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Team D: HARP

Teammates: Alex Brinkman, Rick Shanor,Abhishek Bhatia,
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I. Individual Progress:

For this progress review, I was involved in creating 3D models for the items dictionary. I had made use of the AutoDesk Catch1234 software, where we click pictures of the item and register them together. This open software needs at least 40 images to have a good model of the item. I captured around 60 images for each item, from various rotations and angles for obtaining a solid model of the items. The way the images have to be captured is in such a way that the background of the images doesn't move as the textures and features of the background of the images are primary influencers using which the images get stitched(Fig 1a, Fig 1b).

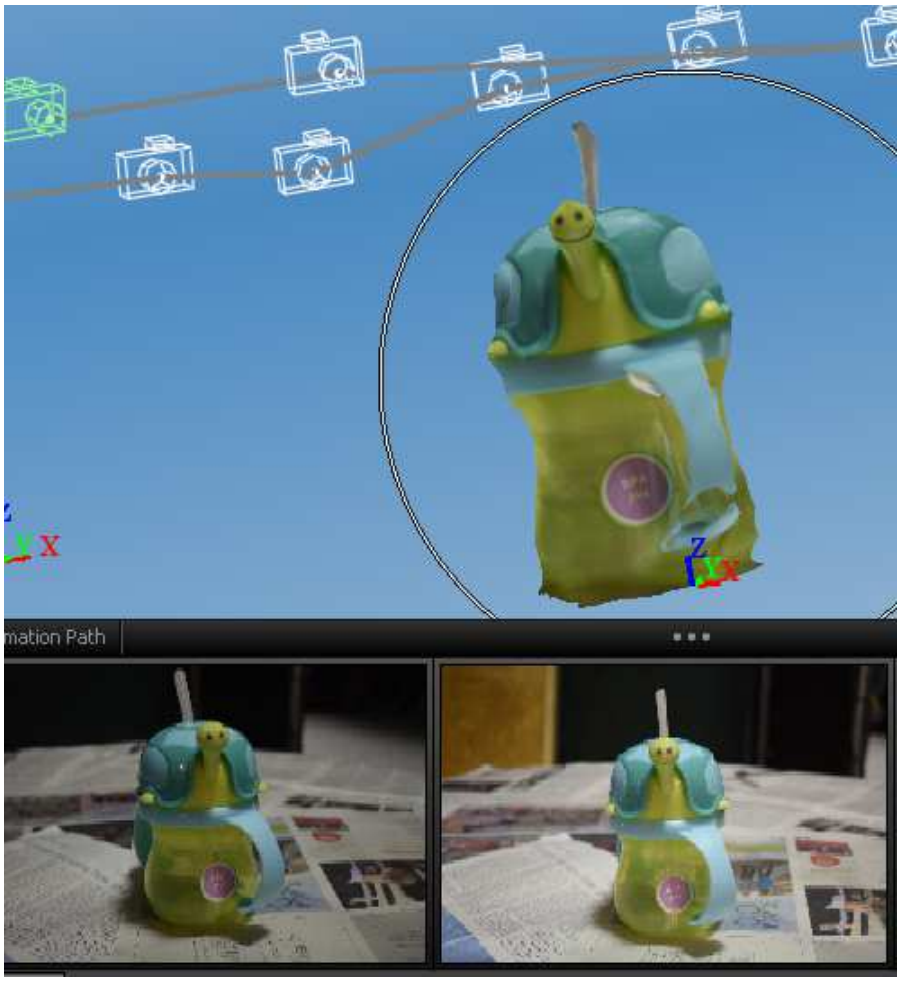

Fig 1a) 3D Model of sippy cup

Above picture is a snapshot of the model created for the item called "Sippy cup". The bottom two pictures are a sample of how the images are taken using a DSLR camera. You can see that the background consists of the textured newspaper. As we rotate the camera 360 degrees this textured background gets detected . While creating the model, the textured background from all the images are

processed and used to stitch the images together creating a solid model of the item. In the above picture, the camera icons depict the angle in which the item was clicked giving us the view point estimate.

Fig 1b) Model for the item – BeefHide

The above is yet another example for an item called BeefHide. To describe the item, it is basically a flexible leather like material in the shape of bones for the dogs to chew. We can see the intricate details, the labeling and depth covered by this model. The output models have boosted the performance of our algorithm. The usage of this model lies in implementing an algorithm called PERCH, that can detect the orientation of a segmented point cloud given the 3D model of the item.

My next task was to evaluate various deep nets that could output the detected item in a cluttered or occluded environment. As we are close to SVE, I have put that to a hold as we have a basic deep net called SegNet working, that can output the detected item. We had to create around 200 training data where we had changed the configurations of items in the bin and clicked pictures of them. We used the generated training dataset to train the SegNet architecture and then test our output images.

II **Challenges**

Biggest challenge that I faced for this week was to decide the lighting conditions for generating the models. My initial models had failed due to improper lighting conditions and shadows. Later, we made a rig setup and used diffused lighting to avoid any shadows. Next challenge was to generate the training data set. Training set is always biased and chances are that we can't use it for global applications. In order to avoid bias, we had to take chances in reconfiguring the setup of items, changing its orientation and position so that we have a wide variety of training data set. We also faced various failures in grasping, some items would get struck in the shelf as the suction cup is just held onto one side of the item.

We are still figuring out a way to overcome that. Irregular point clouds are another big challenge for us as detection fails owing to the sparse cloud

III **Team Work**

Feroze was working on grasping integration. He was working on optimizing grasp planning for the new shelf items, developing strategies for efficient grasping. Alex was working on integration of the entire subsystem, incorporating changes in state machine control as required for smooth operation and interaction of the subsystems. Rick was working on perception, especially testing our newly generated data set on the SegNet architecture. Abhishek was working on perception along with Rick. He was testing the PERCH algorithm and trying to integrate it in our perception pipeline.

IV Future Plans

My future plan is to implement 3D point cloud reconstruction to remove any irregularities in the point cloud captured by the kinect camera. Alex will be working on extensive testing of the entire system. Myself, Rick and Abhishek will be working on perception trying to optimize the algorithm and parallelize the entire perception pipeline for faster results. Feroze will be working on grasp planning based on our failure cases and test cases.