Team F

Individual Lab Report 11

Progress Review 12

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1 Individual Progress

For this PR, I worked on system integration. Specifically, I printed larger April Tags, and made the navigation of the Bebop 2 more robust by adding a neighbor exploring algorithm and controlling the hovering height.

1.1 Printing April Tags

Up until recently, we only had 10 April Tags which was enough for testing the individual subcomponents but is insufficient for testing the entire system. In our SVE specification we require 65 April Tags to cover a 50×50 meter area and thus we need this many tags to test for SVE. Additionally, the April Tags should be printed on a robust paper suitable for outdoor use. The old April Tags were printed on standard A3 paper which absorbed moisture easily and also saw the ink fading.

To get better quality April Tags, I went to the CMU print shop (Tartan Ink) and got 65 April Tags printed on hard A3 paper (Fig 1). This paper is much more robust than the standard print paper and after testing, I can confirm that it can resist most weather effects.

As well, after printing the April Tags, it was required to mount them onto a flat surface to ensure that there are no bends or curves when placed on the ground. I found a stack of cardboard sheets that nobody was using and used that as the basis for the April Tags. Unfortunately I did not find enough of these sheets and so about a third of the printed April Tags are still not mounted.

1.2 Neighbour exploring algorithm

The testing during the last progress review revealed that without an algorithm to explore the surrounding areas of a node, the exploration was not very consistent. Before, we relied on the fact that the April Tags were placed closely together such that when the drone arrived at an April Tag, it would automatically see the next April Tag and would be able to choose its next target accordingly. However, because of GPS drift and strong winds, sometimes the drone would not be position accurately to detect the next node. This would cause the the drone to incorrectly prune the correct path.

A neighbor exploring algorithm was implemented to address this issue. At a high level, previously each node had a certain radius that was used to track which nodes were visited. GPS drift would sometimes fool the algorithm into believing that it reached a node before it actually did. The neighbor exploring algorithm adds 4 more areas to explore to each node. These 4 areas form a square around the central node with the first corner facing in the direction of the target destination. Thus when a drone reaches a node and doesn't find the next April Tag, it will explore the surrounding space (and exploring the area closest to the final goal first).

1.3 Height controller

In addition to the neighbour exploring algorithm, a height controller was added to ensure that the drone flew at the best height to see the ground. We realized during testing that the drone's low level controller was very bad at controlling height during long sequences and often resulted in the drone dropping to 1-2 meters after a while. This is too low for our purposes since it will not have a large field of view. We were reluctant to use the `altitude` topic directly from the driver since that is based on odometry and has drift over time.

Instead, we merge the `altitude` data with the April Tags data. From the April Tags we can calculate the height and we use this height to determine the offset of the `altitude` data. This does depend on a continued line of sight to the April Tags to ensure that the offset remains accurate - we are hoping that the algorithm is able to do so.

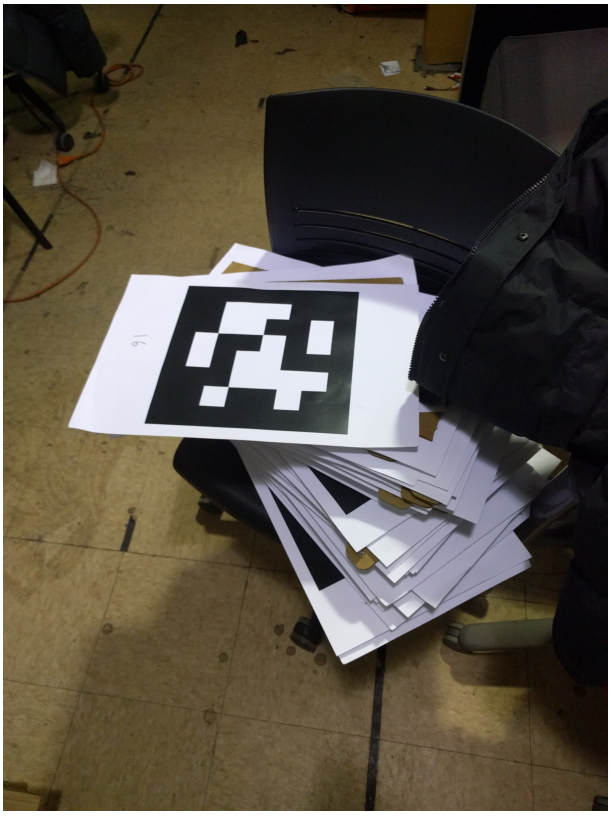

Figure 1: New April Tags

2 Challenges

Most of the challenges now are related to testing. Weather has been a consistent issue and at the time of writing, it's snowing again. Additionally, at the integration stage, a primary bottleneck is the progress on the Husky. It was originally planned to test full integration and sending locations from the drone to the rover but this wasn't accomplished in full since the Husky still had problems with localization and navigation. Thankfully this has been fixed in this PR and so should not be a challenge moving forward.

As always, we have lots of course work coming down in the final few weeks of the semester and it can be hard to dedicate time to work on the system all together. We are aiming for this weekend to perform major testing which will require all of us to finish our other work beforehand.

3 Teamwork

Rahul, Pulkit, Pratibha and Danendra worked on resolving the EKF issue. Danendra was in charge of recalibrating and reintegrating the IMU since that module was suspected to be the problem. Pulkit, Rahul and Pratibha were testing the Husky outdoors and trying various approaches to narrow down the problem. Rahul also helped me with testing the drone's new features (described previously).

4 Future plans

We had hoped to get the full system up and running for this PR since it is dress rehersal. Unfortunately that did not happen but the same goals remain. Next test is SVE so we will need to complete full system testing. Additionally, we will have to get a performance test of the system without the Bebop 2 for

comparison purposes before the SVE. We plan to do this testing this weekend (on campus if it doesn't interfere with Carnival - otherwise at Schenley park or elsewhere).