

# UAV Autonomous Landing

Team Expeditus

Dept. of Computer Science, SDSMT

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## **Team Expeditus**

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## **Sponsor**

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## **Goal**

Software to autonomously take-off, navigate to set waypoints, return to launch pad, and land

# 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

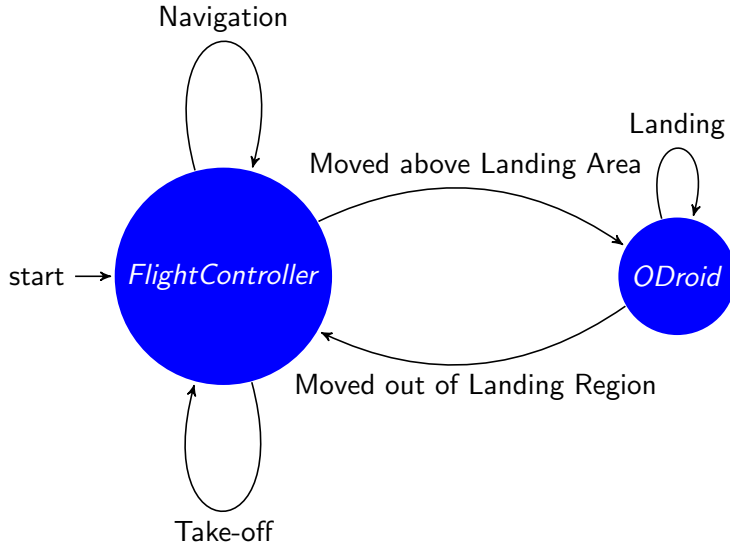
## Phase I

- Manual Flight of UAV
- Autonomous Flight of UAV

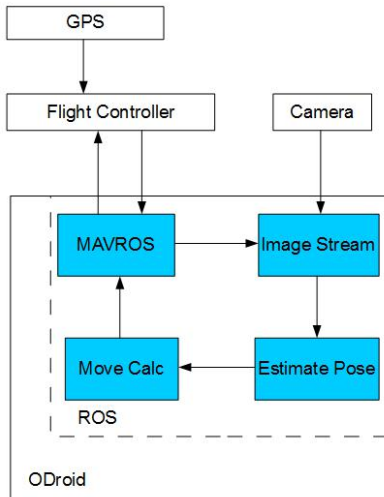
## Phase II

- Autonomous Landing in Simulation
- Autonomous Landing of UAV
- Autonomous Take-off, Navigation, and Landing of UAV

# Approach - UAV



# Approach - Software



# Approach - Landing Vision

Put some stuff here about the landing vision approach, maybe a picture or two

## **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

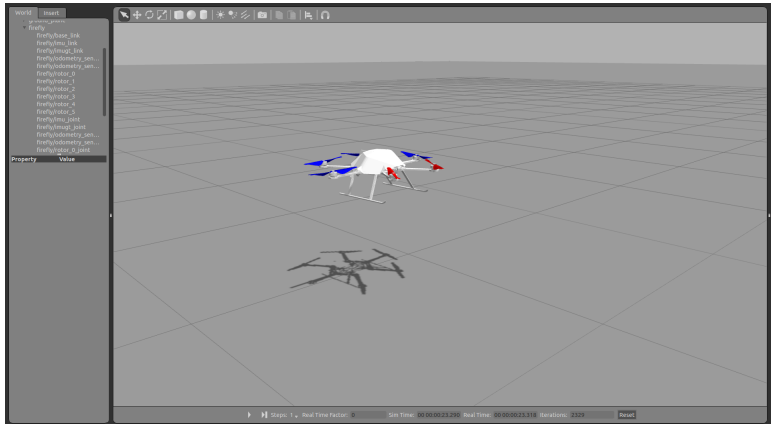
**Language:** C++

## Software Tools

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

## Simulation & Testing:

- Rotors Sim package - Provides Models for Gazebo



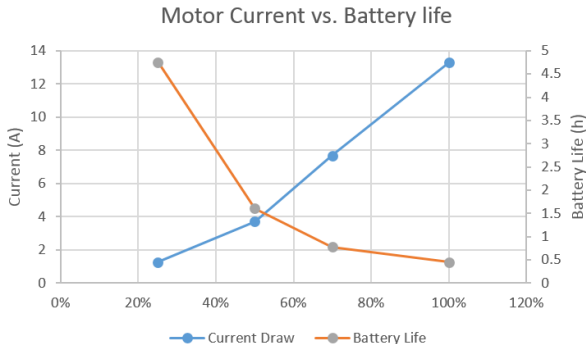
# Development - Software Contd.

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

```
overmind@overmind:~/landingpad/rotors_sim_ws$
overmind@overmind:~/landingpad/rotors_sim_ws$ rostopic list
/clock
/diagnostics
/firefly/command/motor_speed
/firefly/gazebo/command/roll_pitch_yawrate_thrust
/firefly/gazebo/command/motor_speed
/firefly/gazebo/cmd_vel
/firefly/gazebo/true/imu
/firefly/gazebo/true/odometry
/firefly/gazebo/true/pose
/firefly/gazebo/true/pose_with_covariance
/firefly/gazebo/true/position
/firefly/gazebo/true/transform
/firefly/imu
/firefly/joint_states
/firefly/joy
/firefly/motor_speed
/firefly/motor_speed/0
/firefly/motor_speed/1
/firefly/motor_speed/2
/firefly/motor_speed/3
/firefly/motor_speed/4
/firefly/motor_speed/5
/firefly/odometry_sensor/odometry
/firefly/odometry_sensor/pose
/firefly/odometry_sensor/pose_with_covariance
/firefly/odometry_sensor/position
/firefly/odometry_sensor/transform
/gazebo/link_states
/gazebo/model_states
/gazebo/parameter_descriptions
/gazebo/parameter_updates
/gazebo/set_link_state
/gazebo/set_model_state
/rosclock
/rostopic_ago
/rt
overmind@overmind:~/landingpad/rotors_sim_ws$
```

## Hardware Constraints

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



# Development - Hardware Continued...

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>		<b>2557g</b>

1 Motor at 100% produces 970g of lift

Maximum Lift = 5820g

Motors must run at  $2557\text{g} / 5820\text{g} = 44\%$

## Computational Constraints

- Images: 976 x 582 pixels at  $\geq 5$  images/sec
- Processing 1 image thus requires  $\sim 570,000$  operations
- ODroid has 8 cores at 1.4 GHz
  - Ideal throughput  $\sim 10$  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

# Conclusion

Conclusion-y stuff here

# Questions?