SEA AIR & LAND CHALLENGE

Definition of **Air Challenge**
Guidelines

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Rev.	Reason	Name	Date	Int.
--	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	
F	Modify size of drop zones and AOI	S. Zingaro	02/08/2017	
G	Max. cost of robotic system added	S. Zingaro	02/27/2017	
H	Clarifications including max. time	S. Zingaro	6/19/2017	
I	Updated definition of drone size	S. Zingaro	6/28/2018	
J	Changed dimensions to metric	S. Zingaro	2/22/2019	
K	Added drop zone detail and clarifications. Updated cover.	S. Zingaro	6/27/2019	
L	Updated mission scenario and added use of sensors	S. Zingaro	8/27/2020	

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

An explosion has occurred in a downtown metropolitan area. There is a concern that the explosion may have released radioactive elements into the air, jeopardizing the health and safety of all citizens in the surrounding area. In order to safely determine whether or not the explosion is a radioactive threat, an Unmanned Aerial Vehicle (UAV) with radiation detection capabilities is being sent to the scene. With cameras, sensors and automated image processing, the UAV will fly over the region and determine if any radiative matter is present. A live relay of this information will be sent to the first responders, allowing them to remain protected at a safe distance until the best method of response is determined. In addition, the UAV will be able to drop markers on “hot spots” to indicate a radiation danger zone and serve as a warning to the ground crews.

Using sensors that will recognize differences in radiation concentration can increase the safety for the responders and local civilians. Without a fully developed UAV equipped with radiation detection, first responders would have no indication as to whether the explosion site is safe, nor will the surrounding areas know if radiation is heading their way. This Air Challenge explores building and using sensors that could one day be used on UAVs.

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 or wired communications, although most (including the Air Challenge) 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 combination of a sensor and a payload will be developed to provide color detection (red, green, blue) and drop capabilities for a hobby sized multirotor. The multirotor, which is controlled by an experienced pilot or a team member who passes a qualification test, will fly a pattern searching for "radiation hot spots" that have been randomly placed. As the multirotor performs its flight pattern, it must detect the colored coded "radiation" hot spots using a color sensor, signal that the colored "hot spots" have been located, and drop a marker on the "hot spot" (target) to indicate a "radiation danger zone". Obviously, efficiency and accuracy are important aspects of this challenge.

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

- Be safely secured and carried by the multirotor
- Find potential locations (camera or pilot view)
- Identify radiation hot spots using a color sensor and relay this information to the operators
- Drop the markers onto the targets at the hot spots

The team is also responsible for building/selecting a multirotor platform that can:

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

Notes:

- The pilot will be required to always be in visual contact of the multirotor or have a spotter who is always in visual contact of the multirotor
- The teams that are not actively flying may be restricted from seeing the course during the run. The course may be changed between team runs, so that knowledge of one course is no advantage to second runs or other teams.
- A proficiency test will be executed (either by video or in-person at the team's school/facility) by a member of Sea, Air, and Land staff or other qualified personnel, using the team's multirotor prior to Challenge Day.
- If a team pilot cannot pass the flying proficiency test, a pilot may be provided for Challenge Day. Please verify availability prior to Challenge Day.
- On Challenge Day, a brief flight worthiness test will be given to ensure the multirotor and payload are safe for flight.

2.1 Requirements

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

- Multirotor must fit with in a 533 mm x 533 mm (21" x 21") box. This does not include propellers or propeller guards.
- No limits are put on height.
- Airframe must be capable of being flown indoors
- Total cost of the system must not exceed $500
- Pilot or spotter must visually see the airframe at all times during challenge
- Payload, including sensor, 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 youth membership is free for those under age 19.]
- Airframe and payload must pass challenge day safety exam
- Be able to find and identify two areas of "high radiation" by color (red, green or blue as assigned by the judge).
- Be able to signal back to the team that the correct color has been found
- Must be able to drop radiation hazard markers in the two high radiation zones (a target will be provided within the zone).
- A maximum of 10 minutes will be allowed to identify two high radiation areas, signal back that they have been found and drop markers at these two zones to "warn others of high radiation".
- Prior to the run, team will introduce themselves and their design concept in a short "elevator speech" (untimed)

2.2 Color Coded Areas/Drop Zone

Large Fields: Large outdoor field color coded areas/drop zones will have the following characteristics:

- Will be marked by a rectangle
- Drop zone will be 3m x 3m (10'x10')
- Each zone will have a color - red, green or blue
- Drop zones will be scored on proximity to center of zone

Note: Teams may ask the judges to add unique marking to the drop points BUT this must be approved by the Challenge Coordinator.

Outdoor courtyards or indoors areas: Color coded areas/drop zones will have the following characteristics:

- Will be marked by a rectangle
- Drop zone will be at least 30 cm x 30 cm (1'x1')
- Each zone will have a color - red, green or blue
- Drop zones will be scored on proximity to target within zone

2.3 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 sense color – red, green or blue, and signal back to pilot/operator
- Be able to determine optimal time to drop payload

2.4 Course Layout

- The course will have up to nine color coded areas/ drop zones
- 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.

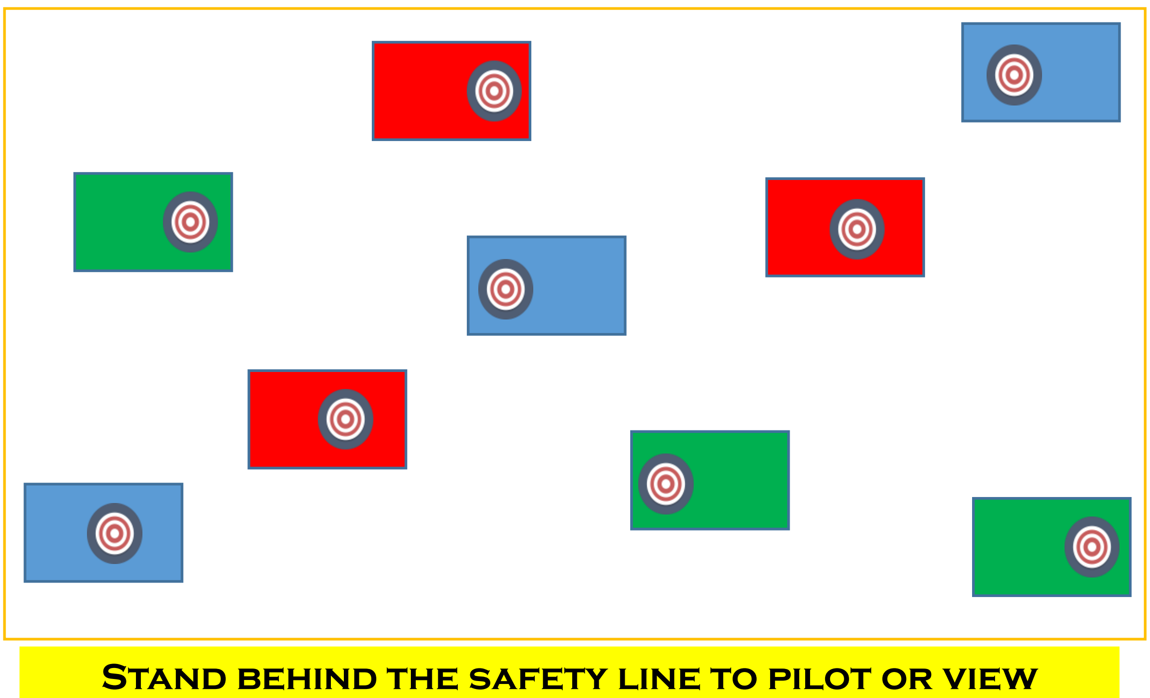

Figure 1 Sample Course Layout

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

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