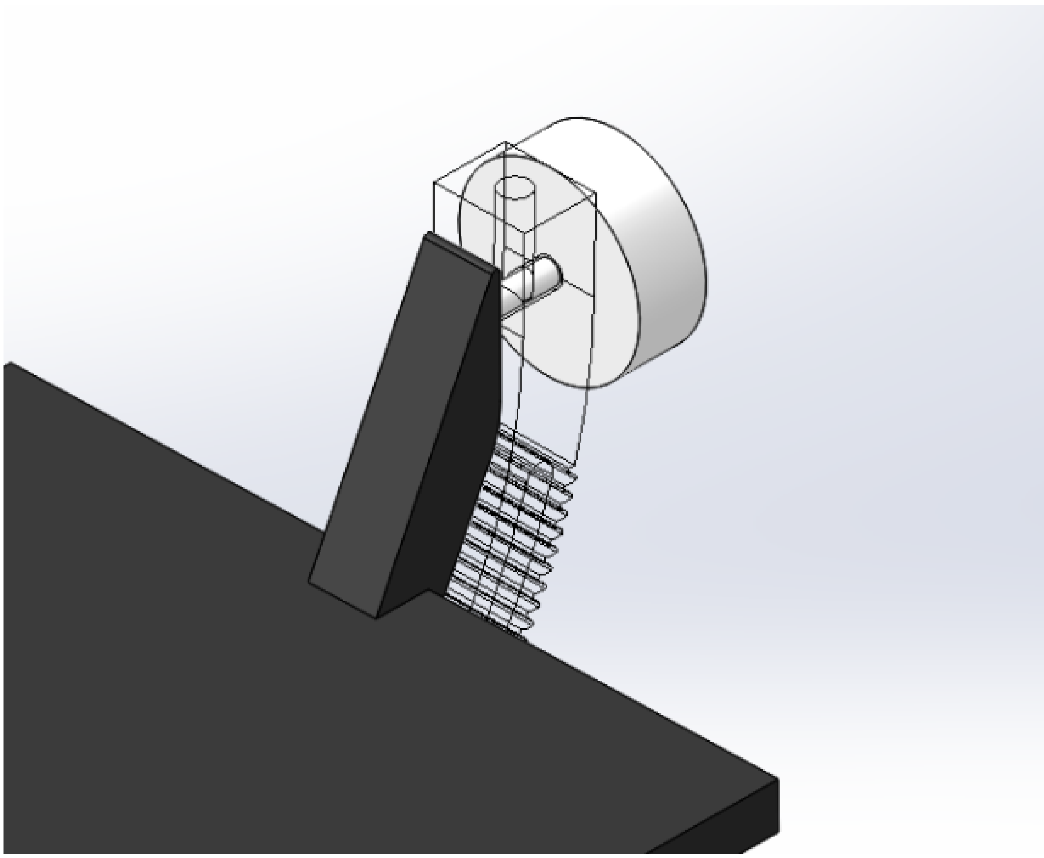
Content by: Cory

Present: Cory, Jamison, Alexus, Aaron

Goals: Figure out a way to rotate the table about the pegs on the base.

Content:

While we were originally planning on using gears to rotate the table about the curved support guide, we couldn't find a good place to mount them on the device. The team came up with the idea to instead just use a dial for turning the table. The dial has a shaft that fits through a hole in the curved support, and into the arm of the table. The shaft will be superglued to the table, so it will rotate when the dial is moved. This idea was based off the dial used on a sewing machine to move the needle up and down.



The above figure shows the dial which goes through a hole in the curved guide and into the table arm. An additional hole was made into the top of the curved guide which will be threaded so a screw can be used to tighten to the shaft once the rotation has been set.

Conclusions/action items:

We've come up with a mechanism to provide rotation about the support guide. Our next actions include:

- Printing the curved guide, dial, and gears
- Finding a bolt in the BME junk hallway

Implemented Z-Translation Device

revisions print • Cory Beek • Dec 12, 2018 @11:24 AM CST

Title: Implemented Z-Translation Device

Date: 30-Nov-2018

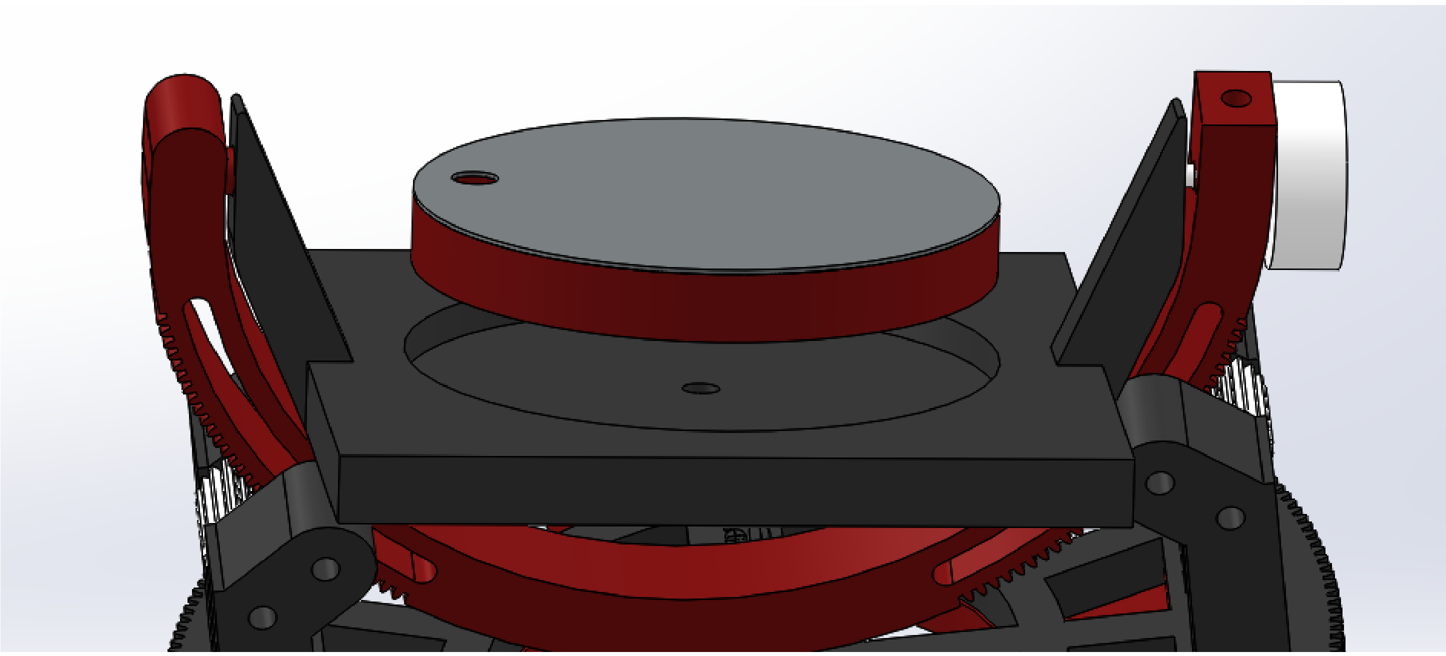
Content by: Cory

Present: Cory, Aaron

Goals: Create the pieces for Aaron's Z-translation mechanism in SolidWorks

Content:

We were able to add the two new pieces for Z-Translation and edit the existing table in SolidWorks. The two new pieces are both circular with 15 cm radii. One will be PLA or ABS and contains two holes: one in the bottom which will screw onto a nut which raises it above the table, and one near the edge which will be used to quickly rotate the piece to adjust the height on the nut. The second piece is a thin metal sheet that will be attached above the plastic piece. This will allow the modular devices to attach with magnets. The existing table was modified to have a circular indent for the new plastic piece. It also now has a hole in the middle for the bolt.



The figure above shows the two new pieces above the modified table. I still need to add the bolt to the assembly.

Conclusions/action items:

Todo:

- Add the bolt to the assembly
- Print the new piece and the table
- Cut our metal sheet to the circle

Added Minor Pieces

revisions print ▪ Cory Beek ▪ Dec 12, 2018 @11:36 AM CST

Title: Added Minor Pieces

Date: 02-Dec-2018

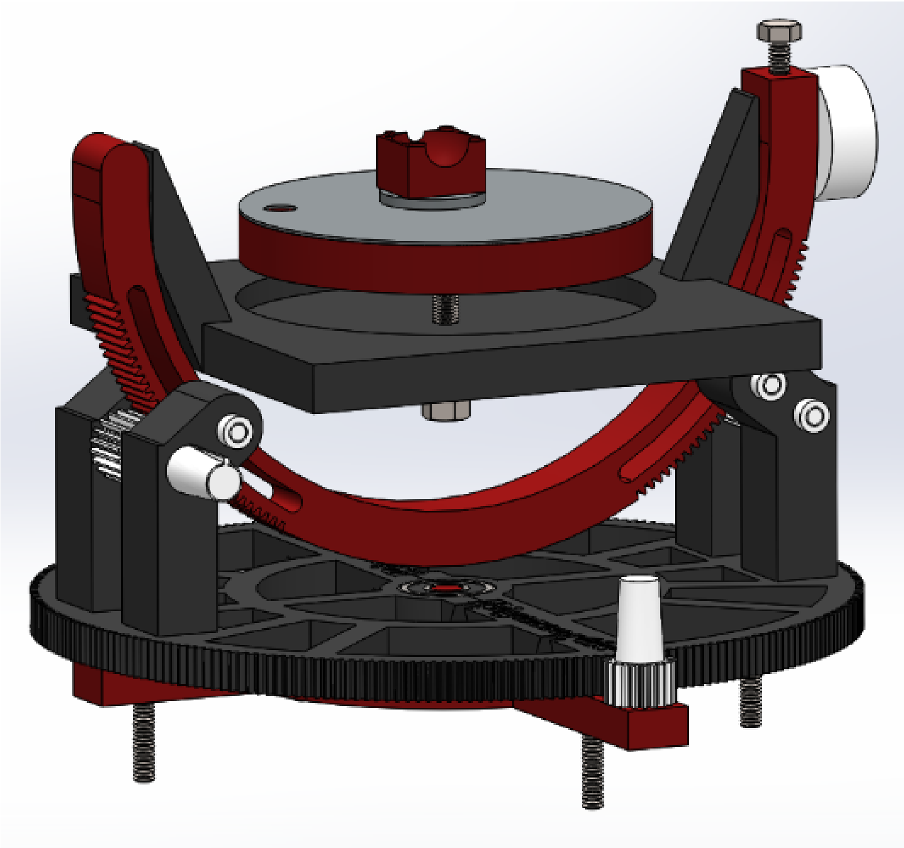
Content by: Cory

Present: NA

Goals: Add all the small pieces to the assembly

Content:

Currently, the assembly was made of just the important pieces that we designed but was missing several small parts for connections. These parts have now all been added and can be seen in the figure below.



Starting from the bottom, four 1/4" screws were added that screw into the bottom of the vibration-less table. In the middle, we found a size 6200 ball-bearing online (https://grabcad.com/library/6200-2rs-ball-bearing-1) and we added a layer of 1/8" ball bearings between the main device and the Underbaser. Next, a knob was designed to turn the gear which moves the curved support, as well as three shafts with cap pieces to hold the gears and slots in place. Two 1/4" hex bolts were added, one for the Z-translation, and one for tightening the dial. Lastly, the eyeball holder device was added to the top along with a magnet.

Conclusions/action items:

The SolidWorks is done, we just need to print the remaining pieces and test the prototype.

Table Modification

revisions print • Cory Beek • Dec 12, 2018 @11:45 AM CS

Title: Table Modification

Date: 03-Dec-2018

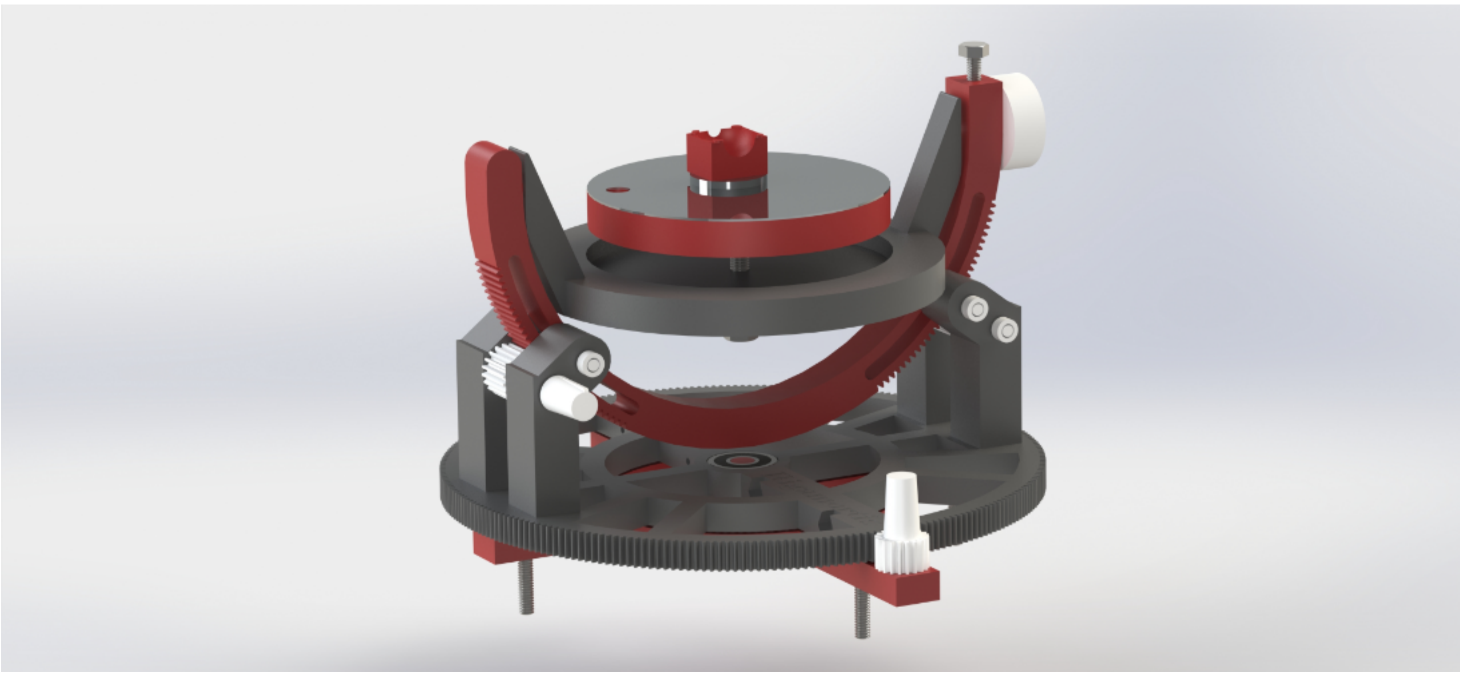
Content by: Cory

Present: NA

Goals: Find a quick fix to make the table smaller so it doesn't bump into the device tower arms when rotating.

Content:

After printing the table, we found that it was a little too big. The area near the corners was hitting the bottom of the device when it was rotating, which greatly prohibited movement. To fix this issue, I changed the table from a square to a circle, which eliminates unused volume. With a circular table, it should be able to rotate 360 degrees about the curved support without hitting anything.



The figure above shows the new circular table which greatly reduces its volume and increases mobility. Note that I also found a way to make awesome images with SolidWorks using the PhotoView 360 Add-in. We will be using images taken from that add-in on our poster.

Conclusions/action items:

The table has been reduced in size by making it a circle. We need to print the new table as soon as possible so we can do our testing before printing our poster.

Dial Mechanics

revisions print ▪ Cory Beek ▪ Dec 12, 2018 @12:12 PM CST

Title: Dial Mechanics

Date: 03-Dec-2018

Content by: Cory

Present: Cory, Jamison

Goals: Use materials analysis to determine the factor of for the dial.

Content:

In order to fit through the curved support, the shaft of the dial needed to be small in diameter, which increases the stress on the part. Under the 3.0 kg load, the dial is the most likely piece to break. The piece was printed in Grey Pro, which has a yield stress of 61 MPa [1], making it stronger than typical PLA or ABS. For our analysis, we simplified the model by leaving the load level and modeling all the weight at the end of the shaft. Realistically, there would be a reaction force distributed around the middle of the shaft where the curved guide is holding up the dial. This would decrease the stress on the dial, increasing the factor of safety to a value larger than our estimate. Rotating the device would decrease or increase the stress slightly depending on the direction, but not greatly affect it. With this analysis, we determined a factor of safety of 2.31. The work can be seen in the attached figure.

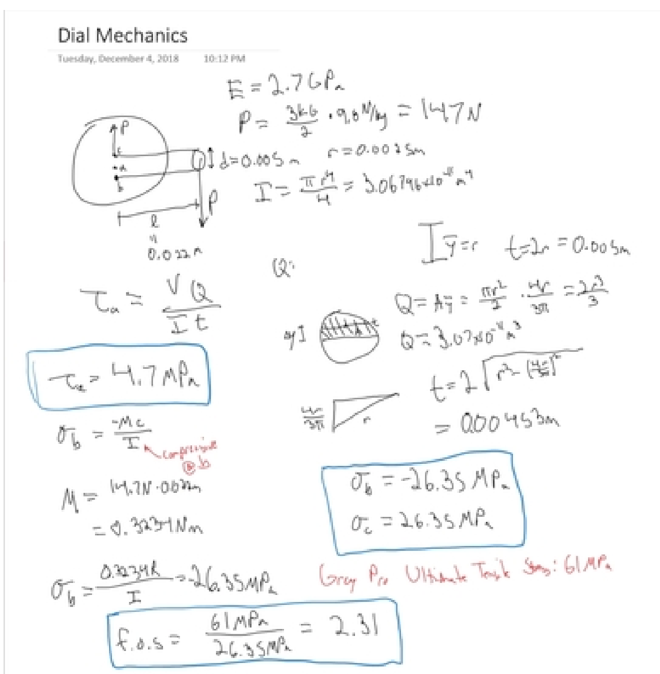
Conclusions/action items:

While ideally the factor of safety would be a little larger than 2.31, it isn't critical for our design. If the part fails, nothing has far to fall. The piece only costs ~$2 to reprint so it wouldn't be an expensive failure. Finding a stronger material will be listed as future work.

References:

[1] “Grey Pro.” [Online]. Available: https://formlabs.com/media/upload/Technical_Data_Sheet_EN_-_Grey_Pro.pdf. [Accessed: 05-Dec-2018].

revisions print ▪ Cory Beek ▪ Dec 12, 2018 @12:08 PM CST



Dial_Mechanics_Math.JPEG(246.3 KB) - download

Different Clinical Imagining techniques

revisions print ▪ ALEXUS EDWARDS ▪ Oct 10, 2018 @12:41 AM CDT

Title: The Basis of Ocular imaging

Date: 09/12/2018

Content by:

Alexus Edwards

Present: N/A

Goals: To understand the different types of ocular imaging and gain more knowledge on the problems.

Content:

Types of Ocular Imaging

Diagnostic imaging

- Scanning Laser Polarimetry (SLP)
- Confocal Scanning Laser Ophthalmoscopy (CSLO)
- Optical Coherence Tomography (OCT)

SLP-

- Determines the thickness of a nerve tissue by examining the birefringence of polarized light as it is reflected off the eye.
- The projected polarized light will have a reflected phase delay -Retardation thus allows for people to estimate tissue thickness.
- Most often the radial birefringence of Helene's fiber layer in the macula as a reference
- Most recent is GDx Pro

A. This uses a laser wavelength of 785 nm and acquires data from 40 degree X 20-degree area of the retina

- Current scanners start with scanning the macular region, which determines the corneal compensation properties, then the scan the optic nerve head.

A. B. This then allows for a sample of the optic nerve, which then allows for the retinal nerve fiber thickness is reported

- This machine provides

A. C. Retinal nerve fiber thickness
D. Nerve Fiber Index

- Nerve Fiber index

A. E. This is formulated by an algorithm, which reports a value that is compared to those with disease status

CSLO-

- This technique is a microscopy with high transverse resolution
- Focuses a beam onto the tissue and filters reflection light from outside the focal point by using a confocal pinhole in front of a photodetector.
- Most common Heidelberg Retina Tomography III

A. F. Which uses a beam with a wavelength of 670 nm and captures a series of evenly space 2 dimension frames.

- The scans are reflectance image of the clinical view of the optic nerve head region.

OCT

- This technique uses a low -coherence interferometry which scatters light Is interfered with a reference beam to create an axial scan of depth-resolved tissues reflectivity.
- Multiple beams are scales simulates to create a cross-sectional slice of scattering media.
- Due to movement, this process is limited to 400 A-Sans/sec
- This technique uses spectrometer and charges couples devices

Conclusions/action items:

Although there are probably many different designs of these 3 type of machinery, these are the types that we will be competing with. Also, there was some good discussion about how they were able to create machinery to account for the movement of the eye and the limitless of the material. This was a great start at categorizing, but I think the next action needs to be the understanding of how the information is useful.

MRI Bed technology

revisions print • ALEXUS EDWARDS • Oct 10, 2018 @12:41 AM CDT

Title:

Accurate Coregistration between Ultra-High-Resolution Micro-SPECT and Circular Cone-Beam Micro-CT Scanners.

Date: 09/20/2018

Content by: Alexus Edwards

Present: N/A

Goals: To understand the different ideas that are out there for beds of medical imaging of animals to gain a better perspective.

Content:

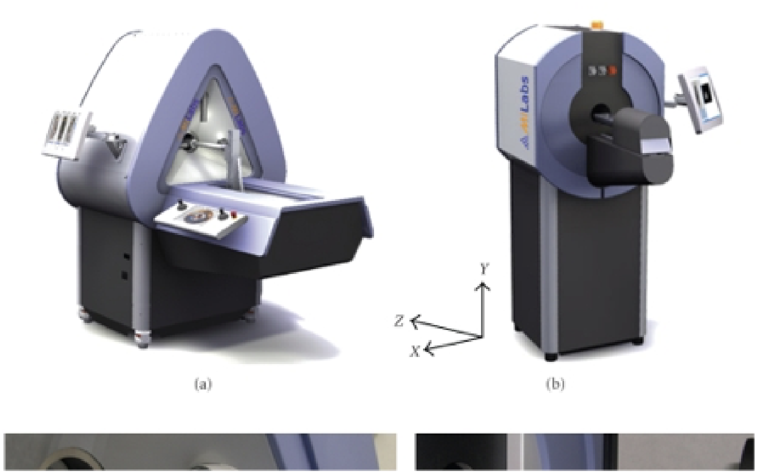


Figure 1: Diagrams of the Micro CT-Scanner

Accurate Coregistration between Ultra-High-Resolution Micro-SPECT and Circular Cone-Beam Micro-CT Scanners.

- This bed is fully transferable and therefore can be swapped for other different bed that can have different animals scanned.
- It can transfer in the x, y, and z directions within 0.04 mm, 0.10 mm, and 0.19 mm.
- The cylindrical shape of the bed allows for an easier transition between the beds of the animals
- It contains an air cooling operation in it
- Bed position is stabilized by conical screw restricting the motion of the bed the X and Z directions, while in the Y direction there is a line of contact between the bed and the robot arm on the topside. Two additional pins restrict the rotation around the axis of the screw and around the line of contact.

Conclusions/action items:

This information was useful because it provided a great layout for the different translational movements in the xy. Since we are thinking about modular attachments this could become useful.

Tripods and Camera Clips

revisions print • ALEXUS EDWARDS • Oct 10, 2018 @12:42 AM CDT

Title: Tripod And Camera Clips

Date: 09/21/2018

Content by: Alexus Edwards

Present: N/A

Goals: Goal was to do research on the structure of tripods to hopefully use it to make a design that will be used for our project.

Content:

Figure 1: Hand-held clamps that allows movement in the three degrees.

This design above has 3 degrees of freedom. This is important to think about because it is activated by just one click and then there is a release mechanism which allows for those degrees of freedom.

Figure 2: Tripod attachment which allows movement in 3 degrees

Tripods move in 3 directions. If you use the tripod and you have the bed mounted to the tripod and then that tripod has gears to move it up and down. You could even have something a little bit more extensive because the tripod is working.

Conclusions/action items: I think looking at a design like this, with the mechanism of a click. This means that with a click it allows for a release of a gear which then allows movement. Therefore taking some of these thoughts and butting them into a design.

Tripod Translational Designs

revisions print ▪ ALEXUS EDWARDS ▪ Oct 10, 2018 @12:38 AM CDT

Title: Tripod Translational Designs

Date: 09/21/2018

Content by: Alexus Edwards

Present: N/A

Goals: I needed to find a piece of equipment that would allow for the "tripod" to be moved to translate.

Content:

Figure 1: Tripod attachment that allows for translational movement.

If you think of something that can be used as a ruler and therefore it can move in a millimeter distance. I think that it would be cool to have a great mechanism similar to this to use to translate. If the piece can move in both the x and y-direction it would only need to have some type of spring to move it in the z-direction.

Conclusions/action items:

From this, I think, I have a good idea on kinda design I can have, and what all the moving parts are going to similar to.

The Park

revisions print • ALEXUS EDWARDS • Oct 10, 2018 @12:40 AM CDT

Title: The Park Design

Date: 09/25/2018

Content by: Alexus Edwards

Present: N/A

Goals: To create a design which specifies and shows all the design that was needed to incorporate in order to create a project that pleases the client.

Content:

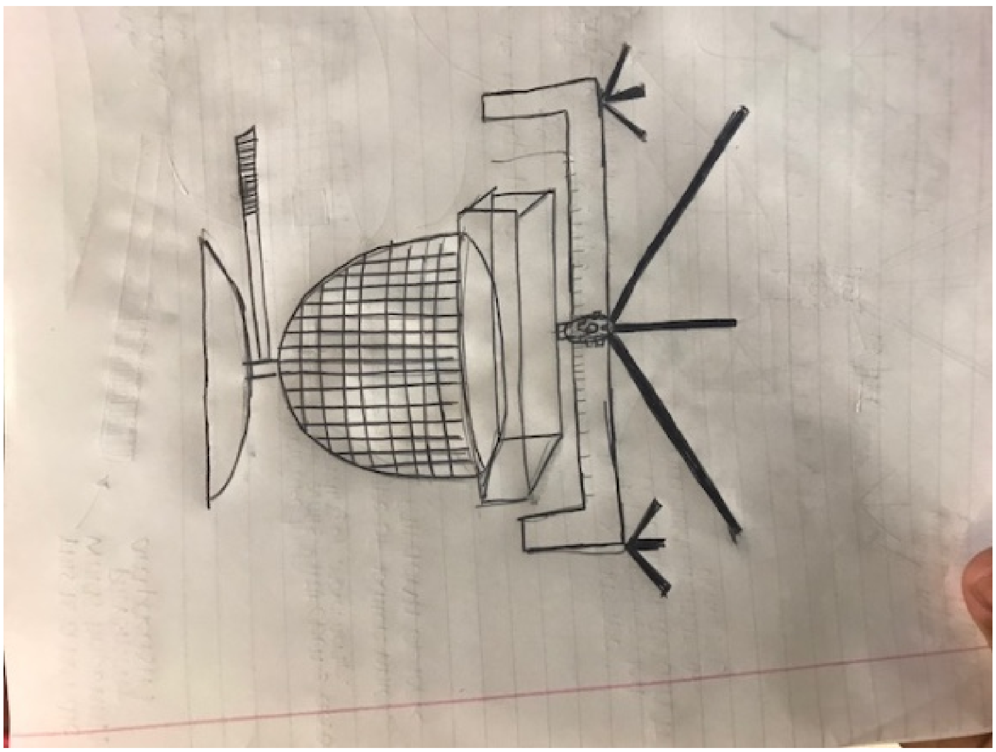


Figure 1: Final sketch of the Park design which is used in the preliminary presentations and report.

This picture allows for an overall grasp of the whole piece. It shows that all together and working simultaneously it is able to allow for the device to acquire all of our design Criteria.

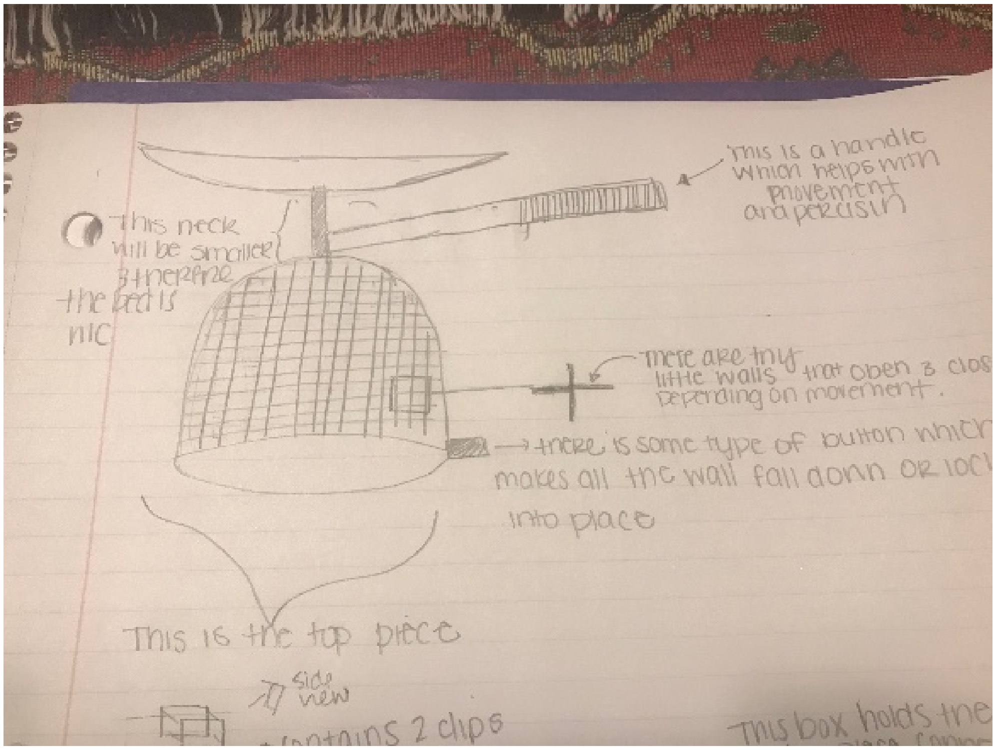


Figure 2: An annotated version of the top piece of the Park.

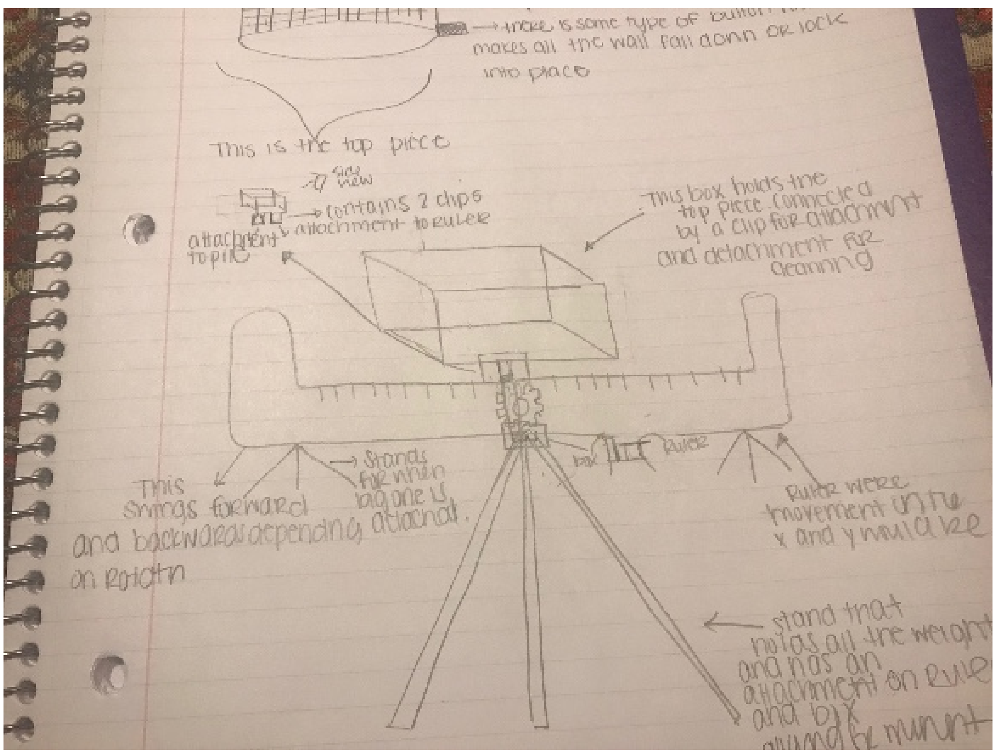


Figure 3: An annotated version of the bottom tripod attachment.

Conclusions/action items:

I think that this design outlines everything that we wanted to have in a design. I think through the whole piece and the outline piece, it shows that this design incorporates a lot of different aspects. Next, we need to look at all the design and pick which ones are going to be in the design matrix.

AOSLO Cones in Retina

revisions print • KEVIN KOESSER • Oct 10, 2018 @02:01 AM CDT

Title: AOSLO Cones in Retina

Date: 10/10/18

Content by: Kevin Koesser

Present: Kevin Koesser

Goals: To better understand the types of cells in the retina and the uses of AOSLO.

Content:

Link to article: https://www.ncbi.nlm.nih.gov/pubmed/10028967/

This research paper discusses the nature of the cells in the retina. The researchers used AOSLO to image short, medium, and long wavelength sensitive cone cells in the retina. These cells are responsible for seeing color. The sensitivity, quantity, density, and spatial orientation of the cone types affect how we see color.

Conclusions/action items:

AOSLO helped researchers capture the first images of the arrangement of short, medium, and long wavelength sensitive cones in vivo in humans. AOSLO corrects for aberration in the lens to focus on tiny photoreceptor cells.

Citation:

Roorda, A. and Williams, D. (2018). *The arrangement of the three cone classes in the living human eye. - PubMed - NCBI*. [online] Ncbi.nlm.nih.gov. Available at: https://www.ncbi.nlm.nih.gov/pubmed/10028967/ [Accessed 10 Oct. 2018].

12/12/18 - Degenerative Eye Conditions

revisions print • KEVIN KOESSER • Dec 12, 2018 @12:30 PM CST

revisions print • KEVIN KOESSER • Dec 12, 2018 @12:47 PM CST

Title: Degenerative eye conditions

Date: 12/12/2018

Content by: Kevin Koesser

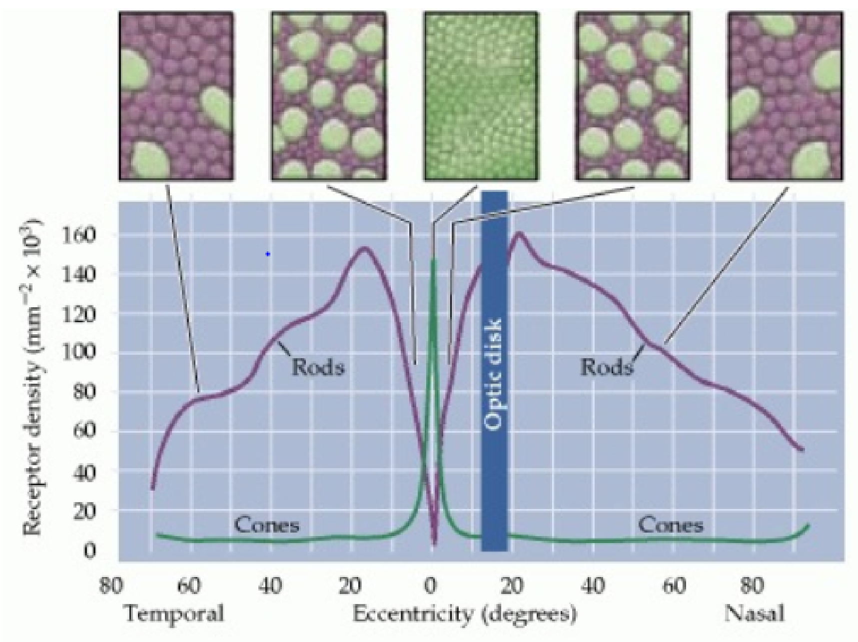
Present: Kevin Koesser

Goals: To understand why degenerative vision research is important

Content:

Glaucoma is caused by genetic predisposition and/or increased pressure in the eyes. It is commonly referred to as tunnel vision because increased fluid pressure strains the optic nerve. Glaucoma may indicate risk for more serious cardiovascular issues.

Blindness can be caused by a lack - or the destruction - of photoreceptors in the retina.



This image depicts the distribution of photoreceptor cells (rods and cones) in the eye. Because photoreceptors exist along the periphery of the eye, it is necessary to rotate the eye for imaging all photoreceptor cells.

Sources: glaucoma - https://nei.nih.gov/health/glaucoma/glaucoma_facts

photoreceptor distribution - https://www.ncbi.nlm.nih.gov/books/NBK10848/

Conclusions/action items:

Here, I found that eye conditions also indicate other disease risk, which further motivates research. Also, rotational eye imaging is required because photoreceptors exist on the periphery of the retina.

10/01/18 - Lab Bench

revisions print ▪ KEVIN KOESSER ▪ Oct 07, 2018 @10:00 PM CDT

Title: Existing lab bench

Date: 10/01/2018

Content by: Kevin Koesser

Present: Kevin Koesser

Goals: Learn more about equipment used in Dr. Rogers' lab

Content:

Link to lab bench: https://www.techmfg.com/products/labtables/cleanbench63series

This bench isolates the microscopes and other lab equipment from vibration for more accurate results. The table top (stainless steel) has a honeycomb design such that equipment with screw on the base can thread into the table. It uses Gimbal pistons to maintain vibrational equilibrium.

Conclusions/action items:

Perhaps our design could include screws on its base that fit into the table top's threaded holes.

Citation:

Techmfg.com. (2018). CleanBench Laboratory Table. [online] Available at: https://www.techmfg.com/products/labtables/cleanbench63series [Accessed 1 Oct. 2018].

10/01/18 - Warming Pads

revisions print ▪ KEVIN KOESSER ▪ Oct 07, 2018 @09:59 PM CDT

Title: Warming Pads

Date: 10/01/2018

Content by: Kevin Koesser

Present: Kevin Koesser

Goals: To understand more about the warming pads used for living specimens.

Content:

Link to Kent Scientific warming pad product page: https://www.kentscientific.com/products/far-infrared-warming-pads/

While imaging, living specimens are heavily sedated so they require warming pads to maintain constant body temperature. The current pads measure 15.2 cm x 20.3 cm x 0.64 cm and have a removable sleeve and a rechargeable battery. The pads generate infrared waves (which animal bodies absorb 90% of) to heat the specimens. Temperature ranges from 20 to 40 degrees Celsius.

Conclusions/action items:

The pads are large relative to the size constraints for our design. We will have to accommodate for the size of the pads on the stage of our design. However, we do not have to worry about temperature (40 Celsius) or bulkiness of heating cables (rechargeable battery powered).

Citation:

Kentscientific.com. (2018). Far Infrared Warming Pads | Mouse & Rat Warming | Kent Scientific. [online] Available at: https://www.kentscientific.com/products/far-infrared-warming-pads/ [Accessed 1 Oct. 2018].

10/02/18 - AOSLO

revisions print • KEVIN KOESSER • Oct 07, 2018 @10:53 PM CDT

Title: AOSLO

Date: 10/02/2018

Content by: Kevin Koesser

Present: Kevin Koesser

Goals: To better understand a microscopy technique used in Dr. Rogers' lab (Adaptive Optics Scanning Laser Ophthalmoscope)

Content:

Link to literature review of AOSLO: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4854423/

Adaptive Optics Scanning Laser Ophthalmoscope (AOSLO) can capture high resolution images of the retina. It can image individual photoreceptor cells, retinal pigment epithelium cells, microscopic capillary vessels, and the nerve fiber layer. The process is quite complex, but it is important for our design that a prism on the microscope must be placed within 1 mm of the eye.

Conclusions/action items:

Our design should allow for convenient use of an AOSLO, so it must have rotational adjustment within 1 mm.

Citation:

Merino, D. and Loza-Alvarez, P. (2018). Adaptive optics scanning laser ophthalmoscope imaging: technology update.

09/13/18 - Stage Design Idea

revisions print

• KEVIN KOESSER • Sep 13, 2018 @04:28 PM CDT

Title: Stage Design Idea

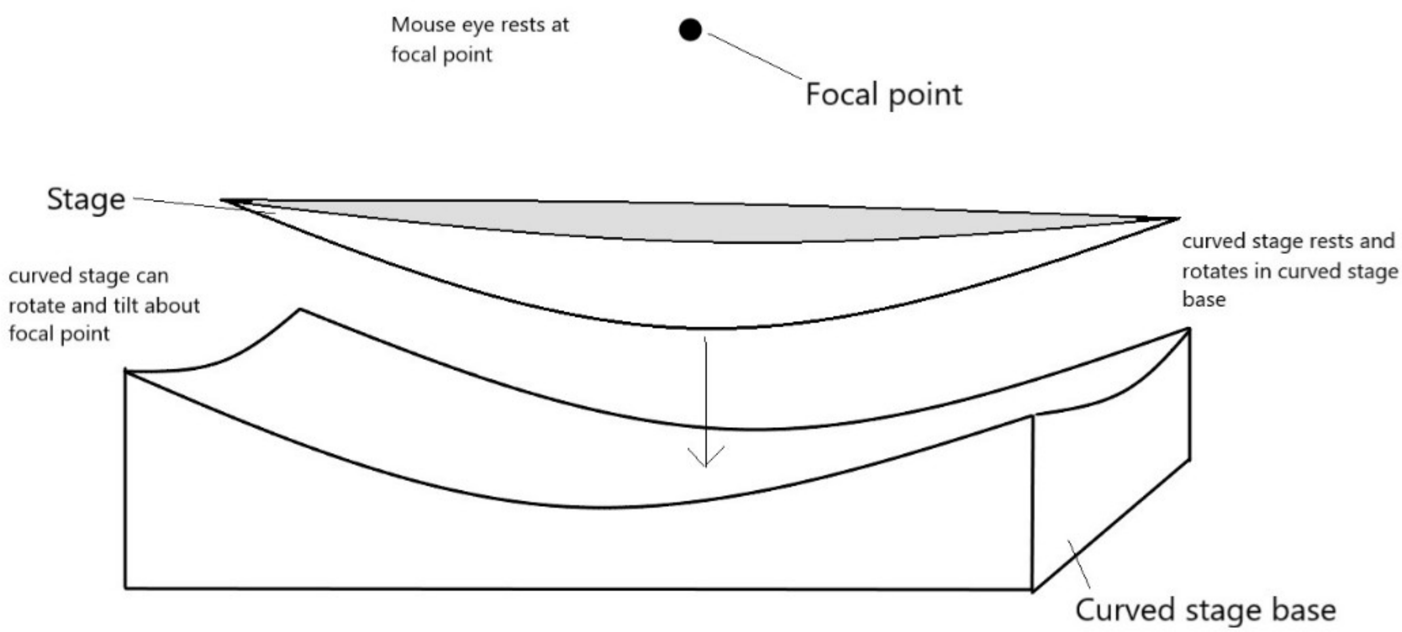
Date: 09/13/2018

Content by: Kevin Koesser

Present: Kevin Koesser

Goals: Brainstorm a potential design

Content:



I thought of this design while walking to class. It is essentially a ball and socket joint in which the bottom of the stage is the ball and the stage base is the socket. The stage van rotate about three axes with origin at the focal point, where the eye of the mouse will rest.

Conclusions/action items:

We may use ideas from this later. I will suggest this design to the group during a brainstorming session.

09/20/18 - Stage Design Idea 2

revisions print • KEVIN KOESSER • Sep 20, 2018 @03:51 PM CDT

Title: Stage Design Idea 2

Date: 09/20/18

Content by: Kevin Koesser

Present: Kevin Koesser

Goals: To brainstorm more potential designs for a rotating and translating microscope stage.

Content:

After several searches on rotating stage designs and rotational joints in general, I came across a joint model introduced by Dr. Stephen Canfield of the Tennessee Tech University to be used as a rotational rocket thruster mount. The so-called "Canfield joint" was briefly adopted by NASA, and there exist several open source designs online (see links below). The Canfield joint has 0-90 degree rotational freedom on every axis, which would be useful for this project. However, it would be difficult to set a focal point.

Links:

Wikipedia page: https://en.wikipedia.org/wiki/Canfield_joint

Video of 3D-printed joint in action: https://www.youtube.com/watch?v=eG5ueWcXt9I

Solidworks files: https://grabcad.com/library/canfield-mechanism-1

Conclusions/action items:

This idea is promising because the Solidworks files already exist, however we would have to determine how to lock the device at a desired position and set a desired focal point about which to rotate. The precision of the device is unknown.

12/12/18 - Plastic Specifications

revisions print • KEVIN KOESSER • Dec 12, 2018 @10:43 AM CST

Title: Plastic Specifications

Date: December 12, 2018

Content by: Kevin Koesser

Present: Kevin Koesser

Goals: To determine material properties of possible prototype plastics

Content:

Plastic Properties										
Material	Young's Modulus, psi	Poisson's Ratio	Shear Modulus, psi	Mass Density, lb/in3	Thermal Exp Coef, 1in/in/F	Ultimate Tensile, psi	Ultimate Compressive, psi	Ultimate Shear, psi	Thermal Conductivit, Btuin/hrft2F	Specific Heat, Btu/lb/F
Acrylonitrile-Butadiene-Styrene DH	380000	0.35	14000	0.03788	3.90E-05	13000	NA	NA	NA	NA
Acrylonitrile-Butadiene-Styrene GSM	320000	0.35	12000	0.03752	NA	10700	NA	NA	1.22	NA
Acrylonitrile-Butadiene-Styrene KJB	320000	0.35	12000	0.04401	5.50E-05	10000	NA	NA	NA	NA
Delrin 100/500/900	410000	0.35	NA	0.05123	4.20E-05	14100	5200	9500	1.60	0.35
Polycarbonate Resin Thermoplastic 101/201	340000	NA	114000	0.04329	3.75E-05	14200	12500	10000	1.35	0.30
Polycarbonate Resin Thermoplastic 121/221	340000	NA	114000	0.04329	3.75E-05	14000	12500	10000	1.35	0.30
Polycarbonate Resin Thermoplastic 141/241	340000	NA	114000	0.04329	3.75E-05	14000	12500	10000	1.35	0.30
Polycarbonate Resin Thermoplastic 141L/241L	340000	NA	114000	0.04329	3.75E-05	14000	12500	10000	1.35	0.30
Polycarbonate Resin Thermoplastic 150	340000	NA	114000	0.04329	3.75E-05	13500	12500	10000	1.35	0.30
Polycarbonate Resin Thermoplastic 161/261	340000	NA	114000	0.04329	3.75E-05	14200	12500	10000	1.35	0.30
Polycarbonate Resin Thermoplastic 181/281	340000	NA	114000	0.04329	3.75E-05	14200	12500	10000	1.35	0.30
Polycarbonate Resin Thermoplastic 3412(20%GF)	800000	NA	209000	0.04878	1.49E-05	19000	16000	10000	1.47	0.28

The Makerspace website does not provide exact information on the strength of ABS. The table above shows the Young's modulus psi, Poisson's ratio, Shear modulus psi, and mass density of ABS. These data corroborate that the ABS is likely durable enough to support a rodent. Further calculations must be done to determine the stress and factor of safety at critical points in the device, after which we will use stronger plastics where necessary.

Reference:

https://www.engineersedge.com/plastic/materials_common_plastic.htm

Conclusions/action items:

ABS data from the table indicates that printing in ABS will provide sufficient durability of individual structural components, but more stress calculations are necessary to determine f.o.s. at points of highest stress.

12/12/18 - Electromagnets for specimen holder

▪ KEVIN KOESSER ▪ Dec 12, 2018 @10:27 AM CST

Title: Stage Design Idea

Date: 12/12/2018

Content by: Kevin Koesser

Present: Kevin Koesser

Goals: Brainstorm a potential design improvement for xy translation

Content:

We want to optimize the magnet strength so that the specimen holder is easy to translate, but it will not slide off the table when the table tilts. Therefore, rather than adding a surface lubricant or decreasing the strength of the magnets, I propose including an electromagnet. The strength of the electromagnet can be adjusted such that it is weak when adjusting the xy-translation and strong when tilting the table.

Source on the properties/types of electromagnets: http://hyperphysics.phy-astr.gsu.edu/hbase/magnetic/elemag.html

Commercially available electromagnet: https://buymagnets.com/shop/246/Electromagnets-and-Power-Supplies/Electromagnets/Round-Electromagnets-Flat-Faced/?_vsrefdom=GAW&kw=&gclid=Cj0KCQiAgMPgBRDDARIsAOh3uyKRCLUCEkvj-TcJoPFPL20lRyAhCvJloGQFYVRRxcOZd0TuTaVEYIIaAsBfEALw_wcB

Conclusions/action items:

If we replaced the current magnets with an electromagnet, then we could modulate the strength of the magnet to optimize both translation and safety.

September 12, 2018

revisions print ▪ Aaron Patterson ▪ Dec 05, 2018 @10:14 PM CST

Title: Anatomy of the Eye

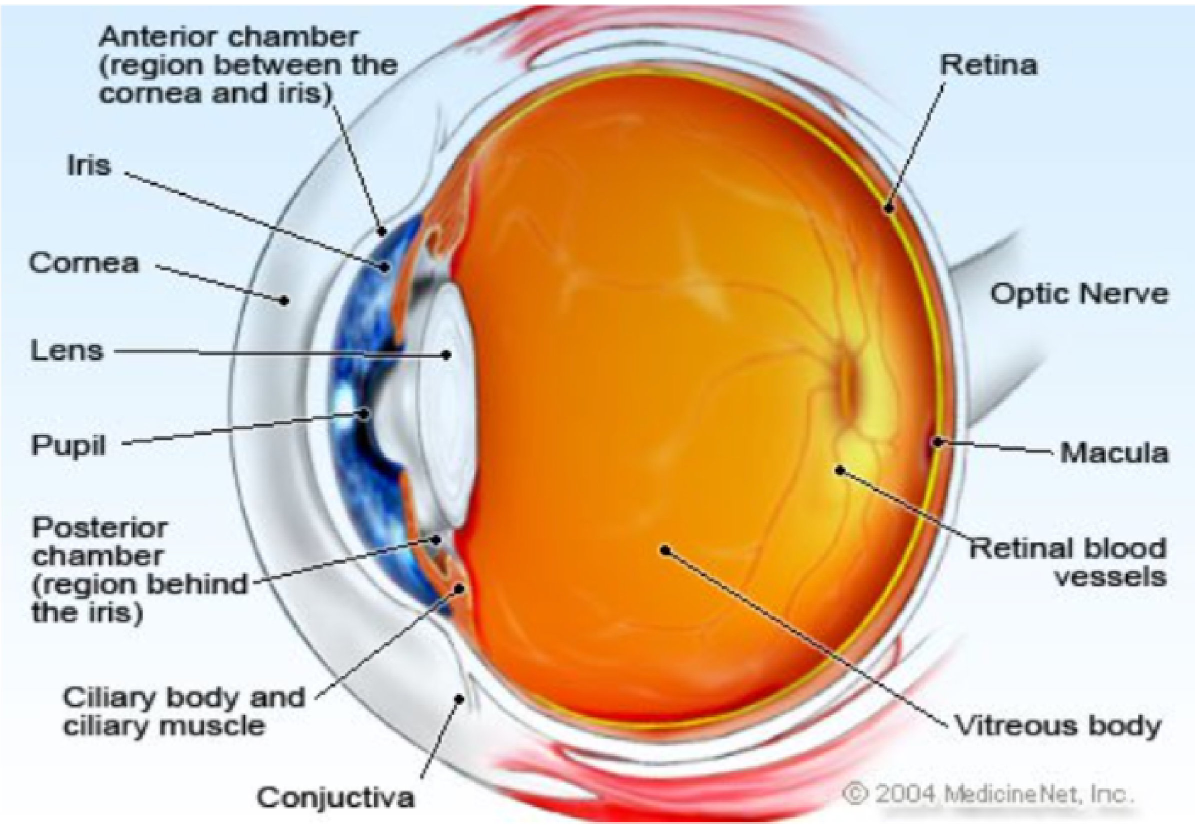
Date: September 12, 2018

Content by: Aaron Patterson

Present:

Goals: To understand the basic anatomy of the eye in order to understand how mobile our microscope should be

Content:



The eye is our organ of sight. The eye has a number of components which include but are not limited to the cornea, iris, pupil, lens, retina, macula, optic nerve, choroid and vitreous.

- Cornea: clear front window of the eye that transmits and focuses light into the eye.
- Iris: colored part of the eye that helps regulate the amount of light that enters
- Pupil: dark aperture in the iris that determines how much light is let into the eye
- Lens: transparent structure inside the eye that focuses light rays onto the retina
- Retina: nerve layer that lines the back of the eye, senses light, and creates electrical impulses that travel through the optic nerve to the brain
- Macula: small central area in the retina that contains special light-sensitive cells and allows us to see fine details clearly
- Optic nerve: connects the eye to the brain and carries the electrical impulses formed by the retina to the visual cortex of the brain
- Vitreous: clear, jelly-like substance that fills the middle of the eye

Reference:

MedicineNet, Inc. *Picture of Eye Anatomy Detail* [Online]. Available: https://www.medicinenet.com/image-collection/eye_anatomy_detail_picture/picture.htm [Accessed: 12-Sep-2018].

Conclusions/action items: Now that we have a general understanding of the eye we should start looking for designs so its possible for our client to image these eyes more efficiently.

September 12, 2018

▪ Aaron Patterson ▪ Dec 05, 2018 @10:23 PM CST

Title: Competing Design Links

Date: September 12, 2018

Content by: Aaron Patterson

Present: Aaron

Goals: To find some microscope designs that are already in use in the research world

Content:

https://www.keyence.com/landing/microscope/lp_vhx_digital_micro.jsp?aw=google-kaenVH137309bb-br&k_clickid=78cb42cc-3795-4bc6-8d29-71c302c3e74c&gclid=CjwKCAjw8uLcBRACEiwAaL6MScre5BphqiIE2B5dwF8Fu896jy6WztAJQLGyXkPaeZ6pvBHNHb4DlRoC3bcQAvD_BwE

Keyence **Digital** Microscopes:

High-tech design and execution of a microscope design

-can view material from any angle

-able to make 2-D measurements but also 3-D measurements

References

Keyence. *Keyence Digital Microscopes* [Online]. Available: https://www.keyence.com/landing/microscope/lp_vhx_digital_micro.jsp?aw=google-kaenVH137309bb-br&k_clickid=78cb42cc-3795-4bc6-8d29-71c302c3e74c&gclid=CjwKCAjw8uLcBRACEiwAaL6MScre5BphqiIE2B5dwF8Fu896jy6WztAJQLGyXkPaeZ6pvBHNHb4DlRoC3bcQAvD_BwE [Accessed: 12-Sep-2018].

Conclusions/action items: Instead of focusing on the digital models I should be focusing on the manual movements. Also, after a meeting with our client I should not be looking at the actual microscopy of the design. Mainly look for rotational and translational technology.

September 16, 2018

revisions print • Aaron Patterson • O

Title: Competing Designs

Date: September 18, 2018

Content by: Aaron Patterson

Present:

Goals: To understand competing designs in order to come up with our preliminary design ideas

Content:

Translational Devices

https://www.deltron.com/Product_Selection_Guide.html?keyword_session_id=vt~adwords%7Ckt~translation%20stage%7Cmt~p%7Cta~264520901441&_vsrefdom=wordstream&gclid=CjwKCAjwio3dBRAqEiwAHWsNVVMzb3YttaikR92QcxCNJr1CH 7qVRzPNRoCqNEQAvD_BwE

Posi Drives® (Lead Screw Driven)

Del-Tron Precision's Posi-Drives® were created to provide an economical solution to simplify the design of motion control systems in some of the more common applications. These ball and crc install with standard fasteners and do not require aligning any components. They are fitted with a lead screw and anti backlash nut and are supplied with a motor adaptor and coupling. Available mounting configurations, with optional limit switches and up to 12" of travel, these linear motion stages provide both accuracy and excellent positional repeatability.

Other industry terms include lead screw stages, lead screw actuators, linear actuators, linear positioning stages, and lead screw driven stages.

Micrometer Positioning Stages

Del-Tron Precision's Micrometer Positioning Stages are often referred to as positioning stages, linear positioners, XY stages, micrometer stages, and micrometer slides. What distinguishes this motion products is the addition of a micrometer which enables the ability to position a load or device in precise increments. Our micrometer positioning stages offer travels ranges from .25" to 2. devices are available in both inch and metric versions and are offered in X, XY, and XYZ configurations. Both linear ball slide and linear crossed roller slide technology are available based on ap most Del-Tron models are available with optional locking micrometers, all are available with Deltron's Posi-Lock feature that enables the carriage of the positioning stage to be locked in place, s the linear motion slide.

Rotational Devices

http://www.standa.lt/products/catalog/translation_rotation?item=243

Rotary stage of Big Platform 7R170-190 is used to rotate manually large optical and other components through continuous 360° with accuracy of 1°, and finely to adjust them within 10° by a mic of 0.5arcmin. The stage has 88.9 mm clear aperture. The platform of the stage has a pattern of M6 and M4 mounting holes for components.

Motorized Translational and Rotational XYZ Stage Device

https://www.youtube.com/watch?v=DQCu3NOahk4

-This is a current design on the market that has all of the movements that we need except for rotation, and is also extremely precise.

-Would have to find a way to add translation to this model which I am not sure is possible.

References

Deltron Precision, Inc. *Product Selection Guide* [Online]. Available: https://www.deltron.com/Product_Selection_Guide.html?keyword_session_id=vt~adwords%7Ckt~translation%20stage%7Cmt~p%7Cta~264520901441&_vsrefdom=wordstream&gclid=CjwKCAjwio3dBRAqEiwAHWsNVVMzb3YttaikR92QcxCNJr1CHlirRaBjW20mXA 7qVRzPNRoCqNEQAvD_BwE [Accessed: 12-Sep-2018].

Standa. *Translation & Rotation Stages* [Online]. Available: http://www.standa.lt/products/catalog/translation_rotation?item=243 [Accessed: 12-Sep-2018].

Conclusions/action items: Present what research I have done to team. Continue looking for ideas to make our design the best it can be.

September 14, 2018

revisions print ▪ Aaron Patterson ▪ Nov 18, 2018 @01:38 PM CST

Title: Design Ideas

Date: September 14, 2018

Content by: Aaron Patterson

Present:

Goals: To come up with beginning design ideas for the stage and holder.

Content:

Labyrinth wooden maze -> rotation aspect of stage

-suspended surface that rotates on two axis using knobs, could be an easy way to rotate the stage

Conclusions/action items:

Continue researching and coming up with new ideas.

September 22, 2018

revisions print • Aaron Patterson • Oct 04, 2018 @12:58 PM CDT

Title: Design Ideas Brainstorm

Date: September 22, 2018

Content by: Aaron Patterson

Present: Aaron Patterson

Goals: To come up with some solid design ideas to bring to the group

Content:

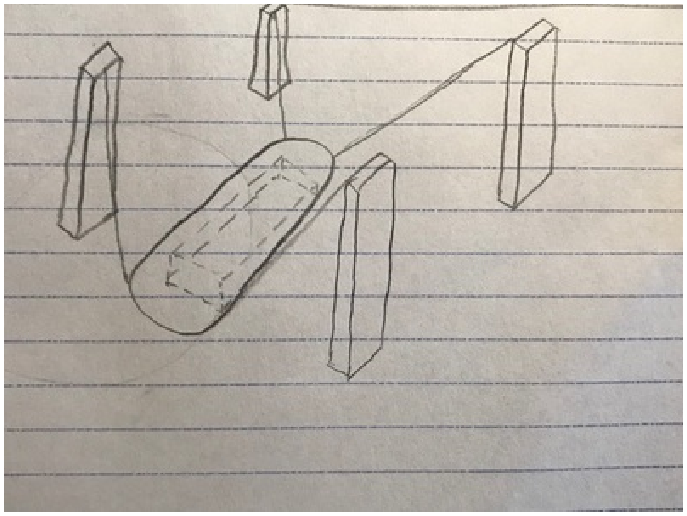
revisions print • Aaron Patterson • Oct 04, 2018 @01:04 PM CDT

This design is a floating design. In my opinion, it is kind of unrealistic because it would be hard to build and kind of difficult to use as well, so this design is not off to a good start. The whole device would be placed on a rotating platform so the angle of viewing the subject would be able to be changed efficiently. The next phase would be the translation. The bottom of the stage would be able to move translationally with a gear system making very precise movements. The more difficult movements are in the z direction and the rotation of the subject. the stage itself would be attached to four strings and four pillars (shown by the glue sticks and lead holders in the picture below. The strings would be able to move up either simultaneously or individually depending on the movement needed. This would allow for the subject to be lifted or dropped to move in the z direction or to tilt forward or backward to provide the necessary rotation needed to image the subject.

revisions print • Aaron Patterson • Oct 04, 2018 @12:54 PM CDT

Floating_Bed_Setup_.jpg(109.5 KB) - download

revisions print ▪ Aaron Patterson ▪ Oct 04, 2018 @12:55 PM CDT

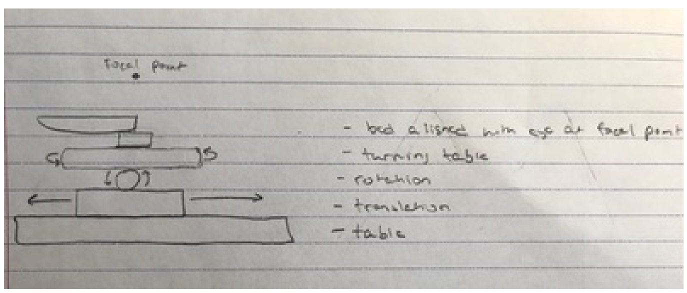


Floating_bed_drawing_.jpg(91.6 KB) - download

revisions print ▪ Aaron Patterson ▪ Oct 04, 2018 @01:09 PM CDT

This modular design is similar to a design that I found doing research on other imaging stages already on the market. This design allows for rotation and translation in the 5 necessary axis while also providing simple methods of doing so. The bottom stage is the translation to move in the x-y directions using a gear and knob system. The next stage is for the rotation of the subject. This would provide accurate precision while rotating the subject, but may cause difficulty depending on how far the subject has to rotate because the turn table could hit either the translation stage or the table itself. The next stage is a simple turn table controlled by knobs for accurate precision. The top stage is the bed for the subject for imaging. The one downfall to this design is that it could possibly be very tall which is unreasonable to build and also would be a pain for the user.

revisions print ▪ Aaron Patterson ▪ Oct 04, 2018 @12:55 PM CDT

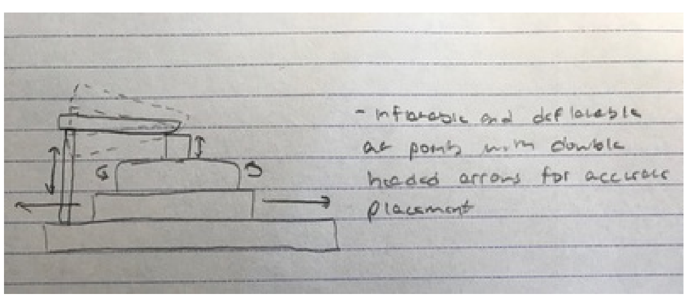


Modular_Stage_Setup_.jpg(44.8 KB) - download

revisions print ▪ Aaron Patterson ▪ Oct 04, 2018 @06:45 PM CDT

This second modular design is almost identical to the one above. However instead of having the z-axis and rotational movement this one has both interconnected. In other words. there are two inflatable rods connect to both edges of the subject bed. When the user wants to raise the bed up they can pump both rods simultaneously. If the user would like to tilt the subject up or down, they can pump either rod up individually. This separation of rotation would make for precise movements that are easy for the user to accomplish.

revisions print ▪ Aaron Patterson ▪ Oct 04, 2018 @12:56 PM CDT



Modular_Device_w_inflatable_rotation_.jpg(49.2 KB) - download

Conclusions/action items: Present the three brainstormed designs to group and see what they think.

SolidWorks Practice and Knob Designs

revisions print ▪ Aaron Patterson ▪ Dec 11, 2018 @01:03 PM CST

Title: SolidWorks Practice and Knob Designs

Date: 11/29/18

Content by: Aaron

Present: Aaron and Lexi

Goals: To practice Solid Works while also creating designs for a knob or potential z-translation device

Content:

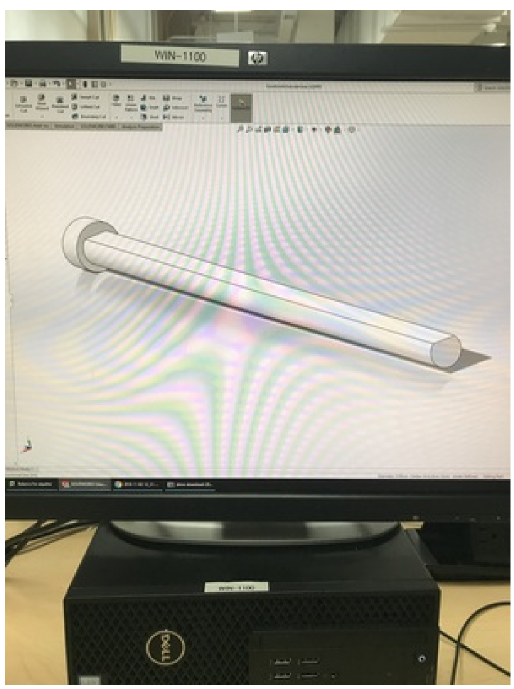
revisions print ▪ Aaron Patterson ▪ Dec 11, 2018 @01:02 PM CST

IMG_2206.MOV(15.3 MB) - download Lexi and I practiced using SolidWorks to make random projects. This was mainly used to practice extruding different shapes and combining shapes.

revisions print ▪ Aaron Patterson ▪ Dec 11, 2018 @01:03 PM CST

IMG_2207.MOV(20.8 MB) - download Lexi and I practiced using SolidWorks to make random projects. This was mainly used to practice extruding different shapes and combining shapes

revisions print ▪ Aaron Patterson ▪ Dec 11, 2018 @01:01 PM CST



56288476485__A10D37D8-48B8-4D4D-BAF6-E9FEB4DD64BF.JPG(2.6 MB) - download This was practice for SolidWorks of one of the knobs that we could possibly use for our design.

Conclusions/action items:

Continue thinking about z-translation edits and solutions to modular holding devices.

For me personally, come up with knob edits and other z-translation devices.

Z-Translation

revisions print ▪ Aaron Patterson ▪ Nov 25, 2018 @10:46 AM CST

Title: Z-Translation

Date: October 18, 2018

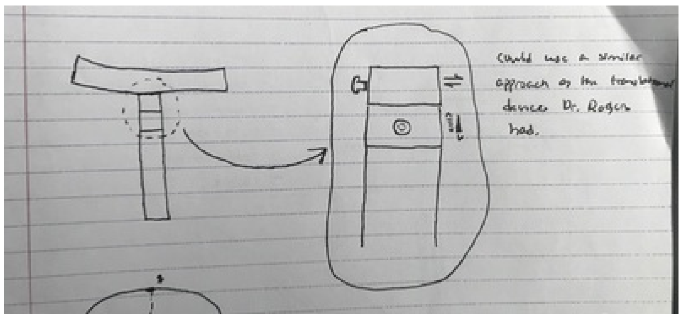
Content by: Aaron

Present: Aaron

Goals: To brainstorm designs for a z-translation movement for our stage

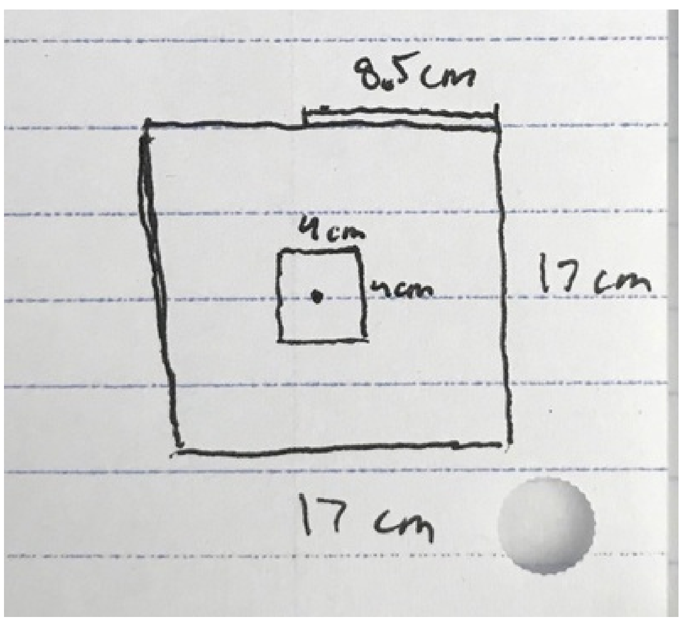
Content:

revisions print ▪ Aaron Patterson ▪ Nov 25, 2018 @10:37 AM CST



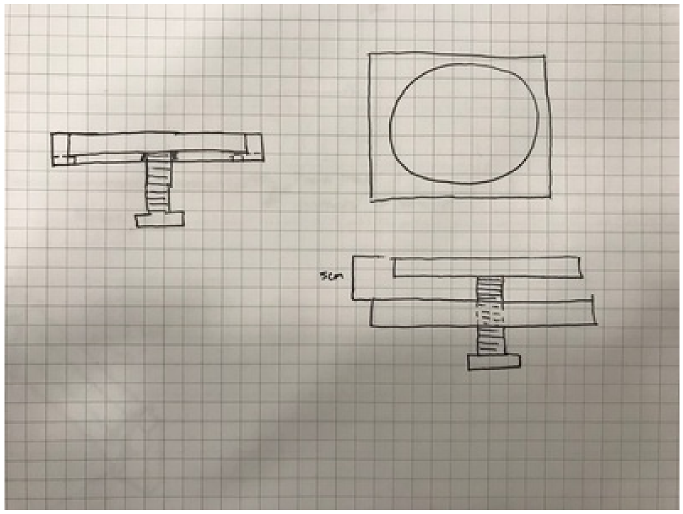
Block_Tranlation.jpg(46 KB) - download This was one of my ideas for a solution to our z-translation. This block tower would allow for z-translation and also micro movements in the x and y directions. These blocks would 4x4x4 cm and stack on top of each other kind of like the translation devices that Dr. Rodgers showed us and some of the devices that we saw in our background research. These devices would allow for small, precise movements that Dr. Rodgers needs when doing the final stages of positioning his subjects. Dimensions for the device can be seen below.

revisions print ▪ Aaron Patterson ▪ Nov 25, 2018 @10:32 AM CST



Dimensions.jpg(70 KB) - download

revisions print ▪ Aaron Patterson ▪ Nov 25, 2018 @10:40 AM CST



Twist_Tranlation.jpg(72.9 KB) - download This was another idea for z-translation. This device in theory would be flushed with our current 14x14cm stage that holds the modular devices. The user then would use the bottom of the device to twist the stage up out of the current stage. This would allow for easy movement in the z-direction and easy movement of the subject in the z-direction. The main stage could be threaded in the middle of the table and we could use a bolt to move the z-translation stage up and down to bring the subject to the focal point.

revisions print ▪ Aaron Patterson ▪ Nov 25, 2018 @10:47 AM CST

Conclusions/action items: Present these ideas to team and continue to brainstorm new ideas

Modular Holding Device

revisions print

• Aaron Patterson • Dec 10, 2018 @08:48 PM CST

Title: Modular Holding Device

Date: October 23, 2018

Content by: Aaron

Present: Aaron

Goals: To brainstorm ideas for a more efficient holding device and micro-stage translation in the x and y directions

Content:

To connect the subject holders to the device itself, I feel like magnets would be the easiest option. This would allow for easy x-y translation adjustment for the user while also keeping the holder firm on the table.

Another thing that I was thinking about was to 3D print only two different devices. I know right now we are planning on three different devices for three different subjects. However, I feel like we don't need the third one. We could combine the 2nd and 3rd subject holders to accommodate the 13-lined ground squirrel and also the typically lab mice. We would also keep the ex-vitro eye holder the same.

Conclusions/action items: Present my idea to team and get feedback on designs. Possibly implement these ideas into our current design. Begin coming up with ideas for z-translation

2016/09/05-Entry guidelines

revisions print ▪ John Puccinelli ▪ Sep 05, 2016 @01:18 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

revisions print

▪ John Puccinelli ▪ Nov 03, 2014 @03:20 PM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items: