Low Cost Drone Light Show

Detail Design and Integration Testing Report

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Group 34

A report submitted in partial fulfillment for the final year Capstone Project in the Faculty of Engineering and Applied Science.

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Table of Contents

List of Figures

No figures were included in this report.

List of Tables

Abstract

The Low Cost Drone Light Show, now officially deemed Project Firefly by the team, is a project that aims to solve the problems of lack of accessibility to drone light shows by public audiences. Drone Light Shows are a form of entertainment and amusement in the likeness of how Fireworks are. You would commonly find Fireworks at a party, an amusement park or on holidays of celebration. However, research and findings shows that Fireworks are not very safe and in fact, cause harm to the environment. Hence, the problem to be solved—this is where drone light shows come in. Drone Light Shows, an already established form of entertainment, provide that same thrill of excitement, if not more, as fireworks do. It requires having movements and sequences of thousands and thousands of drones with lights to create incredibly appealing visuals. The cost for these however, are quite high. This project, therefore, is looking to create and solve the problem of the high cost of drones light shows so that even you, can create one at your parties, celebrations, or even in your living room!

This report will be discussing the progression of the Low Cost Drone Light Show capstone project with particular focus on the acceptance testing progress.

Dedication

To our families and friends.

Acknowledgements

We would like to express gratitude to each other and the time and effort put in to continue and grow this project further in this semester. We would also like to give a nod of thanks to our supervisor, Dr Lixuan Lu and coordinator, Dr Vijay Sood.

Above all, we would like to thank our parents, families and friends for their unwavering support throughout our university years bringing us here, to this final lap. Thank you.

Overview of the Report

This report will be discussing the progression of the Low Cost Drone Light Show capstone project with particular focus on the acceptance testing progress. The testing protocol in response to each requirement is detailed within this report. It includes sections on the Installation Qualification, Operational Qualification and Performance Qualification stages of testing which applies to the drones and mobile application involved in this project..

Acceptance Testing Overview

Testing protocol for this project has been divided into the following phases including Installation Qualification (IQ), Operational Qualification (OQ) and Performance Qualification (PQ). Due to the multiple parts associated with this project, testing on the drone and mobile application components will be done both separately simultaneously before testing the application as a whole.

Installation Qualification

The purpose of installation Qualification includes ensuring proper setup of equipment. This applies to the drones which is the main equipment in this project. The following test cases were used in order to validate this stage.

Installation Qualification

Table 1.0 Installation Qualification - Drone Testing

Test Case #	Description	Test Step	Expected Result	Status
	Wireless network Configuration for the Router. SSID: FireFly Subnet Mask: 255.255.255.0	Connect external devices (2) onto the network.	Devices shall connect to the network with no errors.	PASS
	Test Network Connection for Drone 1.	Connect to Tello Network and send UDP command packet to 192.168.10.1 Port 8889.	Packet shall respond “ok”	PASS
	Test Network Connection for Drone 2.	Connect to Tello Network and send UDP command packet to 192.168.10.1 Port 8889.	Packet shall respond “ok”	PASS

	Test Network Connection for Drone 3.	Connect to Tello Network and send UDP command packet to 192.168.10.1 Port 8889.	Packet shall respond “ok”	PASS
	Test command response for Drone 1.	Connect to Tello Network and send UDP command Battery packet to 192.168.10.1 Port 8889.	Packet shall respond “{}/r/n” where {} is the battery of Tello.	PASS
	Test command response for Drone 2.	Connect to Tello Network and send UDP command Battery packet to 192.168.10.1 Port 8889.	Packet shall respond “{}/r/n” where {} is the battery of Tello.	PASS
	Test command response for Drone 3.	Connect to Tello Network and send UDP command Battery packet to 192.168.10.1 Port 8889.	Packet shall respond “{}/r/n” where {} is the battery of Tello.	PASS

Operational Qualification

The purpose of operational qualification is to test that the components function as intended. This stage applies to both components: drones and mobile applications. The following test cases were used to validate this stage.

Drone Testing

Table 1.1 Operational Qualification - Drone Testing

Test Case #	Description	Test Step	Expected Result	Status
	Configure and send command.txt file to drone 1 for Auto Flight Path. command.txt should include the following: command takeoff left 20	Connect to Tello network and send configured text file with app.py script through terminal.	Drone 1 shall execute 7 commands in order with no errors.	PASS

	right 20 up 10 down 10 land			
	Configure and send command.txt file to drone 2 for Auto Flight Path. command.txt should include the following: command takeoff left 20 right 20 up 10 down 10 land	Connect to Tello network and send configured text file with app.py script through terminal.	Drone 2 shall execute 7 commands in order with no errors.	PASS
	Configure and send command.txt file to drone 3 for Auto Flight Path. command.txt should include the following: command takeoff left 20 right 20 up 10 down 10 land	Connect to Tello network and send configured text file with app.py script through terminal.	Drone 3 shall execute 7 commands in order with no errors.	PASS
	Test shape formation function “poly” which directs the drone to fly in a specified polygon formation. Add the following command to the txt file: command takeoff poly 5	Connect to Tello network and send configured txt file with app.py script through terminal.	Selected drone shall execute the 4 commands and the drone shall fly in pentagon formation.	PASS

	land			
	Switch Drone 1 to AP mode. Create command in Packet Sender with network SSID: FireFly and password: TelloEDU12345.	Connect to Tello Network and send UDP command configure AP packet to 192.168.10.1 Port 8889.	Packet shall respond “OK, drone will reboot in 3s”. Drone shall flash yellow.	PASS
	Switch Drone 2 to AP mode. Create command in Packet Sender with network SSID: FireFly and password: TelloEDU12345.	Connect to Tello Network and send UDP command configure AP packet to 192.168.10.1 Port 8889.	Packet shall respond “OK, drone will reboot in 3s”. Drone shall flash yellow.	PASS
	Switch Drone 3 to AP mode. Create command in Packet Sender with network SSID: FireFly and password: TelloEDU12345.	Connect to Tello Network and send UDP command configure AP packet to 192.168.10.1 Port 8889.	Packet shall respond “OK, drone will reboot in 3s”. Drone shall flash yellow.	PASS
	Locate IP of drones by running network-scan.py script.	Connect to FireFly Network and run network-scan.py in the terminal.	Terminal shall display a list of IPs and indicate online IPs for 3 drones.	FAIL
	Swarmed drones should fly with one script sent. Test swarmed drone by running command.txt on FireFly Network where all drones are communicating. Add the following into command.txt: scan 3 battery_check 20 correct_ip 1=0TQZK7NED02VM	Connect to FireFly Network and run commands txt file with app.py script in the terminal.	All 3 drones shall execute commands in order with no errors.	FAIL

	T 2=0TQZK7JED02TVJ 3=0TQZK5DED02KHL *>takeoff sync 5 *>land			
	Test shape formation function “vertical” which directs the drone to fly into a vertical formation.	Connect to the Firefly network and send configured txt file through the terminal to swarmed drones.	Drones shall fly into vertical line formation.	IN PROCESS
	Test shape formation function “horizontal” which directs the drone to fly into a horizontal formation.	Connect to the Firefly network and send configured txt file through the terminal to swarmed drones. terminal.	Drones shall fly into horizontal line formation.	IN PROCESS
	Test shape formation function “wave” which directs the drone to fly in wave formation.	Connect to the Firefly network and send configured txt file through the terminal to swarmed drones. terminal.	Drones shall fly in wave formation.	IN PROCESS
	Test shape formation function “triangle” which directs the drone to fly into a triangle formation.	Connect to the Firefly network and send configured txt file through the terminal to swarmed drones. terminal.	Drones shall fly into a triangle formation.	Not tested

Mobile Application Testing

Table 1.3 Operational Qualification - Mobile Application Testing

Test Case #	Description	Test Step	Expected Result	Status
	Get Started Button. This button should take the user from the splash screen of the Firefly app, to the login screen.	Click login.	User shall be navigated to the login screen.	PASS
	Login Button. This button should	Login with an authorized	User shall be navigated to the dashboard screen.	PASS

	confirm an authorized user through authentication from Firebase database and take them to the Dashboard screen if successful.	account and click login.		
	Login Button. This button should not allow unauthorized accounts to login.	Login with an unauthorized account and click login.	User cannot login and the following prompt appears on screen: “Unauthorized user, please try again with a valid username and password.”	PASS
	Signup Link on Login Screen. This link should take the user to the Signup screen.	Click on the Signup link. .	User shall be navigated to the Signup screen.	PASS
	Signup Button. This button should insert the user’s information into the Firebase Database and automatically to the Dashboard screen.	Fill in sign up information and click sign up. Then login with a newly created account.	User information shall be added to Firebase Database. User shall be navigated to the dashboard screen upon login.	PASS
	Home Icon on Navigation Bar. This icon should navigate the user to the Dashboard screen.	Click on Home Icon.	User shall be navigated to the dashboard screen.	PASS
	Profile Icon on Navigation Bar. This icon should navigate the user to their profile screen.	Click on Profile Icon.	User shall be navigated to the user to their profile screen.	PASS
	‘Connect Drones’ Button. This button should take the user to the ‘Connect Drones’ screen.	Click on Connect Drones.	User shall be navigated to the ‘Connect Drones’ screen.	IN PROCESS

	‘Make Light Sequence’ Button. This button should take users to the ‘Make Light Sequence’ screen.	Click on Make Light Sequence Button.	User shall be navigated to the ‘Make Light Sequence’ screen.	IN PROCESS
	User should be able to create a Light Sequence from options provided for the number of drones indicated. User can see the options on screen for selection for 3 drones: takeoff land vertical horizontal left right up down wave poly flip	Click on options to make a light sequence then click confirm.	A light sequence shall be created. User is directed to the confirmation screen when confirm is clicked.	IN PROCESS
	Logout Button. This button should log the user out of the app.	Button click	User shall be logged out of the app.	IN PROCESS

Performance Qualification

The purpose of performance qualification is to test stability of the component under operating conditions to ensure intended performance. This stage applies to the integration of all components and the following test cases were used to validate this stage.

Integration Testing

Table 1.4 Performance Qualification - Integration Testing

Test Case #	Description	Test Step	Expected Result	Status
	Authorized User is able to login into the app.	Fill in login information and click the Login button.	User shall be navigated to the dashboard screen.	IN PROCESS
	User is able to access the Light Sequence Screen and options for drone formation are presented. Create the following sequence: takeoff vertical horizontal wave triangle land drone 1 Poly 5 land drone 2 Poly 4 land drone 3 Poly 3 land	Click on Light Sequence from the navigation bar and create a sequence.	Light Sequence can be created by user with no errors.	IN PROCESS
	Drones are able to execute the same light sequence created from previous test case.	Execute the commands.txt created from the previous step to the drones.	Drones execute all commands as indicated in the commands.txt with no errors.	IN PROCESS

Contribution Matrix

Table 1.5 Contribution Matrix

	Michelle	**Munazza**	**Rodaba**	**Nivetha**	**Toluwanimi**
Acceptance Test Overview	yes	yes	yes	yes	yes

Conclusions and Future Work

This report is an update on the continuation of the project of the ‘Low Cost Drone Light Show’ (Firefly). It outlined the progress on the acceptance testing phase on all components of this project. This includes testing on the drones, mobile application and planned integration tests when the system is integrated as a whole. The overall application is a work in progress which will be further explained in the next report. Updates these test cases will be done in the final report for this project.

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