ILR08

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TEAM F: ADD_IN

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Individual Progress

In regards to hardware I have continued to work on the nozzle design I manufactured for the last progress review. One of the greatest difficulties has been producing a heater of sufficient electrical resistance. The nichrome wire I used to construct the heater is uninsulated and thus requires very careful placement on the nozzle tip so that the individual wraps of the coil do not short against each other. I originally calculated needed 12 inches of heater wire to produce a 50W 24V heater, but have found that inevitably some shorts will occur and thus I need closer to 18”. This results in needing multiple layers of heater coil, each which must be insulated with a layer of kapton tape. After numerous hours of carefully winding coils I have produced a nozzle with the correct resistance and successfully extruded filament through it. The completed nozzle is shown in Figure 1.

Figure 1: Custom nozzle and nozzle tip

Astha has taken the lead on software recently but we worked together to devise the collision checking algorithm. The collision check is a stretch goal which will be useful for printing parts which contain multiple or irregularly shaped COTS items. To implement the algorithm we use the .stl model of a COTS item and project it onto the plane of the print surface. We then use a convex hull to create a polygon defining the perimeter of the COTS item. Using a 2D projection of the extrusion nozzle profile we can then evaluate along each G-Code trajectory if the projection of the nozzle enters the projection of the .stl part. This enables us to flag any areas of a print which are not physically reachable due to nozzle and COTS item geometry.

The current collision checking algorithm projects the entire COTS item into 2D and thus is a conservative algorithm which in rare cases may warn of a collision when in fact one is not present. However, the algorithm is easily extensible to three dimensions and time permitting this will be performed.

Finally, I helped Nikhil to isolate the firmware bug which had been preventing control of the R axis. We used an oscilloscope to monitor the output pins of the AVR microcontroller and determined that the current reference was being improperly set. A quick review of this section of the code yielded the issue which was an array indexing error. This was the final major hurdle needed to be able to fully control our rotary joint. The fully assembled joint assembly with motor, slip ring, and extruder nozzle is shown in Figure 2.

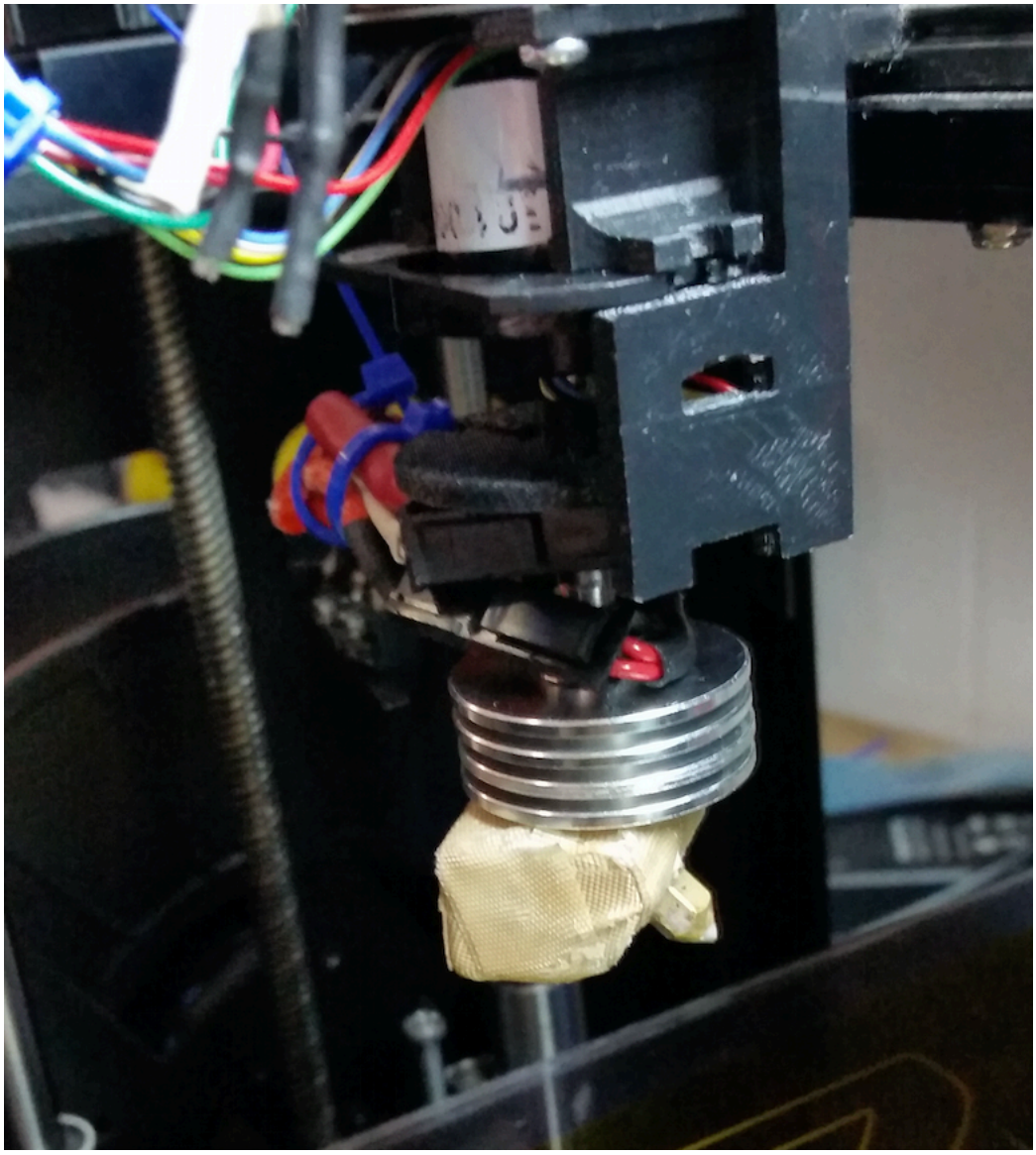

Figure 2: Fully assembled R-Axis joint

Challenges

The primary challenge we are currently facing is clogging of the 'barrel', which is the tube that carries unmolten filament into the heat block. Despite large heat sinks and forced convection, enough heat is travelling through the barrel that over time it heats up and filament becomes molten within the barrel. This molten filament then travels further up the tube until it cools and solidifies creating a blockage. To address this, we are aiming to add a PTFE insulator inside the barrel to prevent heat from melting upstream filament.

Teamwork

Nikhil Baheti: Has continued work on firmware. After resolving the bug which had him stuck last week he is now working on implementing the homing sequence for the R axis.

Ihsane Debbache: Is working on adjustments to the mounting of the homing switch for the R axis. He is using an optointerrupter with a slotted wheel mounted below the slip ring. He will also be performing the homing repeatability test which will require development of a small custom test firmware.

Astha Prasad: Is continuing work on software development. In addition to collision checking she has worked on solving minor bugs (i.e. checkboxes not selecting) in the GUI and will now be transitioning to researching web development.

Future Plans

Our primary goal remains to get the printer fully functional so that we can enter a testing phase. At a bare minimum, to reach this goal we need to solve the extruder jamming issue. Ideally we would also have implemented the R axis homing switch since it will help with repeatability. Both of these goals should be easily achievable within the next two weeks.

In order to accelerate testing we are also hoping to also have our second printer set up nearly identically to the first. To do this we need to construct the mounting hardware for the second printer, which due to the printer's design revision will be slightly different. This should also be very doable within the next two weeks.