Carnegie Mellon University
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MRSD Project II

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# Individual Lab Report 10

# Team C: COBORG

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Remaining Team C Members:

Jonathan Lord-Fonda — Yuqing Qin — Husam Wadi — Gerry D'Ascoli

Sponsor:
Biorobotics Lab

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# 1 Individual Progress

**Description** Since the last progress review, I worked on various integration tasks for full pipeline capability. In particular, I contributed to the integration of the goal getter node, smart manipulation code base, and resolved rate motion compensation controller. In addition, I performed fine tuning and calibration of the camera mount and robot arm in preparation of the progress review demo.

I worked with Yuqing to fine tune and tweak the goal getter node for full pipeline integration. One component we tweaked was the distance threshold of hand detections. The distance threshold is the distance from the T265 camera frame and the hand detection location from a YOLO node. If the hand detection location is less than the distance threshold value, then the location is considered as a goal position. From the last progress review, the distance threshold was increased from 1.0 to 1.5 meters in order to better detect hands within the working task space.

I worked with Jonathan to continue integration of the smart manipulation code base into the full pipeline. One feature that I added were intermediate positions for the robot arm to traverse to after the home position and before the robot arm goes to the goal offset location. The intermediate position will allow the robot arm to maintain a certain configuration such that it is in a better position to perform naive push and goal stabilization onto the part.

I worked with Gerry to fine tune the resolved rate motion compensation and goal stabilization controller onto the smart manipulation code base. Some fine tuning was performed on the push in and push out distances for naive push and pull. The naive push distance dictated how far into the board the robot arm should go to give optimal force onto the part. The naive pull distance dictated how far back should the robot arm retract to release control of the part. The two values were fine tuned in preparation for the progress review demo.

I also fine tuned and calibrated the robot arm and the robot URDF model to ensure optimal accuracy. I remeasured the orientation and configuration of the camera mount with Yuqing. I also performed calibration on the robot arm itself in order to verify the angles of the motors were following the robot model too. Confirmation of the calibration was performed by moving the robot arm in front of the cameras and qualitatively verifying the overlay of the physical arm with the simulated robot arm in RVIZ.

**References**

- N/A

## 2 Challenges

**Description** The main challenges faced were in regards to the integration of all sub-components to the full system. Namely, it is a challenge to work with the robot during several edge case scenarios.

One particular challenge is handling user safety during resolved rate. When the user is shifting around during motion compensation and goal stabilization, the robot arm can end up in a configuration that is invading the user's personal space. This particular challenge is a high risk because the utmost goal of the robot arm is to not to harm the user during its operation.

Another challenge is handling the robot arm when the arm actuates quickly and with a significant amount of motor torque. Because the robot arm is mainly working with position-based control, the arm can exert a lot of force in order to move to its goal position. This can also pose a harmful risk to the user, if any part of the user is in the pathway of the robot arm and the robot does not see the user as an obstacle.

Finally, when the robot arm fails in execution at certain states, the only reset option for the system is to crash all programs and restart the pipeline of the robot arm. Certainly, the team does not want the robot to stall indefinitely until the system is restarted during an actual use case.

**References**

- N/A

# 3 Future Plans

**Description** By the Final Validation Demonstration (FVD), additional refinement and fine tuning will be performed on the robot to achieve an optimal full pipeline operation and reasonable behavior during edge case failures and scenarios. This would entail further calibration of the robot model with the physical robot, implementing several safety features to the actuated manipulation system such as force thresholding on the motors, and error checking to the various states of the actuated manipulation system in order to act accordingly to reset the robot.

In addition, I will also work on implementing more intuitive and reasonable intermediate positions for the robot arm. Perhaps, implementing an intermediate position that is sufficient far from the user but still optimizing the pathway of the robot arm from that intermediate position to the goal point.

**References**


- N/A

# 4 Teamwork

**Description** The division of work between each member of the team was as follows:

- **Husam Wadi** Husam is the project manager of this team. Husam is leading the hardware re-design and re-fabrication of the framework. He re-wired the electrical components together and worked with Gerry, Jonathan, I to wire up the rest of the robot arm. In addition, he created the final main node of which the e-stop can be activated through specific voice commands.
- **Jonathan Lord-Fonda** Jonathan is leading the integration between subsystems and the project validation process. He worked with the whole team to integrate the software, run use cases, debug problems, calibrate, and tune the system. He also worked with Gerry, Husam, and I to wire the robot arm. Working together with Husam, they both worked on the state machine re-design. He also adjusted the testing frame with Yuqing in order to allow for overhead use cases. He continues to work on the path stitching portion of the actuated manipulation subsystem.
- **Gerry D'Ascoli** Gerry is the lead for the voice subsystem. He worked with the entire team on software integration, testing, and fine-tuning. In preparation of progress review demo, he updated the voice subsystem node with status topic, additional voice commands, and keyword fine-tuning. In addition, he updated the voice subsystem node with a feedback publisher to allow other nodes to easily access system audio outputs.
- **Yuqing Qin** Yuqing is leading the vision subsystem of the project. She also worked with Jonathan to re-structure the testing frame for overhead test cases. She has also been working with the rest of the team on the full pipeline integration and testing. She has been working on refining the goal getter node in addition to making tweaks to the vision subsystem to improve hand detection performance. One such vision subsystem tweak was changing out and comparing different hand detection models. Yuqing and I also calibrated the camera mounts together in preparation of the progress review demo.

**References**

- N/A