INDIVIDUAL PROGRESS REPORT

Lekha Walajapet Mohan

Team D: HARP

Teammates: Alex Brinkman, Rick Shanor, Abhishek Bhatia,
Feroze Naina

ILR05

Nov. 25, 2015

I. Individual Progress:

My contribution to the project team for the past progress review was to get live stream data from Kinect1, determine the grasp point on the detected object and work on publishing ROS topics to share the shelf bin knowledge whose details have been discussed further. For the past couple of weeks, we had problems running the Kinect 1 and the vision pipeline, for our project was implemented using the Kinect 2. As the vision algorithm was not robust enough, the minimum range for the Kinect 2 to live stream depth data was 1 meter. This counts as a risk and our mitigation plan was to test the live stream data parallely with Kinect 1. After lots trials, I was able to live stream data from the Kinect 1, which did detect data from a minimum distance of approximately 0.7 metres. I am yet to test the vision pipeline with Kinect 1.

My next task was to determine the grasp point for the detected item. For this fall, we are concentrating on non-occluded, but cluttered environment. As the angle of suction cup is such that it can easily grasp items to its cup from the top surface, I decided to find the grasp point by considering the top plane of the detected object. I will be making it more robust in the future weeks to come. I constructed a cube around the grasp point for visualization purposes(Fig 1). This (X,Y,Z) position gets published to the state machine controller, to initiate grasping action.

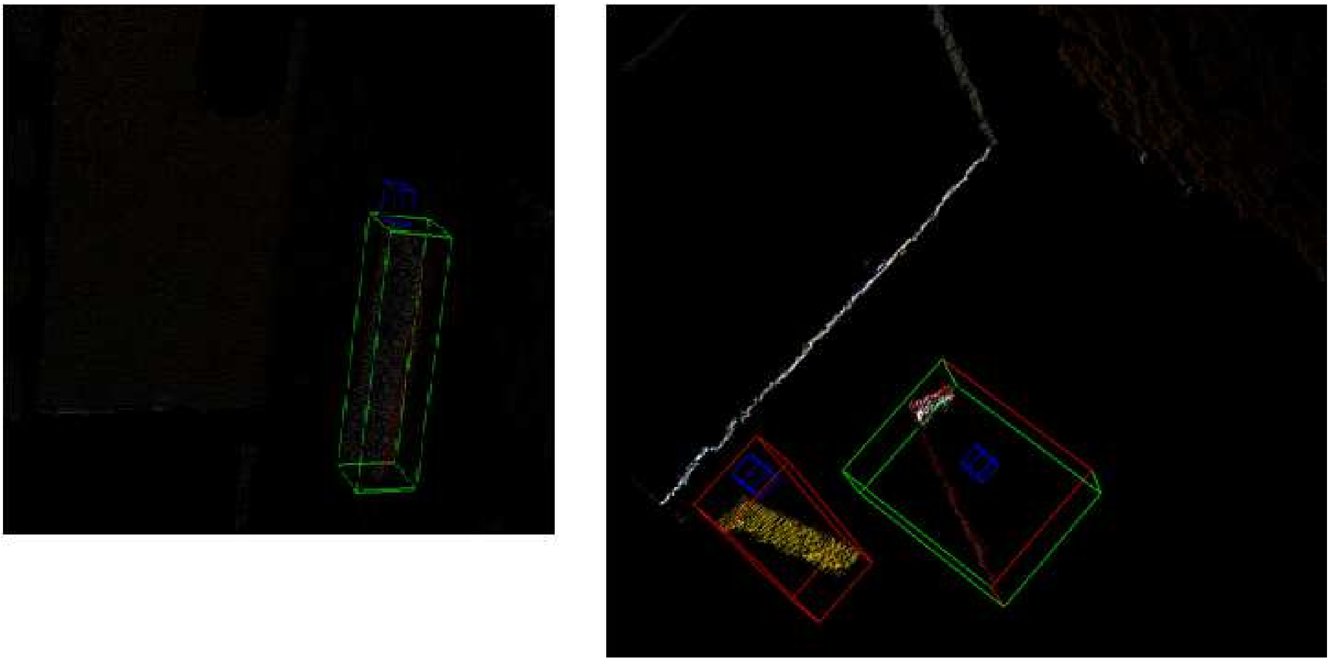

Fig 1 Representation of grasp point surrounded by the blue cube(visualization)

I started working on publishing ROS topics that contains bin knowledge. By bin knowledge, I mean the following:

- Items present in each of the nine bins
- Target item
- Bin number where the target item is present

This will serve as a ROS wrapper function for the vision subsystem. I will be implementing this in python language, that would publish ROS messages.

II. **Challenges**

I faced couple of challenges performing my assigned tasks for the past progress review. Initially, I had problems running the Kinect 1. I had installed libfreenect, Open NI drivers etc., that caused conflicts due to multiple installations. I had to clean them up, referred to multiple blogs and forums that discussed about running Kinect1 and finally found the right way to run it.

The second problem I faced was while trying to estimate the grasp point on the surface of the object. I didn't have the knowledge of X,Y,Z coordinate representation in the point cloud data. The Z represented the depth, but X and Y was unclear to me. So I had to write a code under assumption of X and Y axis, deployed my knowledge gained in the manipulation, mobility and control class to estimate the grasp point. I took the centroid of the bounding box that encapsulated the object and constructed a cube around it for visualization. As my assumption of X and Y axes were wrong, so I had to change the respective parameters for estimating the required point.

Third challenge which I faced was publishing the ROS topic. I am learning ROS extensively, so that it would help me in the integration of subsystems in my project and for future. But currently, due to my limited knowledge in ROS, I am facing issues in writing my ROS wrapper function. I am making progress though with respect to this.

III **Team Work**

Alex Brinkman was working on base planner where he assigned a transform for each bin. He also moved the arm of PR2 programmatically to the shelf bin. Rick Shanor was working on getting point cloud data (Fig 2) for the test objects and running the vision subsystem for the test image. As discussed above, the minimum range for the Kinect 2 was 1 meter. He got in contact with the coder who wrote the algorithm and got a bug fixed that rendered our algorithm to be more efficient. Now we have the minimum range as 0.5m.

Feroze worked on the printed circuit board design and helped Alex with base movement in simulation using Gazebo. The base is programmatically moved towards the bin and the arm is moved to the top order of the bin. At this point, collision of arm with the shelf bins is not considered. It will be worked upon in near future. Abhishek was involved in setting up Kinect 1, which I overtook later. He was working on converting Kinect data to point cloud data, running a comparison with Kinect 2 data.

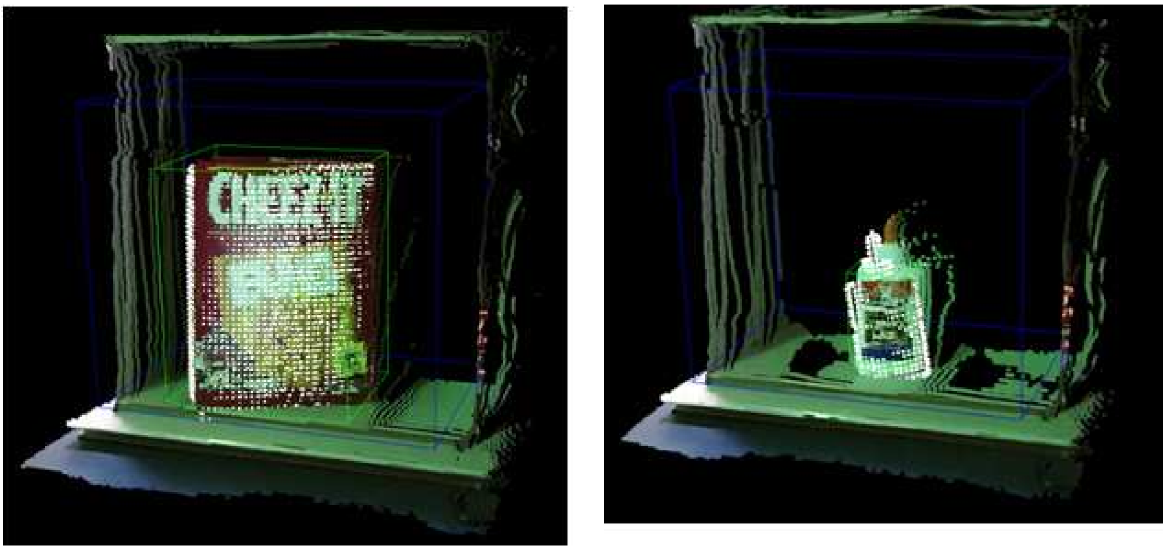

Fig 2. Detected point cloud data, using test image captured from Kinect 2

Picture Courtesy: *Rick Shanor*

III **Future Plans**

Our future plans, as a team involves working on neck, spine and gripper control of the PR2 programmatically. As we have bought new test items, we will also be testing the pickup ability for the newly acquired items. In order to meet the accuracy requirement for the perception subsystem, work will be undertaken to improve its accuracy. Finally, for the Fall Validation, all the actions will be integrated into full hardware in the loop simulation.