R.A.L.P.H

An Easier Way to Scan

Design Portfolio By: Will Volovich

Design Studio 2022-2023

Topic Breakdown

Design Brief
My initial thoughts about different aspirations going into a big project. Contains my plan and problem statement.

Concept Maps
A way to further break down my thoughts. From a general focus area to a map of my potential design.

Survey Data
Summary of data I collected from students involving 3D scanning in general.

Mentor Letter
A letter sent to a chosen professional in the design/engineering field. My Mentor is Joe Hughes, COO of Hascall Denke.

Research
The initial steps taken to begin designing, contains my inspiration for the main mechanical mechanism.

C.A.D, Renderings & Drawings
Pictures of the individual components and assemblies that make up my design.

Pictures and Prototype
Pictures of my invention and previous part iterations.

Project Summary
Overall thoughts and reflection of my project.

Problem Statement

I want to simplify the use of the 3d screening app called ***Heges***. The app uses built in lidar scanners for face unlock on many iphones to produce 3d models. The challenge with this app is there is no easy way to scan the users face, as the user must hold the phone in the same position for an extended time. The process would be easier if the phone was fixed to a bracket and rotated around the head automatically. This is not only more consistent because the phone is scanning the same path every time, but it allows the user to self scan their face.

3d scanners can cost thousands of dollars and often require a power source, external computers, and sometimes a team of trained technicians to use the scanner. **R.A.L.P.H** not only reduces costs, but offers many applications by using existing technology. It provides the ability to produce a detailed 3d model using only an iphone. The scans can then be used for things such as custom helmet fitting for athletes, masks, and even 3d printing a physical model of your head. The product I envision will rest inside a sort of collapsible booth that can be easily transported. The main problem I am trying to tackle is accessibility to this technology. It shouldn't be something special only used at the highest level, if the technology is already accessible then it should be used as much as possible.

Design Brief / Specifications

Create a fixed pop up rig that can accurately scan and produce useable 3d models of the human head/face.

- Keep booth within 2x2 foot or 3x3 foot area.
- Don't over complicate the motor system. Try to avoid arduino.
- Find the best distance from face for optimal scanning.
- Laser cut as much as possible to save time.
- Have one main control box.
- Research proper battery specifications.
- Portablibility
- Have at least 1 complex 3d print, want to push myself in CAD
- Display for user experience/showing off the product. (Airplay might work).
- Live demo

Concept Map (Focus Area)

Something that is more than just a product and is durable.

Features complex components.

Solidly built, make it last.

Focus Area

Can be expensive

Human safety

Needs approval from officials in that field in many cases.

An aid for a bigger picture item.

Fitment of helmets through scanning

Head Protection

Inexpensive

Has more than one use

Scanning

What will be used to scan, phone or mildly inexpensive scanner

Post processing?

Fusion or Blender?

How will I scan

Green - General Design
Blue - Scanning in general
Dark Blue - General notes
Grey - Human Safety

Thought Process

Concept Map (Idea)

Black drop down cloth goes around.

CURVE

Large, many tooth geared ring goes above.

3d printing will be used for carriages/more complex components.

Have a solid mounting system for the camera, should have very little play.

Illuminate corners with light (lidar does not require light, just add to improve user experience.)

Second axis might be incorporated for more precise scanning/angles

Need to buy more filament.

Use laser cutting whenever possible

Get better with arduino

Heges face scanner booth

Make sure to highlight the more complex components of the CAD, maybe with the drawing feature in Fusion.

Purchase rough components now, Motors, hdmi adapters, try to find some sort of display to transmit.

Simple control box with wires. If Possible make wireless.

Keep it simple, geared motors will be easier and make my life easier.

Grey - Design Ideas
Light Blue - Electrical
Dark Blue - Manufacturing

Thought Process

Design Mentor

My design mentor, **Joe Hughes,** is the chief operations officer at Hascall-Denke in Florida. The company manufactures industrial grade antennas and mounts primarily for the military. Being that these mounts are used in the military space they have to withstand the test of time and take a beating. While my mentor may not directly be an engineer, he is certainly involved in the space enough to where I chose to reach out and ask if he wanted to mentor my project. The feedback he gave to me positively impacted my final prototype and without him, I would have continued to push my thoughts in the wrong direction. The letter I wrote to him is on the next page.

Mentor Letter

Feedback From a Professional in a Similar Field

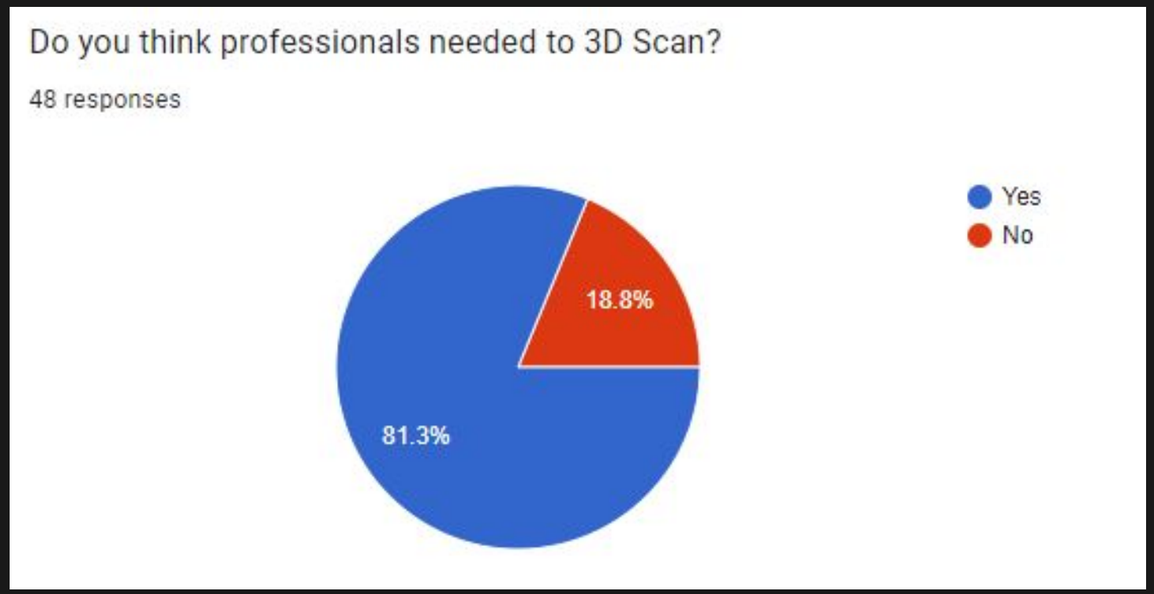
Dear Mr. Hughes,

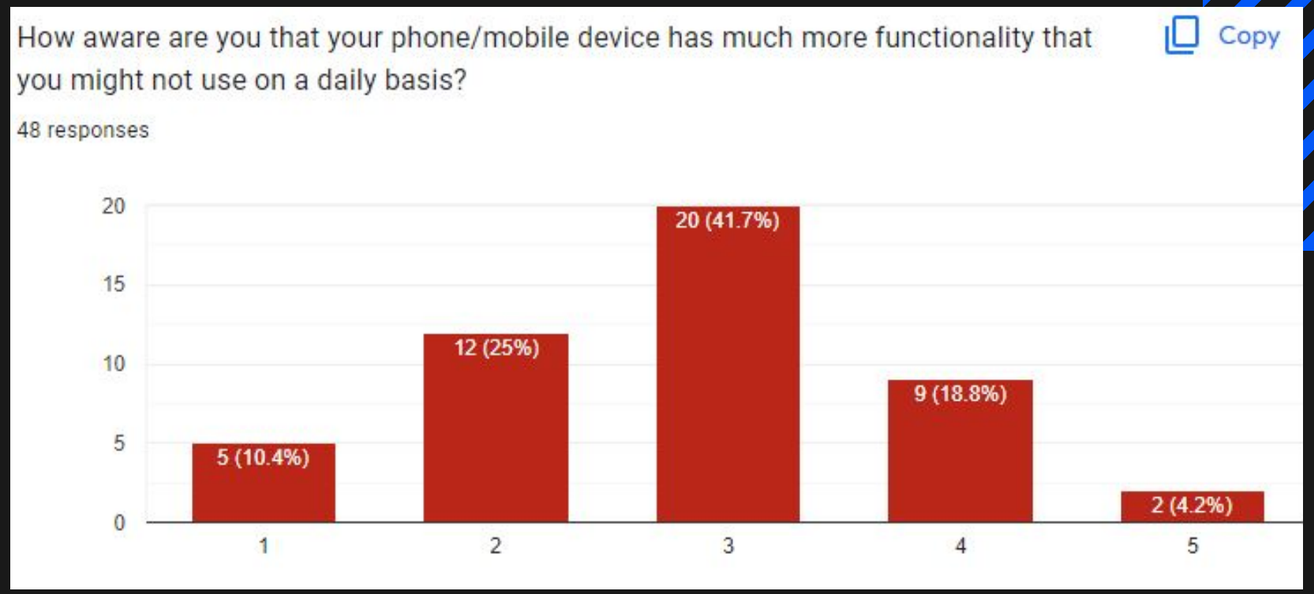
Hello! I am writing to you in hopes you will assist me in a project for school. As you know from our conversation at my Grandparents kitchen table, I continue to pursue CAD, design, and innovation in school. My experience consists of novice engineering classes in my freshman and sophomore years along with continuing to work on my passion independently. This year, my teacher enrolled me in Honors Design Studio. Rather than learning off of planned projects by the teacher, we are assigned to think of a problem at the beginning of the course and solve that problem by the end of the semester. For my project, I hope to make a better way to utilize an app designed for 3d scanning. The app is called *Heges* and uses any iPhones face ID scanner to create detailed scans of a person's face. My goal is to use this app differently. I plan to create a way for the phone to be mounted and rotate around the user's head automatically.

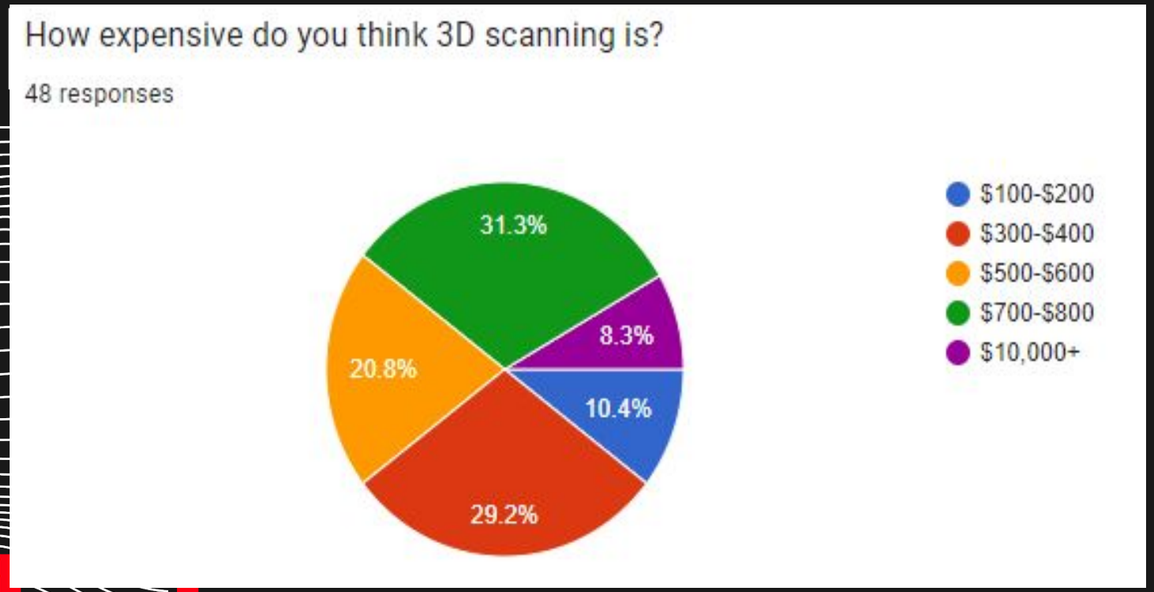
Like many of my ideas, this one stemmed from the internet. Specifically from Youtube, I saw a video of a guy who made a handheld scanner using this app, very similar to a traditional 3D scanner. I have always wanted to experiment with 3D scanning and seeing this video pursued me to buy this app and start scanning. The main problem was when I actually went to scan my head, the technology of the app works great, as long as the user has a steady hand you can produce incredible and usable 3D scans. The problem comes with the user not having a steady hand. Not only do you have to keep the phone at the same distance as you move it around your head but scanning the back of your head is quite a challenge. Unless your arms are crazy long a full face scan will be impossible without the help of another person. A fixed mount for your phone would be the ideal solution. The phone would be placed in a carriage and with the push of a button rotate around your head and make an accurate scan without having to rely on another person and completely eliminate user error.

Should you agree to participate in this design process, you will be communicating with me on one or two occasions providing me feedback on the designs and features I have come up with to solve my design challenge. Having feedback from a professional will give my design a higher quality. It also gives me the opportunity to learn from you. If you were to mentor me it would be a huge success and I hope you will help. Thank you!

Survey Results

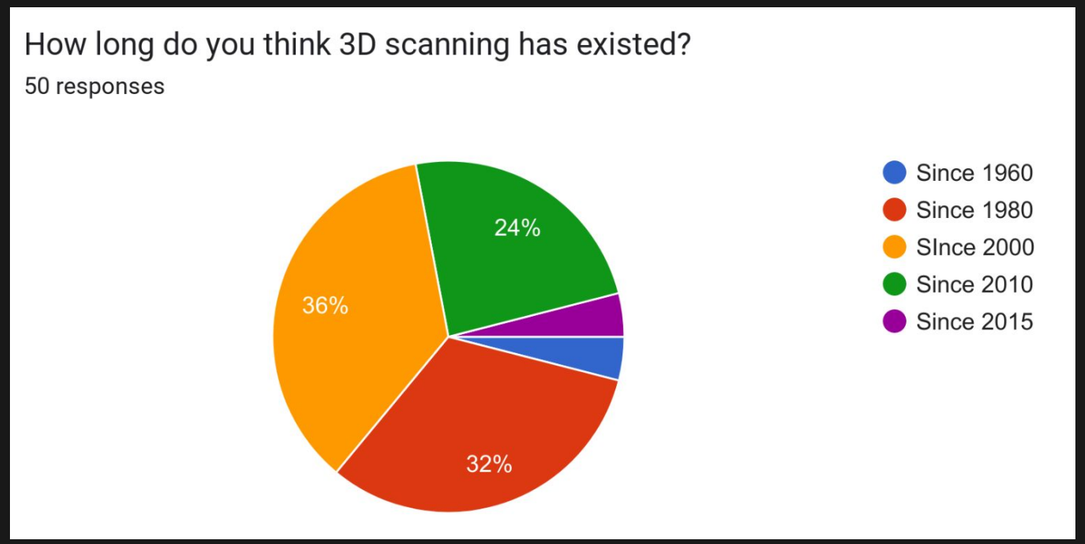


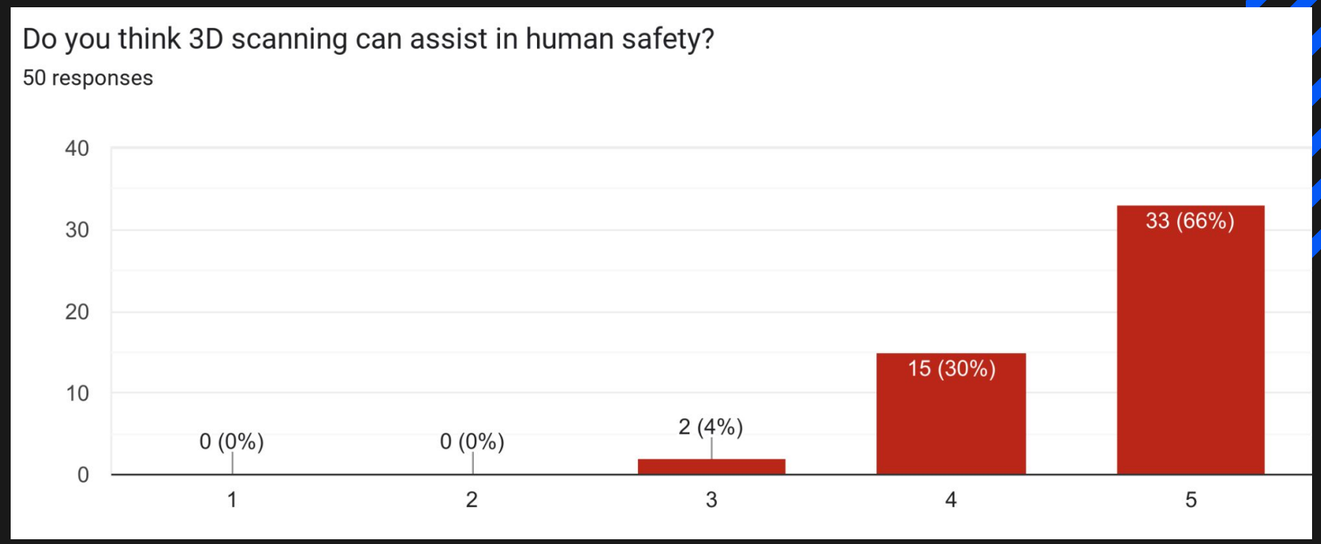


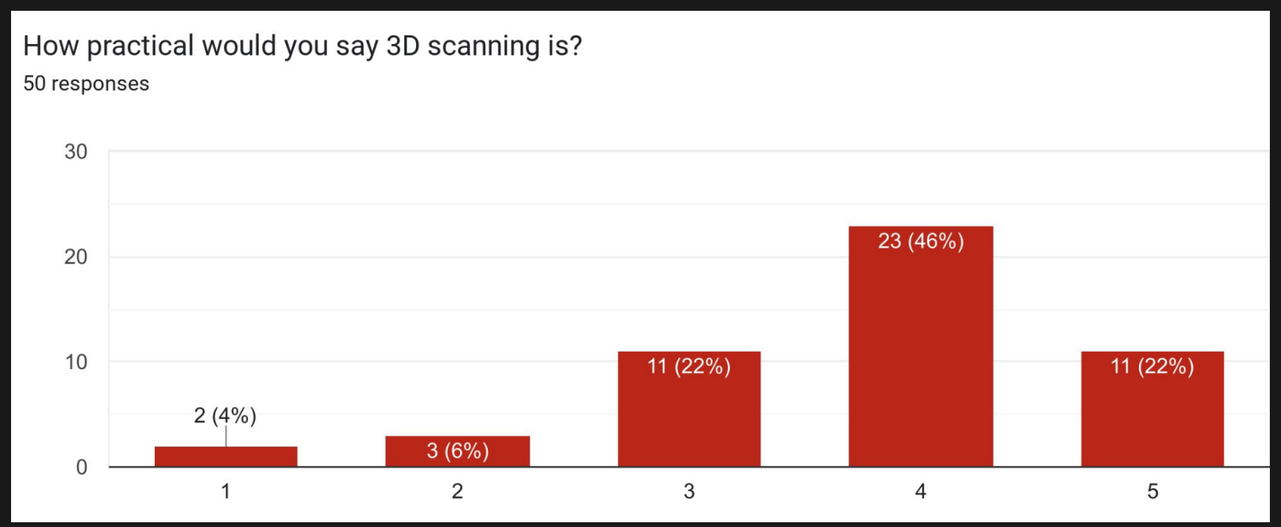


The main takeaway from this area of my survey research is that people don't get maximum use out of their expensive mobile devices, are mislead about the cost of 3D scanning, and believe that professionals are needed to do such a thing.

Survey Results







Additional questions from my survey proved to me that the public thinks this technology is relatively new, only coming into existence 20 or less years ago. The majority of people do believe that 3D scanning can assist with human safety, the added picture of a layered football helmet might have lead them to think this. As for the practicality of 3D scanning, most people do believe that it has a future and can be applied in a majority of fields.

Survey Conclusion

This was a valuable piece of research that will assist me in making something that the public will want. I now know that people don’t get maximum use of their expensive mobile devices. This encourages me to make a product that is inexpensive and user friendly. Labeling my product as a cheap alternative that can yield similar results will also prove against the public belief that 3D scanning can cost thousands of dollars. Lastly, my product will prove to people that professionals are not needed to 3D scan, any consumer of my product should be able to use it flawlessly only requiring knowledge of a basic technological device.

Topic Research

This consists of my thought process when it came to initially planning my design.

Find correct DC motors

- Need to be able to handle the estimated weight of the carriage design. How will it be powered? Ended up going with a low speed, high torque option.

Just hit buy on amazon for the obvious stuff

Keep track of items for price comparison of actual 3d scanners

- If I were to mass produce this product, after refining the final design, I believe it could be sold to the consumer for under 200 dollars. This is a competitive price point vs. traditional 3d scanners. The scanners that do exist in this lower price point are generally for small desktop items only, not full face scanning. So I would say for the value you get out of scanning faces it is worth a 200 dollar price point.

Potential Material/Manufacturing Notes

MDF thickness ½ in

Most likely be cutting 2x every part due to laser limitations.

Main drive spur gear teeth need to be vertical.

Ditch the gears, belt driven is better.

- I found that there was no way a large hundred toothed design makes no sense for this application.

Keep track of motor details, manufacturing, how long stuff will take, cost.

Fusion 360

- Thankfully Fusion has all of the features I need to do this project, not only can I use it to produce a CAD model for 3d printing parts but I can also edit the meshes produced by the scanning app. This involves cleaning up points that might have scanned incorrectly.

Research Continued

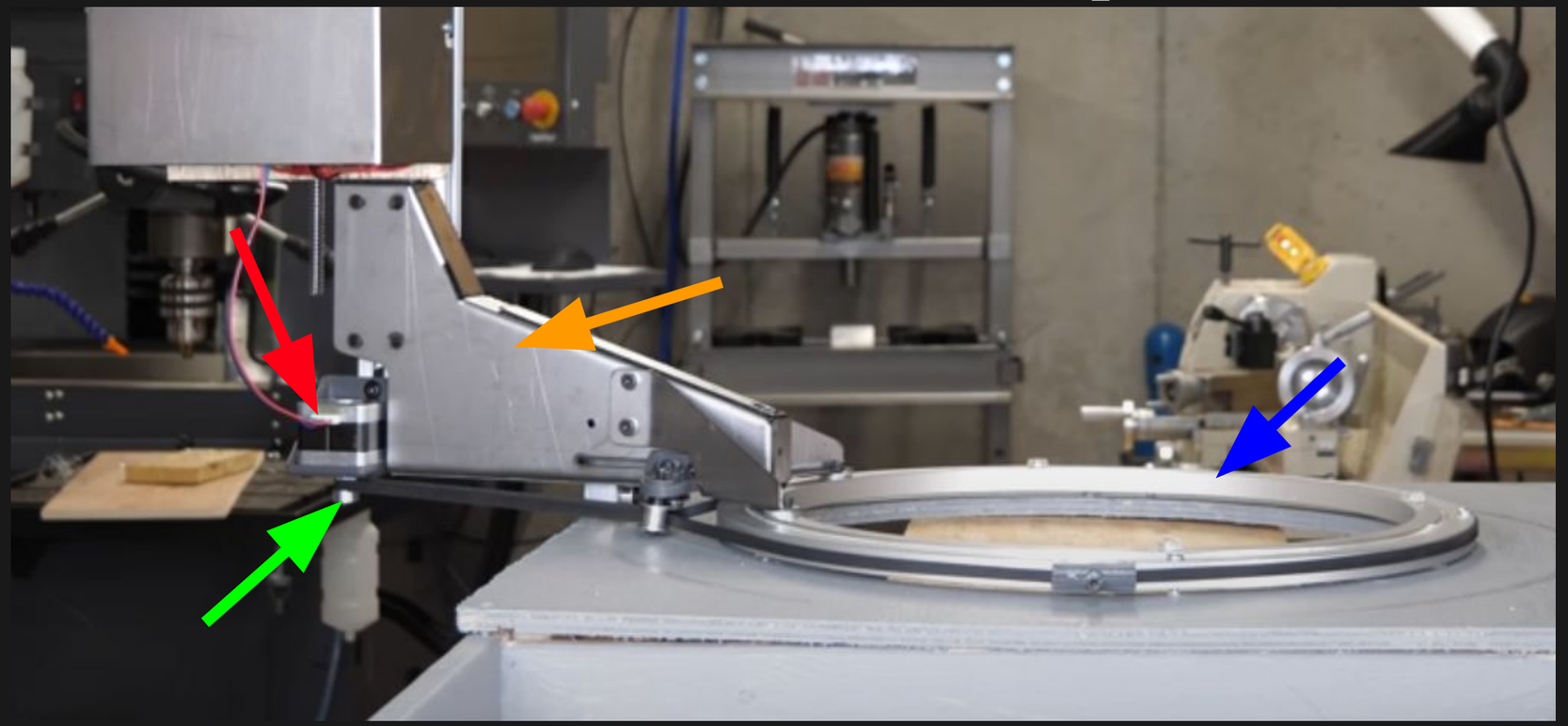
All Materials List

- **3d Printable Filaments:** PLA and TPU
- **Woods:** MDF, card table wood unknown, veneer on top of card table.
- **Metal:** Folding legs of card table are made from steel as well as the folding mechanism.
- **Miscellaneous:** Ball bearings, M4 screws [various lengths used], M4 nuts, 100 RPM 12v DC motor [Larger one], 200 RPM 12v DC motor [Smaller one], belt pulleys, 3 way rocker switches, 22 gauge electrical wire, magnets, 12v power supply, power supply plug, user Iphone, *HEGES* software.

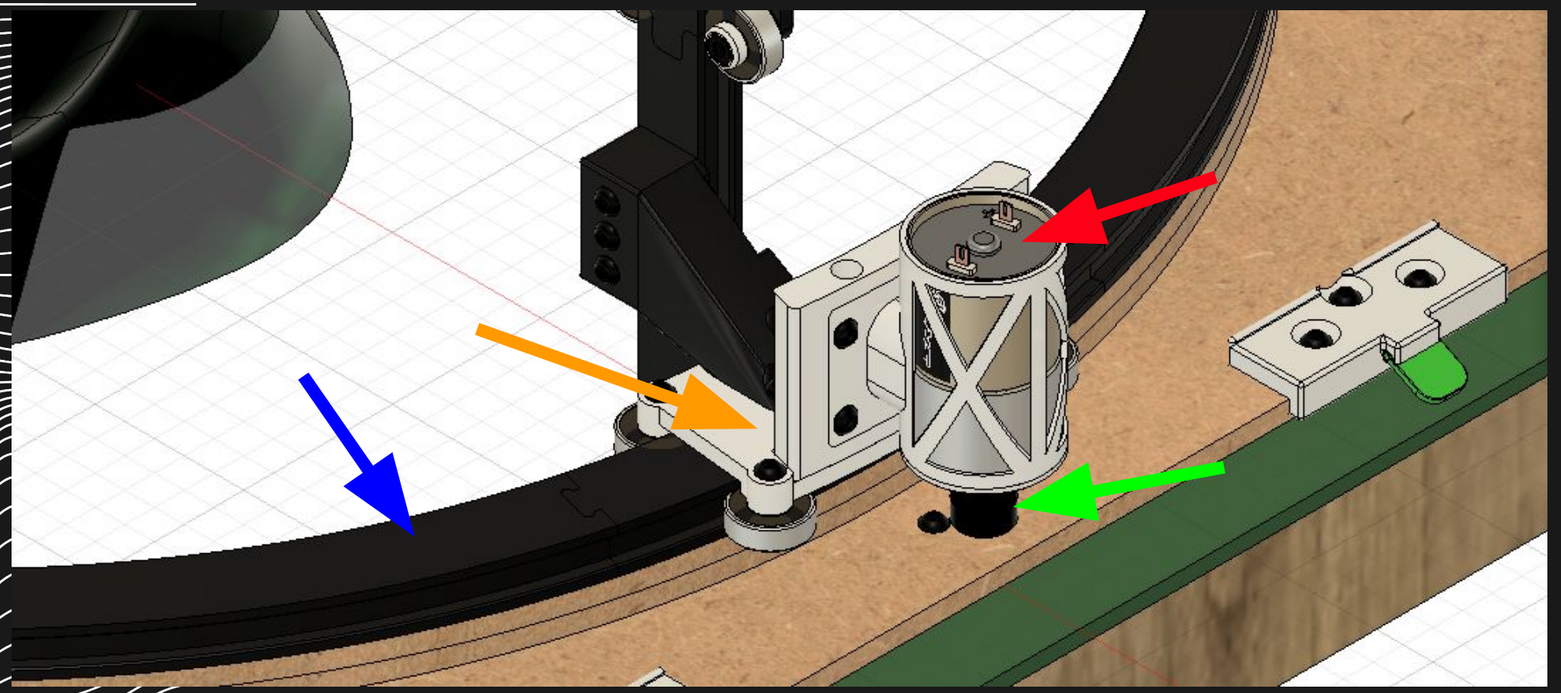
Post Processing

- After scans are complete there needs to be a way for the user to clean up the mesh file created.
- *Meshlab* is a free program that I discovered that is perfect for cleaning up excess noise captured by 3D scanned STL/mesh files.
- The Setting in *Meshlab* that cleans up the model is called a **Screened Poisson.**
  - A screened Poisson is a mathematical equation that (calculated by computer) that locates edges and vertices and ties them together within the mesh.

Inspiration



The motion in the main mechanism was heavily inspired by this one that is much more complicated and precise. This design came courtesy of the youtube channel “Stuff Made Here”. This design uses a stepper motor on a massive carriage to drive a belt which moves his part around the users head. Mine includes the same concept of using a belt that wraps around a large ring. However, mine is made out of PLA plastic, and uses a DC motor rather than a stepper motor.



Points of similarity

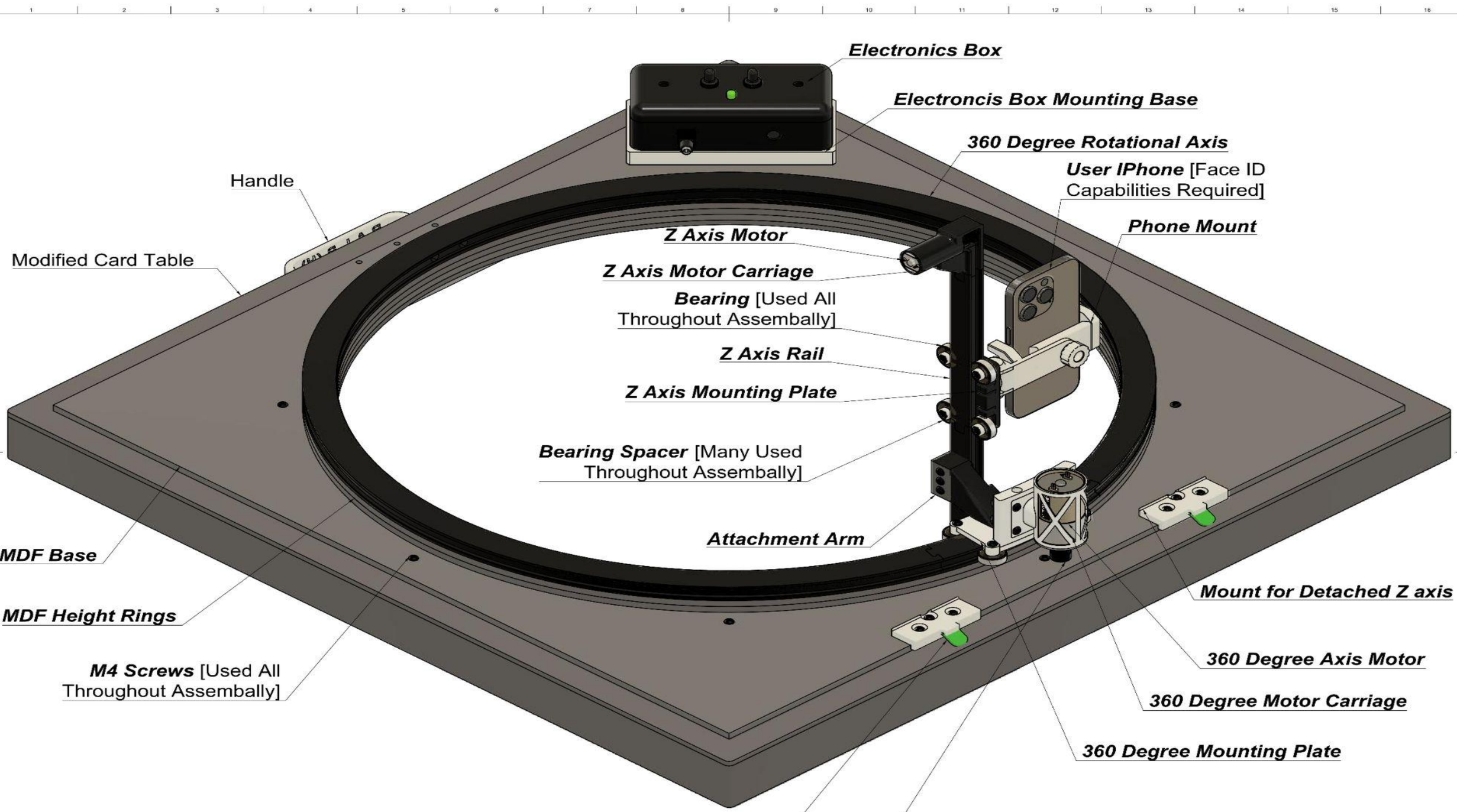
Green - Belt drive
Orange - Carriage
Blue - 360 degree track
Red - Motor

Possible Solutions

Different part iterations that I went through during the creation of my design

Red - Mock Circuit
Orange - Z axis v1
Blue - 360 degree carriages
Yellow - Bearing spacers
Green - Phone/motor hybrid v1
Pink - Electronics box v1
Purple - Mounts

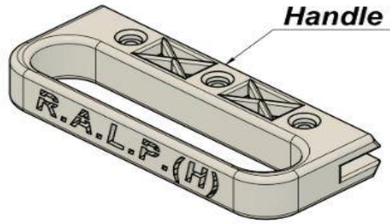
Drawings in Fusion 360



Different Table and MDF Color Used for Visible Line Contrast

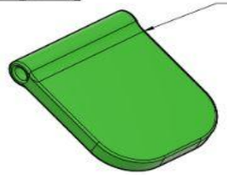
Dept.: Engineering	Technical reference: Orignal Design	Created by: Will Volovich 1/9/2023	Approved by: Mr. Mariano
		Document type: Technical Drawing	Document status: Complete
		Title: R.A.L.P.(H) Final Assembally Drawing	DWG No.: v1
		Rev: 65	Date of issue: 10/1/2022
			Sheet: 1/1

Part Contents Drawing



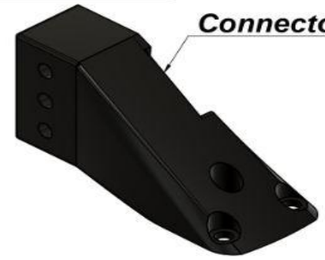
Handle [x1]

Washer [x20]



Finger Tabs [x2]

Electroncs Box Base



Connector Arm

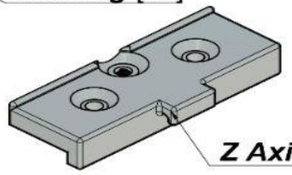
M4 Nuts

M4 Screw [x25][Various Lenghts Used]

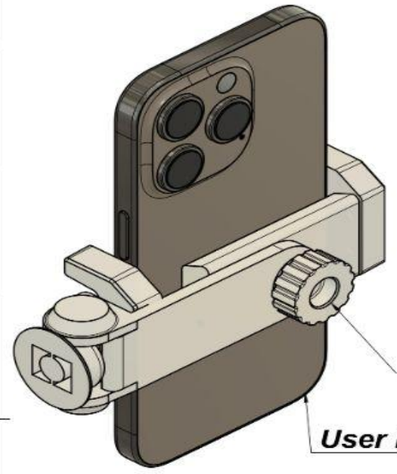
Belt Pully[x2]

Electroncs Box [Included: *x2* 3-way rocker switches, 12v power supply adapter, LED light]

Bearing [x8]

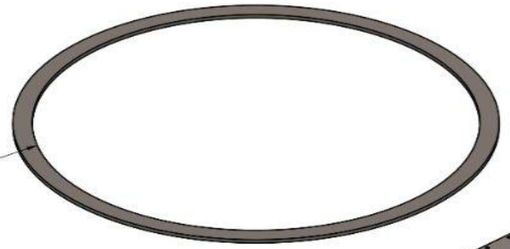


Z Axis Motor Clips [x2]

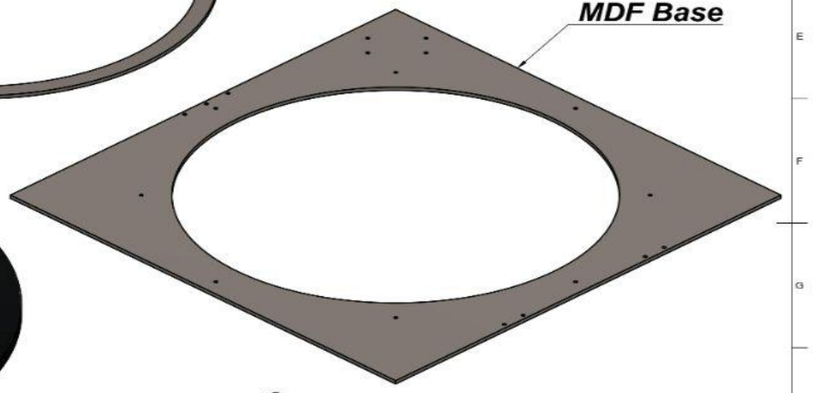


Phone Mount

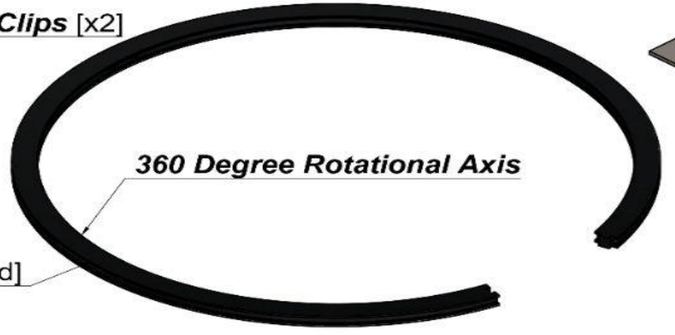
User Iphone [Face ID required]



MDF Height Ring [x2]



MDF Base



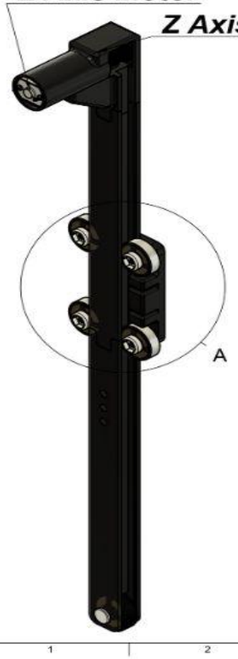
360 Degree Rotational Axis

[12 Printed Segments Used]

Z Axis Motor

Z Axis Motor Mount

A (1:.5)



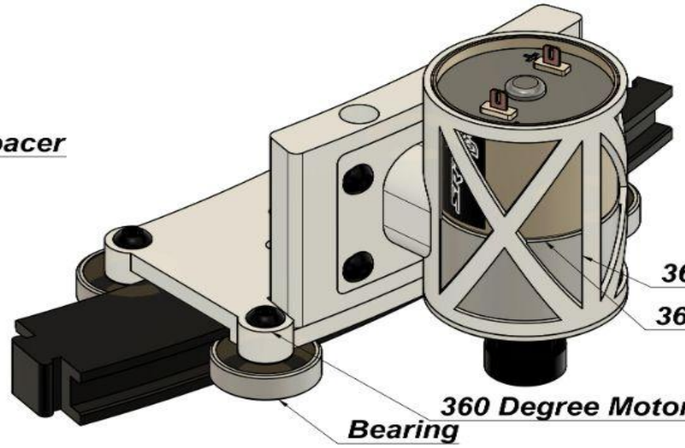
A

Z Axis Carriage

Bearing

Bearing Spacer

Z Axis Rail

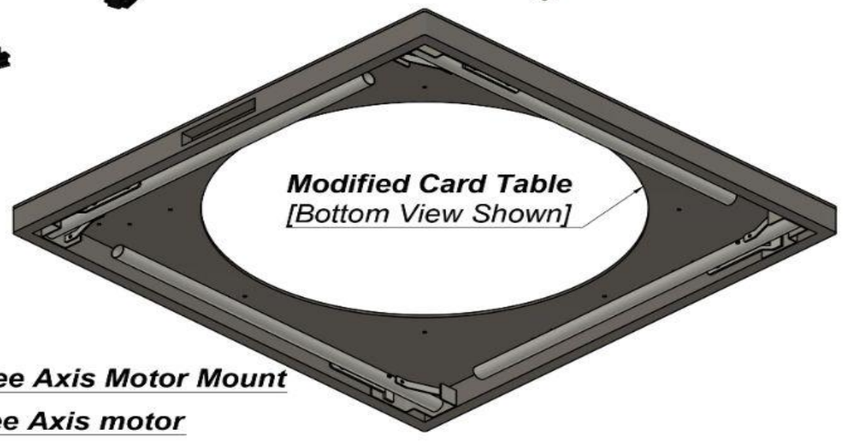


360 Degree Axis Motor Mount

360 Degree Axis motor

360 Degree Motor Carriage

Bearing



Modified Card Table
[Bottom View Shown]

Dept.	Technical reference	Created by		Approved by
Engineering	Orignal Design	Will Volovich	1/9/2023	Mr. Mariano
		Document type: Technical Drawing		Document status: Complete
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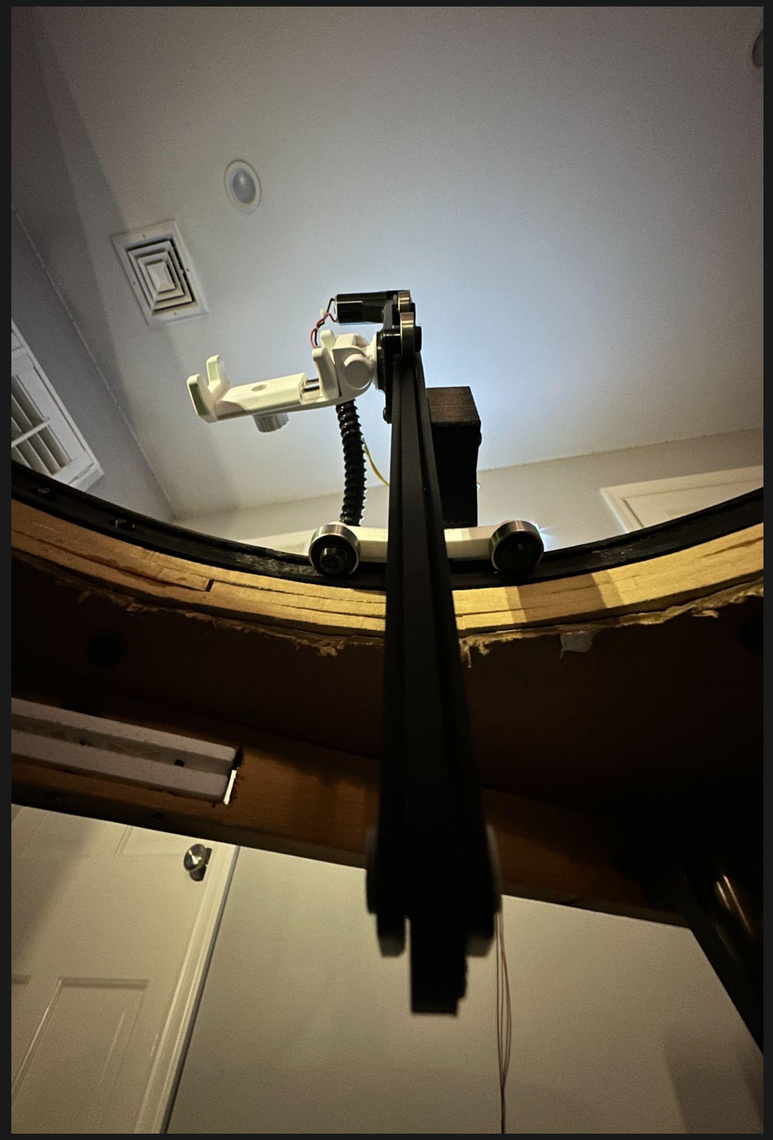
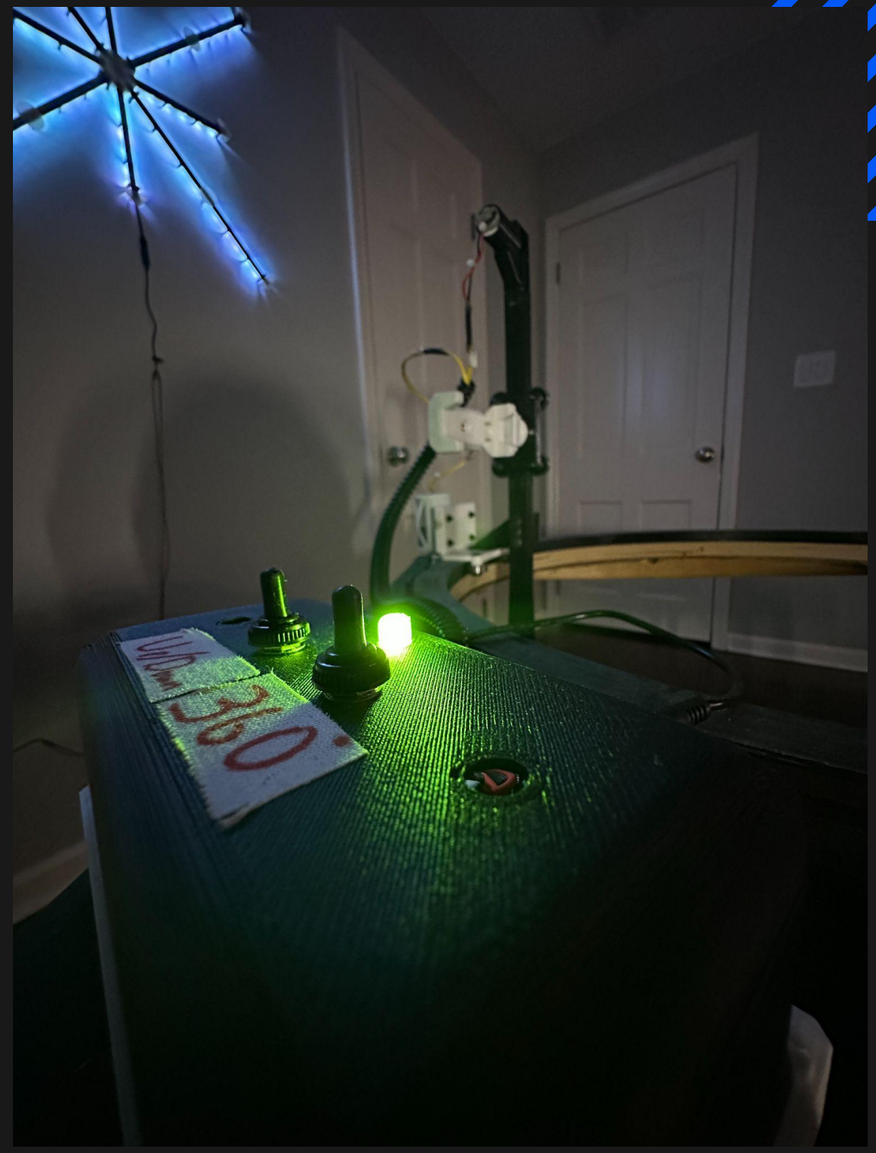
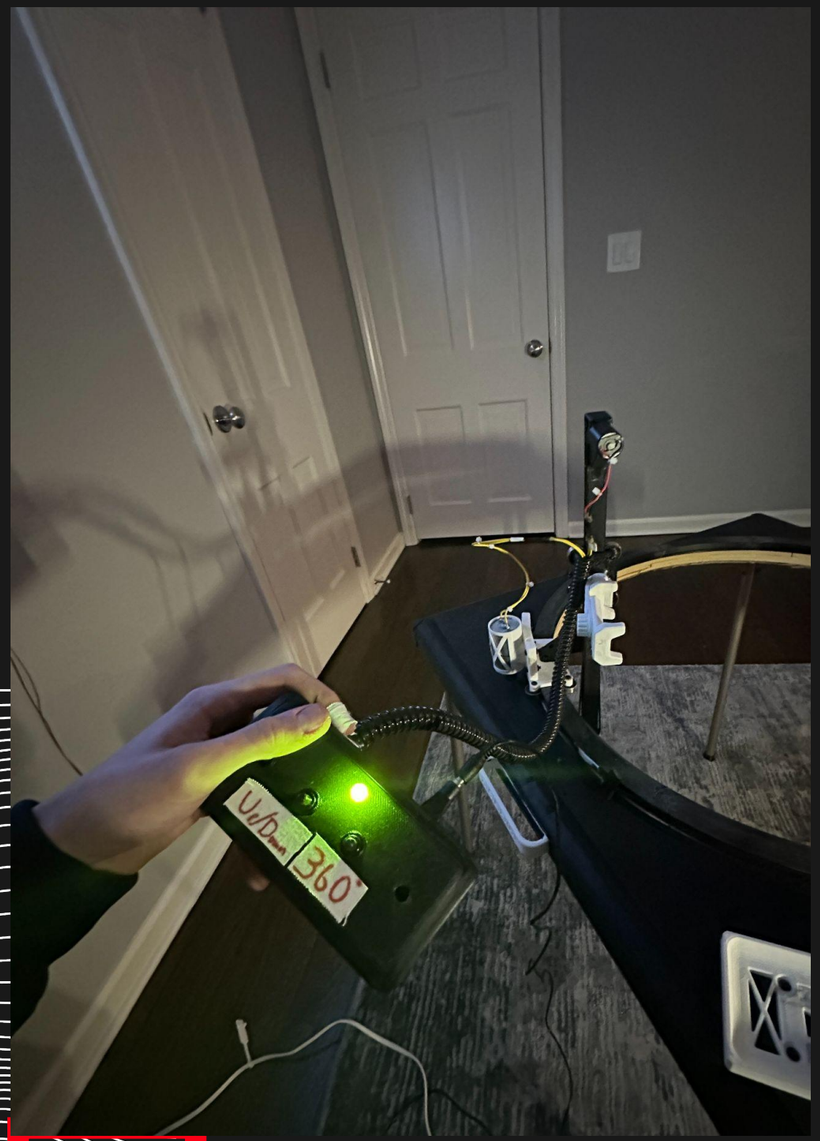
Final Solution

What my model looks like in real life





Final Solution



Summary

Overall I am very happy with how this first prototype turned out. If presented to a company for mass manufacturing I feel like the important points/ideas would stand out as well its areas for improvement, This project was certainly a grind and would be hard to work on especially towards the end of the semester. The beginning of the build was fun, I was cranking out parts every day on my two 3D printers that I have at home. The major design was only changed once at the very start of the project. Originally I planned to drive the carriage with a massive gear that rode along laser cut teeth, that would be where my main track ring is now. If I had done it that way this design would have been much more complicated. After taking inspiration from that Youtube video I bought some belts and never looked back. Working on a project this intensive in CAD and 3D modeling was very beneficial for me. I learned tons of new features that I had not previously discovered and further tapped into the capabilities of this program. After working on this project for awhile I had become dissatisfied with how simple it had now seemed to be for me. If I had shown this CAD model to freshman me, I would have been blown away. But now, I want more complexity. Whatever turns out to be my next project will be much more complicated.

I think the most beneficial part of this project to me (from a CAD perspective) was how to have a better workflow in Fusion 360. In future projects I will now know how to NOT build myself into corners I could not get out of without tons of work. For example, I designed a critical part of my prototype using an incorrect workflow. The part was functional the way I intended but revisions could not be made based on my choices in Fusion. Additionally I really liked incorporating M4 screws into this design, the level of complexity you can reach with a couple of fasteners is crazy. To conclude, this was a project that I spent countless days completing. Dozens of hours for printing parts and making revisions all payed off in the end. The scale that my project was at simply overarched the structure of the deadlines for the standard class so I will work towards my own deadlines in the future. An added benefit of relying on my printers to make my whole project is now they are tuned to perfection and can handle anything I throw at them. Design studio was a blast my first time around and there will be bigger things coming when I take the class again next year...