Individual Lab Report
Weekly Progress

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Team B: Team Space Jockey
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ILR07
February 14th, 2014

1. Individual Progress

While software was the lowest priority over this period, modest progress was made in the form of adding debugging functionality into the Arduino-side code. Rather than using serial print statements any debug information can now be published to a ros topic which the operator can monitor directly. While this doesn't resolve our currency bug with power outage in the rover, but provides a tool which help us uncover the root of the issue.

I played primarily a support role in the mechanical development of the new chassis and attachment mechanism. I was able to impart much of the wisdom and intuition I've gained in 3D printing to guide Nathaniel in converting our MDF chassis into an ABS one. Since it was anticipated that some segments would be composed of multiple pieces, I experimented (See Figure 1) with methods of printing assemblies that could be press-fit reliably and gained insight into the tolerances necessary to make those work. Additionally, after initial experiments with stretchable bands for attachment tread, I moved to experiment with using tank-like treads composed of interlocking segments. This was prompted both by the difficulty of reliably printing the stretchable bands as well as their weakness and tendency to break.

Finally, I also designed and printed precursor assemblies for one of our attachment mechanism prospects. The proof of device I produced is composed of a cam with two followers which can use tension or pressure to move a length of treads into a straight or v-shaped configuration. This device, further developed, may be useful for attaching and detaching the center segment, since the end segments are more easily detached and attached with existing actuated degrees of freedom.

2. Challenges/Issues

At least three members of the team transitioned to roles they hadn't yet filled before, which presented challenges both in familiarizing with the existing progress and taking steps forward. While this slowed development in the short run, I feel it will have returns in the future. In both the mechanical structure and software architecture, we'll soon have much more comprehensive cross-competency which should make it easier to team up on particular aspects as necessary or fill in for members who fall ill or have lapses in their availability.

A major challenge was establishing and holding to a pipeline for development of the new chassis. Given the many interdependencies within the chassis design and between each segment, and the inability to version-control Solidworks models, it was nearly

impossible to split up development of the new chassis. The plan at the onset was for Nathaniel to redesign the chassis and then pass the designs off to me to manufacture and refine the tolerances. The line between redesign and tweaking for 3D printing was blurrier than we expected, however, and we were unable to really put this pipeline into motion as quickly as intended.

As a result of these interdependencies, I was able to recognize a need for greater coordination amongst the team in the coming weeks. As a result, I've set up and have been leading twice-weekly team meetings that I feel have so far been successful at pushing our productivity and coordination along, but I'm still getting a sense for dividing our goals out into springs between each of these meetings.

Finally, a host of challenges arose as we turned to 3D printing as our primary manufacturing medium. In printing large pieces we frequently were met with flaws in printing, such as peeling at the edges, that required new approaches. Among the approaches that showed promise were placing round disks near the edges of large shapes, such that the rafting was extended far enough that any peeling didn't reach the piece we were building, and cutting holes or gaps near the edges of large pieces so that the tensions caused by cooling were smaller and distributed evenly. For smaller pieces, precision is limited, and so our designs had to be built around a minimum granularity. All of this is complicated by the fact that various hardware must be placed inside these chassis pieces, so the manner of assembly is a pressing concern.

3. Team Work

Dipta and Songjie worked together to make April Tag recognition happen. Dipta focused mainly on familiarizing with and later reverse engineering existing tutorial code, while Songjie focused on learning the basics of C++ based ros nodes. The ultimate goal will be to join these two strains of research together so that the code may be integrated into a ROS node that will communicate with our existing architecture. I was able to assist Songjie by explaining the basics of ROS's messaging structure and directing him to the most useful tutorials that I had identified when I was learning the basics myself. My capacity to help with C++ nodes was somewhat limited, however, because I have only worked in Python-based nodes so far. As his expertise improves, I hope we can share knowledge so that we both have a strong understanding of the entire final architecture.

Nate was responsible for the fabrication and BOM for our new power distribution board, and beyond that was a powerhouse in mechanical design. He took lead in developing the new chassis, as well as an attachment mechanism for the outer segments of the robot. While he was unavailable to integrate debugging into his Arduino code, he was able to explain the existing codebase to me such that I was able to do so myself, and as I result I feel much more confident modifying that code in the future.

4. Future Work

For the next progress review, our highest priority remains the development of a stable attachment mechanism. Within the next few days we'll make a decision on whether to continue with dry adhesive or switch to a magnetic solution. I will try to flesh out the cam-based design I worked on this cycle and test it. These new feet will likely require new molding techniques, which I plan to experiment with given my success with the molding first round of foot concepts.

Now that we can debug the Arduino-side code, I also plan to work with Nate to finally debug our power brownout issue. This will be conditional on assembly of the new prototype, as our current prototype is now partially dismantled as we move electronics and other hardware to the new chassis as it is built.

As for that new chassis, as Nate finalizes the center segment and moves on to the ends, I'll set to work refining the printing method for it so that the pieces mate correctly and the tolerances are as tight as possible while allowing for integration of hardware.

5. Figures

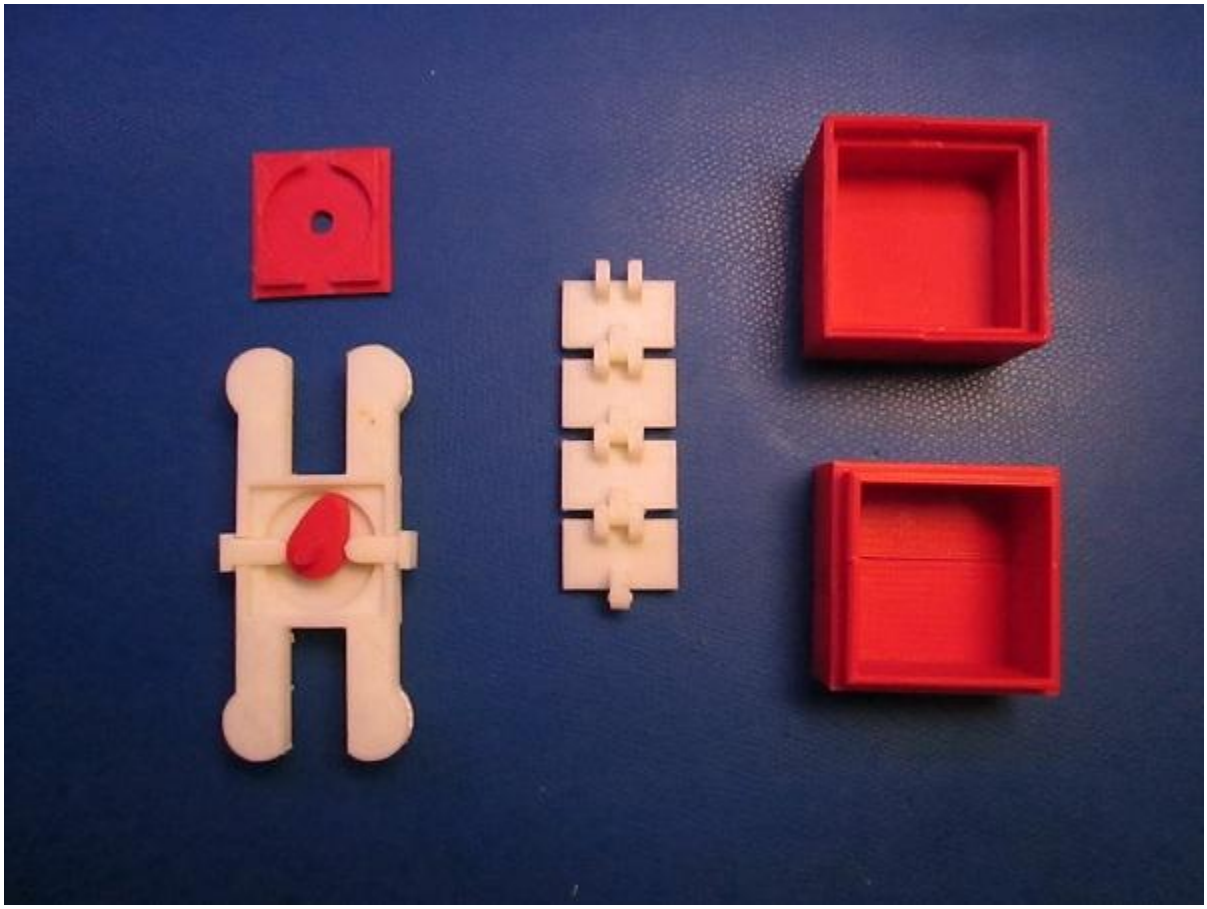

***Figure 1**: Left to right: Prototype cam-based foot, a row of four snap-fit tread segments, two halves of a four-piece box that press-fit very rigidly*