Carnegie Mellon University

16-682

MRSD Project II

Individual Lab Report 10
Team C - COBORG

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Sponsor:
Biorobotics Lab

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1. Individual Progress

For this time period, I worked heavily on assembling the Coborg V2 frame, placing all the components, and wiring up the new hardware framework. This took a significant amount of time and planning, and it required many back to back days to complete. To ensure all the components fit, I first mocked up the layout of the components, then measured out how much wiring I would need. I first mounted the Jetson Xavier using the 3D printed nylon bracket, then I connected the power PCB board created in the first semester. After those components were installed, I mounted all the 3D printed brackets on the rear of the COBORG which hold the USB, ethernet, and power connectors for the COBORG backpack. Sliding all the connectors in place, I then was able to see how to best route them around the Jetson Xavier. The next component to be installed was the ethernet switch which connects the computer to the robot arm. After everything was installed, I painstakingly routing all the cabling with exact length to the components In *Figure 1* and *Figure 2* we see the before and after of the updated wiring*:*

Figure 1. Before Wiring COBORG

Figure 2. After Wiring COBORG

I was also able to complete a full state manager (main.py) for our project, which monitors the state of the COBORG system, and activates the estop relay through a voice command. This command toggles a GPIO pin on the Jetson Xavier, which in turn disconnects power through the relay for the robot arm.

2. Challenges

A personal challenge I faced was that I had to finish the majority of the hardware assembly in less than a week. That required full commitment, with 10-12 hours spent daily to complete the work. The original goal was to have it completed by PR 10 on Wednesday, however I finished on the following Monday. Our team so far hasn't had as much time as we'd like to integrate and test, so we are trying our best to validate the use case by FVD. One issue that I found was that when the estop is activated on battery power, killing the robot arm, when releasing the estop the amount of current that the robot arm draws drains the supply for the Jetson Xavier, causing it to reboot. We tried mitigating this with 10x 1000uF (10,000uF total) capacitors wired in parallel, but this only mitigates the drop from 18.3V to 10.5V (instead of 0V without the capacitors). Our proposed solution was to purchase 20x 10,000uF capacitors (200,000uF total) to mitigate the power blip. Most of my challenges now is ensuring the team has everything necessary to complete testing for the final use case demonstration. I also plan on completing an enclosure for the rear of the backpack by FVD, however, the shop manager is really tied up with the Lunar Rover project. We were supposed to take a look at the vacuum molding machine, which is needed to mold the ABS sheet which will create the enclosure, however he has not had time in the past two weeks to service the machine. Through email, he has confirmed to have the device up and running by the end of this week, which would give me enough time over the weekend to complete the enclosure.

3. Teamwork

Below I detail the progress of the team as the project progresses:

- Jonathan Lord-Fonda:

  Jonathan worked on the smart manipulation branch of the COBORG. His goal was to create a node that updates the robot arm trajectory as it is on the way to the end goal, in an effort to avoid emergent environmental obstacles. I advised Jonathan to let go of this feature, as we do not have time to integrate it into the final use case for FVD. He is now focused on the integration of the COBORG and validation steps necessary for FVD.

- Gerry D'Ascoli:

  In this time period, Gerry continued working on the goal stabilization code using resolved rate with Feng, which still needs more testing and debugging before it can be integrated into the COBORG platform. Resolved rate is having some serious issues with spazzing out if it receives a goal which is outside of the robot's work envelope. They added angle stabilization in addition to cartesian stabilization, and this seems to be working much better.

- Feng Xiang:

  For this time period, Feng worked with Gerry on the actuated manipulation system. They are swarming the resolved rate issues, which is the corner-stone of this semester's development. If resolved rate works, the demo works. If it doesn't work, the demo doesn't work. So he is giving guidance to Gerry and Jonathan on how to improve resolved rate for the FVD demonstration.

- Yuqing Qin

  Yuqing focused her work on actuated manipulation along with Gerry, Jonathan, and Feng. She also assisted me in developing the state input and output structure through ROS. We tried using ROS diagnostics, however after an in depth reading of the documentation, we decided it would be best to use a simpler system. She is also helping with camera calibration and URDF changes as they occur with the hardware system.

4. Plans

For FVD, my plan is to finish the enclosure for the COBORG, ensure all parts are ordered so that we have redundancy/risk mitigation, and to improve the capacitance of the Jetson Xavier to prevent brown-outs. The enclosure is the most involved portion that is remaining, as it requires the modification of a wooden mold, the molding of an ABS plastic sheet, the routing out of 2” holes for I/O brackets, and the routing of two large holes on the front face to make room for an exhaust fan and intake grill. I will also advise the team on how to set up their nodes to report the right states to the main state machine. Asides from that, I will help in any capacity for FVD use case testing in the next week.