Che-Yen Lu
Team E: PLAID
Teammates: Michael Beck, Akshay Bhagat, Matt Lauer, Jin Zhu
ILR11
April 18, 2017

1. Individual progress

For this progress review, we aim to integrate all sub-systems to demonstrate the whole picking scenario. The demonstration is somewhat successful except tissue box can't be identified by FRCNN.

First, I implemented ICP algorithm to ease the risk of apriltag localization issue. Sometimes, the apriltag transform rotate slightly and hence the transform between apriltag and camera is incorrect. To solve such issue, we could make initial guess by initial apriltag transform, and move 3D model according to the transform. After transformation, transformed between 3D model and camera point cloud (ground truth) could be acquired by ICP. Once the transform is aligned with camera point cloud, we can make sure the transform between apriltag and camera is accurate.

I also simplified the bin segmentation server so that it could be used for tote segmentation. This server is mainly for unknown objects. By using depth information, we could black out pixels except items in the tote. However, the result is not impressive so far since the quality of depth data depends on the item characteristics. If the item is reflective or transparent, it can't be detected by using depth data. Another drawback is that if the item is flat and thin, we need to lift the item by putting pad underneath it. The Figure 1 is the objects image after pixels black out.

Figure 1. The image of objects after segmentation

2. Challenges

Although I believe I already mentioned multiple times, the biggest challenge now is

still the shelf and frame fabrication. Wooden shelf and frame are used as system mockup now, which could compromise the system stability when whole system need to migrate from current shelf to final design. As we all know, CNN accuracy is strongly related to image color and lighting intensity, so we may need to fine-tune background color and illumination after we adopt the new shelf. In terms of schedule, I highly doubt that whole system testing could be done before the semester ends. We need new model for FRCNN as soon as possible since this PR we suffer from the inaccuracy of FRCNN, and the issue is due to lack of training images. To mitigate such risk, we need to collect and label around 2000 images for 40 objects.

Second challenge is the system robustness. Currently our system is so fragile that even a tiny failure will cause the whole system crashes, and we suffer from this for several progress reviews. Crashing gracefully or even recovering from fault is the goal we want to achieve. Otherwise, we are not competitive as other teams in competition.

3. Teamwork

For progress review eleven, we focus on different domains and break down the tasks as follows:

- Michael Beck – Project manager. Michael handles project schedule and goal. He keeps helping team to break tasks down and monitor progress of sub-tasks. He also helps Matt to fix linear actuator.
- Akshay Bhagat – Akshay modified classifier to only identify one bin, which is half of the draw. He also implemented grasping visualization.
- Matt Lauer – Matt integrated 7-dof planner to system.
- Che-Yen Lu – I implement ICP to tackle the apriltag stability issue. The bin segmentation result is much better with ICP correction. I also helped team to integrate system for demonstration.
- Jin Zu – Jin helped MSCV teammate to annotate images. She also helped team to analyse FCN results for unknown objects.

4. Future Plans

For competition and the project, the top priority now is to implement a decision maker for perception system. There are so many item types, and for every type system could have different perception pipeline. For example, Perch should deal with rigid unknown items since 3D model is available to identify them. CNN with SVM will be the suitable tools for unknown deformable items, and most of known items could be handled by FRCNN and FCN. Current system is only capable of identifying known items, which is my biggest concern.

Also, well-documented manual should be created. We highly depend on each other to perform system demonstration, which is not efficient. If the documents are created, everyone should be able to operate any sub-systems and work independently so that we can make sure every teammate is productive.

Point cloud fusion is also another important task in future plan. High quality of point cloud could help the grasping sub-system decide grasping poses. In order to acquire better point cloud, experiments of camera positions are needed as well.