ILR04 - Progress Review 3

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Team G: The Pit Crew

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1 Individual Progress

Since the last progress review, my primary task has been the assembly of Blue 2, our surrogate rover for future testing. With the help of my team members, I assembled four gearboxes, attached motors and wheels, and mounted each motor assembly to the aluminum plates that form the chassis of Blue 2. I wired the motors to their motor controller boards and to a voltage regulator, and those components were also mounted to the chassis. I also assembled the pan/tilt turret onto which the RealSense camera will be mounted, as seen in Figure 1, and acquired a motor controller board with which to drive that turret's motors. The next step will be to connect all the powered components to the battery, and connect all the motor controller boards to the USB hub so that they can communicate with the TX2 computer.

I have also continued to act as the project manager for Team G. When we learned that campus was being closed, we decided that we would hold daily stand-up meetings at 9:30 AM every morning. I have been leading those meetings, and I have been maintaining a Trello board with deliverables and tasks, which I update based on the topics discussed in the morning meetings. I feel that this routine necessitates a level of commitment and awareness that keeps us on track with the project despite the extra challenges imposed by working from home. As project manager, I am also responsible for delegating certain tasks based on availability and expertise, and checking in with my teammates to ensure that progress is being made and issues are being addressed as they arise, sometimes on timelines that even daily meetings cannot support.

Figure 1: The PhantomX Pan/Tilt Turret, which will support the RealSense camera.

2 Challenges

Since the last ILR, there has been one challenge common to all the MRSD projects which overshadows all others. There has already been quite a bit of discussion about the effect of the COVID-19 pandemic on these projects, and Team G has already presented our adjusted plans for the future. The most immediate effect of the pandemic was that we had to move all our supplies out of the MRSD lab and into our respective apartments. This caused some difficulty at first since each team member had a different set of parts, not all of which related to their specific area of focus. However, we have now reached a point where each of us has the components that we need most urgently in order to make progress.

Losing access to the lab also meant that certain components I expected to be able to use in the assembly of Blue 2 were no longer available. This forced us to push back the timeline for completing Blue 2 for testing while we ordered additional components. I was able to consult with Jordan Ford, who assembled Blue 1, and determine

which additional items were needed, and all orders for those items were placed last week. The last shipment of necessary components was delivered on Monday, 3/30. I intend for Blue to be 100% mechanically complete by the end of day on 4/1.

From there, we will need to ensure that the TX2 computer properly interfaces with all the components, and that the motor PIDs are tuned appropriately so that the rover can be controlled effectively. Luckily there is a program designed to tune the motors quickly, and therefore this process should not be laborious.

3 Teamwork

The pandemic has made it all the more important for us to develop a robust simulation component to our project. I am grateful to Alex for the progress he has made in this endeavor. He has continued to improve the WeBots simulation environment so that we can simulate the conditions of a lunar pit as accurately as possible. This will allow us to test the robot's navigation capabilities in a way that provides valuable and meaningful data.

Awadhut has continued to lead development on the stereo imaging and edge detection software. He has improved the performance and robustness of the stereo depth reconstruction since the previous ILR, and he has completed the integration of that depth reconstruction into the brinkmanship pipeline. He has also worked on setting up the TX2 that we requisitioned from the MRSD inventory, which turned out to be a non-trivial task that required the use of a second computer.

I also want to acknowledge Awadhut's contribution as our budget manager and inventory manager. He has been the one to communicate with Christine Downey about ordering various components, and has been prompt and efficient about that process in every case.

In addition to their individual contributions, both Alex and Awadhut helped me to build Blue 2. They both assisted in the assembly of the gearboxes and the wiring and mounting of components on the chassis. Alex also 3D-printed a mount for the RealSense camera in order to attach it to the pan/tilt turret.

4 Plans

Currently, we still intend to perform a field test of our brinkmanship pipeline on April 3. We fill confident in proceeding with this test despite the quarantine conditions because none of us have shown any signs of illness and our test site, Gascola, is remote and mostly unoccupied.

Ahead of this deadline, we plan to have Blue 2 fully assembled and to have performed tests of basic software functionality such as teleoperation and edge detection. These initial tests will most likely be performed at my apartment, since Blue 2 is being kept there. It is vital that we verify these functions ahead of the field test, so that our time and effort is not in vain. However, because Blue 2 is still not fully assembled, this will be a tight schedule to keep. We will need to have every component and function ready to be tested as soon as the rover is operational.

Once we have confirmed these functions, we will take Blue 2 to Gascola, where we have identified a small cliff edge that will be perfect for testing brinkmanship. Red Whittaker will assist us by providing tools with which to clear brush along this cliff top, in order to create a clear and traversable testing environment. We will place the rover at the top of this cliff and drive it towards the edge. The brinkmanship software will identify the cliff edge from the RealSense stereo point cloud, and stop the rover before it drives over the cliff. We will secure Blue 2 with a rope in order to ensure that it is not damaged if the brinkmanship software fails to operate properly.

This field test is our primary goal in the coming week, and therefore most of our effort will be dedicated to that. After that, however, we will have other tasks to pursue in order to be able to present our planned demonstrations at the end of the semester. We will continue with the development of the WeBots simulation, and we intend to have an simulation in which a rover model can traverse a lunar environment very soon. We will

also work on developing more complex robot behaviors in response to the output from the brinkmanship routine, beyond merely stopping locomotion. Lastly, we will more fully integrate the pan/tilt turret into the rover so that it can be driven to specified angles in order to automatically generate image panoramas.