Carnegie Mellon University

16-681

MRSD Project 1

Individual Lab Report 2
COBORG

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Sponsor:
Biorobotics Lab

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1. Individual Progress

In our project, we have 3 major subsystems that are being developed for the COBORG:

- Actuated Manipulation (led by Feng Xiang)
- Voice Recognition (led by Gerry D'Ascoli)
- Vision Recognition (led by Yuqing Qin)

The other two team members are Jonathan Lord-Fonda and I. Jonathan focuses on the integration of the subsystems into the final robot, which is the development of unit tests, integration tests, and working on the main ROS node to communicate between the subsystems. As for my technical responsibilities, I split my time between working with Jonathan on the main node, and helping each subsystem with technical challenges that arise while they develop their subsystems. With Jonathan, I reviewed the ROS node map he created and helped update the node map from V2 to V3, with V3 simplifying some aspects of V2 (such as removing the PID "gain_setter" node) and adding other optimization aspects (such as a live homography transform to the RRT-Connect generated path to reduce/remove the need to recalculate paths as the arm moves towards the intended target). Depicted below is the previous version of our ROS node map:

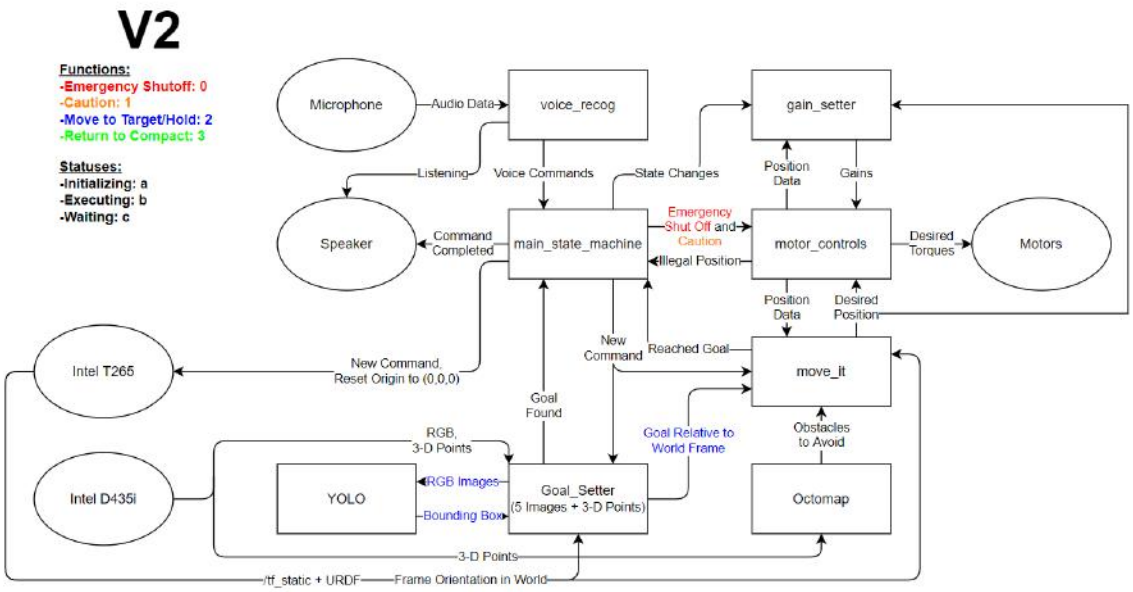

Figure 1. COBORG ROS Node Map V2

I also delved into Intel RealSense's Github repository with Yuqing to discover how to tie the RGB video feeds with the depth map. This is important to us as we need a 1:1 correlation between the RGB bounding box that YOLO creates with a [x,y,z] point

that the robot can reach. This point will be used in conjunction with the V-SLAM localizing camera, the Intel Realsense T265, to track the point in 3D absolute space.

Figure 2. Intel Realsense T265 + D435i

2. Challenges

The main challenge we face in this project is finding a way to transform a depth point generated by the D435i camera to a target that the robot arm can track through Move-It. We will have to understand how to interface the T265 with the TF Tree that ROS creates to correctly transform the relative D435i point with the T265 frame of reference. We are also having some challenges with our voice system in recognizing the correct keyword (“Coborg”) to trigger commands to send to the robot. We are looking into improving our microphone, as we have found it to be less than optimal in voice clarity.

3. Teamwork

Team Member	Work Description for COBORG
Feng Xiang	-Created URDF model -Integrated URDF with Move-It -Got Robot Arm to Move to a point selected in RVIZ
Jonathan Lord-Fonda	-Updated ROS Node Map with Gains node -Updated ROS Node Map for vision system -Added a speaker output to ROS Node Map -Wrote Main State Node -Wrote up semantic Goal_Setter Node -Helped construct the robot holder/testing structure
Gerry D'Ascoli	-Redesigned voice recognition system to work with "Coborg" trigger word -Wrote script to translate verbal commands into robot instructions -Added audio feedback for voice control system
Yuqing Qin	- Installed Realsense D435i ROS package - Launched YOLO v3 on hand detection - Wrapped YOLO model with ROS node - Set up GPU to run the YOLO ROS node - Tested D435i with YOLO node
Husam Wadi	-Cleaned up B512 with the group -Built structure to hold Coborg -Adapted timeline to increased workload -Assisted Jason with intel realsense (T265) -Assisted Yuqing with intel realsense (D435i) -Assisted Jonathan with ROS Node Map -Ensured team used Github when creating COBORG features

Table 1. COBORG Teamwork Detailed

4. Plans

In the next few weeks I will focus on encouraging the team to meet a mid March pre demo date, where we will try to go through a limited run of the SVD. While previously we were targeting the second ILR to conduct this test run, it seems with the influx of homework assignments we will have to delay till the third ILR. For the second ILR we plan on demonstrating these items, which are critical in our path to conducting a full demonstration of the robot:

Voice Command - Software Architecture:

Implement the main node and have basic interfacing with our voice command node. Run a basic test of having a voice command passing a value into the main node.

Robot Motion - Intel Realsense:
Move URDF with T265 as the localization point. The T265 tracking camera will use V-SLAM to localize the robot position.

Vision System - Hand Tracking:
Publish center of two YOLO hand detected bounding boxes to a topic.

5. Appendix

5.1. Figures

Figure 3. B512 COBORG Setup

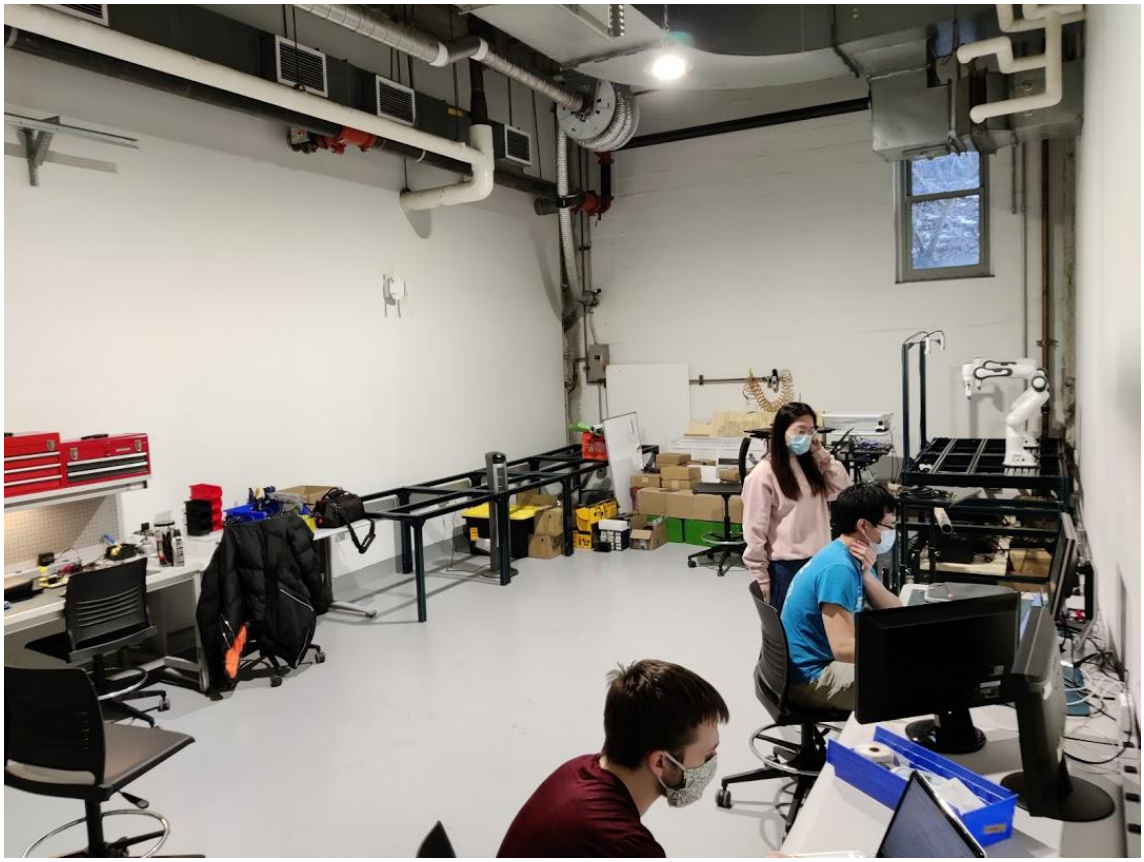

Figure 4. Team Working In B512 Lab