Definition of Air Challenge Guidelines

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--	Original	J. Searle	09/11/2014	
A	Added Payload mounting	J. Searle	12/16/2014	
B	Updated number of drop zones	J. Searle	01/05/2015	
C	Added dimension to payload mounting	J. Searle	02/16/2015	
D	Update to be a multi-rotor platform	J. Searle	09/10/2015	
E	Update new logo	P. Ward	11/01/2016	

1 Introduction

1.1 Purpose

The purpose of this document is to define the Air course for the Sea, Air and Land Challenge.

1.2 Scenario

There are a number of contained forest fires that require precise, aerial water drops due to their remote location. The exact location of these fires is not known, so a pilot must detect the correct location for the drop, and then carefully target the location with water drop. In the future, unmanned aircraft will perform this task to reduce costs and risks to pilots. Unlike a manned aircraft, which has an experienced pilot, the unmanned aircraft must carry its own sensors to detect the fire, and a method to remotely actuate the payload to drop the water. The first task in this challenge will be to perform payload drops into the fire areas. In addition to this task, in a normal firefighting operation, the ability to take pictures and provide situational awareness is also critical. Thus, the cameras that are used to detect the fire, may also be used to determine the location of firefighters, fire trucks or structures. This challenge provides the opportunity to build a payload that could one day perform these types of task on an unmanned aircraft.

1.3 Definitions

Tele-Operated (or remote controlled) – References a type of robot that has an operator making decisions about the operation of the robot. Sensory data from the robot or other device (video, telemetry, etc.) is delivered in near real time to the robot operator, and the operator makes decisions about what the robot is supposed to do (e.g. turn left/right, speed up/down, deposit a payload etc.). This is the type of operation used by hobbyists and may also be called operator in the loop. This can either be accomplished by wireless of wired communications, although most applications dictate wireless communication.

Autonomous - The robot has a sensor package that collects data, and based on computer processing, makes decisions without an operator on how it is to operate and what it is to do. The general rules of an autonomous robot are:

- Gain information about the environment (Rule #1)
- Work for an extended period without human intervention (Rule #2)
- Move either all or part of itself throughout its operating environment without human assistance (Rule #3)
- Avoid situations that are harmful to people, property, or itself unless those are part of its design specifications (Rule #4)[i]

2 Challenge

For this challenge the payload developed will provide the detection and drop capabilities for a hobby sized multirotor. The multirotor, which is controlled by an experienced pilot or a team member that passes a qualification test, will fly a pattern searching for simulated fires and objects of interest that have been randomly placed. As the multirotor performs its flight pattern, a payload must detect the simulated fires (colored rectangles) and drop an object (which simulates a water drop) on the target. The payload will also be used to search for other items located in "areas of interest" and provide information about them. Obviously, efficiency and accuracy are important aspects of this challenge.

The team is responsible for designing a tele-operated (or autonomous payload) that can:

- Be safely secured and carried by the multirotor
- Find and identify drop zones
- Drop the objects into the drop zones
- Provide imagery on objects located in "areas of interest"

The team is also responsible for picking a multirotor platform that can:

- Safely carry the payload
- Fly for the duration necessary to complete the challenge

Notes:

- The team members that are not the pilot or spotter will be unable to see the course during the run. The course may be changed between team runs, so that knowledge of one course is no advantage.
- The pilot will be required to always be in visual contract of the multirotor or have a spotter who is always in visual contact of multirotor
- If a team pilot cannot pass the flying proficiency test a pilot will be provided for challenge day.
- A flight worthiness test will also be given to ensure the multirotor and payload are safe for flight.
- Proficiency test will be executed (either video or in-person) by a member of Sea, Air, and Land staff, at team's school using the teams multirotor.

2.1 Requirements

To receive maximum score on the air course the vehicle must complete the following

- Multirotor must fit with in a 21" x 21" box without propellers.
- No limits are put on height.
- Airframe must be able to fly inside
- Pilot or spotter must visually see the airframe at all times during challenge
- Payload must be secured to Airframe
- Pilot must pass "Sea, Air and Land qualification flight
- The pilot must be a member of the AMA to fly challenge day

    - [AMA is free for people under 18. This is under review and might not be a requirement]
- Airframe and payload must pass challenge day safety exam
- Be able to find and identify two areas of interest.
- Be able to determine what object is located in 2 areas of interest
- Must be able to hit 2 drop zones.

2.2 Drop Zone

Drop zones will have the following characteristics:

- Will be marked by a rectangle
- Drop zone will be 10'x10'
- Each zone will have a unique high visibility color
- Each zone will have a unique number identifier
- Drop zones will be scored on proximity to center of zone

Note: Teams can add unique marking to the drop point if desired BUT must be approved by challenge coordinator.

2.3 Area of Interest

Area of interest will have the following characteristics:

- Each area of interest will have a unique high visibility color
- Each area of interest will have a unique number identifier
- Each area of interest will have a unique Item located in them
- Each area of interest will be 8'x8'

2.4 Key Design Points

The following bullets are some key design points that will be instrumental to the success of your vehicle.

- Have a field of regard of 180 degrees
- Be able to look ahead in direction of flight
- Be able to determine optimal time to drop payload
- Identification of areas of interest that are not drop zones
- Able to meet GTOW weight

2.5 *Course Layout*

- The course will have up to five drop zones
- The course will have up to 5 areas of interest
- The course will NOT have a specific pattern of for the flight

Figure 1 is a possible course layout derived from the above given description. This is a template for the air course and not meant to be an implementation diagram.

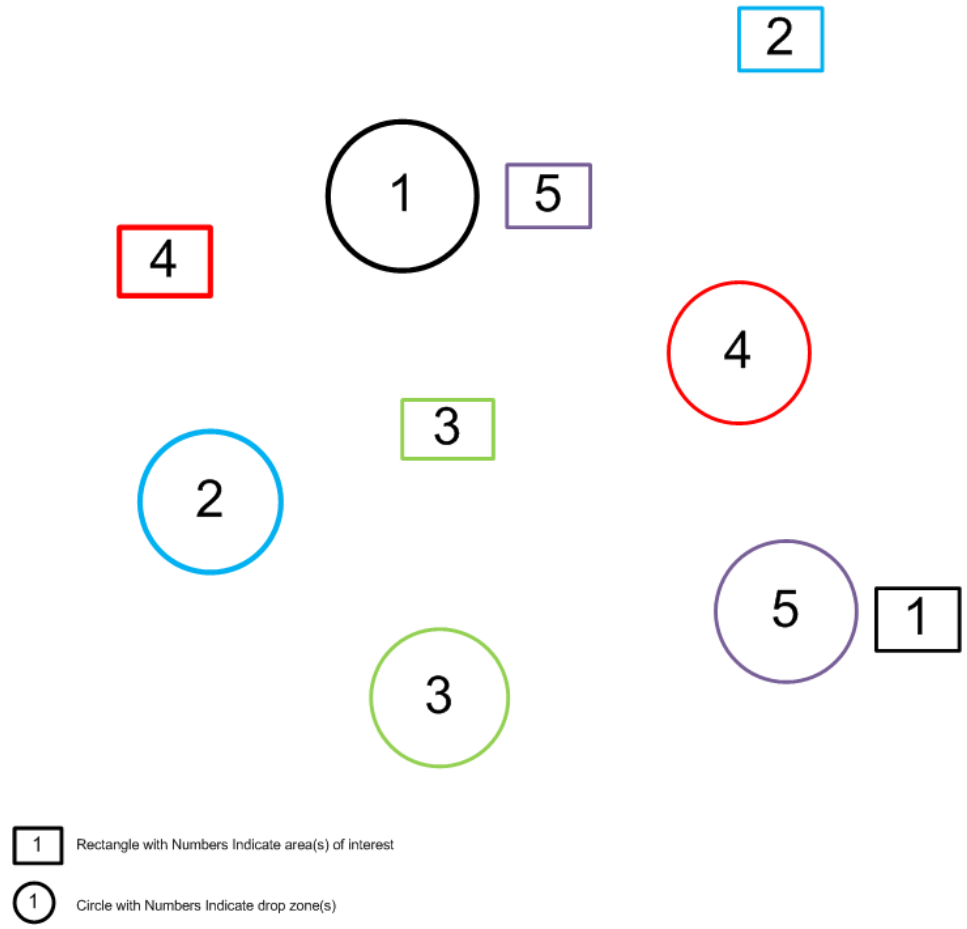

Figure 1 Course Layout

[i] http://en.wikipedia.org/wiki/Autonomous_robot

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