UAV Autonomous Landing

Team Expeditus

SDSMT MCS

October 23, 2015

UAV Autonomous Landing Project

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Sponsor
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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

Testing

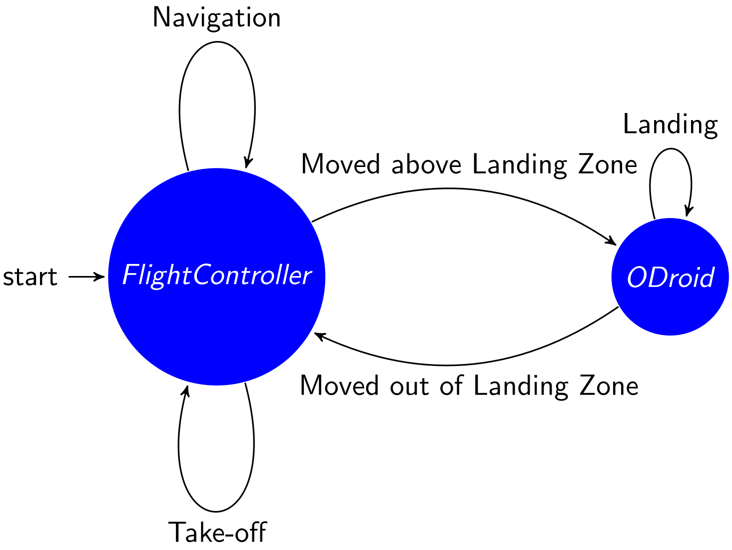
Phase I

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

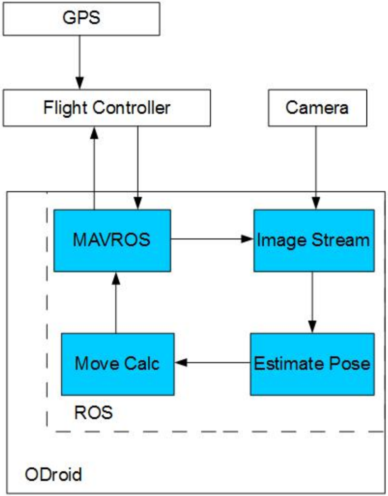
Phase II

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

Approach - UAV

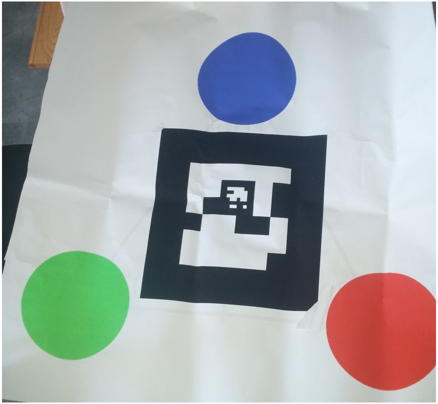


Approach - Software



Approach - Landing Vision

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



Approach - Landing AI

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 - Software

Development OS: Ubuntu 14.04
Languages: C++ and Python

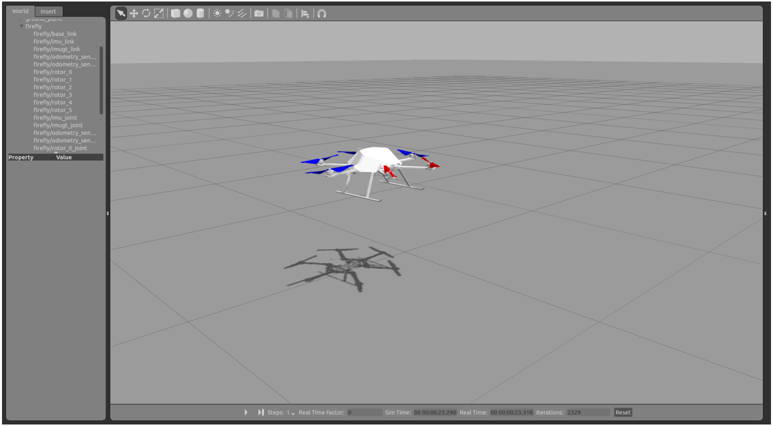
Software Tools

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

Development - Software Contd.

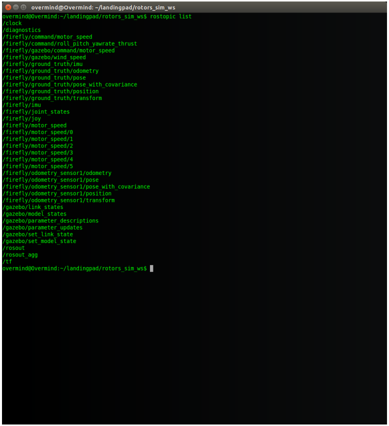
Simulation & Testing:

- 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



Development - Hardware

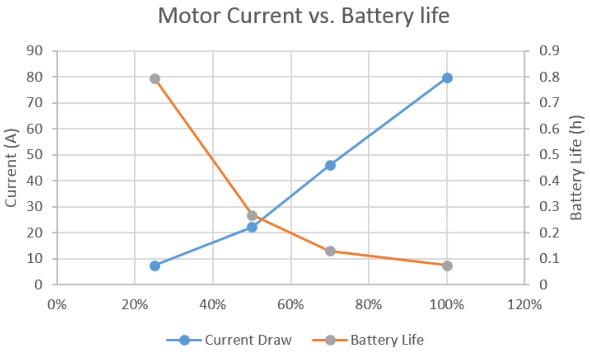
Item	Quantity	Total Weight
DC Motor	6	372g
Frame	1	1300g
Battery	1	680g
Camera	2	140g
ODroid	1	48g
GPS Module	1	17g
	Total	2557g

6 Motors at 100% produces 5820g of lift

Motors must run at 2557g / 5820g = 44%

Hardware Constraints

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



Development - Hardware Continued...

Computational Constraints

- Images: 976 x 582 pixels at $\geq$ 30 images/sec
- Real time image processing requires $30 * 976 * 582 = 17 Mflops$
- ODroid has 8 cores at 1.4 GHz
    - Ideal throughput ~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		
TOTAL	$1000.78	**TOTAL**	$443.17

Work Accomplished

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

Setbacks/Risk

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

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?