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Team F: ADD_IN

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ILR06

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I - Individual progress

My goals this week were to make the mount and assemble it along with the stepper motor and slip ring and to do some preliminary tests, and also to pick and order a second printer and redesign the heat block.

1.1 - Making the mount:

The preliminary design for the mount was done in fall, and as expected, at the beginning of spring the stepper motor and slip ring were both delivered, so I 3D printed the mount using the Makerbot printer. But this part took some iterations, namely 3 redesigns to get it right, because of 2 main reasons:

1 - The custom stepper motor dimensions were not true exactly true to the 3D model. So I had to take measurements and update the CAD drawing.

2 - While doing the first design I did not put enough thinking on how it will be printing, which is especially important when printing without support, the figure 1.1 highlights this.

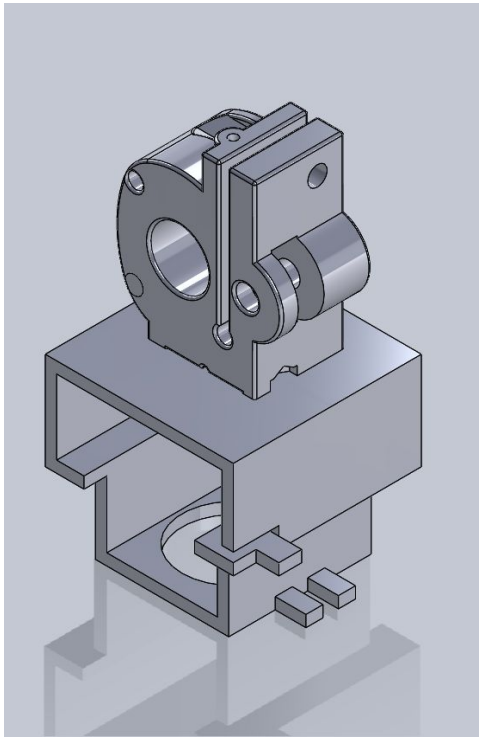
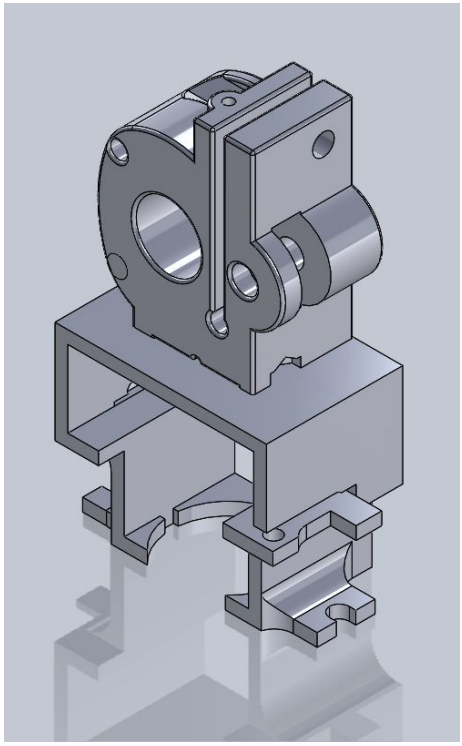


Figure 1.1 a) Mount Ver 1



b) Mount Ver 4

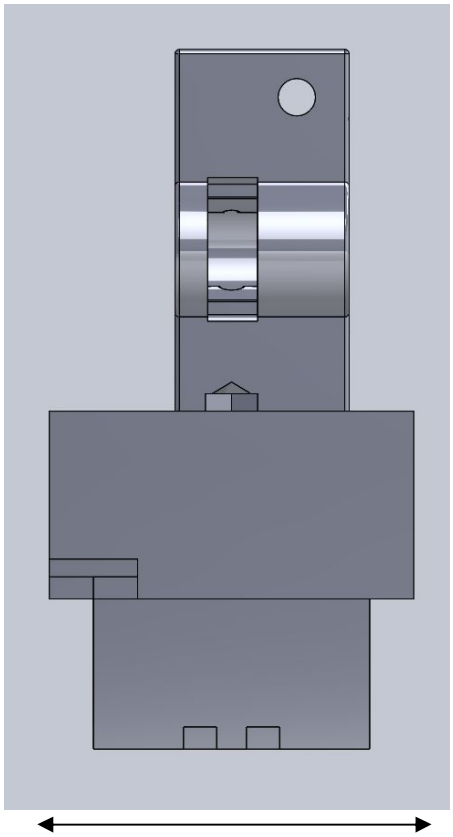
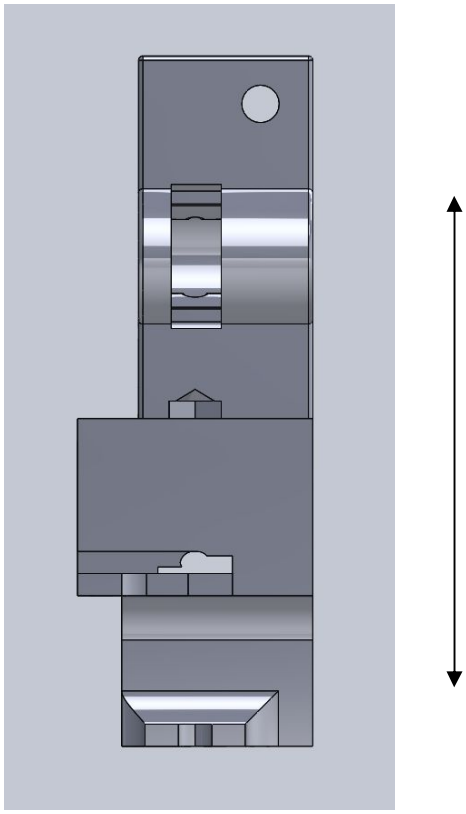


Figure 1.1 c) Mount Ver 1 side view



d) Mount Ver 4 side view

After printing the mount Ver 1 in a vertical position, the results were not good. (The double arrow is to highlight the print bed, i.e. the side on which the part is printed). So I decided to print the Mount Ver 4 on the side shown by figure 1.1 d. mostly to get a better finish on the upper part of the mount which is more crucial. But before doing that I had to redesign the mount to be flat on that side, and thus shift the mounting holes for the stepper motor. This along with other modifications, such as adding filets to remove straight angles, were mostly to improve the finish. And the final mount works fine.

After that I had to figure out a way to connect the motor and slip ring with the hot end. A coupler was considered, but it was preferred to have it in one straight piece in order to conserve concentricity as much as possible, and reduce offsets in the nozzle tip while rotating. So to do that we are going to machine a straight hollow tube that will go through both the stepper motor, the slip ring and the heat block. And a thicker tube will fix on the inside tube with a set screw, and have M6 threads to screw on directly in the heat block. Figure 1.2 shows a rendering of the assembly.

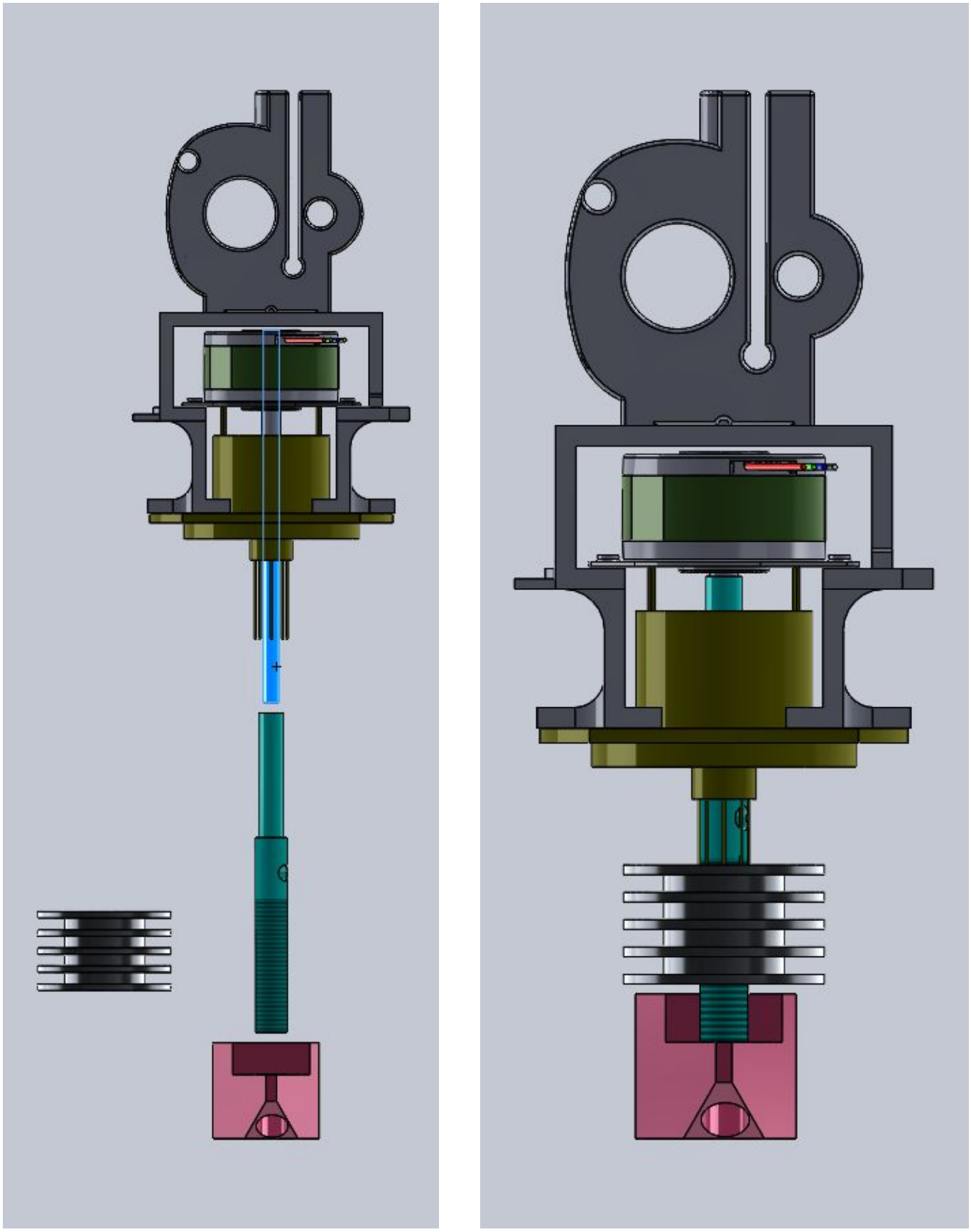


Figure 1.2 a) Rotary joint assembly, exploded view b) Rotary joint assembly

The inside tube is an off the shelf smoothbore seamless stainless steel tube, while the outside tube will be machined out of an M6 threaded rod.

Also, since there is no PTFE insulator, and we have an all metal hot end to preserve straightness(like most new generation hot ends). We have already ordered heat sink washers that will screw on the outer tube.

1.2 - Picking the printer

This part was fairly straightforward. I did some research on the state of the art of 3D printing, as we were considering getting a different, more recent printer. But Although there were many innovations since the 3D printer we are using came out in 2012, mostly by Makerbot (smart extruder), Ultimaker or BOXZY. But these have hot ends that are not suitable to be modified for rotation and obstacle avoidance, and the hardware and software were completely different. So after consideration I realized that our main objective was to speed up the process of testing our custom extruder under various parameters, and having a different printer, although it might have superior features, would add too much overhead to enable that, so we bought another Makergear M2.

II - Challenges

The challenges these past two weeks were to first, get a good and working part out of the Makerbot, since there are moving parts in the filament drive and the surface finish was not good, I had to do a lot of post printing fixes. For instance all holes had to be drilled out to the specified diameter, and filament threads removed, without damaging the part. The other challenge was coupling on the stepper motor shaft, which is smooth. Having a standard coupler such as the one in figure 2.1 is not ideal since those will add about 20mm to the lenght, and might reduce concentricity. So we decided to glue on the thinner tube to the inside of the hollow shaft (but we have a backup stepper). and fix the outer tube with a set screw.

Figure 2.1 Shaft coupler

III - Teamwork

During the past two weeks, Nikhil focused on getting the firmware ready, this part is mostly done although he ran into some hardware trouble, which is the fact that the E1 port on our current board that we are going to use to drive the rotary joint does not seem to work with microstepping. So during the following days we will try with the newer backup board and see if the problem still persists. Astha and Dan worked on building the software framework for

generating the 4 DOF G-code. Taking a more global and scalable approach and also started thinking about the web implementation of our software

IV - Future Plans

Our future plans are first to have both new nozzles manufactured, which will be undertaken by me and Dan, who does the machining. Nikhil will be completing the firmware modifications, and Astha and Dan will be making the software GUI. Once that is done we will start testing printing around a COTS item. And I will also set up the second printer and start doing test prints with our new nozzle while varying parameters such as angle of printing, nozzle tip aperture and material surface on which we will be printing. And we will also set up a formal testing process in the form of a spreadsheet to keep track of it and figure out the optimal parameters.