Carnegie Mellon University

16-682

MRSD Project II

Individual Lab Report 9
Team C - COBORG

Husam Wadi

Teammates:
Feng Xiang, Jonathan Lord-Fonda, Yuqing Qin, Gerry D'ascoli

Sponsor:
Biorobotics Lab

October 28, 2021

Table of Contents

1. Individual Progress

For this time period, I primarily focused on the hardware development of the COBORG. The parts were delivered on October 21st at 2:43PM, which is important as we have been working non-stop since then to get the robot frame to version 2.0. We originally planned to have the hardware framework **completed** by October 17th, however that was not possible due to shipment delays from the manufacturer. I stripped down the previous hardware assembly of the COBORG, which was primarily scrap metal and duct taped electrical components down to the camping backpack frame which straps to the user's back. Once I removed all of the previous components (outside of the camping backpack frame) I contacted Tim from the machine shop and requested access to the wood shop in the basement, as that wood shop has a spray painting booth in which I could paint our parts. I decided to repaint the camping backpack frame black, as it has been chipped and scratched from all the testing done to it over the years. I also had to paint the block that holds the robot arm, as that part came plain to expedite the shipping. Once the parts were painted, I quickly assembled the new black aluminum extrusions to the painted camping backpack frame and the robot arm. I then helped Gerry identify how to wire the COBORG HEBI actuators using the mini molex connectors.

While these activities were happening, in parallel I was 3D printing iterations (some were final) of components and brackets for the new assembly. These include a 3D printed PLA mount for the speakers, a bracket to hold the battery packs, a bracket to further solidify the camping frame to the extruded aluminum enclosure, the camera assembly, external electrical connector brackets, and a 3D printed Nylon bracket to hold the Jetson Xavier. These parts are yet to be connected to the backpack, but will be in the upcoming days. In *Figure 1* we see the paint booth that was used, and in *Figure 2* we see the current condition of the COBORG*:*

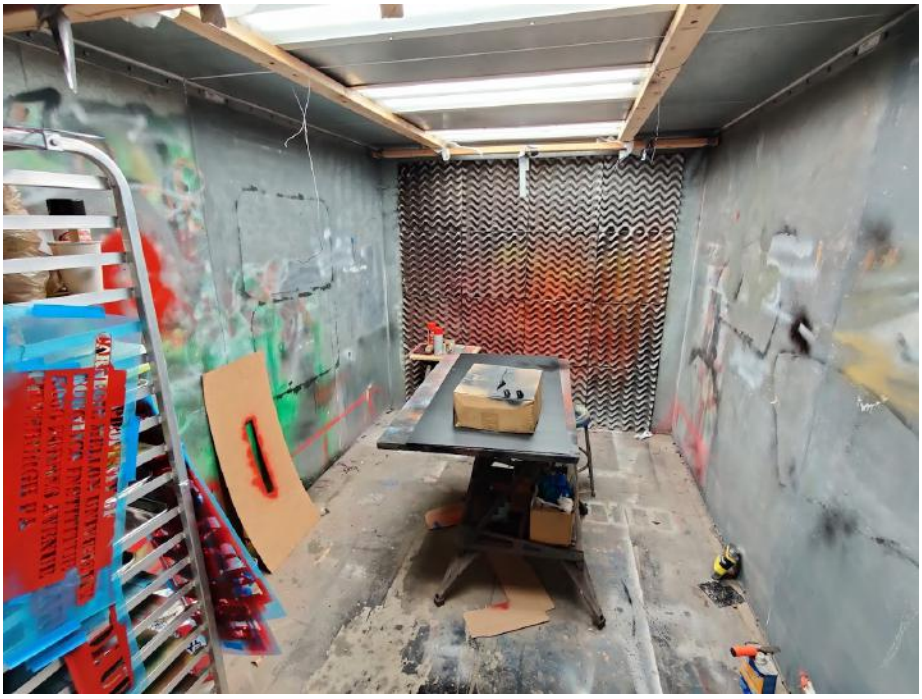

Figure 1. Paint Booth

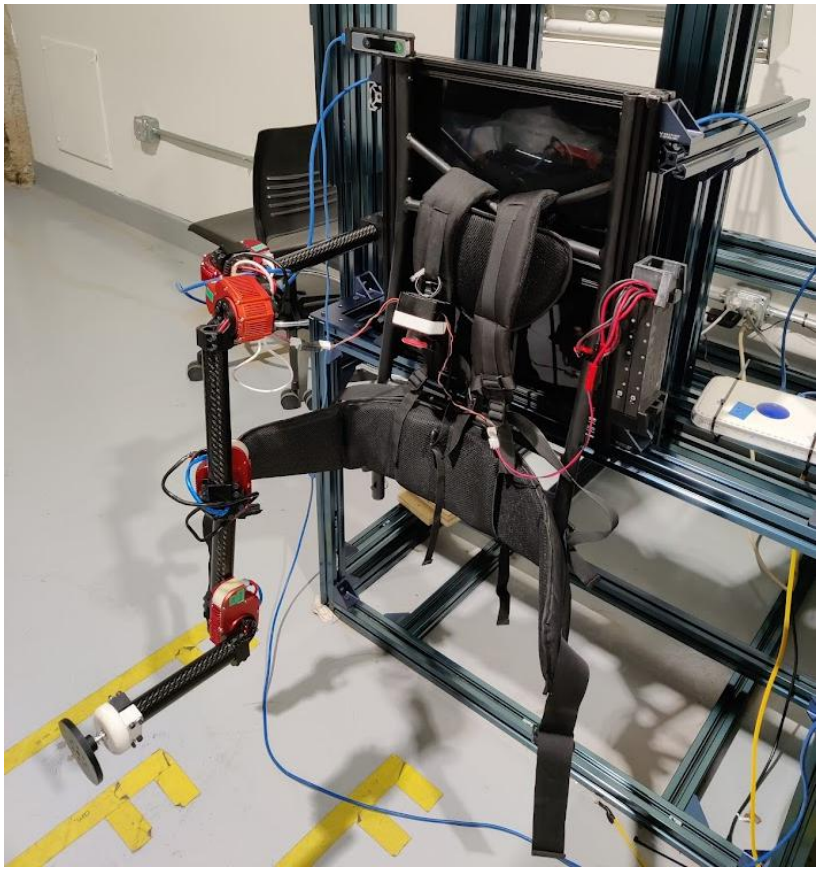

Figure 2. COBORG Current State

2. Challenges

A challenge that we are facing is that the hardware delays have a significant, real, and immediate impact on our ability to integrate and validate the COBORG project. While we are working around the clock to catch up to our original timeline, we have to drop any items that would be “nice to have” to only servicing items that are “critical to have”. This is because, as we integrate, we discover new challenges that require time to address. One example is recently we tried running the Jetson Xavier on the LiGo lithium battery, and to our surprise it turned off after 5 minutes of activity. This is critical, as we have to run the robot untethered for 20 minutes with the robot arm moving + the computer being powered. We also were finally able to run advanced manipulation on the new robot arm, and we found many issues with running stabilization in real time.

A personal challenge I face is that I must finish the majority of the hardware assembly by the end of this week. This has required my full attention, with 10-12 hours spent daily to complete the work. Even with this level of commitment, and even with the help of other teammates, I was not able to complete the assembly by the progress review. Assuming we finish the assembly by Friday, we will be able to have three weeks of integration and testing before FVD.

Another challenge is that there are some electrical updates related to relay control of the safety mechanisms in the COBORG. We want the COBORG to deactivate/kill motor power when someone says “STOP STOP STOP”. We also want a magnetic treadmill latch to control the safety switch if the user pulls on the cord.

3. Teamwork

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

- Jonathan Lord-Fonda:

  For this time period, Jonathan continued working 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. While the logic of the node worked, Move-It, the plugin that plans the robot arm, would stop the arm every time it got a new plan. This made the robot arm jerky when using the updater node. We may have to not integrate this feature, as it requires modification of established nodes within our system.

- 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. They were able to successfully demonstrate the arm working with cartesian movement, and for our use-case, this may be enough for our FVD. He also was instrumental in redoing the wiring of the robot arm, and is looking to wire the ethernet for the arm this weekend.

- Feng Xiang:

  For this time period, Feng worked on creating the "Goal-Getter" with Yuqing. This node had been previously removed as it was not necessary for a single camera. However, once we migrated to a two camera solution, it became necessary to have a node which averages the positions between the two cameras and outputs a single goal target. Feng also worked on the smart manipulation with Jonathan and Gerry.

- Yuqing Qin

  Yuqing focused her work on the "Goal-Getter" node with Feng. Together they brought back the node and were able to solve edge case scenarios in which the two cameras would output dual positions for each hand in certain regions of the FOV. She also helped with the overall updates to the software framework with Jonathan.

4. Plans

For the next ILR, my plan is to finish the hardware integration, as this is the top priority. The next ILR consists of a FVD pre-run, in which we will try to complete a full use case of the COBORG system. Once I complete the hardware integration, I will work on the updated E-stop design. This includes a pull cord mechanism instead of the current push button, and a relay that kills power to the motor on the "Stop Stop Stop" voice command. The final task planned for the next sprint is to convert the main node from an open loop state machine to a closed loop state machine. This will require feedback from the other nodes into the "*/state_input"* ROS topic. We also have plans to update the end effector, which will take design, integration, and validation. The main overall goals have stayed the same, as the hardware integration will conclude this week, and the goals listed above are dependent on the completion of the hardware.