BME Design-Fall 2018 - JAMISON MILLER
Complete Notebook

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JAMISON MILLER

on

Oct 10, 2018 @12:15 PM CDT

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Team contact Information

revisions print

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

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Project description

revisions print • 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

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.

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.

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:

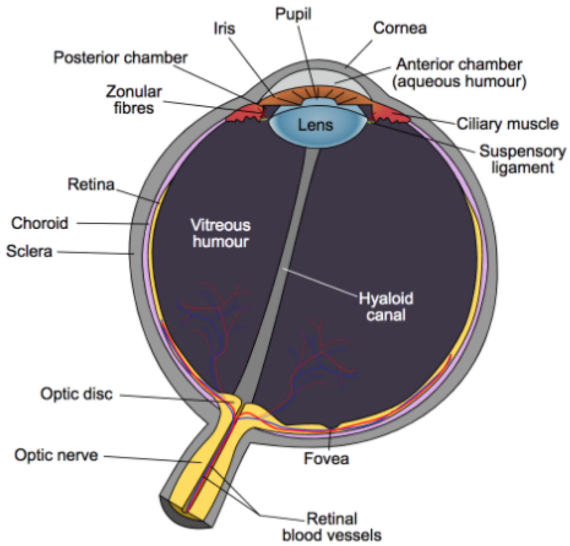


Figure 1. Anatomical Diagram of the eye

<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

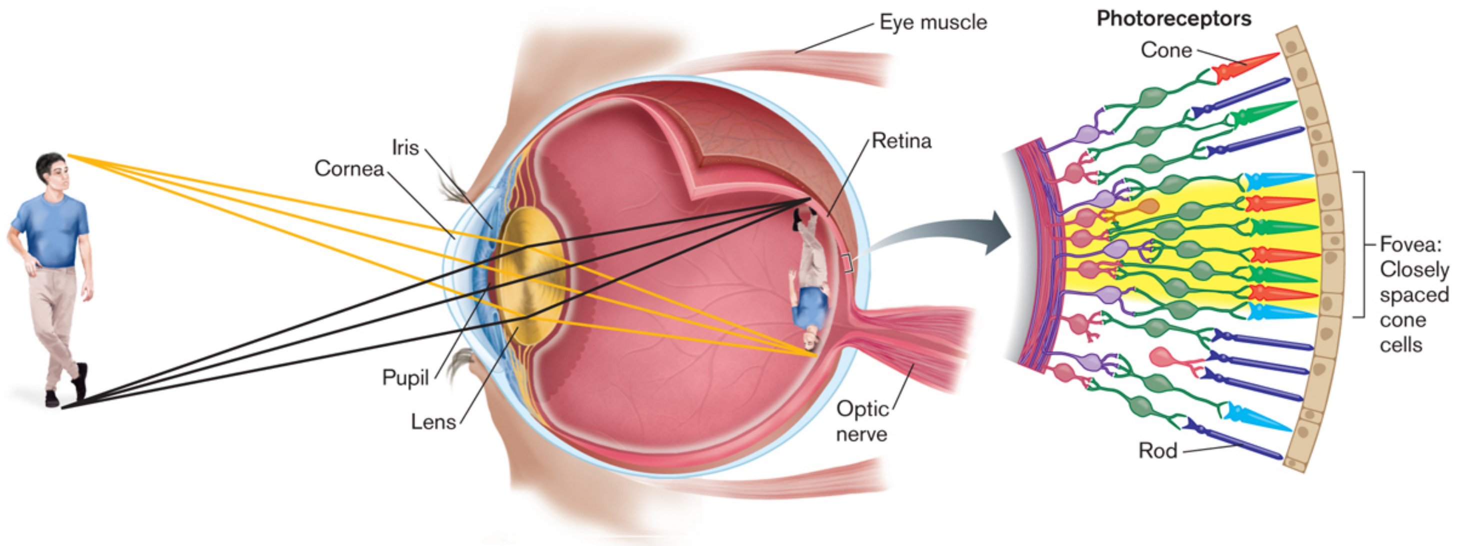


Figure 2. Anatomical Diagram of an eye and how it interprets signal input.

<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:

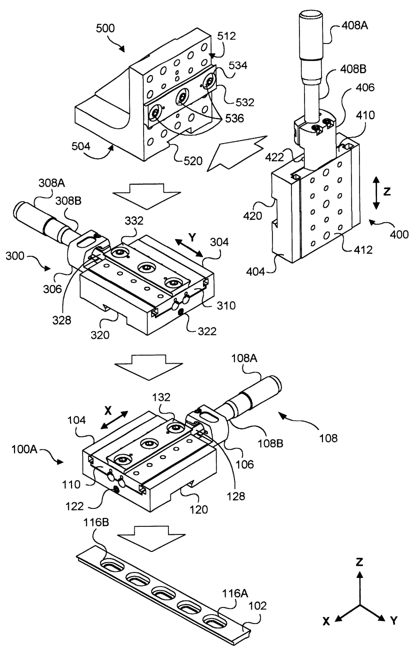


FIG. 4B

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.

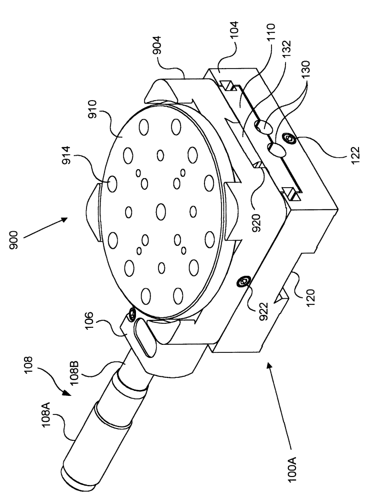


FIG. 9A

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

<u>Modular Rotational Piece</u>

- 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.

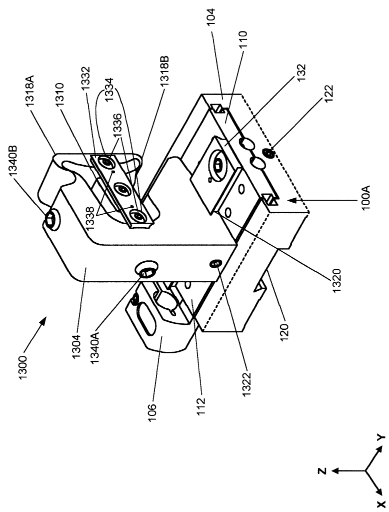


FIG. 13

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

<u>Translational Device</u>

- 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:

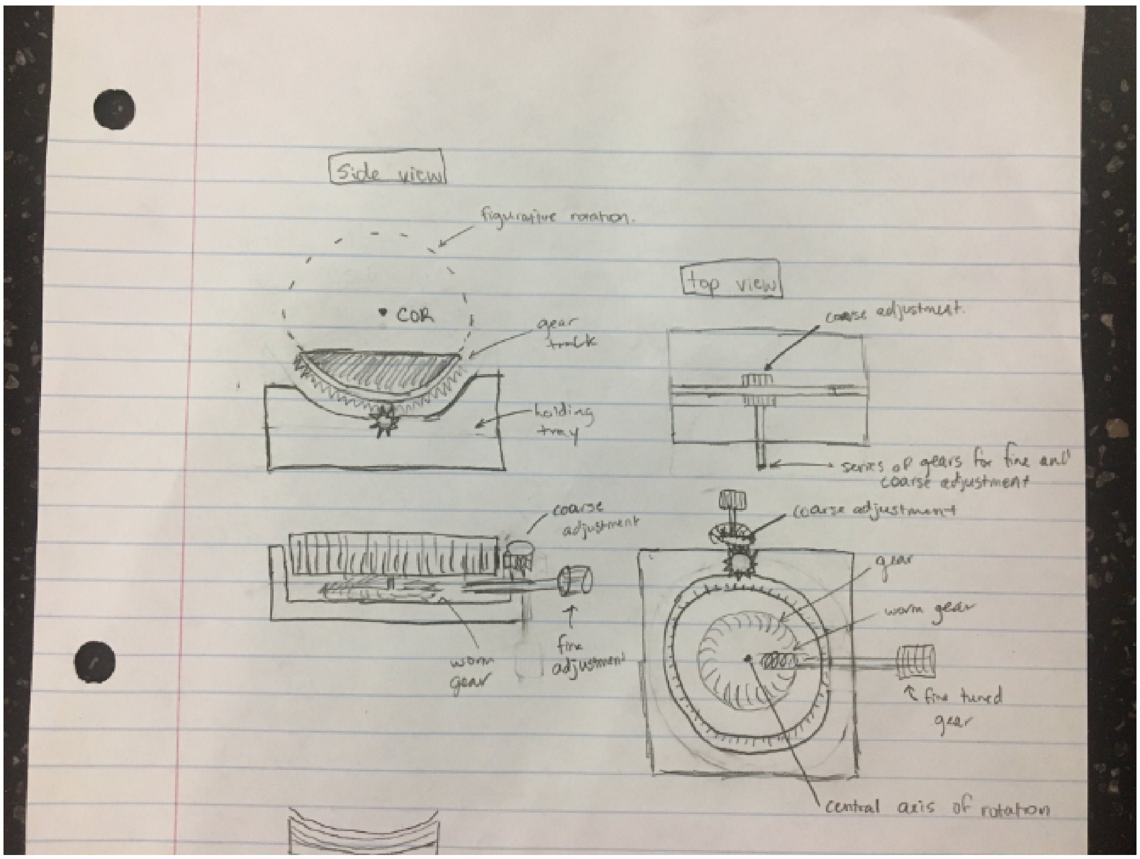


Figure 1. The above figure represents the modular stage design for the roll and yaw motion.

- 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:

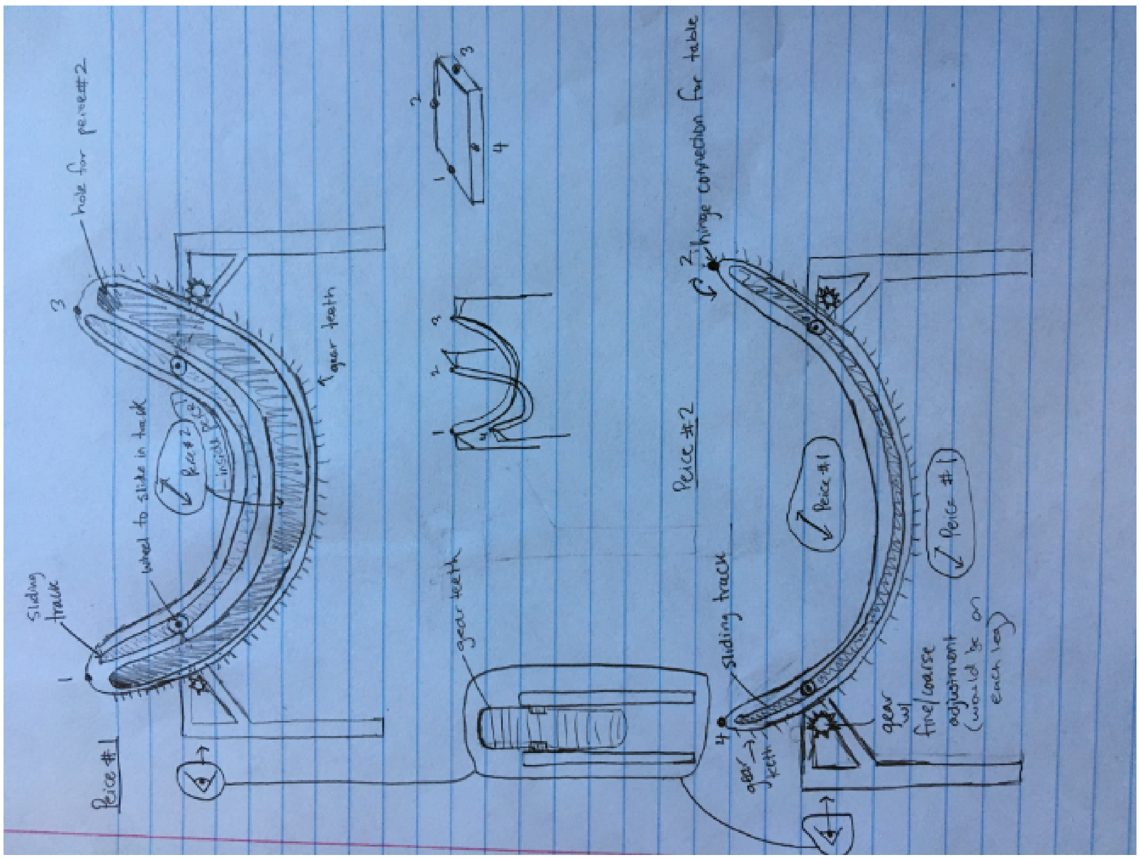


Figure 1. The above figure represents a rough sketch of the spider leg design.

- 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.

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.

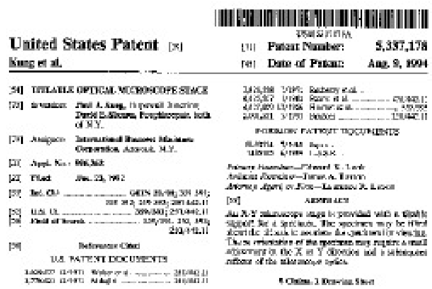
Content:

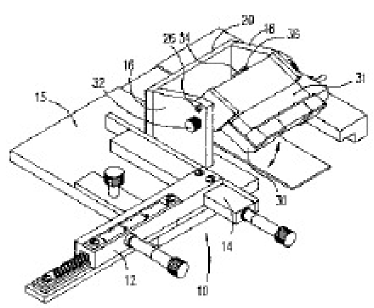
- This device allows for translational movements in two directions, and rotation about either the x or y-axes (but not both).
  - Due to the simple hinge used for rotation, a similar method would be difficult to use if we wanted to get 3 degrees of freedom for rotation. By stacking hinge joints, the 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 [19]
Kang et al.
[11] Patent Number: 5,337,178
[45] Date of Patent: Aug. 9, 1994
[54] TITLABLE OPTICAL MICROSCOPE STAGE



US5337178.pdf(476.2 KB) - download

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

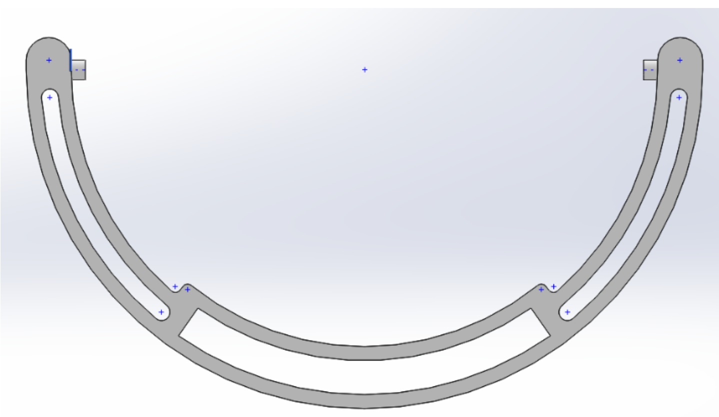
Content by: Cory

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.



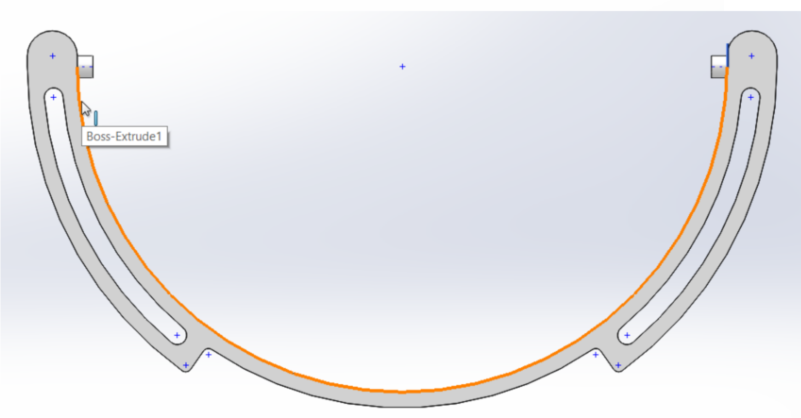
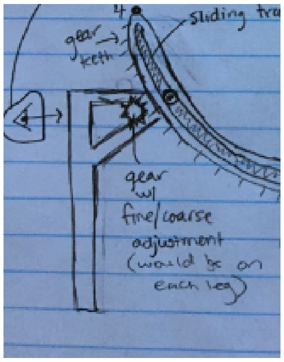


Image1: The new large guide featuring separate attachment and small guide slots. Image 2: The new small guide which is skinnier in the center so the large guide can be shorter. Note that the dimensions on the upper sides of both guides are the same.

- 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.



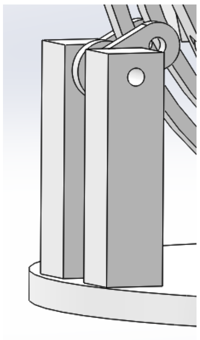


Image 3: Jamison's original attachment arm. Image 4: The new attachment arm and supports. The circular gear which controls movements of the guides can be seen as well in the middle.

- 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.

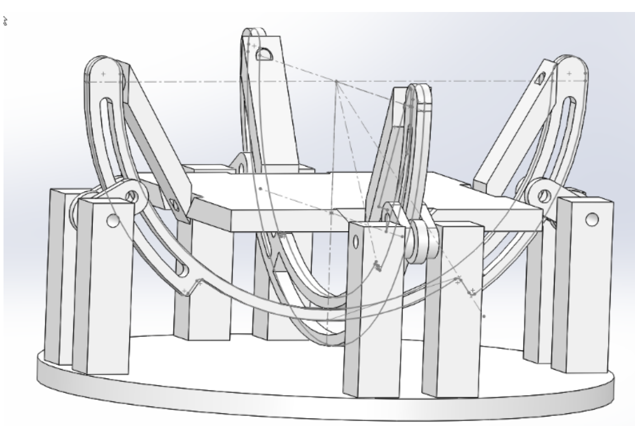


Image 5: This image shows the table dropped below the axes of rotation (viewed in the sketches). It also features the four table arms that connect the table to the guides.

- 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.

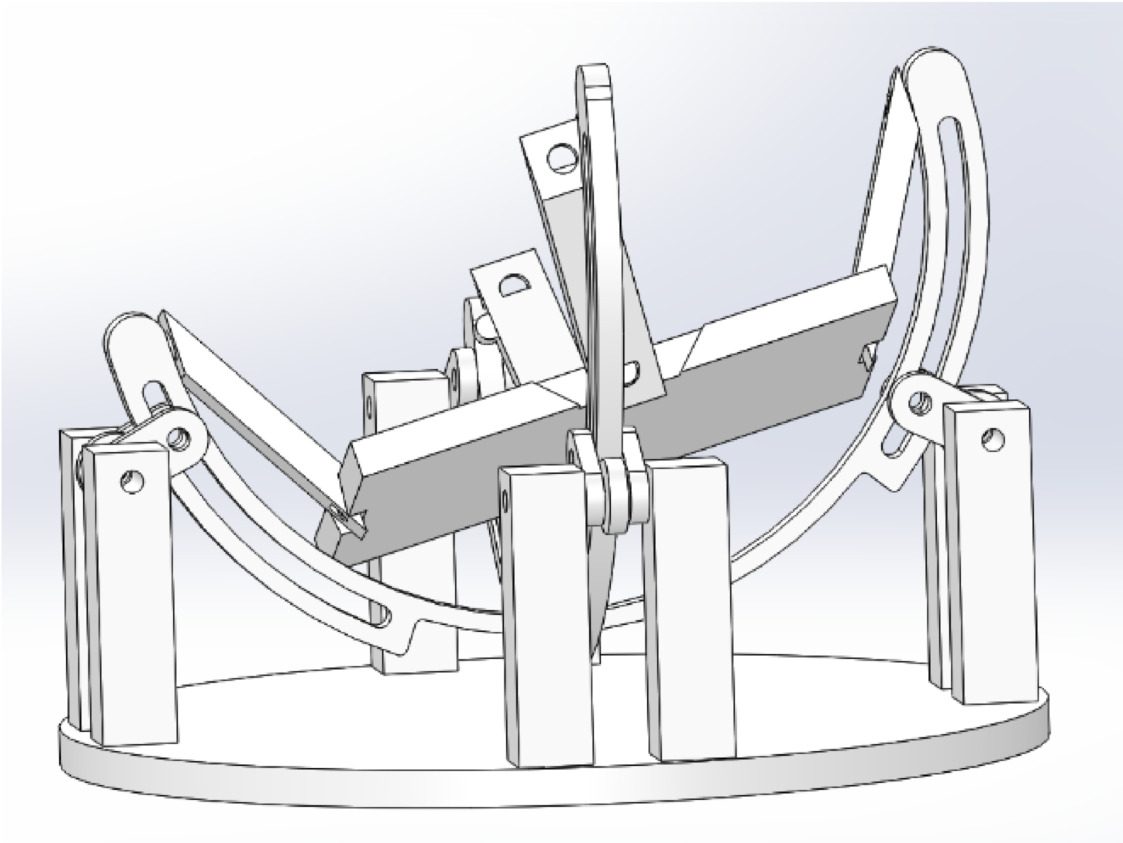


Image 6: This shows that the table arms can no longer attach to the guides if both guides are rotated at the same time.

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.

New Page

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:

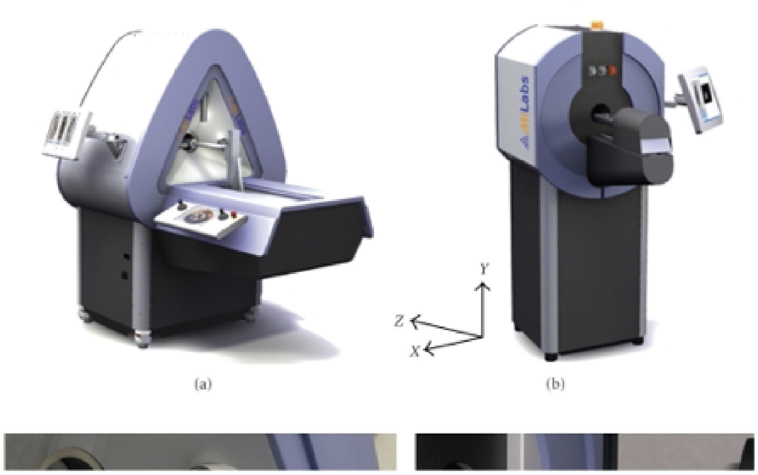


Figure 1: Diagrams of the Micro CT-Scanner

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.

New Page

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:

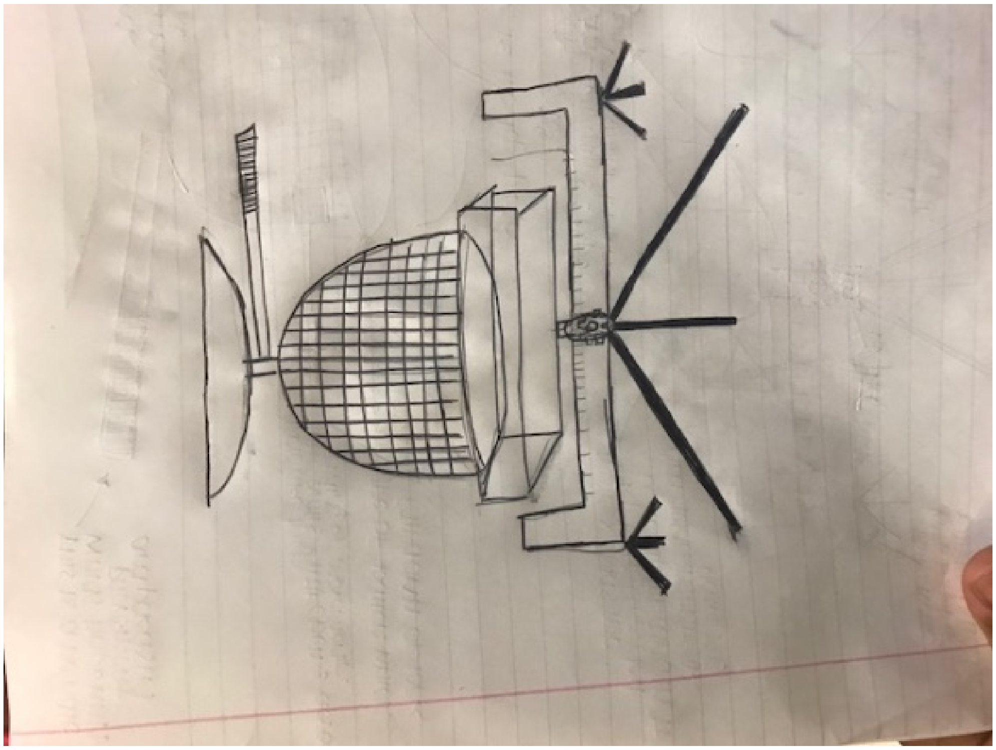


Figure 1: Final sketch of the Park design which is used in the preliminary presentations and report.

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.

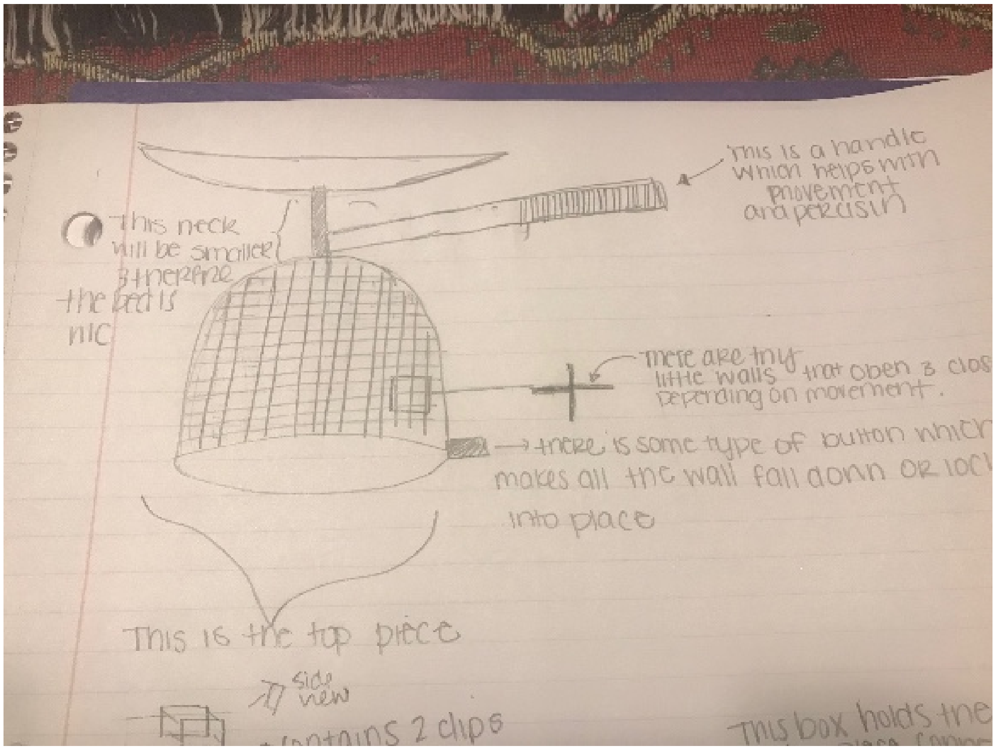


Figure 2: An annotated version of the top piece of the Park.

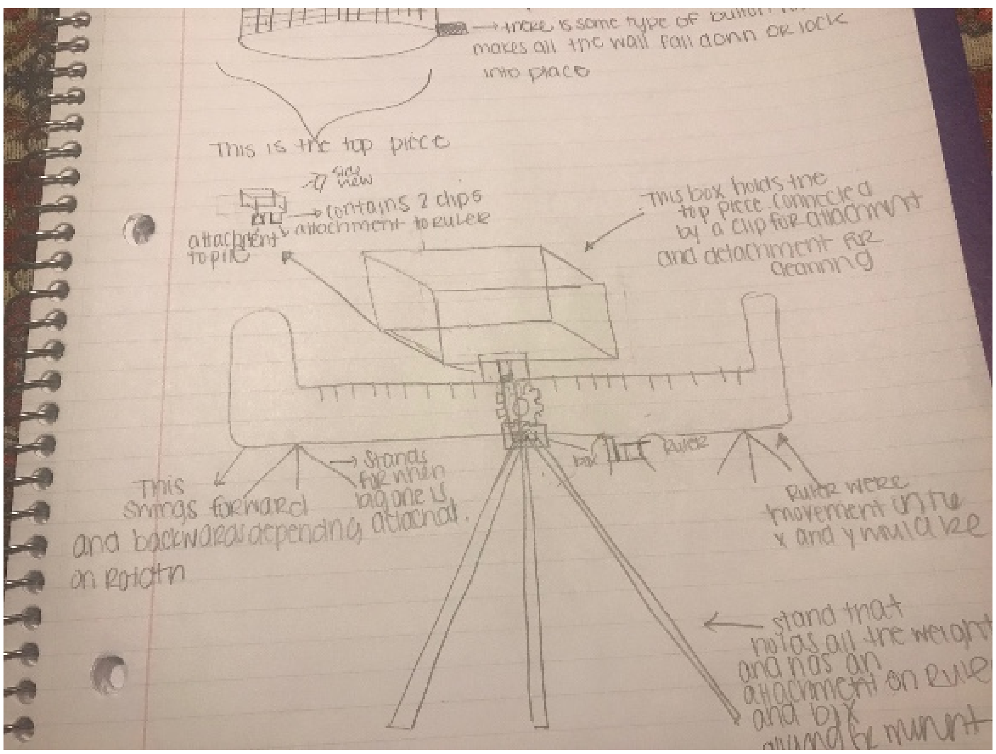


Figure 3: An annotated version of the bottom tripod attachment.

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].

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].

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].

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.

Stage Design Idea

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

Title: Stage Design Idea

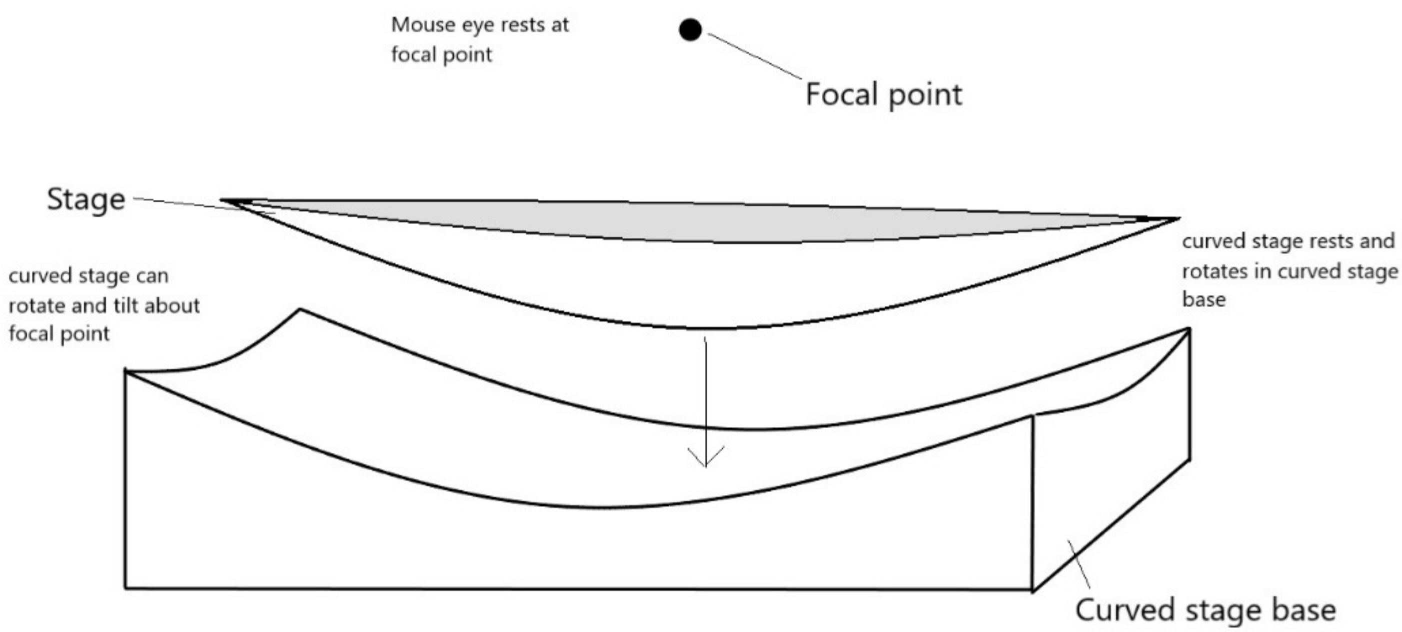
Date: 09/13/2018

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.

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.

September 12, 2018

revisions print · Aaron Patterson · Oct 09, 2018 @09:10 PM CDT

Title: Anatomy of the Eye

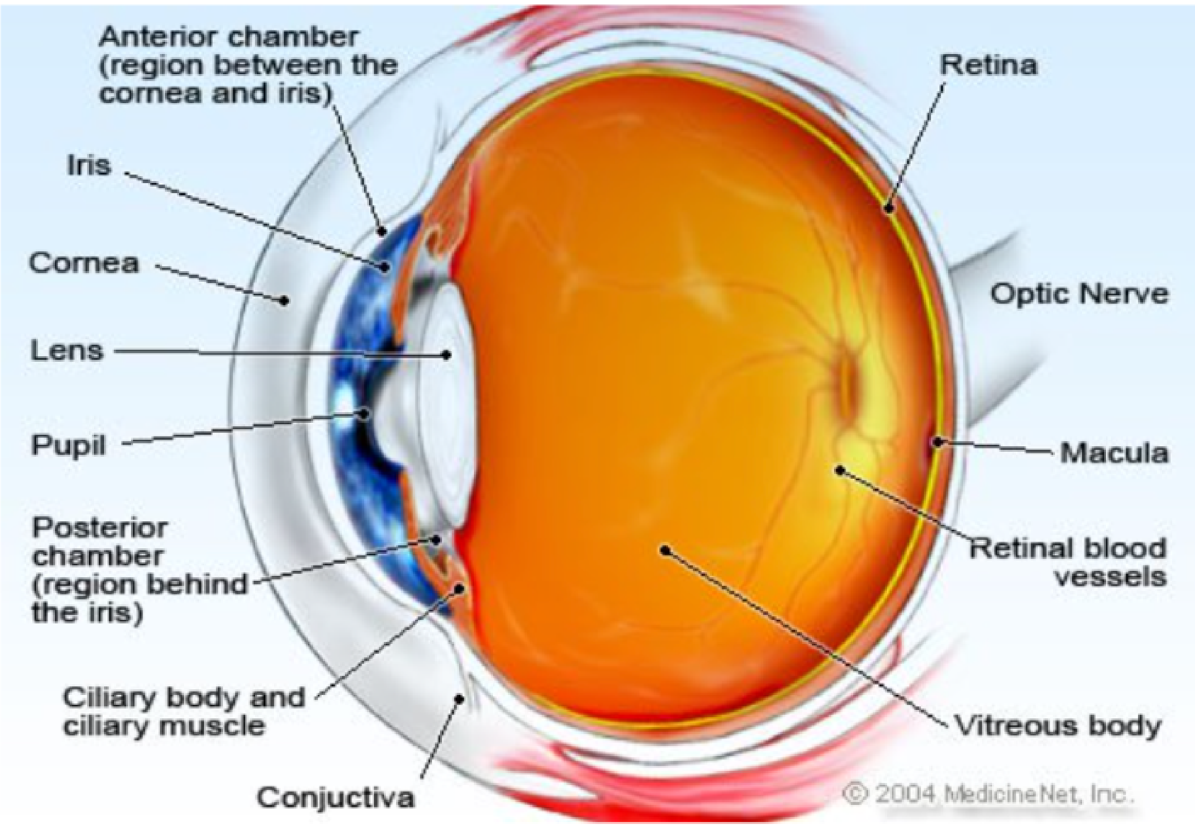
Date: September 12, 2018

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

revisions print • Aaron Patterson • Oct 09, 2018 @09:27 PM CDT

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

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 • Sep 14, 2018 @01:02 PM CDT

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:

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:

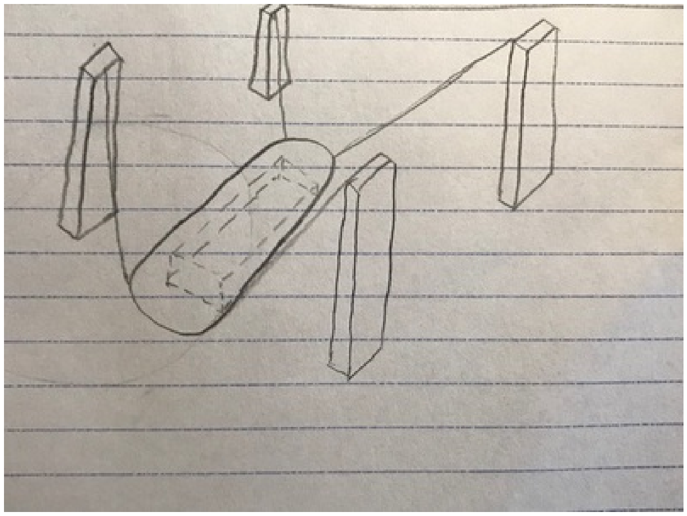
revisions print ▪ Aaron Patterson ▪ Oct 04, 2018 @01:04 PM CDT

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

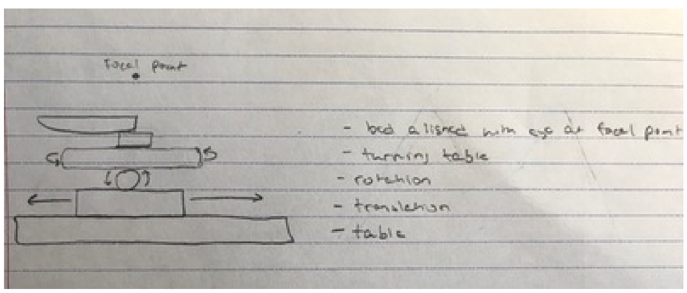


Floating_bed_drawing_.jpg(91.6 KB) - download

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

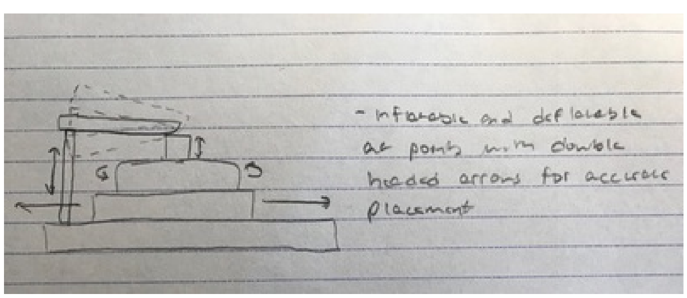


Modular_Stage_Setup_.jpg(44.8 KB) - download

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.

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: