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Personal Progress

This week I focused mostly on getting our hardware set up and conducting our flight tests with the DJI Matrice 100 we are using for testing.

We first did preliminary testing with weights in a static flight (just hovering above the ground) to get an indication of how stable the altitude control was on the quadcopter as well as how much battery time we could expect for flying. The DJI Matrice is more efficient at translating sideways, so the more conservative estimate of flight time could be determined by having the quad keep it's vertical position for as long as possible. Table 1 shows the results of that first flight

Table 1

Flight Number 1	
Takeoff Weight	3.05kg
Duration	8 minutes
Results	● Stable altitude control ● Some oscillation in height due to wind gusts
Flight Number 2	
Takeoff Weight	3.45 kg
Duration	13:45
Results	● Stable altitude control ● Some oscillation in height due to wind gusts ● Battery drain from 100% to ~30% ● Position control stable, drifting slightly in higher wind speeds

After those initial tests, we proceeded with our test plan to add some additional weight to the aerial system and characterize the dynamic limits of the system. For this, we went to Schenley Park and did two flights there, summarized in Table 2, with a visual of the test in Figure 1.

Table 2

Flight Number 1	
Takeoff Weight	3.65kg
Duration	4:15
Results	● Started testing with battery at ~30% ● IMU error showed after landing ● Slightly twitchy yaw (jerked a couple of times) ● Otherwise very stable

	● Low wind environment
Flight Number 2	
Takeoff Weight	3.65 kg
Duration	7:15
Results	● Ended test with battery at ~30% ● IMU errors after landing ● Good agility under 3-4 m/s flying speed ● Dropped in altitude significantly at anything over 5 m/s ● Hovering quad remained stable in altitude and position

I also worked on the hardware and integration of the aerial system. This past week I ordered a bunch of hardware to improve the setup of the existing setup. A constant theme is making sure we are not too heavy, so I am keeping an eye on the overall weight of the system. On change I am making in this effort is to remove extraneous mounting material. For the Fall Validation experiment, we mounted the Velodyne VLP-16 LIDAR with a 3D Printed adapter plate. There are two problems with the existing solution:

- Added weight: At the current print density and existing volume, the adapter plate weighs over 60g.
- The LIDAR can still spin. This is an unfortunate byproduct of the design of the LIDAR that only includes one bolt hole and no other locating features.

To solve these issues, I'm removing the 3D printed part and attaching straight to the lightweight DJI frame plate. In addition, I ordered a set of thin jam-nuts in order to help tighten down against the bottom surface of the Velodyne LIDAR to prevent it from spinning and throwing off our map, since our map requires careful alignment of the Velodyne to the DJI Matrice axes.

In addition, I ordered some additional hardware to eliminate weight out of the Velodyne cable and control box. However, we had some problems getting some readings out of the LIDAR recently, so that task has been delayed in order to aid in the debugging of our existing setup.

Figure 1: Testing quad dynamics with weights

Figure 2: IMU error we experienced during the test flight

Challenges

The weather has only been moderately cooperative when it comes to flying the drone. It seems that whenever we have a free opportunity to test that is the day that it is snowing or raining. Hopefully with a little bit of better planning and the improving weather we won't be as hindered by this as we have been in the past.

Additionally, I personally was delayed with some ordering. We ordered a power module a while back and still have not received it, so that unit testing has not been able to take place.

These past two weeks have also been particularly busy for all of us in school, and with different project teams it's been especially hard to align schedules and make as much progress as we would like on the project.

Teamwork

Shivang

- Quadcopter flight test plan
- Obstacle avoidance control plan
- Interfacing with DJI controller for obstacle override

Hari

- Replication of software stack on Jetson TX2
- Correction of sound warning software for 3D implementation

Joao

- Obstacle avoidance control plan
- Interfacing with DJI controller for obstacle override

Nihar

- FPV camera work, hardware selection and software on Jetson TX2
- Voice commands
- Obstacle segmentation/classification

Future Work

We will be working in earnest to get the hardware finalized on the quadcopter and doing as many flights as possible in an effort to get data for development of features as well as to bring up the functionality we had in FVE in the air as soon as possible. In the next few weeks, we will also be running our first pilot feedback session to get user information in how to approach the user interface and how to convey the information we are displaying appropriately. The following are some specific tasks in order to achieve those goals:

- Finish assembly and hardware integration (Nick)
- Dynamic Flight Tests (Shivang and Nick)
- Communication Tests (Shivang and Nick)
- Obstacle avoidance control software architecture (Shivang and Joao)
- Obstacle avoidance code implementation (Joao)
- Sound warnings and software stack implementation (Hari)
- FPV Camera feed (Nihar)
- Pilot visualizations for screens (Nihar and Joao)