





Meet the Development Team





BACKGROUND

3/545 Z.R

15-102

ETERNAL FLIGHT







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Introduction Problem



Drones have extremely limited battery life (typical maximum of 20 mins)

- Limited range due to battery shortcoming
- Current approach: drones must land to recharge or switch battery
- Drones are needed in remote areas without infrastructure
- Setting up remote infrastructure is expensive



Solution

Switch drone battery in flight to allow "eternal flight"



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Receiver navigates to Tanker using GPS coordinates





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Receiver navigates to Tanker using GPS coordinates Receiver lands on Tanker using computer vision and controls algorithm





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Tanker hot swaps battery from Receiver using custom battery switching mechanism



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Tanker hot swaps battery from Receiver using custom battery switching mechanism

Receiver undocks and takes off once battery is replaced







HARDWARE





Receiver and Tanker Model



Receiver

Parts Overview



Pixracer Flight Controller

ETERNAL

- Raspberry Pi Zero W
- u-blox NEO-M8P GPS
- 4 Raspberry Pi Camera v2.1
- 5 Battery Holder Compartment

Weight: 1068 grams





ETERNAL Tanker Parts Overview DJI N3 Flight Controller 2, 3 Raspberry Pi Zero W u-blox NEO-M8P GPS 3 5 Actuonix Linear Actuator Switching Base & Landing Alignments 5 AprilTag Platform 6

Weight: 3679 grams





Power Distribution

3/643 Z.M

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Power Distribution

1

2



Receiver Requirements

4S 14.8V LiPo Battery

1

5V (2A)

Raspberry Pi Zero W - 250mA Raspberry Pi Cam v2.1 - 150mA u-blox NEO-M8P Module Pixracer Flight Controller

Tanker Requirements

6S 24V LiPo Battery

7V (600mA) Linear Actuator - 400mA

5 V (1A) Raspberry Pi Zero W - 250mA u-blox NEO-M8P Module

Power PCB









Power PCB

- Two layer PCB 47 mm x 84 mm
- Receiver and Tanker circuitry on a single PCB
- Components include voltage levelshifting and backup battery IC



FUNCTIONALITY

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Waypoint Navigation

Centimeter-Level GPS Accuracy

- Tanker determines own GPS coordinates with centimeter-level accuracy using RTK
- Tanker communicates GPS coordinates to Receiver over WiFi
- Receiver navigates above Tanker using GPS





Landing Control System

Precision Landing using Computer Vision

- AprilTag fiducial marker provides x, y, z (linear) and roll, pitch, yaw (rotational) coordinates
- Receiver uses Pi Cam to collect AprilTag inputs and runs a controls algorithm to land stably on Tanker



Controls Algorithm

Precision Landing Controls

- Hovers over AprilTag using PID controls algorithm
- Velocity, Position, and the Integral of Position are independently scaled and input into the system
- Algorithm works on XYZ directions independently
- Controller inputs emulate an RC system





Battery Hot Swap

Mechanical Battery Switching System



Battery Hot Swap





Individual Battery Case







Receiver Battery Holder

Parts Overview



Tanker Switching Base







2 Actuonix Linear Actuator

ETERNAL

FII













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Eric Sandoz Yogananda Isukapalli Carrie Segal Brandon Pon Forrest Brewer



Thank you!

