Individual Lab Report 7

Nathaniel Chapman

Team B: Space Jockey
with Brian Boyle, Ardya Dipta Nandaviri, Songjie Zhong
February 14th, 2014

1 Introduction

This work has been primarily focused on mechanical design and fabrication, with prototyping work ongoing on the main chassis components, as well as alternative adhesive foot designs. In addition, I finalized and sent off our new Power Distribution board for printing, and ordered all the parts necessary to fabricate that component.

2 Individual Progress

This week, most of my efforts were spent working on the Chassis redesign and fabrication. I began by working on the linear actuator component. This redesign is intended to be much smaller, and fully 3D printed, in practice, I was able to shrink the linear actuator down to roughly one half of it's former size, with coreesponding savings on the weight of the ABS chassis components. Currently, this part is in a 'sharpie prototype' stage, which means it is working as intended, but has many adjustments (indicated in sharpie in figure 1) that need to be made before it's ready for total system integration.

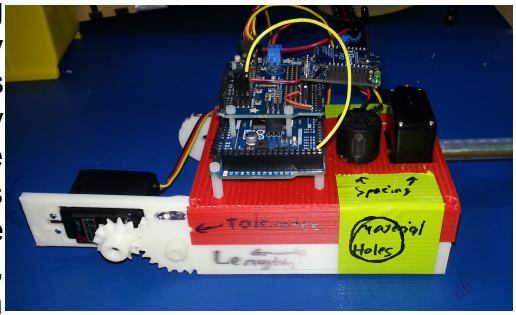

Figure 1: New Linear Actuator component, showing revision marks and rotary joint test.

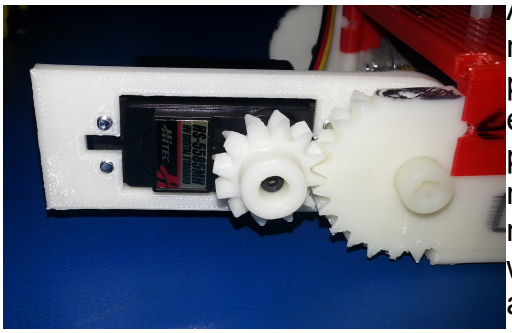
Figure 2: Detail of geared rotary joint design, showing a 1:2 joint ratio.

As part of this development effort, I also tested the new, 3d-printed V-gear rotary joint design. I had printed several test gears in the past, but after some experimentation, I figured out a standard pitch profile that worked well, and built a parametric gear model, that allows me to easily tailor the gear ratios needed for each joint. In practice, this worked out well, as the joint actuation was smooth, quite rigid, and had no noticeable gear lash due to my carefully designed curved gear tooth profile. A detail of the rotary joint design can be seen in figure 2.

For one final piece of fabrication, I began work on one of our new adhesive foot prototypes. The design for this prototype is that it has an adhesive-covered flexible band to adhere to the surface, but can be removed by levering the whole foot around one of it's end joints. I have designed and printed the flexible track component, which is ready to have the vytaflex material cast on its underside and be tested early next week. It can be seen in figure 3.

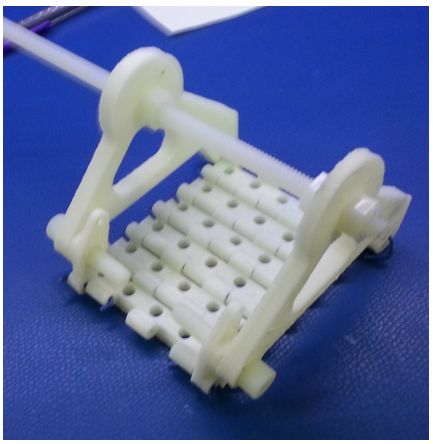

Figure 3: Adhesive foot prototype, showing flexible surface and A-frame support structure.

Finally, my last main task this week was to finish the power distribution board redesign, and send it off for fabrication. After the redesign, it is only 2” by 2.5” as opposed to the old board which was much larger. Alex from Team and I were able to panelize our boards together, and send them off for fabrication, the BOM has been ordered, and we should be able to begin assembly as soon as all the parts are delivered.

3 Challenges / Issues

The biggest issue I encountered this week was the challenge of 3D printing the larger chassis components successfully. During the printing process, I encountered a recurring issue where the cooling ABS would peel off of the build plate, and create warped pieces whose tolerances were too badly skewed to connect with other chassis components as intended.

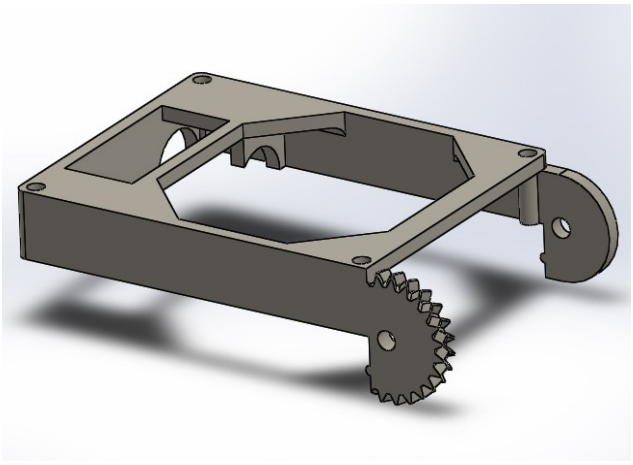

Figure 4: Redesigned Linear Actuator housing, showing octagonal strain relief cut.

Fixing this issue proved to be a challenging task. The Solidoodle was actually capable of printing more level prints, however its lower print quality and layer separation issues resulted in generally inferior parts. Part of the solution I found was to raise the makerbot's bed temperature up to around 135° C and lower the extruder temperature somewhat. However, most of the detachment came from the shrinking of the large flat surfaces in the chassis component being printed. To combat this, I added strain relief holes just inside the four corners of the printed part, this decreased the peeling forces due to thermal contraction at any point on the bed, and yielded a usable print. For future development, I will take this feature to the extreme, using as few large flat surfaces as possible, which will solve the shrinkage issue, as well as save on printing time and material. The current

working version of this part is shown in Figure 4, showing the large, strain relief octagonal cut in the bottom surface.

4 Efforts By Team Members

In the last two weeks, Songjie and Dipta have been focused on getting our robot's localization working with April Tags and ROS, so far, they have been able to receive images from our wireless camera, and process some images to derive the April tag's location, however, they have yet to get those pieces working together, and pipelined into ROS, so we can include them in the robot's localization routine, They will continue to work on this for the next project review.

Brian has been working on getting the Arduino code debugged, and adding more debugging features into the GUI. As well as designing a separate adhesive foot design in parallel to mine in hopes of getting a working prototype very soon.

5 Future Plans

For the next progress review, we would like to be able to repeat our fall validation experiment (horizontal walking) from last semester with the new chassis design. We also plan to have our attachment mechanism working. Towards that end, we will be testing our adhesive prototypes early next week, and if they do not yield the results we desire, we will be scrapping them, and developing a magnetic solution as soon as possible. Alongside that, we intend to have our April tag pipeline working, (with localization in ROS), and to continue our software debugging efforts.