

First Semester Progress Report

Programmable Flight Controller

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Abstract

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1 List of Acronyms

1. BLDC - Brushless Direct Current
2. GUI - Graphical User Interface
3. PWM - Pulse Width Modulation
4. ESC - Electronic Speed Controller
5. USB - Universal Serial Bus

2 Objectives and Deliverables

2.1 Overall Objective

The main objective of the project is to develop a programmable flight controller that responds appropriately to control inputs and disturbances. The flight controller will receive control inputs over WI-FI from a base station. The base station can be any device that is WI-FI enabled and has the appropriate software installed. The software on the base station will be a graphical user interface (GUI) that allows the user to send control inputs to the drone and view statistics of the drone during operation.

The objectives of the project have been broken down into what will be accomplished in the first semester (Short term objectives) and what will be accomplished in the second semester (Long term objectives). These objectives along with specific details of each can be viewed in sections 2.2 and 2.3 respectively.

2.2 Short Term Objectives (October 2016 - December 2016)

2.2.1 Simulation

The simulations will allow us to gain an understanding of how the controller will respond to specific inputs. The simulation can then be tuned until the output is within the constraints set by Dr. Rhineland. We will be simulating both the flight dynamics and controller using MATLAB and Simulink exclusively.

2.2.2 Construction of the Drone

The drone parts will arrive separately and assembly will be required. The extent of the assembly will be to attach the 4 brushless DC motors and batteries to the base of the drone. On top of the assembly the preliminary layout of the required hardware will be decided on. The layout is subject to change as we begin the final assembly in the second semester.

2.2.3 Initial Design of the Controller

A preliminary design of the flight controller will be constructed in software.

2.2.4 Initial Testing

The initial design of the controller will be tested using the brushless direct current (BLDC) motors supplied by Dr. Rhineland. The initial tests will allow us to gain insight on what changes to the flight controller must be made in order to meet the constraints. Along with the testing of the controller

tests will be conducted to characterize the BLDC motor and electronic speed controller (ESC)

2.3 Long Term Objectives (December 2016 - April 2017)

2.3.1 Graphical User Interface Design

The graphical user interface (GUI) will be installed on any base station intended to be able to operate the drone. The key features of the GUI include: A means to access the controller, displays drones position (Coordinates and altitude) and the ability to load a new build onto the drone. Some minor features will include: displays the current software build on the drone, current flight time and total flight time.

2.3.2 Base Station Configuration

This will entail installing the GUI onto the base station and configuring the base station network adapter to be able to communicate with the raspberry-pi on the drone.

2.3.3 Network Tests

The intent of the network test is to gain an understanding of the network strength at various distances. A preliminary idea of how these tests will be conducted is to ping the raspberry-pi from the base station to see the time of response at these distances.

2.3.4 Final Controller Tests

The final controller tests will be identical to the tests run during the first semester of the project. The purpose of these tests will be to verify that the appropriate changes were made in order to meet the defined constraints so that flight tests of the drone may be completed.

2.3.5 Flight Tests

The flight tests will be run to validate that each constraint has been met to the best of our ability. The tests include, but are not limited to: looking at the drones response to disturbances, response to control inputs, response to loss of communication and verify that the GUI is reporting the expected data.

2.4 Deliverables

The final deliverables will be as follows:

1. Constructed drone
2. User manual
3. Graphical User Interface

2.4.1 Constructed drone

The constructed drone will consist of the base and BLDC motors supplied by Dr. Rhineland. The microprocessor and microcontroller used for de-

velopment and testing are property of Dylan Humber and Lucas Doucette respectively.

2.4.2 User Manual

The user manual will outline technical details of the controller design, instructions on how to use the GUI and characteristics of BLDC motors and ESC's.

2.4.3 GUI

The GUI will be loaded on to a Universal Serial Bus (USB) so that it may be installed on any device that Dr. Rhinelanders desires to act as a base station. The graphical user interface will be able to be installed on Linux, Windows and MAC devices.

- 3 Background and Significance
- 4 Proposed Approach and Validation
- 5 Preliminary Report
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- 7 Distribution of Tasks
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