Team F

Individual Lab Report 7

Progress Review 8

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Teammates

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February 16, 2018

1 Individual Progress

For this progress review, most of my work has been in deciding whether the fiducial marker limitations seen during FVE would be an issue and also continuing with the work toward the next PR. There was no specific demo for the drone this PR because the next PR will involve a significant implementation of the drone's controls.

1.1 Glossy fiducial markers

During FVE, we had some flying height issues with the Bebop 2. Specifically, there was a lot of glare from the April Tags that made flying higher impractical since the April Tags weren't being detected. The height during which this was encountered during FVE is 5m. Over the past month, we have looked at different approaches into possibly addressing this issue since we have to eliminate or invalidate this problem for SVE. The specific approaches that we tried are listed below.

1. Use non-glossy paper in an effort to find paper that reflected less. Unfortunately, talks with various print shops and an exhaustive search online have lead us to believe that the normal paper is the least reflective.
2. Use the camera mode on the drone for higher accuracy pictures. The main problem with this approach is that the camera stores files to the internal storage and needs to be ssh'd into to retrieve the files. We do not feel that modifying the underlying API driver to communicate to the Bebop 2 is worth the effort since it is unclear whether the problem lies within the ROS driver or if its an innate limitation of the Bebop 2.
3. Use a matte laminate for the paper. We could not find any reasonably priced matte laminate to put over the April Tags. The non-glossy glass covers that we found were for photos and much too expensive for our purposes.
4. Use a matte spray. This is the approach that we went with. During testing, we found that we can fly to a height of 6m without the glare becoming overwhelming. This is a modest increase of 1m.

However, we also found that during testing, it was not actually necessary to fly high. This is something that we discussed with Professor Dolan. While it may be nice to fly higher, if the drone is able to survey the entire area at 5m and with sufficient accuracy, there is no need to fly higher. The current approach works so we have reevaluated the need for this functionality and believed it to be non-mandatory.

1.2 Progress toward autonomous exploration

I'm also working toward the goal for the next PR. Specifically, for the next PR, we want to show the ability for the drone to find and navigate through a chain of April Tags. This work requires the following steps.

1. Localize the drone separately from the graph used for the April Tags. This is because tf2 does not allow for parents to be switched and thus the drone always has to be manually localized with respect to the home April Tag. This is complete - see figure below for details. Notice that the connection between the drone and the tags on the ground is between the first (home) April Tag. This is despite the fact that the first April Tag is not in view.

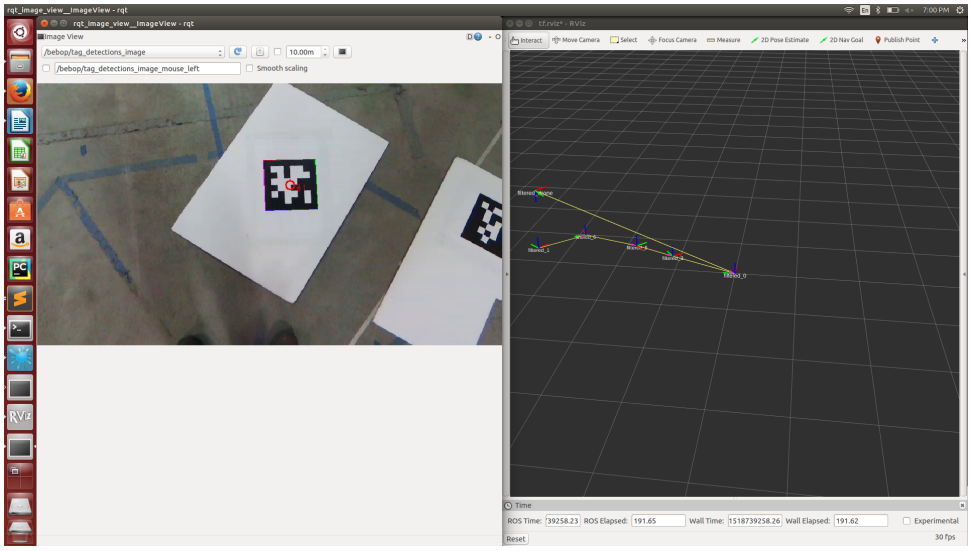

Figure 1: Drone localized separately from main graph

2. Implement a flight controller for the drone to follow a specific April Tag. Specifically, the drone needs to be able to navigate to any April Tags that it sees. This is currently being worked on.
3. Develop a graph search algorithm to select the path that goes to the node closest to the destination. For this, we will probably use a version of A* with euclidean distance as a heuristic.
4. Combine steps 2 and 3 so that at each step, the algorithm chooses the next node as the target and the drone flies to it. Iterate until arrival at destination.
5. Test outdoors.

2 Challenges

A definite challenge in trying to test the capability of the drone outdoors is the weather. The weather in the past week has been suboptimal for drone flying, especially during the weekends when the fields are empty. In addition, the cloudy overtone has made it hard to judge the effect of glare when the sun is clearly visible.

A challenge with the localization task is debugging the transforms inside ROS. Due to the bidirectional nature of the internal graph, we have to constantly be aware of whether a transform needs to be inverted. In addition, when a transform is not inverted, the mistake is not immediately obvious. Instead, it is only when the transforms start moving and they move in the opposite direction that we know something is incorrect.

3 Team work

Pulkit and Rahul worked together on point cloud filtering, clustering and segmentation. This is an important task for us as it allows us to determine the main body of an obstacle and avoid it as needed. Pratibha was involved in integrating the IMU module into the Husky platform. Danendra worked on setting up our new WiFi module so that it can cover the extended range that we need.

4 Future plans

The main focus for this semester is the AGV. As a result, Pulkit and Rahul will continue to work on the Husky and using the LiDAR to perform obstacle avoidance. In fact, the plan for the next PR is to show a basic version of this functionality. Danendra will work with Pratibha on improving the performance of the IMU and setting up the other sensors as required. I will stay on the Bebop 2 and implement an exploration algorithm for the next PR goals.