Individual Lab Report 6

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Team A / The Avengers

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1. Individual Progress

Over the past two weeks, I've (a) assembled and tested a new UAV platform (b) tested the NicaDrone Gripper, and (c) prototyped the sensor mounts for the drone underbelly.

a. X-8+ Build and Testing

The first task upon returning this semester was the build of our new drone, the 3DR X-8+. We moved away from the BirdsEyeView Aerobotics' FireFly6 because it is better supported and a more refined product. It is also easier to type.

The product came nearly ready-to-fly out of the box. After some troubleshooting, we successfully got the drone airborne under manual control. Difficulties of the setup are detailed below in the *Challenges* section. Our first flight can be seen in *Figure 1.* Team members practiced for half an hour indoors to get familiar with the drone and its handling. In one day, we accomplished more than we had in a month the semester before.

Figure 1: Initial Flight of the X-8+

Once I had a firm understanding of manual flight, I took the drone to Flagstaff Hill of Schenley Park in order to test the "loiter" and waypoint-following capabilities. Loiter requires GPS so it couldn't be tested inside. Testing it on the hill gave a consistent hover. However, it was marginally easier to control than the standard flight mode.

Setting up waypoint provided its own surprise due to operator error. Again, detailed in the *Challenges* section below. After some work, the drone successfully moved to a point 100

meters up and 100 meters east of the launch point. The point is shown in Mission Planner in *Figure 2.* The drone can be seen at that position in *Figure 3.*
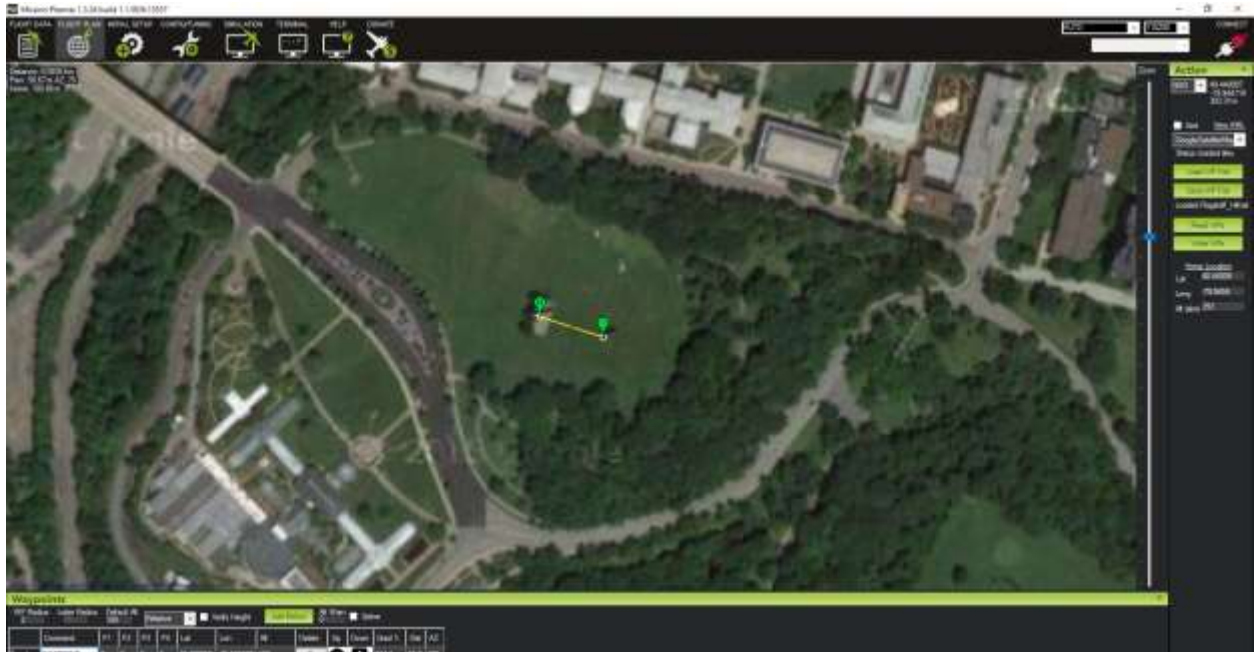

Figure 2: Screen capture from Mission Planner of Waypoint Test

Figure 3: Drone at Waypoint during Test

Mission Planner, the control interface for the X-8+ maintained connectivity even at this range. In the future, we will stay much closer to the ground

b. NicaDrone Table-Top Testing

In order to continue with our project, I had to test the functionality and performance of the NicaDrone Electro Permanent Magnet. The device can be seen in *Figure 4.* To complete the test, we connected the "gripper" to the DC power supply through the 3-pin connection on top. Only the 5v Source and Ground Terminals needed to be connected as controlling the on/off function can be controlled by the button on top. We will make use of the PWM Terminal via the Pixhawk in the future for electronic activation of the magnet.
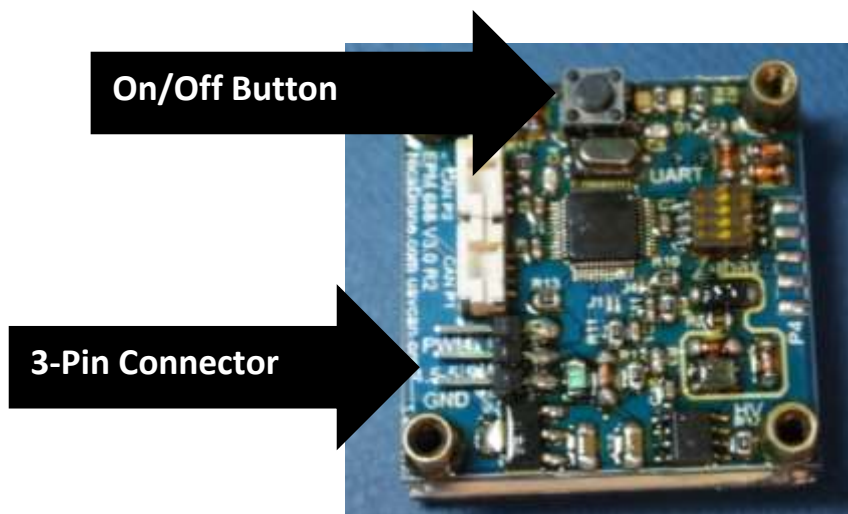

*Figure 4*: Top view of NicaDrone Electro Permanent Magnet "Gripper"

Connecting a metal plate to the bottom of the gripper, then power it on, ensured resulted in a strong connection. The exact weight is unknown; however, it is several times the weight of any box we would want to attach to the drone.

c. Underbelly Design and Fabrication

The final task that I undertook was the design and fabrication of the drone's underbelly. Specifically, I was responsible for mounting the NicaDrone Gripper, PX4 Flow, LidarLite, and camera to the bottom of the drone.

Design was done in phases. Starting with the base for the NicaDrone, we worked outward to the sides of the package. The current design attempts to balance the camera on one side with the PX4Flow and LidarLite on the other. This design minimizes the effect on the center of gravity, but still needs to be validated. The current design is visible in *Figure 5.* The current

design is modular, allowing us to more quickly tweak the individual components before moving toward a more elegant design.
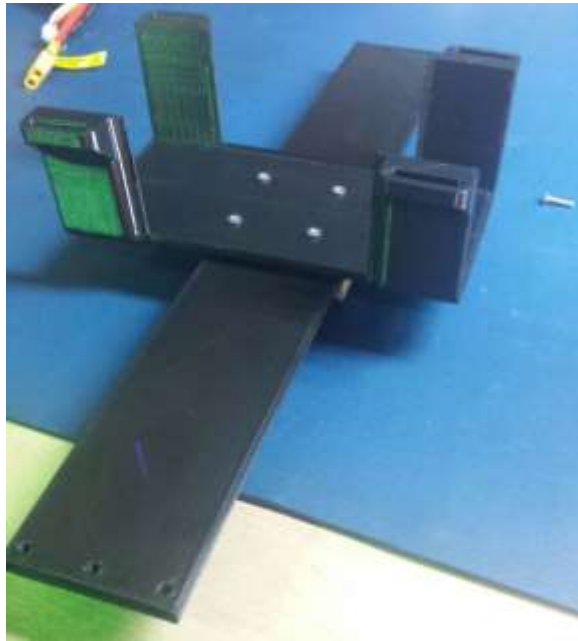
| (5.a) | (5.b) |

Figure 5: First Generation Underbelly Design. (a) Top View (b) Bottom View showing Gripper attached

II. Challenges

The assembly and testing of the 3DR X-8+ had two main challenges. The first was a calibration issue and the second was operator error.

In the first issue, a fault was caused by our inability to get a good GPS fix. At that time, Pittsburgh had heavy cloud cover and we were near several large building which further complicated the issue. On a clearer day, I took the drone to Flagstaff Hill and completed a full calibration of the drone. After that, the fault was resolved and tests of the loiter mode and waypoint-following were successful.

The second issue was a fall from 200+ feet by the drone. This was caused by a dead battery. The drone survived with minimal damage. However, we will incorporate into our procedures swapping out batteries before any waypoint test. This should eliminate similar problems in the future.

III. Teamwork

Team A made a concentrated effort return to schedule. We met over break as a team and with faculty to reevaluate our project. The team ordered the X-8+ prior to Winter Break and were able to begin working immediately upon our return for the semester.

Each team member took on different components of the task. This allowed the team to build their individual skillsets while expediting the work.

Tushar Argawal

Tushar has continued progress with the Odroid. In addition to establishing a full backup on a second Odroid, he successfully connected the Odroid to the Pixhawk. He is now able to view Pixhawk data via the Odroid and to send commands from the Odroid to the Pixhawk.

Pratik Chatrat

After careful analysis of the requirements of the new platform, Pratik abandoned the sonar array in favor of the Hokuyo Lidar. He has also been working on the navigation stack for the drone. The navigation stack is able to calculate a path and velocities to a selected point using information from odometry, Hokuyo, and a transform.

Adam Yabroudi

Adam has officially left the team and will no longer be featured in future ILRs.

IV. Plans

Before the next PR, the team has four main goals:

1. Contol UAV using Laptop
2. Integrate LidarLite
3. Modify Package for NicaDrone Integration
4. Run Navigation Stack in Simulation