Autonomous Aerial Vehicle Midterm Presentation I

Team Six

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Table of Contents

UAS (Unmanned Aerial System) Background

UAS's have been around since as early as 1849 – (Austria attached explosives to controlled balloons)

Modern UAS's became effective in 1987 with electronic decoys, electronic jammers, and real time video reconnaissance

As of 2010, 41% of the total DOD aircraft are unmanned Based on estimates by the Teal Group, $6.6 billion will be spent in 2013 worldwide on Unmanned Aerial Systems [1]

Northrop Grumman Triton UAV can fly for 24 hours or up to 11,500 nautical miles without refueling [2]

Competition Requirements

Competition requirements broken up into 2 categories: Primary and Secondary

Primary Tasks are weighted 60%; Secondary,40% [3]

Primary Tasks: • **Autonomous Flight** • **Area Search**	Basic Requirements:
Secondary Tasks: • Automatic Target Detection • Actionable Intelligence • Off-Axis Target Locating • Emergent Target Detection • Simulated Remote Information Center • Interoperability Task • Infrared Target Locating • Air Drop System	• Vehicle must fly between 100ft and 750 ft MSL • Max mission time of 40 minutes, bonus points for completion between 20 and 30 minutes • System must display real-time speed and altitude • System must display no-fly zone • System must be able to capture images • System must be able to fly to given waypoints

Decision Matrix

Objective	Competition Priorities	Cost	Difficulty	Required Time	Risk	Totals
Autonomous Flight	10	10	8	9	5	**42**
Buy New Plane	6	4	9	9	10	**38**
Modify Old Plane	4	8	6	6	4	**28**
Retractable Landing Gear	2	6	6	5	6	**25**
Glass Camera Door	3	9	8	9	9	**38**
Retractable Camera Door/Gimbal System	9	5	5	3	6	**28**
Infrared Camera	7	0	5	7	0	**19**
Modular Design	3	7	4	4	5	**23**
Autonomous Takeoff/Landing	7	9	5	6	3	**30**
Autopilot System Training	2	7	3	3	8	**23**
Autonomous Target Recognition	7	9	3	3	8	**30**
Air Drop System	7	6	6	7	8	**34**

Decision to Purchase a New Plane

Flaps will be pivotal in autonomous takeoff/landing

- Increased lift allows for faster, more stable takeoff and lower stall speed for safe landing

Electric motor will allow for increased image quality

- Vibration from gas powered motor caused distortion in images captured by previous design team

Fuselage will not require repairs before modification and implementation of new equipment

Previous design group’s plane will used for low risk flight practice and equipment testing

Choice of Camera Implementation

Gimbal system: self-leveling camera mounted externally

- Positive: allows level camera angle while plane pitches, rolls, or yaws
- Negative: expensive, difficult to implement

Glass door approach: stationary camera inside fuselage

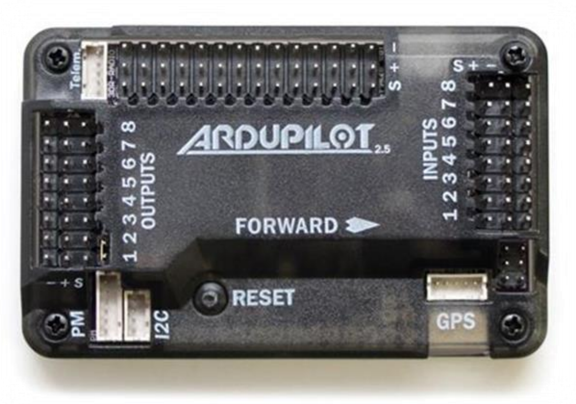
- Positive: low cost, does not disrupt air flow, easy to implement
- Negative: plane must stay level during flight to gather useful images

The glass door approach will be tested as soon as possible to determine validity. If problems are encountered, the gimbal system will be utilized.

Autonomous System

Autonomous Flight

- Ardupilot Mega 2.5
  - Inherited from last year’s plane;
  - Mission Planner interface software;
  - 3-axis gyro, accelerometer, magnetometer;
  - Barometric pressure sensor for altitude;
  - GPS module;
- Bonus points will be given for this task
- System Training
  - Not part of the competition requirements, proposed early design concept;
  - Learn how to customize autopilot software;
  - Increase maneuverability and stability;



Autonomous System

Autonomous Takeoff/Landing

- High risk and difficulty task
- New plane offers better stability and control for landing
- Bonus points will be given in the competition

Autonomous Target Recognition

- Intensive Image processing
- Bonus points will be given in the competition

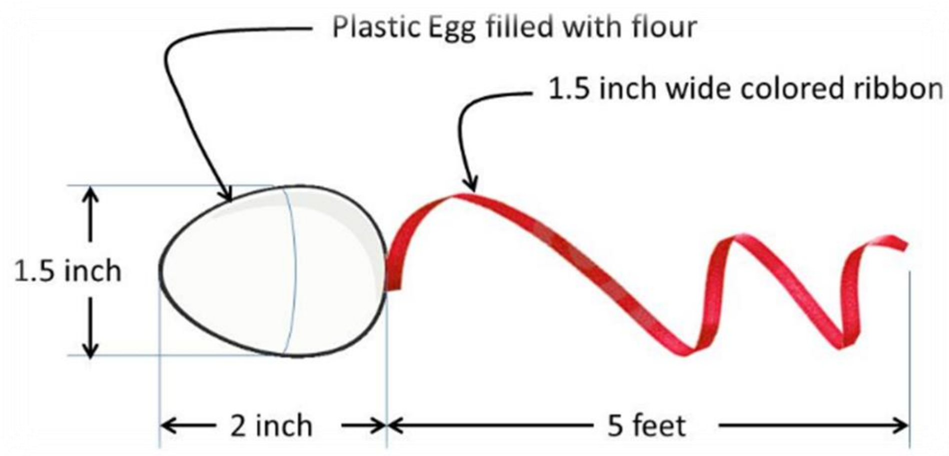
Air Drop System

This task will simulate supply drop or fire retardant release

Egg Canister filled with flour

Mechanism may be autonomous or manual

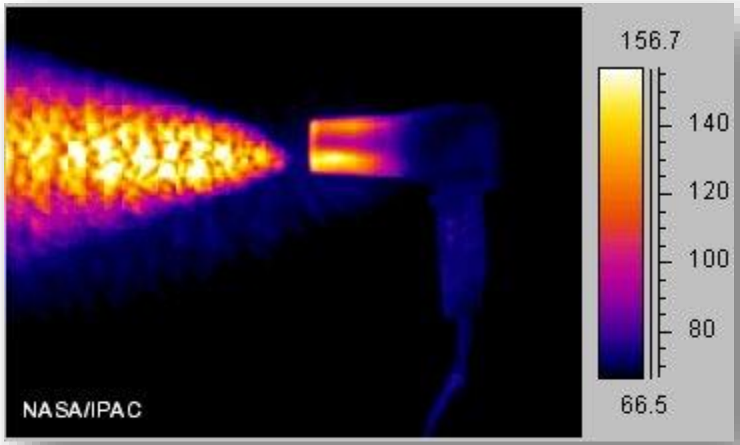
Autonomous Air Drop will be given bonus points



REJECTED OPTIONS

Infrared Camera

- High cost
- Secondary objective in competition

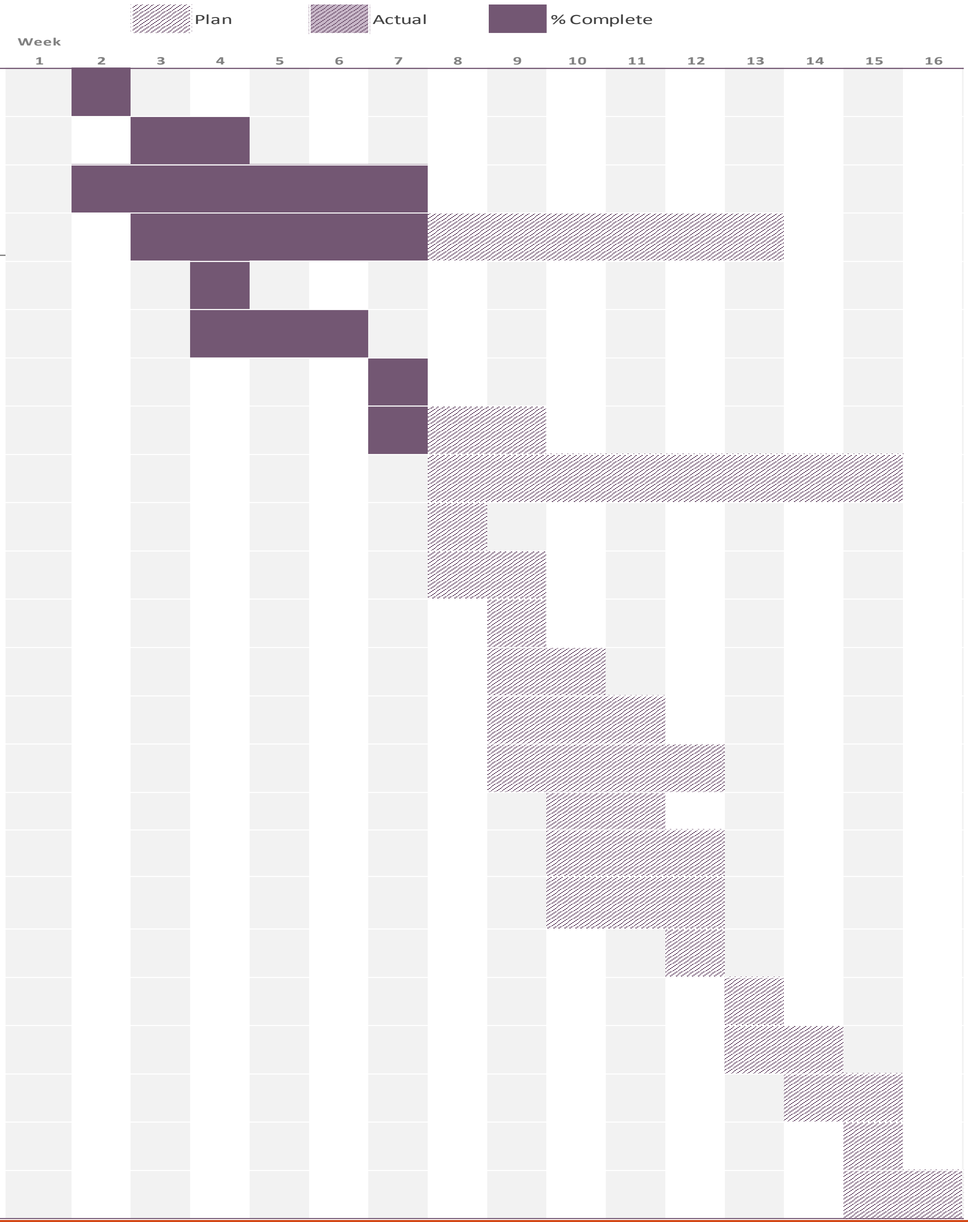


Retractable Landing Gear

- No priority in competition
- No significant aerodynamic benefit
- Long time to build
- Risk of failure/difficult landing

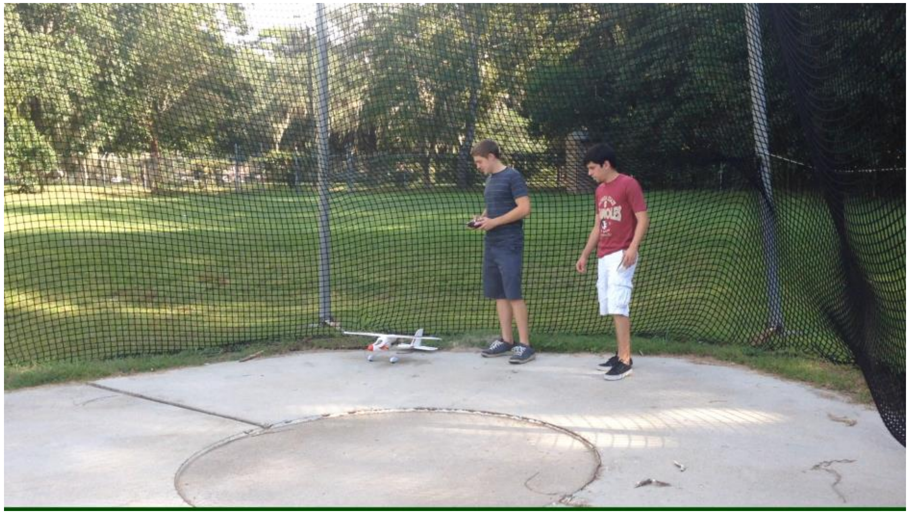
AUVSI Project Plan

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION
Initial Meeting with Team Sponsor	2	1	2	1
Assess State of Old Plane/Equipment	3	2	3	2
Code of Conduct	2	6	2	6
Work on Website	3	11	3	5
Needs Assessment	4	1	4	1
Research Possible Planes/Visit Hobby Shop	4	3	4	3
Purchase Practice Plane	7	1	7	1
Make Last Year's Plane Flyable	7	3	7	1
Practice Flying	8	8	0	0
Purchase Competition Plane	8	1	0	0
Midterm Report	8	2	0	0
Midterm Presentation I	9	1	0	0
Build Plane	9	2	0	0
Test Autopilot System	9	3	0	0
Imagery Analysis	9	4	0	0
Determine Necessary Hardware and Software for Flight	10	2	0	0
Design CAD Drawing for Retractable Landing Gear	10	3	0	0
Design CAD Drawing for Trap Door Mechanism	10	3	0	0
Purchase New Camera System if Necessary	12	1	0	0
Buy Necessary Hardware and Software	13	1	0	0
Design CAD Drawing for Gimbal System	13	2	0	0
Final Report	14	2	0	0
Final Design Presentations	15	1	0	0
Begin Equipping Plane with Gimbal/Landing Gear	15	2	0	0



Future Outlines

- Decide what kind of engine to use
- Decide which secondary objectives will be accomplished
- Choose the best camera and housing system - glass or retractable door
- Decide whether or not to use the gimbal system
- Test autonomous flight
- Learn to pilot RC planes



References

1. (http://www.fas.org/sgp/crs/natsec/R42136.pdf)
2. (http://www.fas.org/sgp/crs/natsec/R42938.pdf)
3. http://www.auvsi-seafarer.org/documents/2014Documents/2014_AUVSI_SUAS_Rules_Rev_0.2a_DRAFT_13-0930-1.pdf

Questions?