Faculty of Engineering and Applied Science
ENGR 4940U Capstone Systems Design for ECSE I

Low Cost Drone Light Show

Team Retrospective Report

Group - 34
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1. Things That Went Well

Understanding General Drone and Drone Light Show Technology

Going into this semester, our group had limited knowledge on the exact mechanics of a drone and how a drone light show works. One of the main things that went well this semester was for us to build a strong knowledge base on drone mechanics and software. This included research about the critical components, types, use cases, electrical connections and the physics behind drone flight. Understanding drone light shows and existing technologies such as Intel Shooting Star and Spaxel also helped us brainstorm ideas on how we could incorporate the main theme of a light show in a low cost setting. Only by understanding these base principles, were we able to come up with our design plan.

Auto-path set up for single Tello EDU drone

Setting up an auto-path for the Tello EDU was one of the main goals of this semester. This is because one of the main requirements of a drone light show is to have a pilotless flight path. The drone must be able to move to a certain location or formation without the use of manual guidance from a pilot. After setting up the UDP connection through the Tello WI-FI access point, we were able to customize a script to set a default list of commands for Tello to follow. The driver script was used to read a command text file, which fed the read commands into the Tello Object stored in another script. This connection allowed us to set all of the commands we wanted Tello to follow without the need for a manual user control.

Creation of manual commands to be read into Tello

Having an expandable and scalable program was vital to ensure that we can further continue towards our project goal of setting a drone light show. Another component that went well this semester was being able to customize how and what types of commands we want to send to Tello. The default Tello SDK 2.0 offers a variety of commands that can be used to control Tello but we knew that to create a drone light show, we would need to initialize different commands in order to control the formations. We were able to create our own “poly” method which allowed a single Tello EDU drone to fly in a formation to create any regular polygon of choice by the user. This is important moving forward as we want to incorporate these custom commands for multiple drones to follow. Another critical component to this semester was having a way for the commands to be easily configured as we want to expand this project to be customizable by a user through a UI such as a mobile application.

2. Things That Surprised Us

Cost of Drone and Drone Parts for custom build

When starting this project earlier in the semester, we had anticipated that the cost of drones would be very high and thus, opted into researching more about making our own custom build. The ultimate thing that surprised us was the high cost of building the drone from scratch and through various research, the lower cost of a Tello EDU drone. This discovery made us change our initial approach to the project and led to the decision to pursue the Tello EDU path.

Initialization of the drone upon receiving and setting up UDP connection

When setting up the UDP client connection to Tello EDU drone, we had an issue due to hardware configuration that was needed. When we received the Tello EDU, we were not expecting this problem and had to do research through various sources in order to figure out the issue. After writing out the script, we were certain that this was not a software issue. Turns out that recalibration of a Tello Drone was needed sometimes when using a new drone for the first time. This can be done through the default Tello app which upgraded the firmware.

Battery consumption of Tello EDU drone

When we were researching options for different drones, we came across Tello EDU due to its convenient connectivity through a WI-FI access point and UDP set up. Something that we did not consider was the battery life of a Tello EDU which is around 13 minutes flying time compared to 1.5 hour charging time. Although we had brought a spare battery, this made testing as we were configuring the scripts to be less efficient as we had to wait for the battery to charge before proceeding further.

3. Lessons Learned

Setting up proper physical testing environment

One of the core components of a drone light show is to set up an auto-path for the drone to follow. This means that no manual control should be needed. When we were first creating and testing the commands, there were times when the drone was not acting as expected which caused it to crash into nearby objects or make abrupt movements. Although the drone is relatively durable throughout different incidents, we quickly learned that having a proper testing environment was critical to ensure that we do not break the functionalities. This included setting proper cushioning at takeoff and landing points, removing all nearby obstacles and ensuring enough room is allotted.

Investing in backup battery and additional charging dock
As mentioned, one of the lessons learned from this past semester is the limited battery life that Tello EDU drones have. This made testing our scripts to be inefficient at times as this could not be done simultaneously and ultimately used up more time. We will be investing in more back up batteries and charging docs to ensure that we can switch out the battery as needed.

4. Final Thoughts

Throughout this semester our team has gained a better understanding on what needs to be done in order to have a successful experience with drones. We have also gotten more comfortable with working with drones, ensuring that next semester will be an easier experience when it comes to working with multiple drones and continue to build upon our design. As mentioned there were many obstacles we had to overcome, but having successfully passed them this semester we feel navigating our issues next semester will be easier.