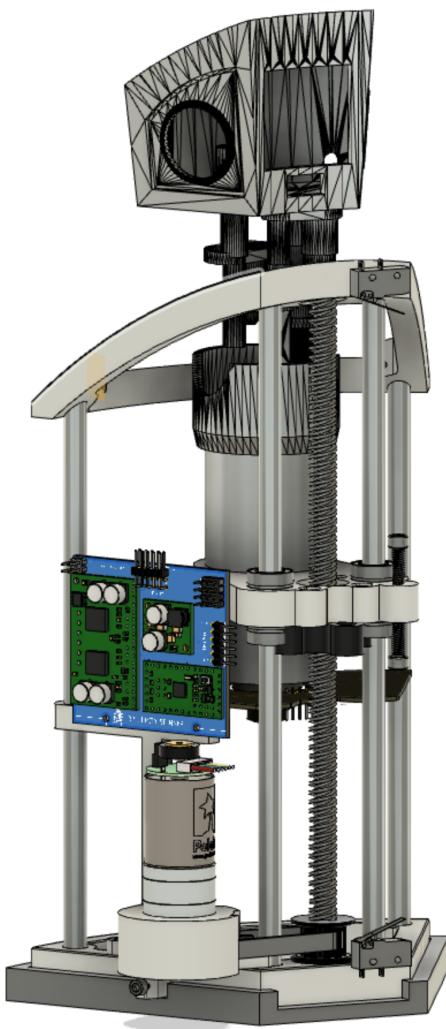


Greg Hulette's Periscope Instructions v0.1



The latest files and instructions can be found on my Github.

<https://github.com/greghulette/PeriscopeLifter>

*****I want to warn you that these instructions and files have not been verified by other builders so please build at your risk. Please feel free to modify/alter and provide feedback so that we can collaborate and make this better for the community.*****

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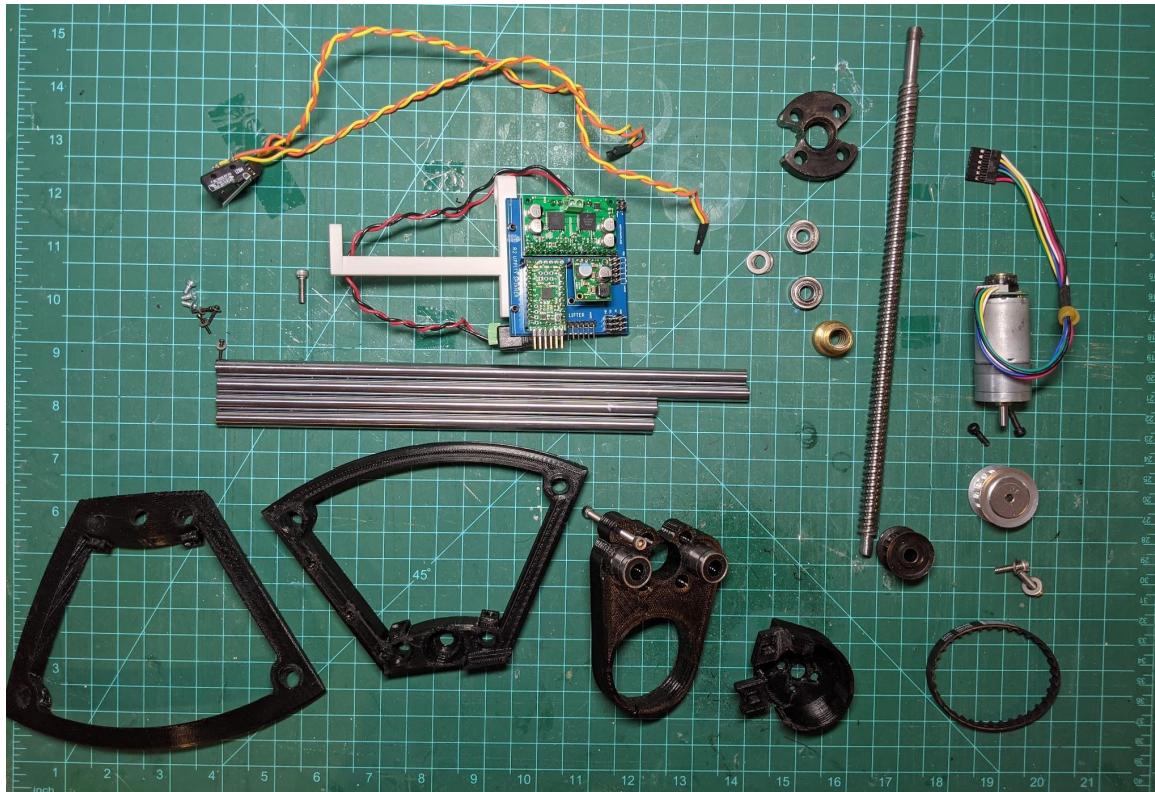
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Date: 15OCT21

Background

With the lack of availability of the IA Parts periscope lifter, I challenged myself to create one that works similar to that design, but with the limitation of being able to make it myself without access to a machine shop. I only have access to a 3D printer, and some basic power tools. (Dremel, Drill, Saws) With those design requirements, I set the following rules

- Make all my designs open source. Everyone is free to download and modify any part of this system. I just ask that you share your work with the community. No selling of these designs. I'm making these files and designs freely available and expect any work you do will follow this principle.
- Use 3D printed parts where possible
- Source all material from McMaster when possible
 - I like the idea of getting everything in one place
 -
- Maintain the footprint of the IA Parts lifter to work with Doug's Warp Core Base Plate
 - This decision had me change the design and required modifying the purchased parts to allow it to fit in a more condensed area. (More on that later)
- Use the Uppity Spinner as my control system

With these design rules, I set out and started designing my lifter in Fusion 360. The Fusion 360 Archive file will be available on my GitHub for your use/reference.



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Procurement

There are a number of parts that will have to be procured. The following table has the parts to procure and URL's to the parts. These may be updated in the future by the manufacturer and prices are as of 27SEP21.

Part Description	MFR PN	Qty	Link	Price	Total
Lifter Motor	Pololu 25D 4841	1	https://www.pololu.com/product/4841 (12VMotor) https://www.pololu.com/product/4801 (6V Motor Not tested yet)	\$36.95	\$36.95
Rotary Motor	Pololu 25D 4847	1	https://www.pololu.com/product/4846	\$36.95	\$36.95
Lead Screw (18")	99030A986	1	https://www.mcmaster.com/99030A986/	\$9.80	\$9.80
Motor Coupler	ROB-12493 1	1	https://www.sparkfun.com/products/12493	\$4.99	\$4.99
Pulley for Lead Screw	6495K744	1	https://www.mcmaster.com/6495K744/	\$19.12	\$19.12
Pulley for Lifter Motor	615422	1	https://www.servocity.com/4mm-10-tooth-pinion-pulley/	\$6.99	\$6.99
Inside Nut	95072A126	1	https://www.mcmaster.com/95072A126/	\$27.14	\$27.14
Brass Nut	92174A039	1	https://www.mcmaster.com/92174A039/	\$2.16	\$2.16
Linear Rails (need 4, can cut from these 2)	190459822893	1	https://www.amazon.com/8mm-600mm-Cylinder-Optical-Diameter/dp/B087Q5X82S/ref=sr_1_21?dchild=1&keywords=8mm+rails&qid=1632841589&sr=8-21	\$20.99	\$20.99
Linear Rail Bearings (Need 2)	884017612032	1	https://www.amazon.com/LM8UU-Linear-Bearings-Length-Printer/dp/B087WPGQ8T/ref=sr_1_8?dchild=1&keywords=8mm+bearings&qid=1632841677&sr=8-8	\$10.95	\$10.95
Lead Screw Bearings	3759T58	2	https://www.mcmaster.com/3759T58/	\$8.60	\$17.20
Linear Motor Belt	6484K117	1	https://www.mcmaster.com/6484K117/	\$4.36	\$4.36
Limit Switches	7658K11	3	https://www.mcmaster.com/7658K11/	\$3.70	\$11.10
Aluminum Pipe	4561T411	1	https://www.mcmaster.com/4561T411/	\$17.46	\$17.46
Magnet for Mount	5862K105	4	https://www.mcmaster.com/5862K105/	\$1.73	\$6.92
Uppity Spinner		1	https://astromech.net/forums/showthread.php?30746-RTouch-%E9&p=547405#post547405		\$0.00
Threaded inserts	94180A333	21	https://www.mcmaster.com/94180A333/	\$18.39	\$18.39
				Total:	\$251.47

Table 1. Parts to Purchase

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Screws Needed (Still working to complete this table but the parts are correct)

Part Description	Length	MFR PN	Qty	Link	Price	Total
M3 x7mm screws	7mm	91290A115	21	https://www.mcmaster.com/91290A115/	\$8.65	\$8.65
M3 x10mm screws	10mm		4			
#0-80 3/8" screw	3/8"		2			
#6-32 1/2" screw	3/4"		1			
#6-32 3/4" screw	1"		1			
#2-56 1/2" screw	1/2"		2			
1/4-20 Hex Head >1.5"	>1.5"		1			

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Modifications to Purchased Parts

There are a few modifications that are needed in order to have everything fit properly.

Risers

The 2 risers purchased from Amazon need to be cut down. There are (2) risers needed and 8.25" and (2) risers needed at 10"



Picture 13. Large Riser @10"



Picture 13. Short Riser @8.25"

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Lead Screw

The lead screw also needs to be cut to 10". It then has to have the threads filed off on the ends. The ends need to be $\frac{1}{4}$ " for the bearings and timing pulley to slip on.



Picture 14. Lead Screw Length



Picture 15. Lead Screw Upper



Picture 16. Lead Screw Lower

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If you have a lathe, this will probably be an easy operation for you. I did not have a lathe and had to get creative. I mounted the lead screw in some extra bearings that I had. I used the McMaster Low-Profile Mounted Sealed Steel Ball Bearing Two-Bolt Flange, for 3/8" Shaft Diameter, Fixed Alignment bearings.(PN:7208K51)



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Periscope Pipe

Cut the pipe to the proper length
TBD

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3D Prints

There are 6 parts to be 3D printed. None of the parts are very large and can most likely be printed on any 3D printer. I used PETG to print out all of these parts and printed everything at 100% infill. You may not need 100% infill, but I wanted to make it as strong and dense as possible. The files can be found on my GitHub repository. <https://github.com/greghulette/PeriscopeLifter>

Part Name	Qty to Print
Base Plate	1
Top Plate	1
Lifting Motor Mount	1
Periscope Holder	1
Mounting Bracket	1
Electronics Mount Main Body	1
Electronics Mount Spacer	1

Table 2. Parts to Print

Print Settings:

Nozzle Temperature: 235C

Bed Temperature: 75C

Infill: Not applicable because of the next settings.

Outline/Perimeter Shell: 7

Bottom Solid Layer: 5

Top Solid Layer: 500 - This makes the print 100% solid. I found that using 100% infill did not make it completely solid. I chose 500 because none of my prints have more layers than that.

Layer Height: .25mm

Support Material: Yes. (some parts may not need it but I left it in there and let Simplify3D decide if it was needed.)

First Layer Speed: 45% (I like to print the first layer very slowly. My printer responds better to this slow first layer)

These are the settings that worked for me, feel free to play around with your settings when you print..

Optional:

All of these parts can be printed at xometry.com for a price. When I got a quote, it ranged from \$251 - 458, depending on how fast you want them. The quote was using Nylon 12 with Selective Laser Sintering (SLS). I had an earlier version printed with this setup and it was extremely good quality.

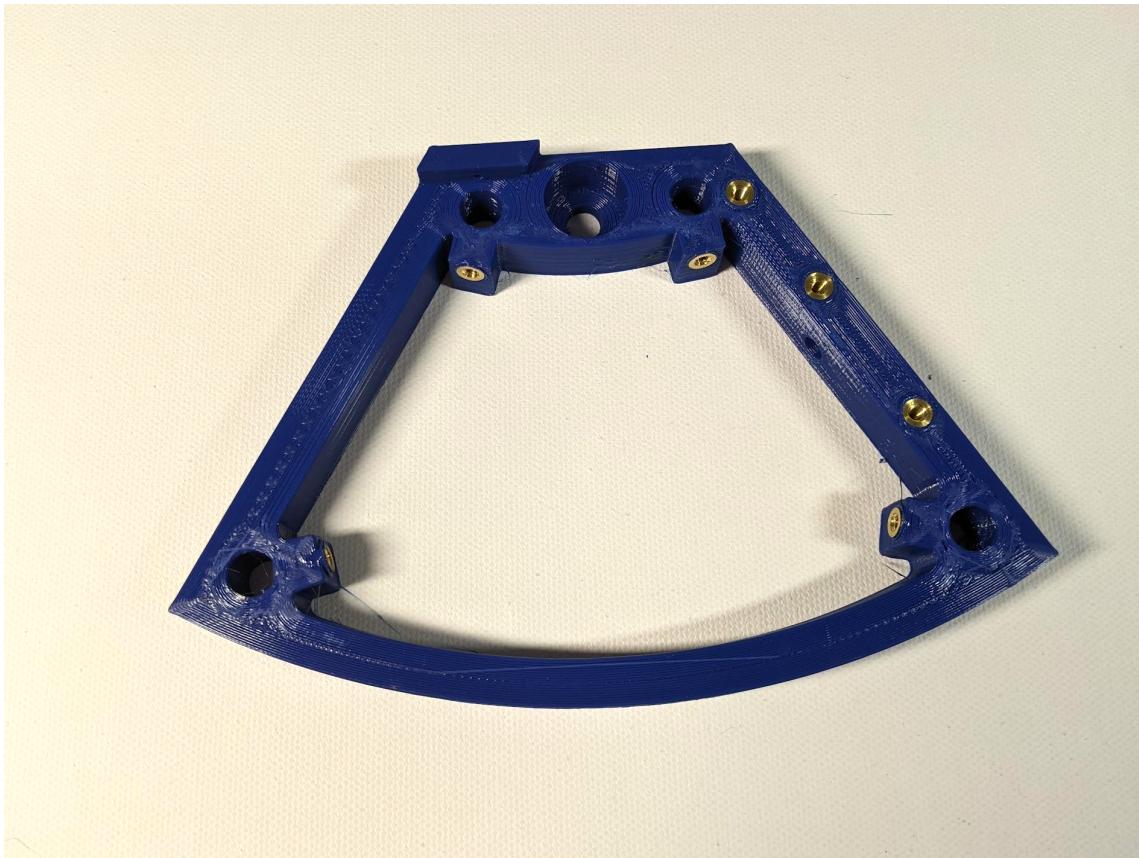
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Base Plate

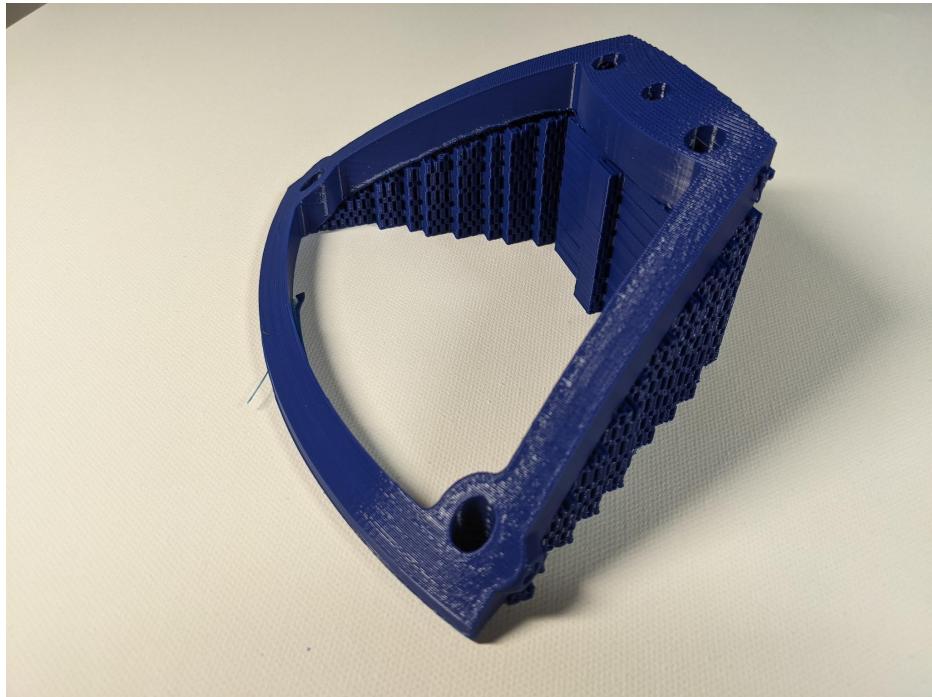
I printed this with the bottom face down on the printer. This part required no support with my settings.



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Top Plate

I printed this with the bottom facing the printer. This piece requires a lot of support.



With the support left in place

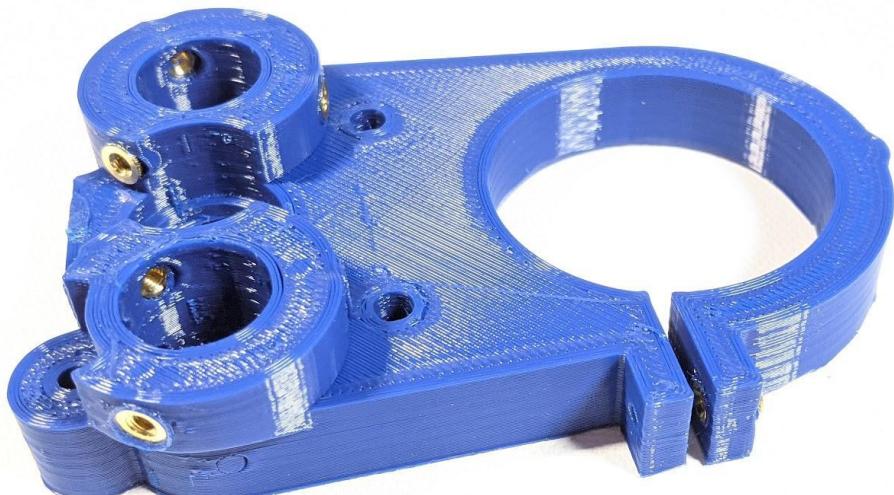
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With the support removed

Periscope Holder

I printed these parts with the top facing down.



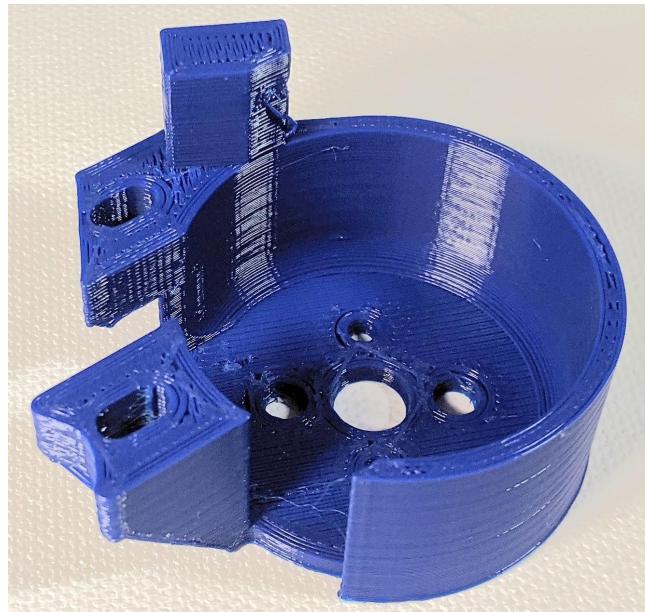
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Lifting Motor Mount

I printed these parts with the top facing down.



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Electronics Mount Main Body and Spacer

I printed these parts with the top facing down.



Mounting Bracket

This piece is designed for the “Peace Sign” dome plate with the Darren Muller Domes



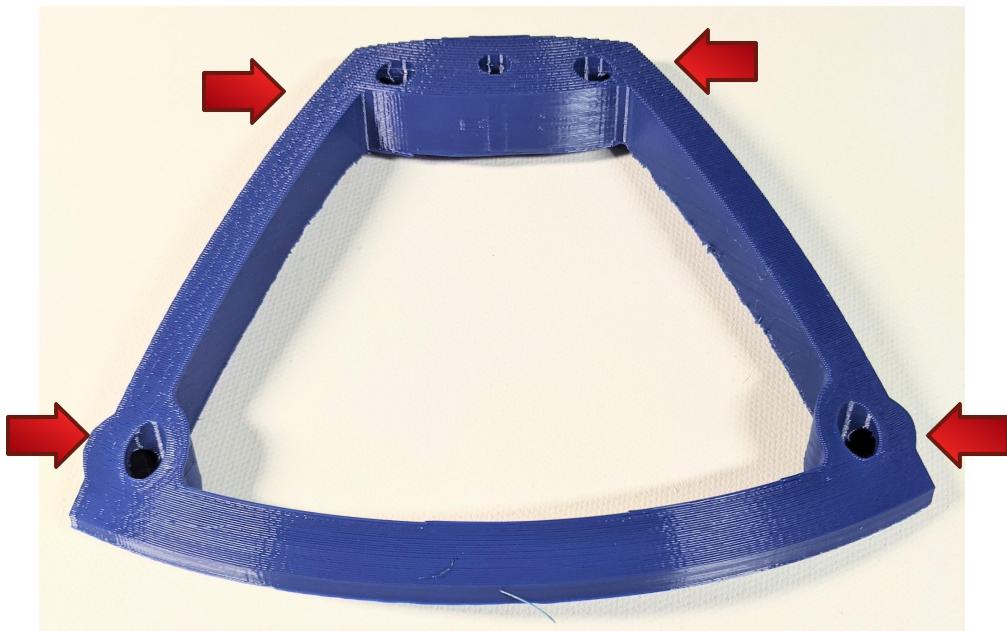
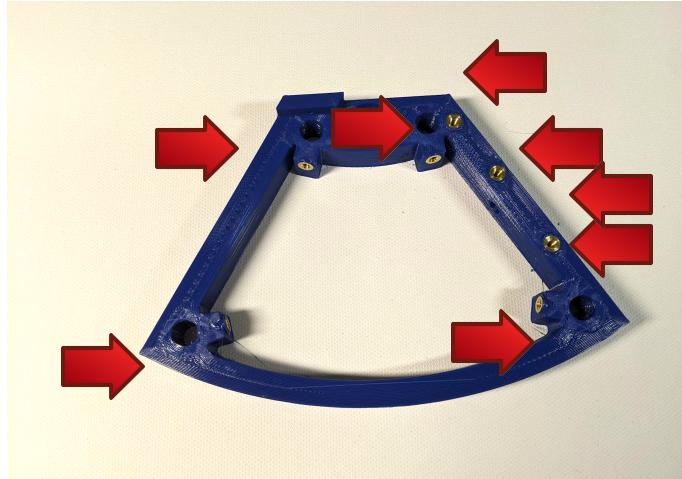
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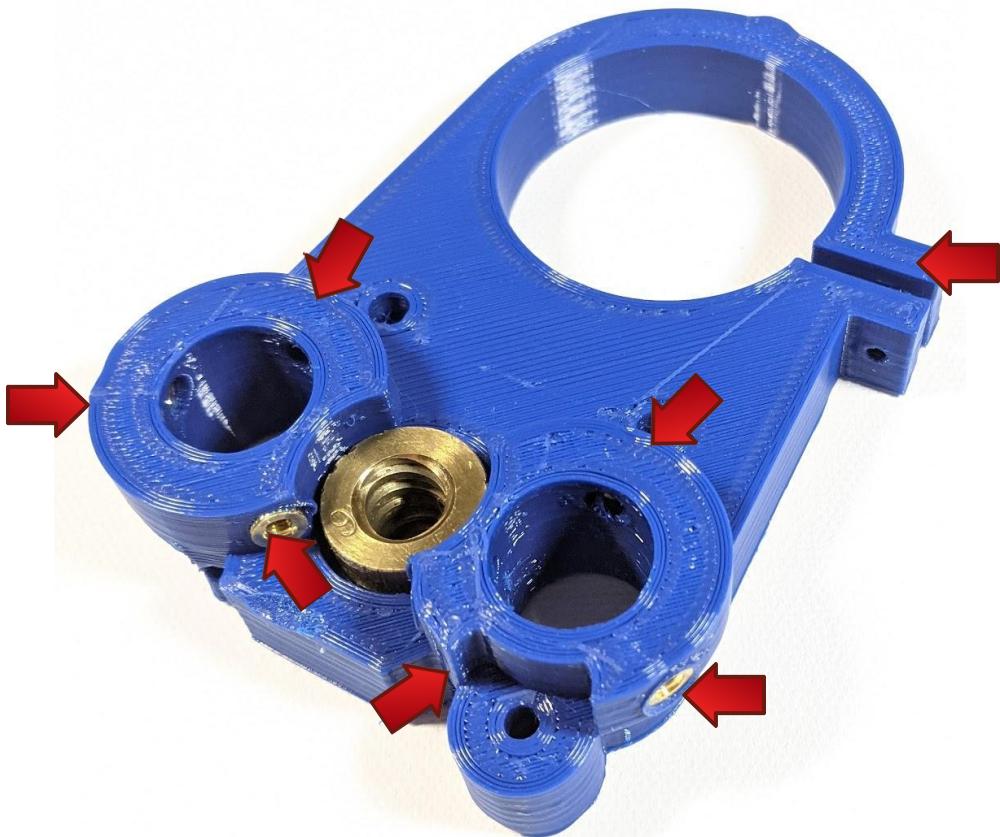
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Build Steps

1. Insert the threaded inserts into the 8 locations on the base, 4 locations on the top plate, and 10 locations on the Periscope Holder





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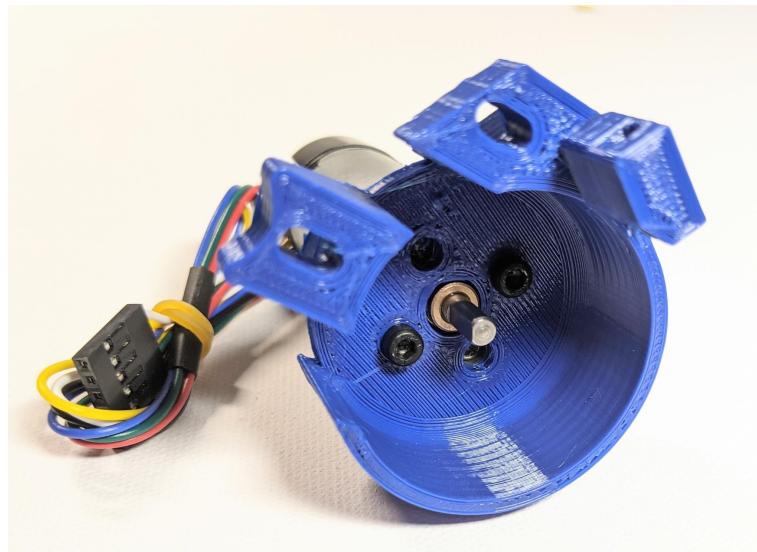
Bottom

2. Drill out each of the riser holes in the base and top plate with a 5/16" bit. Also drill out the electronics mount hole that slides over the riser.
3. Push the risers into place into the bottom piece. (I have found it helpful to wait to place the riser by the motor mount until the lifter motor is installed. This will make it easier to screw in the bolt) Make sure to push the risers down all the way. This will be needed to have a good magnetic connection to the mounting bracket. The Mounting bracket holds on to the periscope lifter with these risers. A light blow of the hammer may be needed to seat them all the way.

4. Place M3 x bolts into the threaded inserts that secure the risers in the base



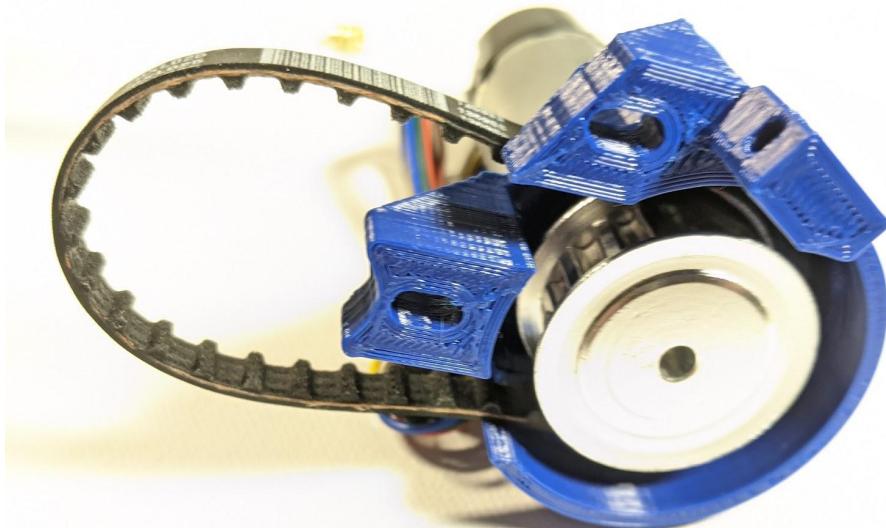
5. Mount the lifter motor to the motor mount



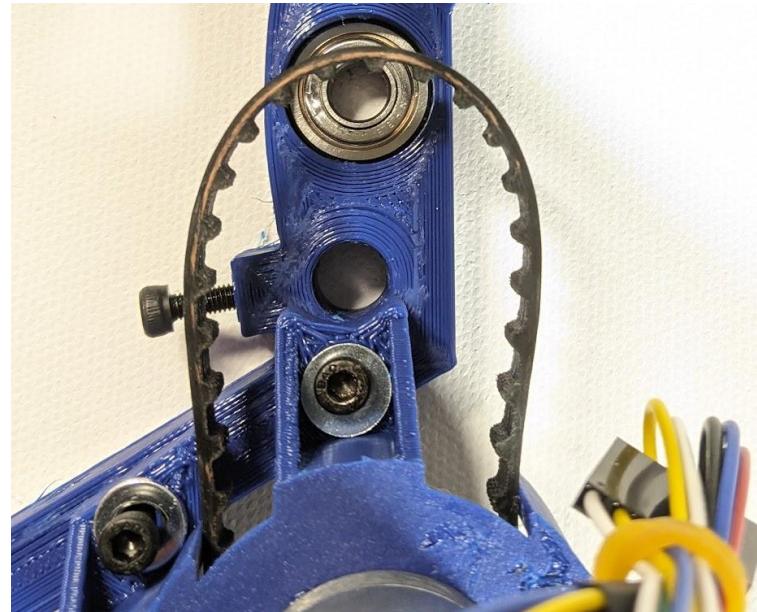
6. Install the 4mm pulley onto the lifter motor



7. Place the belt around the motor pulley



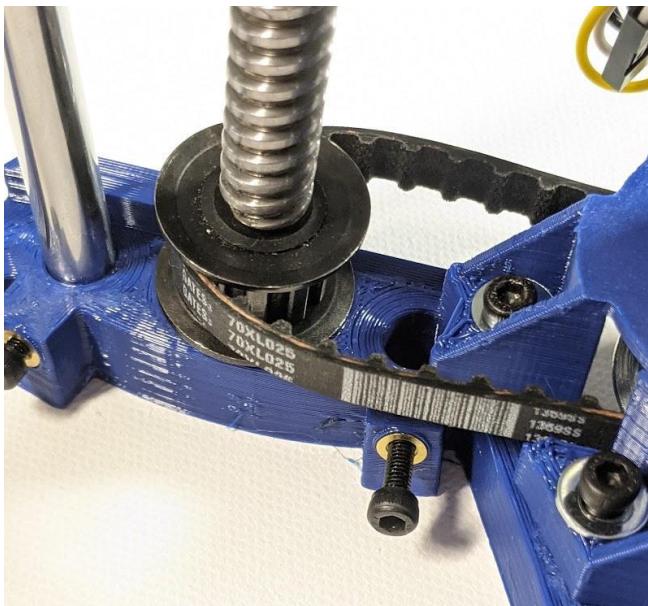
8. Install the lower bearing into the base plate
9. Bolt the motor mount down. Only loosely screw it down as you'll tighten it after you install everything else. I did use washers on these bolts.



10. Install the $\frac{1}{4}$ " pulley onto the lead screw

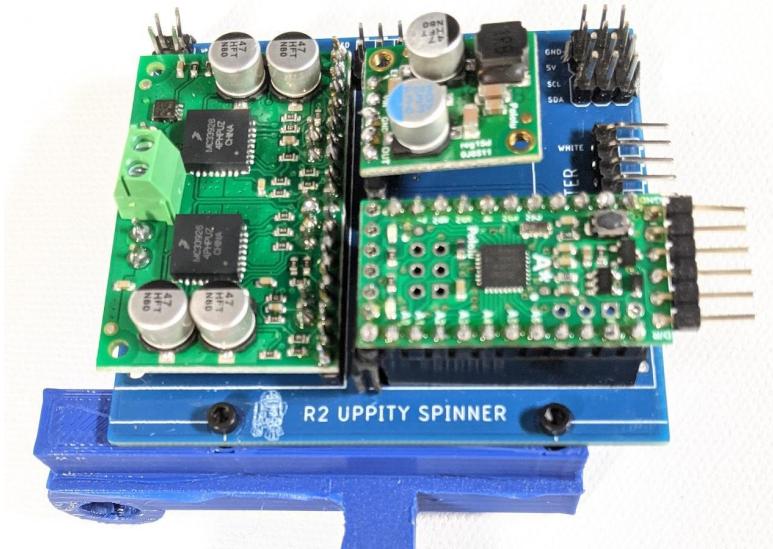


11. Place the lead screw into the lower bearing through the belt



12. If you waited to install the last riser until the motor was mounted, you can now install that and tighten the M3x7mm bolt to secure it.

13. Mount the Uppity Spinner to the electronics mount with the #2-56x1/2" bolts

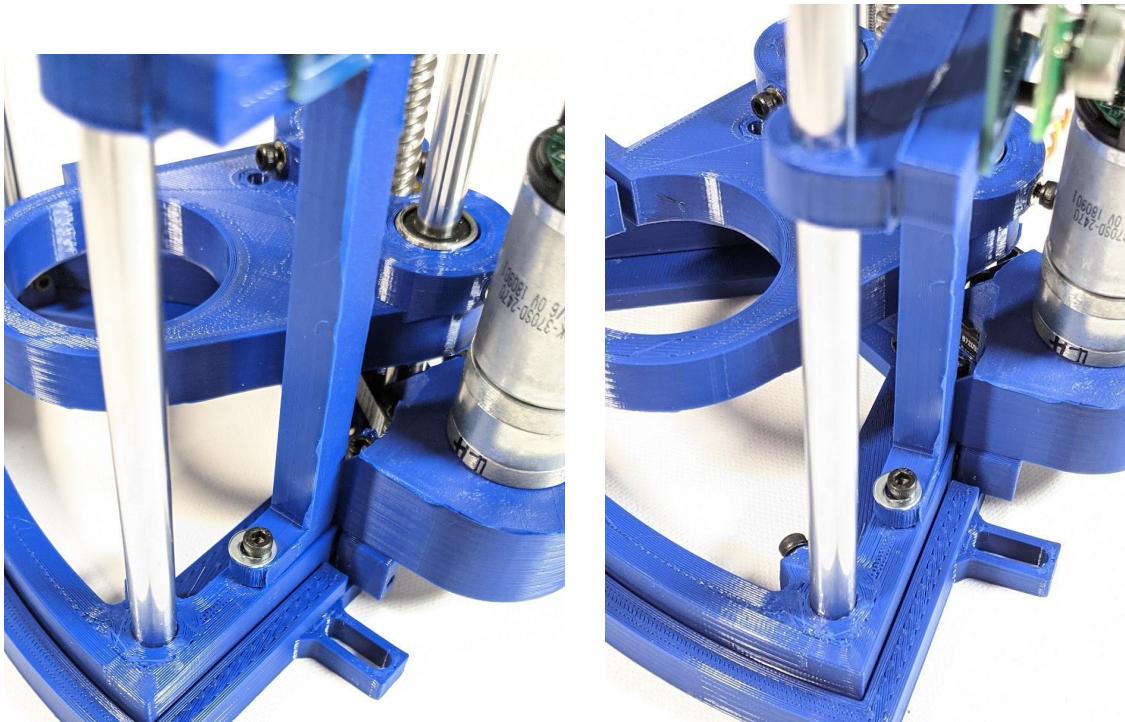


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14. Place the electronics mount onto the front post and secure it to the base with an M3x10mm bolt. I once again used a washer in this step.



15. Install the brass nut and inside nut onto the periscope holder and tighten it.



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16. Place the linear bearings onto the rear risers



17. Thread the lead screw through the periscope lifter's inside nut



18. Push the linear bearings into the periscope holder and secure them with the screws. This is a little tricky because you need to make sure they aren't pushing too hard in any one direction or the periscope will not go up and down easily. Take it slow.

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19. Place the upper bearing onto the lead screw

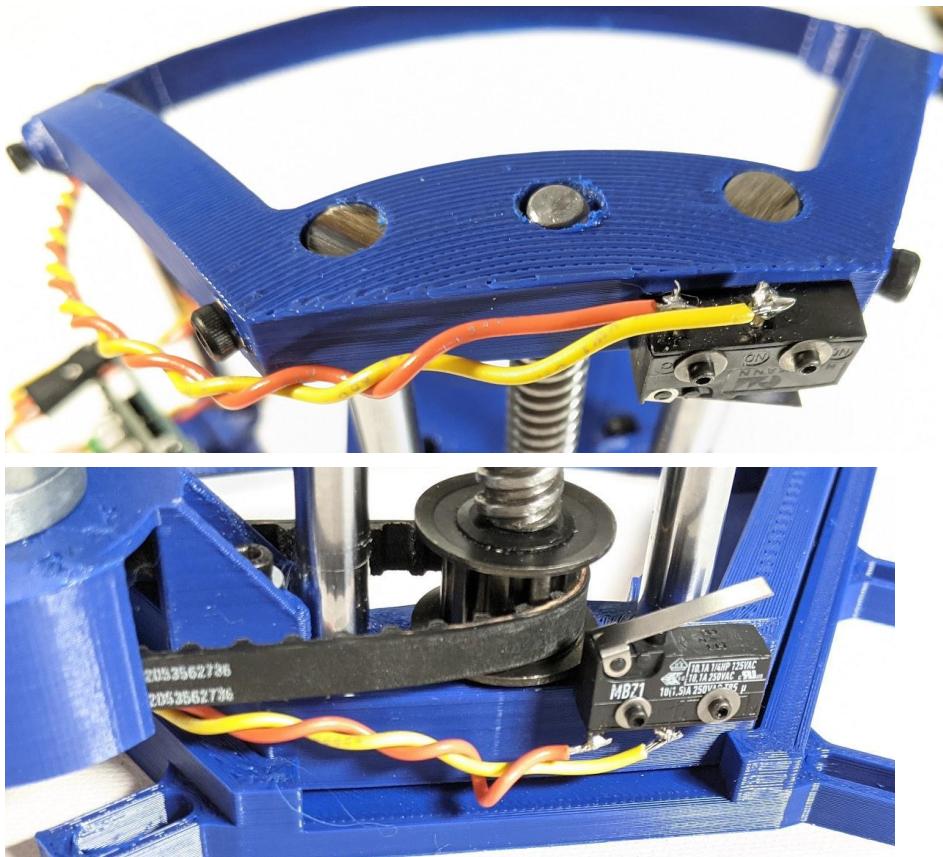


20. Place the top plate on the 4 risers and lead screw. When you do this, the lead screw should only move up and down a small amount. If you make this too tight, the lead screw will not turn freely and be difficult to turn.

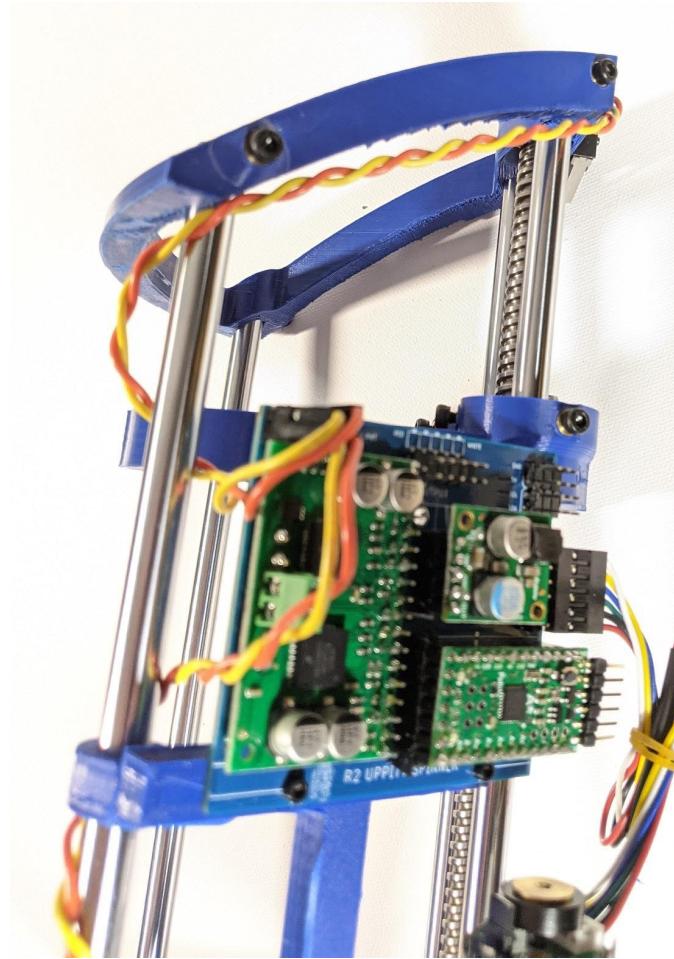
21. Install the 4 screws into the top plate to secure it to the risers

22. Install the limit switches on the base and top plates

23. Install the limit switch screws into the holes on the top and bottom of the periscope holder with the #0-80 $\frac{3}{8}$ " bolts (I have already soldered on the wires in these pictures, but you can easily wait until after to do this to ensure you have the correct length.



24. Solder on wires to the limit switches and connect them to the Uppity Spinner. I terminated my ends that go into the Uppity Spinner with some connectors. You could solder them on directly, but it would be more difficult to change/disassemble later.



25. Build Complete- for now. I'm still working on the rotary system.

Programming/Control

Please refer to the Uppity Spinner documentation for the details.

<https://github.com/reeltwo/R2UppitySpinner>

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