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Team D: CuBi

Teammates:

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Individual Progress

The main focus for this review was to make the vision pipeline more robust for satisfying the SVD and start integrating vision with other subsystems. I worked mainly on the following:

- Finalized the pipeline and hyper-parameters for our 3D vision (non deep learning). Improved results are shown in **Fig.1.**
- Developed program to detect Alvar Tags which would act as our dropping locations for the toy. Results are shown in **Fig. 2.**
- Conducted initial tests on the SVD site as shown in **Fig. 1**.
- Published pose of both Alvar Tags and Objects with respect to the robot.
- Researched about ways to improve vision pipeline and also alternatives.

Results:
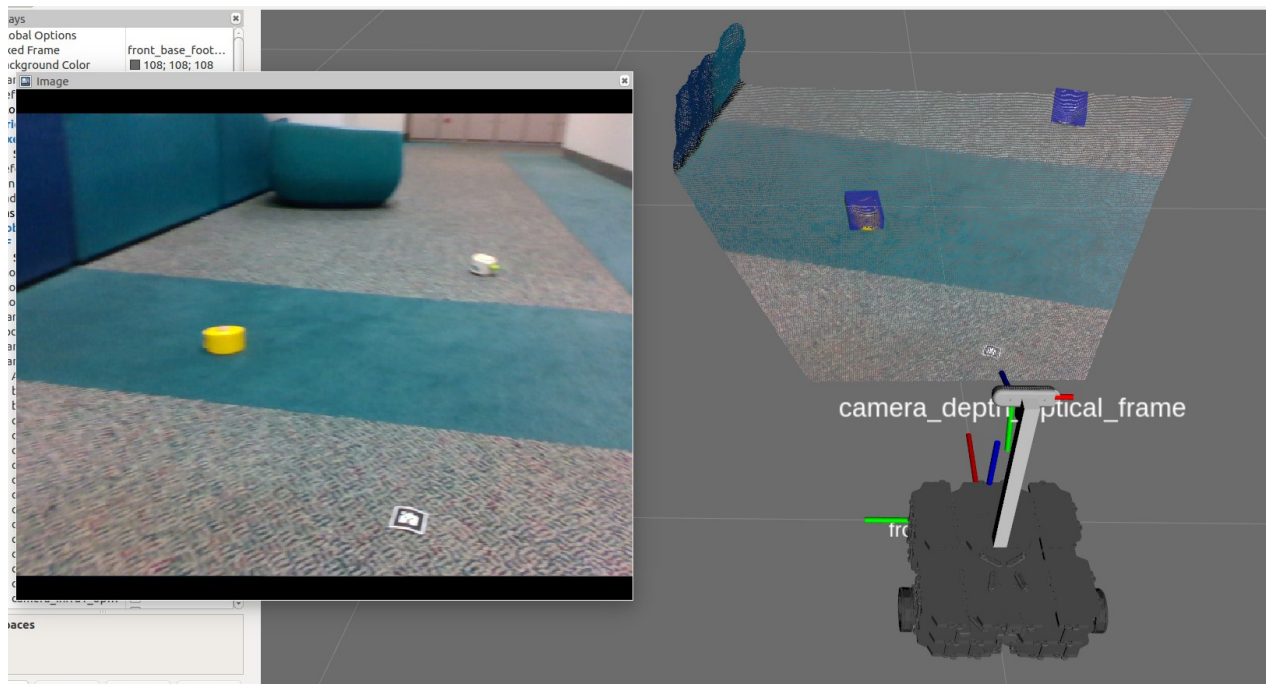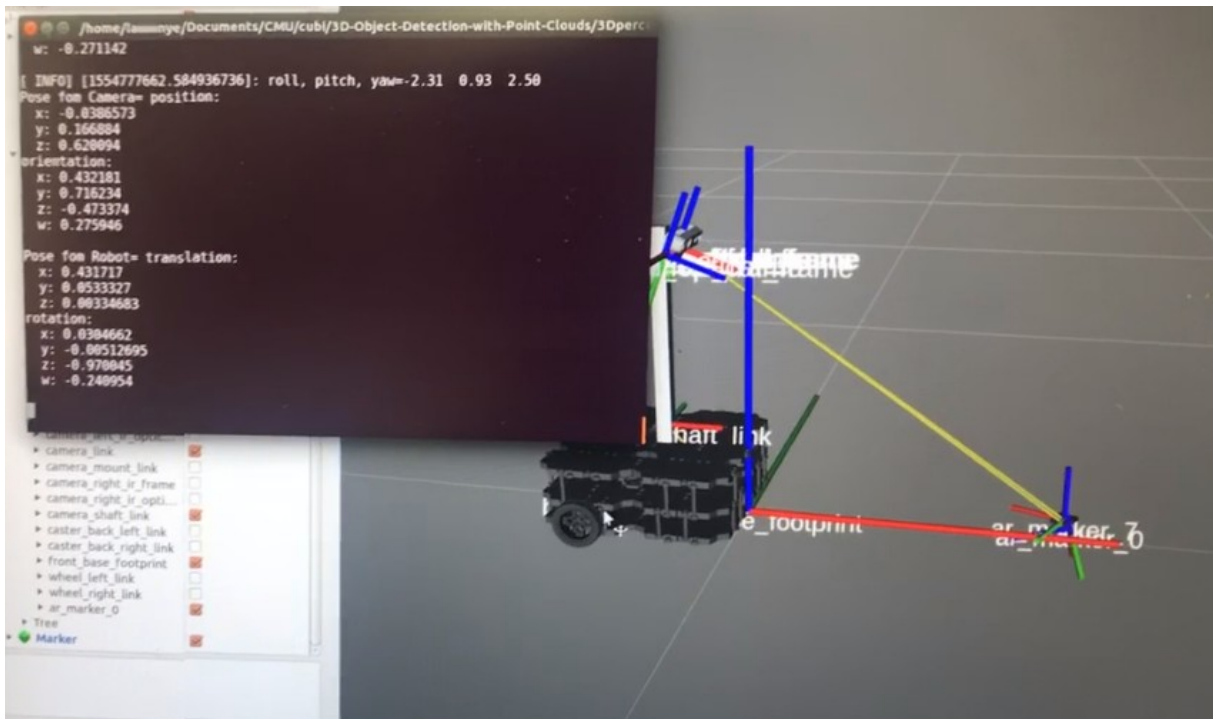
Fig. 1 Results of improved 3D object detection

Fig. 2 Alvar Tag detection

Challenges

Individual challenges:
The major challenges were/ are with their proposed solutions:

- **Noisy detections (False positives)**
  Improved the hyper parameters of the 3D detection pipeline. Tried 4-5 different methods from PCL. Developed some priors. Reordered the functions in the pipeline. Better memory management for improving speed further.

- **Objects detected that do not fit the FOV of camera**
  Found a way to see objects that touch the maximum FOV and remove them. Can identify them later when they can be seen completely.

- **Keeping track of and assigning id to individual clustered objects**
  Have to Implement SORT algorithm

Team challenges:
The major challenge for the team this time was to start integrating different subsystems. Setting up Jetson is taking a lot of time. Previously we were blocked by CMU to use the network on

Jetson. We are installing the real-sense library. Traction was another challenge as the robot was getting stuck because of the weight of the manipulator. Positions of the wheel were changed to improve this and some weight balancing was performed. One challenge that recently came up is that when the toy is small, it doesn't get gripped properly and gets stuck between the two fingers. We are looking into different lengths of the fingers as shown in **Fig. 4.**

Teamwork

Important work I did for teamwork this time was to fix the position of the camera and put he corresponding values in the URDF so that more people can work on vision without worrying about its calibration and get the poses with respect to the robot. For. Example in the case of alvar tag detection.

Following describes the work done by the team members and how I interacted with them:

Paulo:
3D printed more mounts for the LiDAR and PCB and helped Bobby to solve traction problem. LiDAR mount has been shown in **Fig3.** He also 3D printed more grippers as can be seen in **Fig 4.** I interacted with him for camera calibration and LiDAR placement.

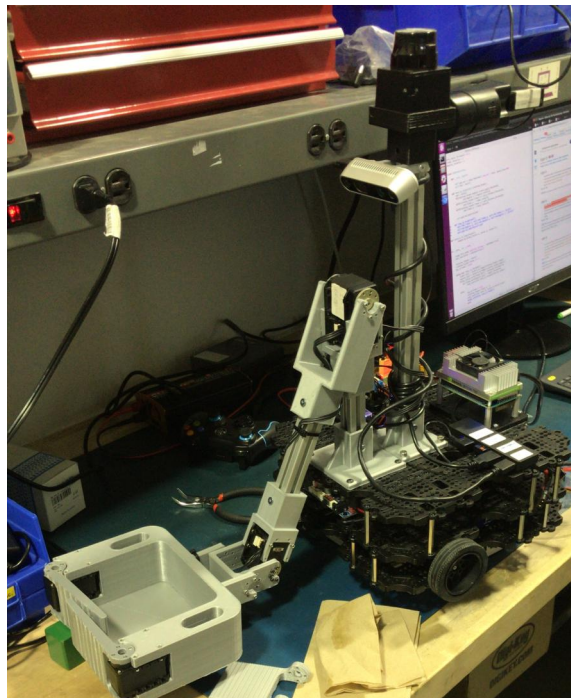**Fig. 3. Final robot assembly after changes (LiDAR mount and new wheel positions)**

Fig. 4. Various grippers

Bobby:
Attached various connectors to the PCB and attached all the components to complete the robot design. He also worked on resolving TX2 issues. I discussed with him about the final flow of our architecture and worked with him to get the required packages installed on Jetson Tx2.

Jorge and Nithin:
Worked on finalizing the motor movements (Calibration, dropping toys). They are also working on reaching target positions given alvar tag/ object pose. I interacted with them for the pipeline for target tracking and developed the alvar tag detector so that they can make CuBi reach it.

Future Work

Individual plans:
- Test 3D vision pipeline on Jetson, make the last 5% optimization for SVD.
- Maintain a list of current objects and try to assign same color to clusters rather than random colors at every frame.
- Continue R&D for learning based techniques for vision.
- Work with Paulo to complete URDF.
- Work with Jorge and Nithin on 2d object detection.

Team plans:
- Complete all requirements for the SVD.