



Mailbird

PROPOSAL FOR AN AUTONOMOUS DELIVERY SYSTEM
WEDNESDAY, JANUARY 22, 2014

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1 Project Description

ABSTRACT

This document details the preliminary approach to an autonomous package delivery system. A summary is given of the design specifications, and of the system that will be created to satisfy those conditions. Consideration is given to design decisions, technical specifics for implementation, and the anticipated use of the completed system. In addition, procedures are defined for project management, financial operations, and distribution of equipment after project completion.

EXECUTIVE SUMMARY

MailBird is a proof-of-concept automated mail system. A successful guidance system will use GPS to bring a quadcopter within five feet of the desired landing area. Subsequent to GPS localization, it will use a custom built guidance module to dock within a tolerance of 1 inch. The technical aspect of the project will be designing an aircraft guidance module and associated ground station (if necessary) to land in a precise location carrying a deliverable. This will be accomplished with a quadcopter equipped with an augmented precision external landing module (APELM), for extreme accuracy. The APELM will be designed to use infrared optics and LEDs to determine position. This module will interface with the flight controller to guide the docking procedure. After creating an effective, precision landing system, if time allows the system will be extended to include a software suite and mail delivery peripherals. The final result will be a comprehensive autonomous delivery system supported by a suite of a custom-designed scheduling, pick-up and delivery software.

2 Technical Approach

DESIGN STANDARDS

GPS frequency/information protocol – GPS data transmitted over the L1 frequency band (1575.42 MHz), using NMEA 0183 data protocol.

Flight Height – *H.R. 658 (FAA Air Transportation Modernization and Safety Improvement Act). SEC. 334 (b)* Standards for Operation and Certification – Not later than December 31, 2015, the Administrator shall develop and implement operational and certification requirements for the operation of public unmanned aircraft systems in the national airspace system. This will most likely be close to SEC. 334 (c) Agreements with Government Agencies (2) The agreements shall – (C) allow government public safety agency to operate unmanned aircraft weighing 4.4 pounds or less, if operated – (ii) less than 400 feet above the ground; (iii) during daylight conditions; (v) outside of 5 statute miles from any airport.

RC Frequency – Manual flight control transmitted over 2.4GHz spread spectrum.

MARKET CONSTRAINTS

The MailBird system is intended to deliver small packages from a central hub to predetermined mail-drop locations. The idea is directed towards a market that requires frequent or scheduled delivery of packages with essentially immediate delivery. Market attributes including economic feasibility, manufacturability, public health and safety, social opinion, environmental impact, and political implications were taken into consideration when designing the MailBird system.

In order for the project to be marketable at all it must first and foremost be designed with the idea of profitability. With a low investment cost for the entire system and even less when equipping the tracking module to an already built Arduino based delivery system the MailBird is easily and cheaply integrated into any delivery role. However the true gain comes from savings in labor and fuel costs. The MailBird is completely electric requiring only to be charged after every fifteen minutes of flight time. LiPo batteries power the system mainly due to their power to weight ratio, but also because they hold long battery life up to 1000 charge cycles and a cheap replacement cost. With a designed ten minute flight radius and instantaneous delivery the MailBird is designed to increase the productivity and satisfaction of an entire campus.

The system is designed to be manufactured as two separate components that when combined make up the complete MailBird delivery system. The first component is the landing sensor and algorithm which are simply manufactured on a printed circuit board to be attached to a number of autonomous delivery vehicles. The second component, the quadcopter requires human interaction to manufacture and test. Combining the two components using I/O ports on the Arduino based flight controller completes the MailBird delivery system. The final step for user compatibility requires developing delivery routes to fit each campus setting.

Considerations when designing delivery routes on heavily populated campuses include avoiding densely foot traffic areas as well as developing delivery schedules around times with high pedestrian activity. The most dangerous aspect of the system to human safety is the four propellers approaching speeds of 1090rpm which provide lift and maneuverability for the MailBird. Propeller guards have been added into the quadcopter design in an attempt to prevent any incident.

Even though any unwarranted malfunction that would cause the quadcopter to fall out of flight could possibly be dangerous to the public the design chosen develops a simple, clean, safe image in the public eye. This image along with custom designed flight paths avoiding areas of high traffic and at the maximum altitude allowed by law will keep the MailBird out of a weary public eye.

Using the maximum allowed altitude not only eases the mind of the public, but it also cuts down on the noise pollution to the environment. Designed to fly at an altitude upwards of 400ft the MailBird delivery system is barely audible. The system is also 100% electric only requiring 33W per charge.

However, it is not only the minds of the public that must be convinced of its safety and ethics, the design is also largely shaped by politics and government regulations. Recently with allegations of the government's invasion of privacy and the fear of drones being folded into this spying scheme there is a fine line to what robots can be designed to do. The MailBird design does not contain a video camera that could be used for unwanted data acquisition. If not handled correctly it may be equipped with aftermarket components for unwanted militarization or espionage. The MailBird is designed to calculate accurate altitude information in order to abide by FFA airspace regulations and remain on a level legal for RC vehicles.

3 Management Approach

4 Budget

5 Timeline

6 Facilities To Be Used

DESIGN LAB – HARDWARE CONSTRUCTION

Development of MailBird's hardware components will use lab facilities provided by Auburn University. Lab 368, a research lab provided by Dr. Roppel provides the necessary tools to manufacture and test the electrical circuits required to build the APLEM. The lab provides design tools such as bread boards and soldering irons and expendables such as wire, resistors, capacitors etc. The lab will also serve as the primary location to store and assemble the quadcopter and APLEM module. The MailBird team (Team 1) has recovered the first workbench on the left wall of 368.

LABS 308 & 310

The computer labs provided by the Auburn University Electrical Engineering Department will be the primary location for software development, team meetings, document preparation, and presentation preparation. The labs provide fast computers with large monitors for group work and software development.

TESTING

During the initial design phases of MailBird, testing requiring flight by the quadcopter will take place outside. During development, the unpredictability of flight paths and the need for accurate GPS coordinates necessitate (for the safety of the craft and other people) that a wide open area be used. Later in the development process when the aircraft's flight has become more stable and predictable the APELM system can be tested and refined inside Lab 368.

7 Disposition Agreement

A Disposition Agreement executed as of January 13, 2014 and effective as of the 1st day of May, 2014, by and between Auburn University and Hugh Dillon, Rick Holloway, Zach Hawkins, Ben Smith, Hunter Thorington was created to ensure the fair and proper transfer of all MailBird property at the end of the semester. This agreement can be found in Appendix I.

Appendix I

DISPOSITION AGREEMENT

This Disposition Agreement (this "Agreement"), executed as of January 13, 2014 and effective as of the 1st day of May, 2014, by and between Auburn University herein "Auburn" and Hugh Dillon, Rick Holloway, Zach Hawkins, Ben Smith, Hunter Thorington (herein "Team 1") In consideration of the mutual promises and covenants herein contained, the parties hereto agree as follows:

WHEREAS, Rick Holloway has agreed to lend full and unrestricted use and access to his personal custom model quad copter, herein "the Bird" to Team 1 for time period January 13, 2014 – May 1, 2014

WHEREAS, Auburn shall not retain any rights to the use of or access to Rick Holloway's "the Bird"

WHEREAS, Team 1 shall accept as repayment for Rick Holloway's generosity that all personal expenditures required for the development of "the Bird" shall be relinquished to Rick Holloway as personal property.

NOW THEREFORE, subject to the terms and conditions herein and acceptance by the Transferee Rick Holloway, and the Transferor Team 1 hereby agree to undertake the following actions as defined in Article I herein for the consideration stated herein.

ARTICLE I

TRANSFER OF THE BIRD

1.01

Immediately upon the execution of this Agreement the Transferor shall transfer the Bird to Rick Holloway.

1.02

The bird shall be free and clear of all liens and encumbrances and the Transferee shall have good title to the Bird immediately upon the execution of this Agreement.

By:

/s/ Thaddeus Roppel c/o Auburn

/s/ Zach Hawkins

/s/Hugh Dillon

/s/ Ben Smith

/s/Rick Holloway

/s/ Hunter Thorington