Carnegie Mellon University
16-682
MRSD Project II

Individual Lab Report 09
Team C: COBORG

Author: Feng Xiang

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 have continued to collaborate with Yuqing to implement the goal-getter node, Gerry to implement the resolved rate motion compensation and stabilization controller, and Jonathan to implement the smart actuated manipulation code onto the hardware system. A lot of progress was made to test and begin integration of these features with the full pipeline of the COBORG.

The goal-getter node is a ROS node that serves to collect proposed 3D goal locations from both camera nodes and output a filtered and averaged 3D goal pose as a message published in a ROS topic as well as a published frame using the ROS *tf* publisher. The node also utilizes distance thresholds and the *tf* package to output a viable goal pose relative to *MoveIt's* world frame in addition to updating that goal pose globally as the T265 tracking camera was moved and re-oriented. This way, the actuated manipulation subsystem can acquire an obtainable and updated goal position for the robot arm to actuate and stabilize to. In collaboration with Yuqing, the goal-getter node has been implemented and tested on the Xavier Jetson computer with two Intel RealSense D435i cameras and one RealSense T265 tracking camera. As shown in the screenshot below (see Figure 1.1), after acquiring hand detection locations from the two camera nodes, the goal-getter node ouputs a *tf* frame as shown through *RViz*. This frame as well as the published ROS message is consistently updated as the T265 global tracking camera is moved around.

I also worked with Gerry to test and begin integration of the resolved rate motion compensation controller with the actuated manipulation pipeline. This closed-loop position controller is intended to turn on when the robot arm is performing naive push and stabilization onto the 3D goal point. Moving around the T265 tracking camera will update the global pose of the goal, which the controller will provide a smooth trajectory to adjust and reorient the robot arm to the global goal point. This controller will also be implemented when the robot arm is performing naive pull before actuating back to the compact position. The resolved rate controller feature was implemented onto the Xavier Jetson computer, and tested with 3D goal points from the goal-getter node. Qualitatively, the robot arm is able to maintain a global position for a significant amount of time under nominal movements from the T265 camera.

I also worked with Jonathan to implement and begin testing of the smart actuated manipulation code. Initially, this task was an upgrade to the existing actuated manipulation code in order to implement an adaptive motion planning algorithm against static objects, a robust motion compensation and stabilization controller (i.e. resolved rate controller being led by Gerry), and two state machine instances: an external state machine to communicate with the main state node and an internal state machine to provide oversight over the actuated manipulation subsystem. Due to technical challenges and time constraints, the adaptive path planning capability has been omitted from this progress review until the feature is functional. The code has been implemented onto the Xavier Jetson, and current testing was performed with the goal-getter node and the resolved rate motion compensation controller.

The screenshot shown below (see Figure 1.1) displays an instance where the goal-getter node processed the hand detections from the two camera nodes and outputs a filtered *tf* frame relative to the *MoveIt* world frame.

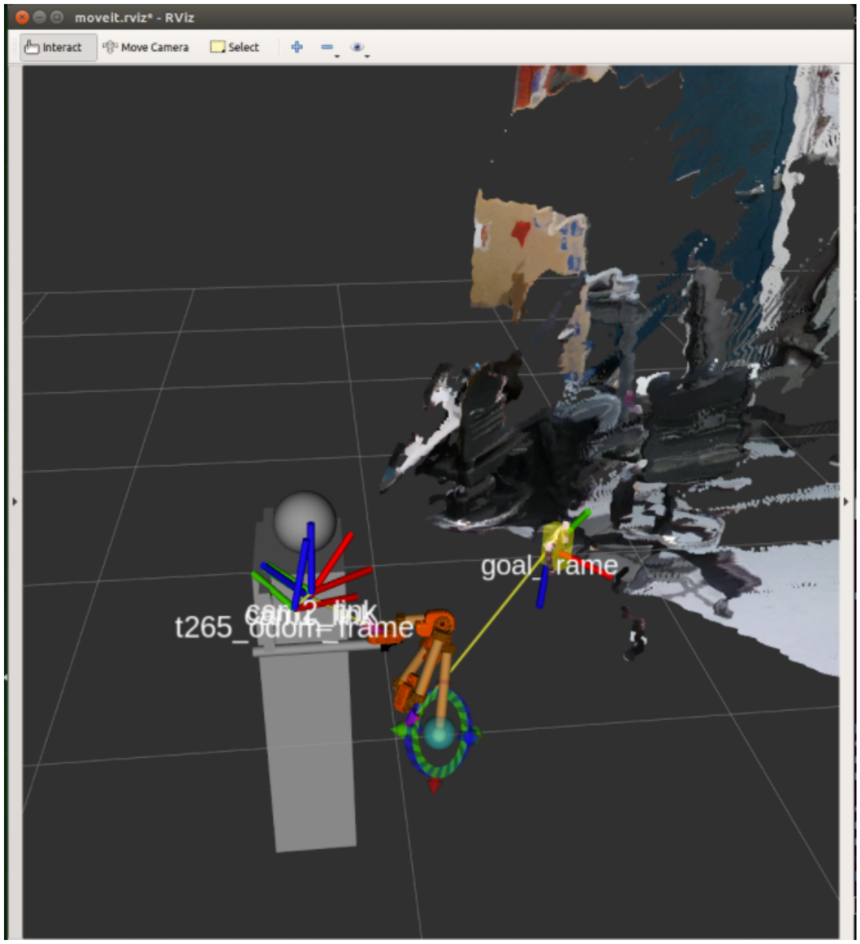

Figure 1.1: Constantly updated tf frame published by the goal-getter node.

References

- N/A

2 Challenges

Description The main challenge throughout the resolved rate controller, goal-getter, and smart actuated manipulation code work was resolving the individual and combined edge cases from each task. Coming into the next progress review, integration will prove to be a significant challenge, as work will be done to integrate all features and nodes to the full CoBorg pipeline. Resolving edge case scenarios and failures while still implementing functionality to our use case is critical to reducing risk and resolving this challenge going forward.

Another challenge was the frequent boot-up failures of the Intel RealSense cameras. When the pipeline is started, it is crucial for all three RealSense camera nodes to boot up successfully. It was a frequent occurrence that at least one of the RealSense nodes fail to boot up when the pipeline was started which means that all programs have to be cancelled through terminal and restarted in order to cycle the RealSense cameras nodes again. This occurrence proves to be a significant risk to the project and efforts are being made to mitigate and resolve this occurrence so it does not happen as often during our use case.

References

- N/A

3 Future Plans

Description By the next progress review, most, if not all, nodes and features will be integrated and tested on the actuated manipulation system. This includes the goal-getter node, smart actuated manipulation code, and the resolved rate motion compensation controller. Testing of this fully integrated pipeline will be performed along with the updated hardware framework.

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. He is leading the fabrication and assembly of the new hardware framework which includes assembly of the robot frame, 3D printing of components, spray painting and finishing parts, and assembly of electrical components onto the backpack frame. In addition, Husam has also been updating the CAD model and making necessary design adjustments in order to resolve any minor assembly flaws.
- **Jonathan Lord-Fonda** Jonathan is leading the integration between subsystems and the project validation process. He is leading the development of the smart actuated manipulation code and adaptive path planning functionality. He continues to develop the adaptive path planning capability and intends to implement this capability when functionality is achieved. In addition, he has also assisted Yuqing and Gerry with design advice to the goal-getter and resolved rate controllers, respectively.
- **Gerry D'Ascoli** Gerry is the lead for the voice subsystem. He is leading the development of the resolved rate motion compensation and stabilization controller. This means coding, implementation, and testing the code with the Xavier Jetson and physical robot arm. In addition, he has also been working with Husam to install all electrical components onto the new robot backpack frame.
- **Yuqing Qin** Yuqing is leading the vision subsystem of the project. She is leading the development of the goal-getter node. She has also ensured the goal-getter node was well integrated with the resolved rate controller and the smart actuated manipulation code as well.

References

- N/A