Definition of **Land Challenge** Guidelines

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1 Introduction

1.1 Purpose

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

1.2 Scenario

A wildfire moving through a game preserve has scattered the animals and destroyed some of their habitat. As the high winds continually shift the wildfires, the danger of the situation would be increased if manned rescue teams were dispersed to locate and gather the animals. Therefore, your team with an unmanned land rover is being sent for the animals in order to bring them in for safety and evaluation. The animals will be placed in temporary housing until the fire is extinguished, repairs to the habitats can be made and the area is safe.

Ground robots are becoming increasingly more sophisticated and utilized in different types of applications including emergency situations. This application of the technology provides a critical link to injured or stranded people and animals and keeps first responders out of harm's way until safe passage can be established.

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 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, i.e. where am I? What is around me? What is my path?
- Work for an extended period and move either all or part of itself throughout its operating environment without human intervention
- Avoid situations that are harmful to people, property, or itself unless those are part of its design specifications

2 Challenge

The object of the Land Challenge is to design and build a tele-operated (or autonomous) land based vehicle that can locate, pick up and move various objects to their associated drop locations. Each team will have two runs in the course with a break in between to make adjustments and recharge. There will be a maximum run time of 10 minutes for each of the two runs, so efficiency and accuracy are important aspects of this challenge.

In this challenge, there will not be any direct viewing of the course by the robot driver(s). This will mimic true operations, where the rover is controlled using situational awareness provided by cameras and (optional) sensors. The course will also be changed between runs, so that knowledge of one course is not an advantage.

2.1 Dimensions and Accuracy

All dimensions and characteristics given in this document are approximations. Robots should be designed with an error +/- 10% on any given dimension. Colors may not be uniform. Walls are not guaranteed to be exactly perpendicular to the floor nor square to one another.

A successful robot will be able to handle small misalignments, inaccuracies, discolorations, and other course imperfections. You must test your robot under less than ideal conditions and verify that it works properly.

2.2 Definition of Objects

The objects in this challenge simulate the animals trapped in a dangerous environment. It is not acceptable to damage the objects during delivery. The objects will have the following characteristics:

- Each object will have a unique, high visibility color
- Each object will have a unique numerical identifier
- Each object will be at least 25 mm x 25 mm x 25 mm (1” cubed) and at most 65 mm x 65 mm x 65 mm (2.5” cubed)
- Each object will weigh between 115 g and 455 g (0.25 lbs. to 1.0 lb.)

2.3 Drop Point Definition

The objects previously described must be delivered to the appropriate emergency center, simulated by a drop point. The animal taken to one drop point will be different that the animal taken to another drop point. The drop points will have the following identification:

- Each drop point will have a unique high visibility color that matches the object
- Each drop point will have a unique numerical identifier that matches the object
- Each drop point will be 200 mm x 200 mm x 200 mm (8” cubed)
- Each drop point will be a 4 sided box with a lip on the open side
- Each drop point will have an open top
- Each drop point will vary in height along the course
- Each drop point opening will be no higher than the walls of the course

Figure 1 Drop Point

2.4 Obstacles

The course may have terrain elements and physical obstructions that the vehicle must surmount or avoid. The obstacles will have the following characteristics:

- The minimum clearance between obstacles will be 300 mm (12”)
- The maximum height of the obstacles will be 300 mm (12”)

2.5 Course Layout

The overall shape of the course is shown in Figure 2. The location of objects, drop points, the roadway and obstacles will vary. There may be up to six objects and drop boxes.

- The land course will be a 3 m x 3 m (10’x10’) box with starting area.
- The land course will have 0.6 m (2’) high walls.
- The starting area will be 0.6 m x 0.6 m (2’x2’).
- The color of the walls should not be the same as any object or drop point
- The bottom of the course will be the ground on which the course is set up (cement, asphalt, wood floor, carpet, vinyl tile, etc.). If the floor is covered with a protective layer, all free edges shall be taped so as to not obstruct robot movement.

Note: Figure 2 is an example layout. This is a template for the land course and not meant to be an implementation diagram.

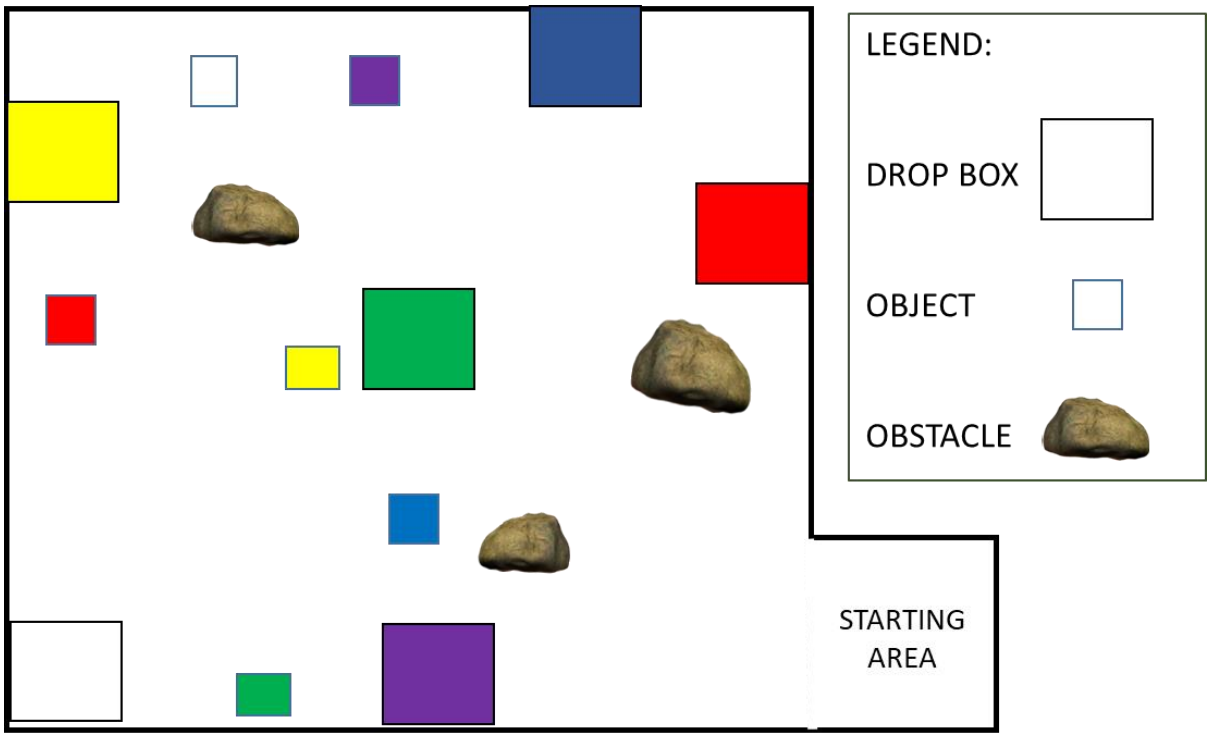

Figure 2 Course Layout

2.6 Requirements and Scoring

To receive maximum score on the land course, the robot and team must complete the following:

- Team to introduce themselves and robot design concept in a short "elevator speech" (untimed).
- Robotic system must fit within the starting box and be no taller than the wall at the beginning of the run. It may unfold, as needed, after the clock has started.
- Traverse the course without being touched by the team and without direct line of sight (hint: use sensors or cameras to navigate remotely).
- Locate and retrieve all objects (in the order provided by the judges).
- Carry the object while traversing the course.
- Locate and navigate to the corresponding drop point.
- Deposit the object in the drop point.
- Complete the tasks without recharging or replacing batteries.
- Complete the tasks in under 10 minutes.
- The total cost of the robot must not exceed $600. Bring a copy of the final BOM/Cost List on Challenge Day to share with the judges.

Once the team places the robot inside the course, a timer will start. The team will have 10 minutes to complete the challenge. If the challenge is not completed, points will be awarded for each object/drop point combination given the following (please refer to the rubric for specific point awards):

- Find Object
- Pick up Object
- Carry Object
- Locate Drop Point
- Deposit Object

If at any time during a run, your robot becomes disabled and must be touched in order to continue, a one minute penalty will be added to your final time. Each time a team member touches the robot, an additional penalty will be added. The timing clock will not stop during this time.

The goal is to complete all of the tasks in the least amount of time. Each team will have two separate runs. The course layout and obstacles may change from Run 1 to Run 2 to provide a greater challenge.

2.7 Key Design Points

The following are some key design points to consider when designing the robot. They are not all required, but are suggested for maximum probability of success.

- Must fit within the starting box
- Ability to move forward and backward, turn left and right
- Ability to visualize the area of operations in the course
- Ability to transmit visual information to team and command controls to robot
- Ability to identify objects and drop off boxes
- Able to grasp and release object
- Ability to raise and lower object
- Ability to place object in delivery box
- Ability to navigate around or over obstacles

3 Open Class

In addition to the previously described challenge, there will be an Open Class demonstration. Any team can enter, but it is not required or counted towards the main challenge scoring. The purpose of the Open Class is to allow teams to demonstrate some functionality that goes above and beyond the prescribed challenge. Some examples include (but are not limited to) autonomy, extra small or large object retrieval, or low visibility navigation. The Open Class may be viewed and voted upon by the other teams present for Challenge Day. The Open Class teams may also be awarded bonus points or put the team in consideration for the Innovation Award. Any team wishing to participate in the Open Class should notify the host at least three weeks ahead of Challenge Day.

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