

# **13<sup>th</sup> IEEE UAE STUDENT DAY, 2019**

## **Common Design Project (CDP) Competition**

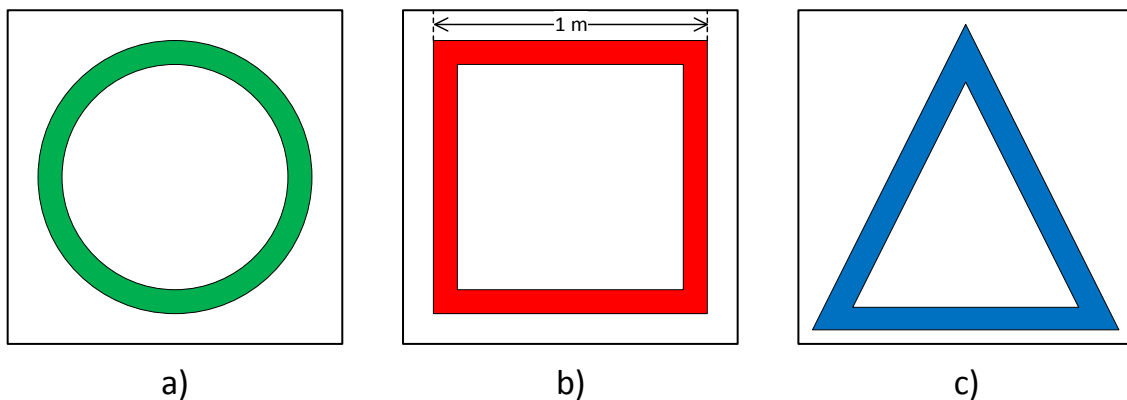
### **Autonomous Drone Landing**

#### General Information

- Undergraduate engineering students within the UAE are eligible for this competition.
- Each institution can submit a maximum of two projects for judging in this competition.
- Each team shall comprise a maximum of 5 members.
- Total cost for each team must be less than 4000 AED.

#### Project Description

Design and implement a vision-based control algorithm for a small unmanned aerial vehicle (UAV) or drone to autonomously search for, detect and land on a specified landing zone. Three landing zones with different markers (as shown in Figure 1) will randomly be placed on the competition arena. The drone should autonomously detect and locate the landing zone with the red square marker (Figure 1b). The drone can be equipped with a camera for the detection of the landing zone. The autonomous control system can use the images acquired by the camera to detect the target, estimate its relative pose and finally plan a navigation path to perform the landing maneuver.



*Figure 1*

#### **The Drone**

For safety reasons, the size of the UAV is restricted to a maximum volume of 0.7m x 0.7m x 0.7m.

**The Arena**

The competition will be performed in an indoor arena (part of a basketball playground). Two sides of the arena will be concrete walls. The other 2 sides will be a 5 m high net. The floor will be dark green with some yellow and white lines.

- The flying arena is 9.6m x 10m x 5m.
- The landing pad dimension is 1 m x 1 m.

**Task Specification**

## » Initial condition

- The participating team positions the UAV in stationary mode on the ground at the start location.
- Three landing zones will be placed at random locations, with random orientations, inside the arena.

## » UAV take off, exploration and landing

- A whistle will indicate the start of the challenge and a timer is started.
- The UAV takes off and searches for the specified landing zone.
- The UAV safely land on the landing zone (crash landing is not allowed) and the timer is stopped.
- The challenge maximum allowed time is 5 mins.

**Scoring**

- To complete the challenge and achieve a score, the UAV must land (with propulsion off and rotors not spinning) within a distance of 50 cm from the vertical or horizontal center lines of the landing pad and within 5 mins (300 secs) from the start of the trial.
- Collisions with arena walls will be penalized by a 5% reduction in score for each collision.
- Each team will be allowed 2 trials per challenge and will retain the maximum score from either attempt.
- The score (S) is calculated based on:
  - **distance** (D) from the drone center point to the center lines of the landing pad,
  - task completion **time** (T),
  - and number of wall collisions ( $N_c$ ).

- The scoring formula is

$$S = \left[ 0.7 \times \frac{50 - D}{50} + 0.3 \times \frac{300 - T}{300} - 0.05 \times N_c \right] G_T \times G_D \times 90 \quad , \quad 0 \leq S \leq 90$$

$$\text{where } G_T = \begin{cases} 1, & \text{if } T \leq 300 \\ 0, & \text{if } T > 300 \end{cases} \quad \text{and} \quad G_D = \begin{cases} 1, & \text{if } D \leq 50 \\ 0, & \text{if } D > 50 \end{cases}$$

- A roll-poster is required and will be graded out of 10.
- Total score is out of 100.

Autonomous Landing Score (S)	/90
Roll-Up Poster Score	/10
Total Score	/100