Individual Lab Report - ILR03

Lunar ROADSTER

Team I

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1 Individual Progress

In this phase of the project (from PR1 to PR2), I have primarily worked on getting the Dozer Assembly up and running, along with other auxiliary tasks.

1.1 Dozer Assembly Manufacturing

The CAD of the new dozer assembly was finalized in the previous stint. I shared my design and manufacturing plans with Tim to gather his insights and implemented last-minute changes needed for quick prototyping. I led the entire manufacturing phase of the assembly, with Ankit assisting me throughout. The various components were manufactured as follows:

- **Dozer Blade**: As discussed in the previous ILR, an aluminum sheet was chosen as the material and was shear-cut in the FRC workshop. It was bent to the desired curvature using a roller bending machine.
- **Dozer Arm**: As discussed in the previous ILR, the .dxf file of the dozer arms was used for CNC routing. The holes for the pivot point and the cross-members were also included in the .dxf to increase precision. The remaining holes for the yoke mounts and the blade mounts were manually made using a vertical drill (See Figure 1).
- **Yoke**: An aluminum square tube of cross-section 20x20mm was used as the yoke that connects both the arms to the linear actuator. All the holes for mounting on this yoke were made during a vertical drill(See Figure 2). Additionally, a cross-member for added stiffness was made using a hollow cylindrical Al rod, which was tapped on both sides and fixed at one of the mounting points on the arms.
- **Mounts**: Standard off-the-shelf L-brackets of different sizes were used to make the mounts for the dozer blade and the yoke.

Ankit and I assembled the entire structure. I ordered sleeve bearings and shoulder bolts of appropriate sizes for the pivot, allowing the arms to be mounted to the chassis with the required pivot configuration. The remaining components were secured using standard fasteners to complete the assembly. The final assembly is shown in Figure 3.

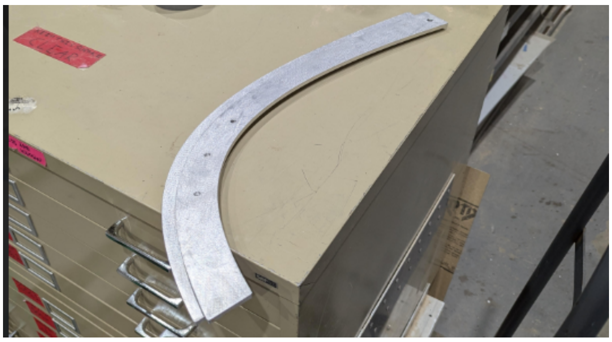

Figure 1: Dozer Arms (CNC Routed)

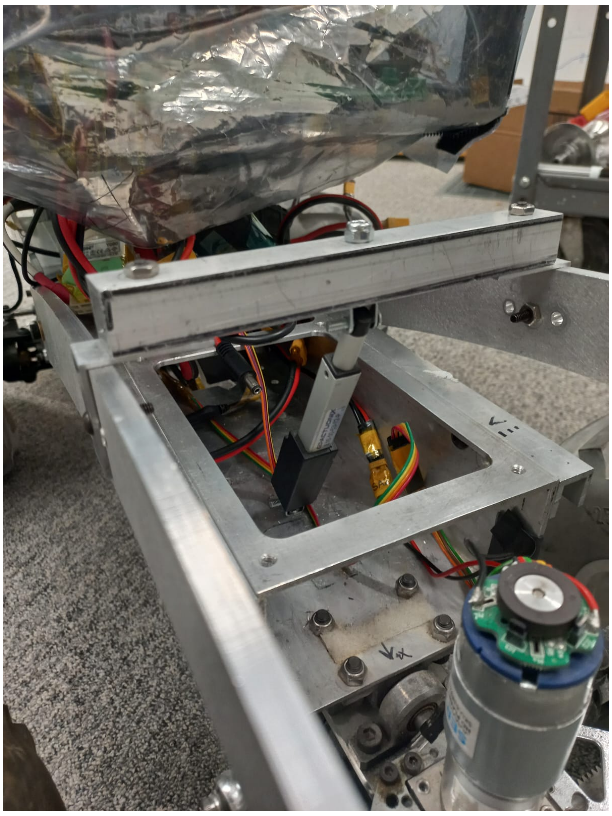

Figure 2: Yoke to connect Dozer Arms with the linear actuator

Figure 3: Dozer Assembly mounted on the rover

1.2 Linear Actuator

After procuring multiple linear actuators of different specifications, I started testing these with the new dozer assembly. I assembled the actuators one by one using their compatible fasteners and mounts on the chassis. The actuated end of the actuator was connected to the yoke in the center (Figure 2). I connected the Linear Actuator Controller (Figure 4) with the actuator(also Figure 4) and the Arduino Due to control the actuator. For testing, a simple PWM HIGH(255) and PWM LOW(0) signal was sent, and the full range of the actuator, along with the lifting capacity, was tested.

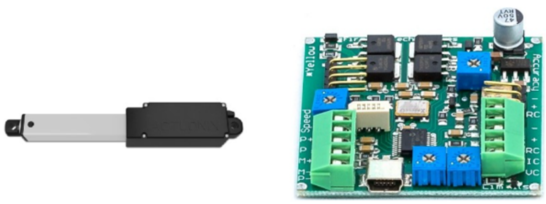

Figure 4: Linear Actuator and Linear Actuator Controller

1.3 PCB Assignment: Conceptual Design

I also completed the team task of conceptually drafting out the requirements of the PDB. I started by defining the power sources and their specs. Next, I listed all the components that will directly draw power from the PDB and used their respective datasheets to determine the operating ranges and peak values of current and voltage that the components will require. The over-current/over-voltage protection methodologies were also defined. This will help the team in developing a schematic and, subsequently, a PDB.

2 Challenges

One of the key challenges that I faced was the availability and access to the FRC workshop. The manufacturing phase of the dozer assembly heavily depended on securing active working time in the FRC workshop. We struggled to coordinate with Tim to access the workshop while he was present, as it was closed at other times. This induced an unforeseen delay in meeting our hardware deadline and pushed us back by a few days. However, we later scheduled specific time slots with Tim for his guidance on fabricating certain components. Ankit and I worked tirelessly to complete the manufacturing and assembly as quickly as possible, finishing the entire assembly in just two days to prevent further delays.

Secondly, I faced some issues with testing the linear actuator. The actuator I initially selected lacked the power to lift the assembly off the ground. This was due to the assembly being significantly heavier than expected, as thicker raw materials were used for the yoke, arms, and cross-member. To address this, I tested an actuator with a higher gear ratio. This improved the lifting mechanism, allowing us to successfully test its functionality. We are still iterating on the type of actuator we want to use, and it will be finalized by the next PR.

Finally, one challenge I faced while working on the conceptual design of the PDB was understanding the existing platform. Since we inherited the rover from the previous MRSD team (CraterGrader), we aimed to develop a PDB compatible with their system, including motors and controllers. However, understanding their existing electronics, circuitry, and design logic for the PDB was challenging due to minimal documentation. I drafted the conceptual design using online resources on the components and electronics.

3 Teamwork

The team completed many individual and collaborative tasks this week, which are listed here:

- **Ankit**: Ankit and I collaborated while manufacturing the dozer blade assembly. We also collaborated on implementing the lifting mechanism with the linear actuator and shortlisting different actuators for subsequent testing. He also worked on updating the wheel design, helping Simson with creating an occupancy grid of the map, and creating a schematic of the PDB with Bhaswanth
- **Bhaswanth**: Bhaswanth collaborated with Ankit and me to implement the actuation of the dozer lifting mechanism. He also collaborated with William to finalize the localization stack and worked with Ankit in developing the schematic of the PDB. He was also involved in assisting Simson to map the Moon Yard using the FARO Scanner.
- **Simson**: Simson led the mapping of the Moon Yard using FARO Scanner, collaborating with Bhaswanth. He also worked with Ankit to tune parameters for the algorithm that creates and occupancy grid map using the map generated using the scans.
- **William**: He worked with Bhaswanth to finalize and conduct preliminary testing of the localization stack. Their work is also related to Simson's work on the map, as the map will serve as the global map frame for localization.

4 Plans

Moving forward, I will be responsible for developing the tool planner. This includes devising an optimal methodology for cutting and filling sand, determining when to lift the dozer blade, and identifying where grading should occur. I will collaborate with Ankit on this task and utilize inputs from the navigation stack, which Simson and Bhaswanth are developing. Additionally, I will integrate the tool with the teleop stack to enable joystick control of the dozer. Further refinements to the dozer assembly will be carried out in parallel based on testing and feedback from our sponsor.

I will also be responsible for documenting and collecting conclusive data from the upcoming tests.