Progress Review 11
Project Pegasus

Tushar Agrawal

Team A – Avengers Ultron
Teammates: Pratik Chatrath, Sean Bryan

ILR #10
March 31, 2016

1. Individual Progress

After the last Progress Review, the UAV was capable of autonomous takeoff and landing in addition to finding a visual marker and following it. Also, basic obstacle avoidance was demonstrated.

Controlling Nicadrone (Electro Permanent Magnet) using Odroid
We had demonstrated that the Nicadrone can be used to pickup and drop packages through pixhawk (the flight controller). This was demonstrated using the Ground Control GUI. I decided to set up the control of Nicadrone using the Odroid. As we had shifted to the PX4 software stack, the standard DO_SET_SERVO mavros messages were not available. Based on my research and understanding of the PX4 Firmware, the current system allowed direct actuator control, but it overrides the position control required for autonomous motion. I made minor tweaks to the firmware to enable secondary actuator control (actuators not responsible for flight) while maintaining position control separately. Appropriate mixers were enabled to forward actuator control data to the motor ports. Finally, I made a code for the Odroid which sent appropriate actuator control messages through mavros to engage and disengage the Nicadrone.

By default the NicaDrone would continuously disengage. Hence, when an engage command was sent to the Nicadrone, it would engage and then disengage again continuously. Later, I discovered this was because due to the firmware tweaks, the RC CH7 was directly linked to the Nicadrone and was causing the continuous disengage of the Nicadrone. I needed the RC to send neutral PWM (which causes the Nicadrone to hold current position) instead of disengage, but the CH7 switch on the RC only allowed LOW and HIGH PWM. As CH6 knob was capable of sending full range of PWM vallues, I used the mixer on the RC controller to send CH6 values as CH7, which gave full RC control on Nicadrone. And finally, after setting the RC Nicadrone channel to neutral, the engage command worked perfectly from the Odroid. Image 1 shows the RC CH6 and CH7 controls. It is noticable that CH6 is only a 2 position switch, while CH7 is a rotatable knob.

Image 1: The RC controller showing channels 6 and 7. As seen, CH6 can accommodate all PWM values whereas CH7 can only accommodate 2 positions

Video 1 (https://youtu.be/DfzokrjzPI8) demonstrates the package delivery process without obstacle avoidance.

Tuning navigation stack parameters for Obstacle Avoidance

Based on the performance of obstacle avoidance in the last progress review, Pratik and I continued to test and tune the navigation stack. We tested multiple sequential goals for forming the lawnmower search pattern. We faced several issues in this setup. At low altitude, the UAV was not able to maintain its altitude from the ground which led to deformed lawnmower trajectories. As shown in the Progress Review, the trajectories are relatively better formed at higher altitudes, but it is difficult to test obstacle avoidance at such altitudes.

After several tuning iterations, the trajectory control was relatively better, but still worse compared to position controlled trajectory. (as shown in package delivery without obstacle avoidance)

Results are seen in video 2 (https://youtu.be/PA02JiuCp_w) as shown in the Progress Review.

Miscellaneous

After suffering a few crashes, we decided to buy a full spare set for all parts of the UAV. As this model had been discontinued (in Feb 2016), spare parts were soon drying up in the market. I found an on-line marketplace which still had few parts available, but were

only able to get a spare set of fiber parts as everything else was sold out. Finally we have spares for almost everything except the aluminum arms, which we do not expect to damage beyond repair.

2. Challenges

We had multiple challenges in this week:

- The nicadrone control through Odroid was challenging. In the first version, everything would work fine until the RC was switched on, after which the nicadrone started disengaging continuously. This was finally resolved by changes on the RC side and ensuring that the RC package control was set at the neutral position.
- Multiple crashes of the UAV led to several quick repair steps. Most of these worked well, but the health of the UAV is depleting. As a result, we have ordered further spare parts.
- Parameter tuning for navigation stack is also proving to be a challenge, especially when the UAV velocity control seems to be less stable at low altitudes.

3. Teamwork

As per our test plan goals, we set up the entire package delivery system without obstacle avoidance and are continuing to tune the navigation stack for multi-waypoint trajectory execution.

Pratik and I worked on worked on the tuning parameters and trying to stabilize the UAV at low altitude flights.

We both helped Sean, who fabricated the previously designed flagpole style obstacles.

After multiple UAV crashes, we all worked on repairs and decided which spare parts were critical for our SVE.

We plan to further refine the package-less delivery and add the functionality of returning back to initial position after delivering the package. Secondly, we want to tune the navigation stack parameters for smother trajectories at relatively lower heights (around 5-6m), and use the flagpole style obstacles for obstacle avoidance.