Progress Review 8

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Team D: Human Assistive Robotic Picker

Teammates: Alex Brinkman, Feroze Naina, Abhishek Bhatia, Lekha Mohan

ILR07

February 10, 2016

Individual Progress

Over the past two weeks, I made progress on several fronts. First, I fabricated the base for the UR5. Second, I redesigned the gripper and Kinect mount such that the design less limited the configuration space. In addition, I prepared the Amazon Picking Challenge video submission and wrote the proposal. On the perception front, I started experimenting with PERCH, a perception pipeline developed in the SBPL. Finally, I developed a tool that can label testing images for validating perception algorithms.

To fabricate the base, I band sawed mounting plates. I then drilled the hole pattern based on a laser cut stencil. Finally, I cut the 80-20 to length and assembled the frame. Overall, the process was very straightforward. The base is very stable, although we might need to weigh down the legs.

As we were testing arm motions in simulation, we noticed in some configurations the planner struggled to solve a trajectory. After troubleshooting, the root of the problem was our end effector design. The profile of the tool was too high above the mounting flange, and thus the Kinect would intersect with the arm. In order to fix this, I redesigned the end effector such that the Kinect is now centered on the flange. This results in a much larger workspace and improved motion planning. This modified design can be seen in figure 1.

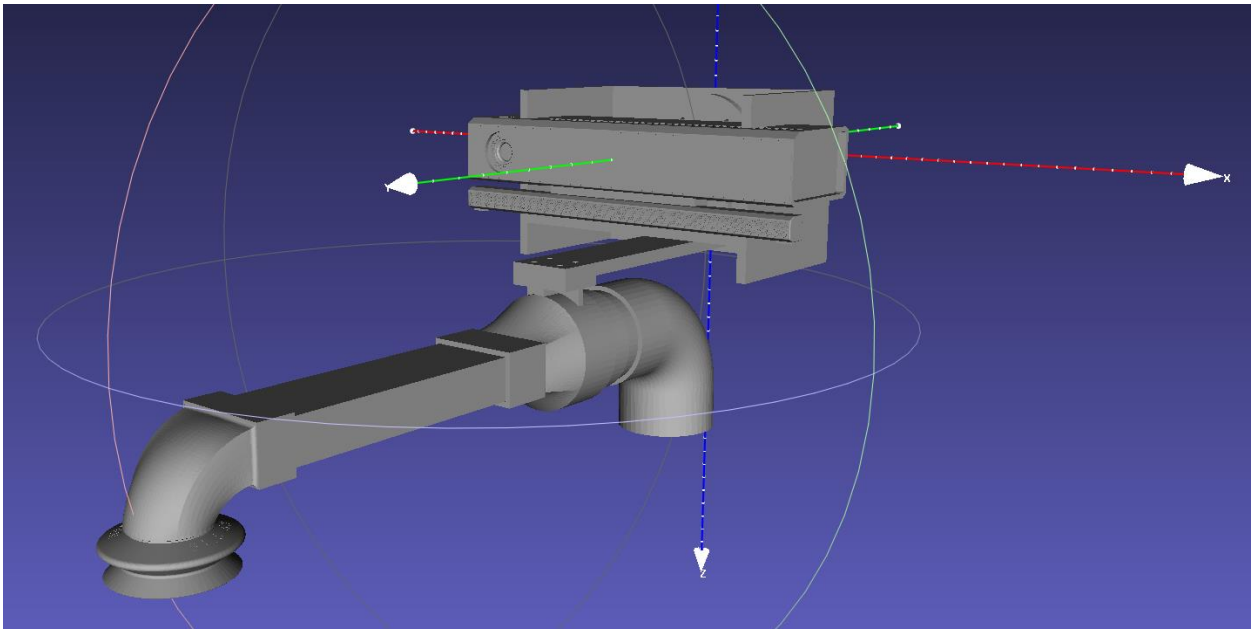

Figure 1: New End Effector Design

Next, I spent a lot of time editing a video and writing a proposal for the Amazon Picking Challenge submission. In this video, we demonstrate localization, motion planning, vision processing, and grasping. In addition, Alex and I scripted end to end picking and stowage task demos. This submission was submitted on February 10th. A snapshot from our video can be seen in figure 2.

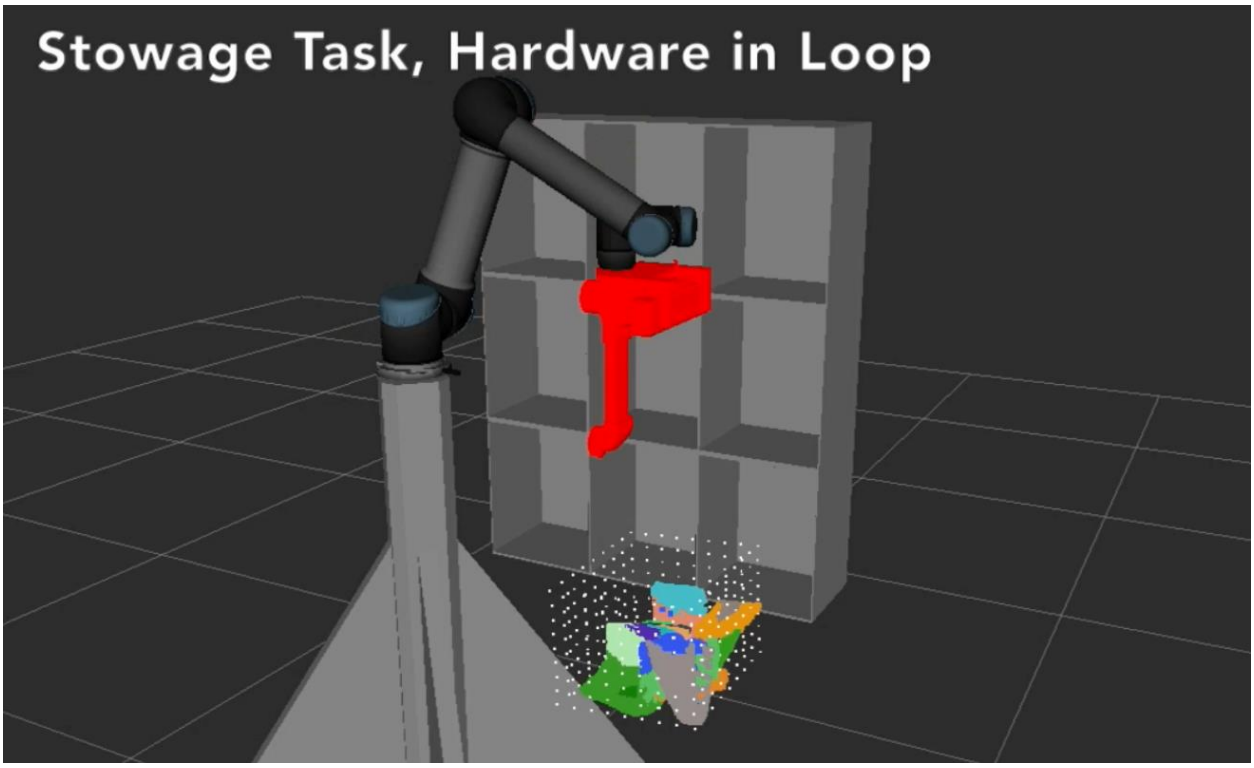

Figure 2: Video Submission Screenshot https://youtu.be/oGq05wN7mmg

Recently, I have been working with Abhishek, as well as Venkat Narayanan from SBPL, to benchmark an algorithm called PERCH. This algorithm renders scenes using item models and implements an A* like search to globally identify object locations. In its current state, the algorithm is slow but also very accurate and can handle heavy occlusions. If we can speed up performance, we will use this algorithm in place of our current vision pipeline.

Finally, I developed a tool that will allow us to annotate images we capture during testing. Specifically, the plan is to save all point clouds we capture during system level testing. Afterward, we will go through these images and annotate where the items are manually. Then, we can write a script to test all these images whenever modifications to the perception algorithms are made, to verify our changes actually improve the system. Figure 3 shows the intermediate steps of lining up a ground truth image. This process can be time consuming, but is worthwhile in the long run.

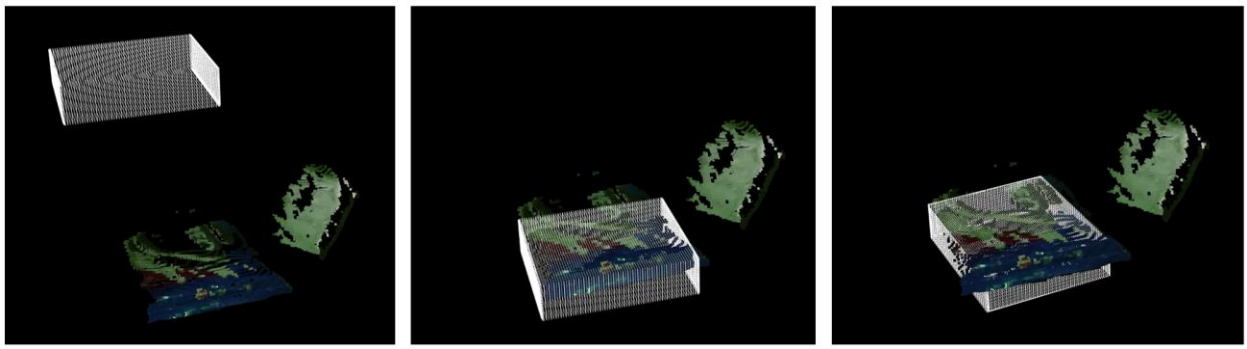

Figure 3: Model Scene Alignment

Challenges

As a team, our biggest challenge has been waiting for the UR5. We have been trying to expedite the process with CMU's contracts office. Personally, I have been struggling with system level computer issues. First, I broke my graphics card drivers several times trying to get Nvidia Cuda to work on my machine. Then, I had to wipe my machine because I auto-update some packages by accident. Hopefully I can work out these bugs soon.

Teamwork

Over the last two weeks, Lekha and Alex have been working on grasping algorithms. Specifically, Lekha is working on an off-line tool such that we can label good grasping surfaces on each item. Alex is working on an on-line tool to select a grasping surface once the item is identified on the shelf. Feroze has been working on organizing the code base such that we tag code on GitHub as we develop more functionality. Alex worked with me to script the tasks for the APC video. Recently, Alex developed a tool to visualize the workspace of the robot for a given set of constraints. Finally, Abhishek worked with me to get PERCH up and running. He has also been dealing with system level issues on the lab computer regarding Kinect2 drivers.

Plans

From now until next progress review, I will fabricate a new end effector and Kinect camera mount. In addition, I will test SimTrack, a tool that we might use to generate item models once the new APC database is released. To get this running, I need to continue working out Cuda issues. In addition, by next week, the UR5 should arrive. I will be working to get that up and running. We hope to demo the UR5 moving autonomously to each shelf bin by next progress review.