

Individual Lab Report - 11

Team D: CuBi

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Teammates:

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Individual Progress

This week work was primarily focussed on dropping the toy into a box and other integration tasks. To drop the toy in a box, an AprilTag is attached to the box so that CuBi can detect the box's position and orientation in order to drop the toy.

Previously, the technique for dropping of a toy is described as follows:

- CuBi detects and picks up a toy.
- It then rotates and goes to the home position to drop the toy. Home position is defined as where CuBi started initially.
- A transform between the home point with respect to odom frame and CuBi base frame helps CuBi reach the home pose.

But this method was prone to errors and CuBi did not always reach the desired pose. This was aimed to improve by using AprilTags on the box. The ROS AprilTag package was used to get pose of the tag. The initial idea is described:

- To start CuBi in front of the drop box, CuBi picks up toy and now rotates to drop the toy.
- Now CuBi reaches an approach point in front of the box and gets the AprilTag pose.
- The AprilTag's pose is then used to get a desired point on the ground that CuBi needs to reach for drop-off.

The transform between the AprilTag and goal point on the ground is obtained by manually placing CuBi at the drop-off position and reading the AprilTag pose. But this method had a problem. There were still issues of misalignment while dropping. Additionally, the goal position was determined according to the odom frame which means that the map is not being used. By using the map information (frame and location) the accuracy could be better and more importantly CuBi can start from anywhere in the map instead of restricting its home position to be in front of the box.

So instead of calculating the goal pose for dropping with respect to the odom frame, every pose was calculated with respect to the map frame. This made CuBi localize better and achieve correct pose to drop the objects. Bobby helped me with all the tasks.

Also, I helped fix some issues while testing and integration. There were some issues with the testing site that needed to be fixed, for example, the alignment of the area, and remapping. Additionally, there was a mechanical issue with a broken joint in the manipulator. I helped fixing it.

There was an issue of CuBi not aligning to the toy properly to pick up. This was hard to debug as there were multiple layers of code involved in the mobility pipeline. But

CuBi always seemed to miss a toy by its right side so there was a pattern. The goal and the toy's position were simultaneously visualized on Rviz to find any discrepancies between them. It was found that there was an offset between the toy's position and goal position due to a wrong variable being published to the goal topic. Fixing this bug improved CuBi's picking up capability but it still needs to be refined.

Also, while working the Dynamixel motor of manipulator stopped working due to overcurrent. This was a big issue that we faced in the previous semester. Since we had experience with this problem, we were able to fix it quick. So, the Dynamixel SDK was used to find the motor according to its baud rate and ID. Once the motor was reset, it worked fine.

Challenges

The challenges we faced this time were mostly integration issues. One of the unexpected mechanical failures happened at a critical time. While everyone on the team had been focused on software integration, this failure made us realize that we needed extra for all the 3D printed parts. The failure occurred due to fatigue of the material. Also, numerous issues popped up when integrating systems, like false positives from the object detection pipeline which was fixed by neglecting objects too close to the walls. I faced issues in making CuBi move to the exact desired position. The code that we wrote is not really organized and that made it hard to achieve the task.

Teamwork

Jorge integrated a part of exploration strategy on to the robot. He also worked on inflating the obstacles size so that CuBi does not crash into the walls like it used to while testing. He also helped me conceptualize the toy drop off initially. Bobby worked on a lot of integrating tasks and making CuBi more robust. He took care of the overall system working. He helped me a great deal with the toy drop off too. Laavanye had been working on tuning the parameters for the object detection pipeline and making it more robust to the environment. Paulo had worked on generating way points given traversable paths. He also integrated cost function to the map so that CuBi moving close to walls will be penalized than going along the middle.

Plans

Next step for me would be to align CuBi with respect to the toys properly. Currently CuBi misses the toy when it tries to pick up by a margin. This is a pressing problem as it could derail one of our core requirements of picking up 80% toys. CuBi needs to orient itself whenever it goes pick toys off the ground. For the team, integration of all sub systems and testing are huge tasks that lie ahead of us. We are at a good place with respect to all our requirements and overall objective of our project.