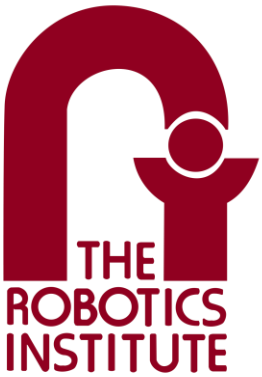

Carnegie Mellon University

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Team C: Lunar-X

16-681 ILR02

Teammates:

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Submission Date: Feb. 16th, 2023

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1. Individual Progress

Since the previous progress review, I have been working on project management and fabrication of the drum for the excavation robot.

1.1 Project Management

I brought the team onboard with using JIRA and updating their tasks on the Kanban board. By utilizing JIRA's Kanban board feature, the team can visually see and track the progress of individual tasks as they move through different stages of development, from 'To-Do' to 'In Progress' and 'Done'. This provides the team with a clear overview of the project's progress, and it helps the team members to understand how their tasks fit into the overall project timeline. JIRA and its Kanban board to the team can help to streamline the project management process, improve communication, and ensure that everyone is on the same page regarding the project's status and progress.

We made a compelling submission to the Project Management team presentation where we talked about adopting a blend of traditional and agile project management methodologies, our work styles and how we handle our stand-up meetings.

1.2 Fabrication

This week, I helped fabricate the beta prototype of the bucket drum to be used in our robot for the Spring Validation Demonstration. This follows the weeks of iterations of our alpha prototypes where my 3D printed several designs, tested it on the Moonyard in the Planetary Robotics Lab and evaluated its results. After achieving the maximum efficiency of 50% as reported by NASA, we decided to go with the circular drum design with elliptical protrusion and 500 degrees of rotation.

The fabrication plan and Solidworks models were prepared by Hari and we got it reviewed by Tim Angert from the Field Robotics Center. This involved some design iterations and we converged to the plan of rolling stainless steel sheets to form the body and flat aluminum disks to form the sides. These were to be joined by pop riveting them supported by clamps. Hari and I looked up the various clamp models suggested by Tim and went ahead with the 330 since it was symmetrical and offered sufficient spacing for the rivet gun and the drum structure.

Fig 1: Main body of the fabricated bucket drum

We started by cutting rectangular strips of stainless steel and the aluminum disk of the required shape by the sheet metal cutter. We learned about operating the CNC cutter and choosing appropriate drill bits and settings. We then filed the edges and drilled through the holes to achieve a hole of diameter 0.1253 inch, so that rivets of 0.125 inch diameter could fit in. This was followed by marking the orientations of clamps in each hole of the disk and the pop riveting them through. In some holes, the clamps were supposed to be riveted on both sides and these were slightly more challenging to do. We then passed the stainless-steel sheet through the rolling machine to achieve the required diameter approximately. This is so that orienting the sheet holes with the disk-clamp holes becomes easier.

Next, we pop riveted the sheet, starting from the inner edge. This was the most challenging, yet fun task of the job. The inner edge required carefully orienting the clamp holes, using temporary clamps and spanners, and tactfully inserting the rivet guns along the hole orientation. It involved a lot of precision and force, and as we moved towards the middle of the sheet, it was super easy. The last two holes on the outer edge were also particularly challenging because the curvature of the sheet on the ends was slightly off and a lot of force had to be applied to orient it correctly.

Fig 2: The inside of the drum

The two drums in the middle took us 2 hours each to fabricate and clamp, while the outer ones took just 15 minutes each. This shows the dexterity involved with clamping and riveting a drum on both sides. We had anticipated some angle error in the planar orientation of the end plates. But we were surprised to know that we achieved an error of 0 degrees (the resolution of measurement was 1 degree).

2.0 Challenges

The fabrication of the drum involved several challenges.

- It was difficult to keep up with the design plan since it is difficult to imagine the way of inserting the rivet gun and orienting it along the clamp hole.

- Since the drum design had variable radius of curvature while the rolled sheet had nearly the same radius of curvature, there were several places where aligning consecutive holes along clamps was difficult.
- Applying a lot of force to align holes introduced the risk of damaging the parts
- Minor mistakes in the alignment during riveting would cause the rivet to be done wrongly and be drilled out

3.0 Teamwork

We did our best to distribute work evenly among team members, both for the lab and for the Lunar-X project. Contributions for each team member (other than myself) are listed below:

Hariharan Ravichandran
Hari and I worked together on fabricating the bucket drum. He also made the design and fabrication plan for the drum.

Dhruv Tyagi
Dhruv planned the sensor configuration and simulated the views of the Intel RealSense cameras on Gazebo.

Vivek Chervi
Vivek has made the first version of electronics architecture and is preparing a detailed version of it.

Vibhakar Mohta
Vibhakar worked on setting up the ROS modules for IMU and Intel RealSense cameras and receiving data stream from them.

4.0 Plans

Before the next progress review, I plan to develop a 3D reconstruction and segmentation algorithm for the berm.