

# UAV Autonomous Landing

Team Expeditus

Dept. of Computer Science, SDSMT

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## **UAV Autonomous Landing Project**

### **Team Expeditus**

Jonathan Dixon, Dylan Geyer, Christopher Smith, Steven Huerta

### **Sponsor**

Dr. Larry Pyeatt

## Goal

- receive a set of waypoints
- autonomously take-off
- navigate through waypoints
- return to launch pad
- land on the pad with the correct orientation

## Limitations

- landing platform is a fixed position
- landing platform is a stable, horizontal surface
- environment is ideal(no wind, gps available, no obstacles)

# Phase Objectives

## Phase I

- Build UAV
- Flight Controller Operating Correctly
- Simulation Environment Available

## Phase II

- Autonomous landing ready for simulation
- Autonomous landing ready for UAV

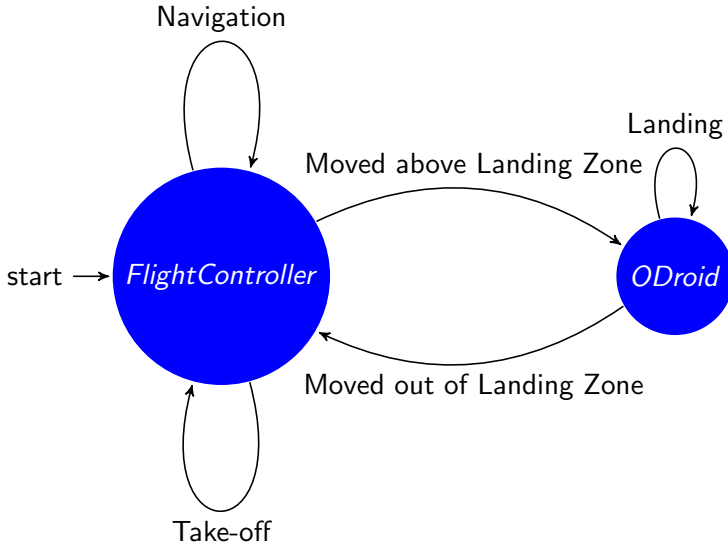
## Phase I

- Test manual flight of UAV
- Test of flight controller autonomy on a course

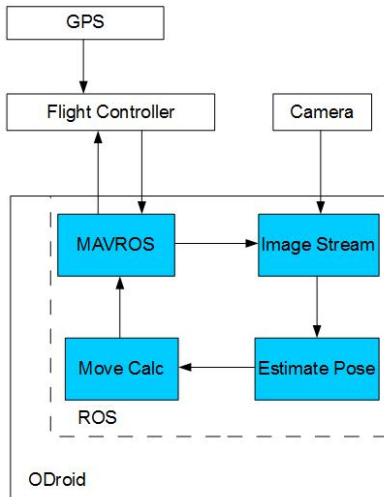
## Phase II

- Test of simulated landing
- Test of UAV autonomous landing on landing pad
- Test of UAV task integration

# Approach - UAV

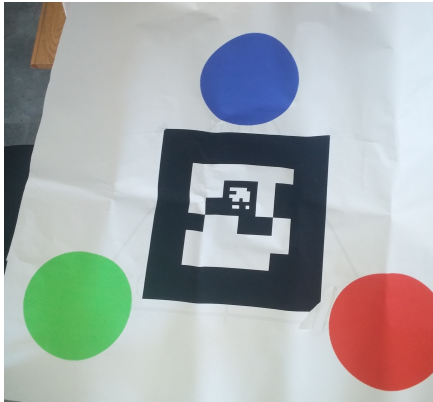


# Approach - Software



# Approach - Landing Vision

- AR/QR tags for orientation and range.
- Colored blobs or LEDs for orientation.
- Example of AR Tag and colored circles similar





## **Artificial Neural Network (ANN) Approach:**

- Use Flight Controller to reach landing pad waypoint
- Switch to landing mode using ANN
- Land on landing pad or get within some distance to switch to vision

**Development OS:** Ubuntu 14.04

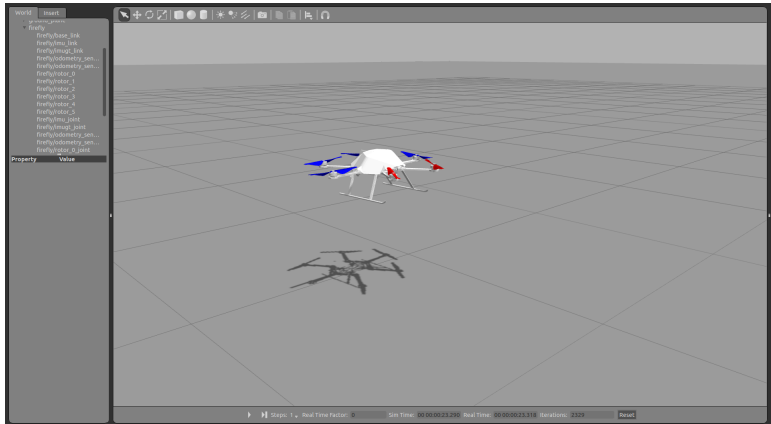
**Languages:** C++ and Python

## Software Tools

- Robot Operating System(ROS)
- Gazebo
- APM Planner

## Simulation & Testing:

- Rotors Sim package - Provides Models for Gazebo



## Development - Software Contd.

- MavRos - Communication with Pixhawk through ROS
- Testing - All components will be tested in simulation before being deployed on UAV

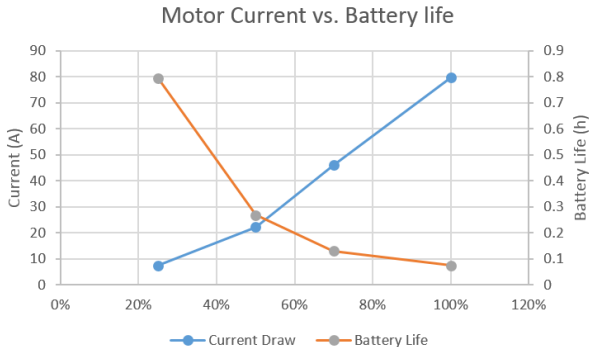
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Item	Quantity	Total Weight
DC Motor	6	372g
Frame	1	1300g
Battery	1	680g
Camera	2	140g
ODroid	1	48g
GPS Module	1	17g
<b>Total</b>		2557g

6 Motors at 100% produces 5820g of lift  
Motors must run at  $2557\text{g} / 5820\text{g} = 44\%$

## Hardware Constraints

- 6000mAh Battery
- Power ODroid + Peripherals
- Power 6x DC Motors



## Computational Constraints

- Images:  $976 \times 582$  pixels at  $\geq 30$  images/sec
- Real time image processing requires  $30 * 976 * 582 = 17 \text{ Mflops}$
- ODroid has 8 cores at 1.4 GHz
  - Ideal throughput  $\sim 1$  Billion operations/sec

# Cost

Build 1		Build 2	
Item	Cost	Item	Cost
Controller	\$199.99	Controller	\$199.99
ODroid	\$75.95	ODroid	\$75.95
Sensors	\$167.23	Sensors	\$167.23
Frame Kit	\$242.48		
Power Kit	\$119.98		
Radio Set	\$100.00		
Extra Parts	\$95.15		
<b>TOTAL</b>	<b>\$1000.78</b>	<b>TOTAL</b>	<b>\$443.17</b>



## General

- Review previous iteration documentation & code
- Begin pilot training for manual control
- Review Landing Pad model with Landing Pad teams

## Setup Development Environment

- Ubuntu 14.04
- Gazebo/Rviz
- ROS - Jade Distro

## Inspect Current Quadrotor

- Identify missing or non-functioning components
- Generate order list

## Risk

- Reliance on Flight Controller
- Dependency on external team for Landing Pad
- No UAV Backup

## Setbacks

- Non-functional components
- Little carry-over from previous year

## Team Expeditus

- has adapted focus of tasks based on conditions
- is making progress on those tasks
- is on track to complete Phase I goals



# Questions?