

Artificial Intelligent Related Drone (AiR Drone) Competition Rules

(Autonomous Race)

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1.0. General Information

- 1.1. Team members - Each team, consists of 2 Students and 1 Supervisor.
- 1.2. In order to improve the research on Drone stability, Teams drone may use any stability or avoidance sensors. Mission should be completed without relying on GPS/GNSS data.
- 1.3. Participant should be around the competition field or pit stop during the competition.
- 1.4. If the team late for 10 minutes after the referee called, the team will be consider as walkover for that attempt.

2.0 During Game

- 2.1. Referee can stop the game anytime if the drone may damage the field or injure a person.
- 2.2. Participants cannot fly or hover the drone if there is a person in the competition fields.
- 2.3. Participants cannot enter in the competition field once the game started
- 2.4. Once the drone crashes or touches the ground or lands on the ground, or tangles on the net, the attempt is considered to end, and the score will be counted before the touch on the ground.
- 2.5. When landing, the first bump on the ground is consider as landed location.
- 2.6. No team members are allowed to enter the competition field once the game stated

3.0 Rules of the Game

- 3.1. These rules are directing to develop a new autonomous system for drones using computer vision and machine learning algorithms for indoor environments without relying on any

GPS/GNSS data.

- 3.2. Physical specification of the drones must abide by the rules below. Otherwise, the drone is not allowed to take part in the competition.
 - The size of the drone (including propellers) should be smaller than 100cm.
 - The weight of the drone (when flying) should be less than 3.5kg.
 - Only electric motors and actuators are allowed, using fuel-based motors is not allowed.
- 3.3. There is no limitation on the type of drone (airship, helicopter, ...) except that the drone should be capable of vertical flight.
- 3.4. Based on the competition venue, It is possible to have a level of magnetic or electromagnetic interference in the playing field. Although the OCs will try their best to prepare the field with the best possible condition, it is recommended to have a complementary sensor system for compass reading (heading) and low dependency on wireless connections (wifi).
- 3.5. All the decision made by the game officials is final.
- 3.6. Referees have the right to rule out any attempt if any suspicious activity or an unfair attempt is found and also to stop any dangerous run.

4.0. Game Structure

- 4.1. In this competition, each team has to reach the finish position as fast a possible while passing through the gates. Each team will have 20 minutes and a maximum of 5 tries. Drones have to take off from a starting point, pass the gates in a predefined order and reach the final gate and land to complete the lap(s). There can be a single or multiple laps of the track. Based on the number of participant teams and their performance.
- 4.2. Each race's time will be recorded and, in the end, the best attempt of the team will be selected. The time will be calculated from the take-off moment until the drone passes the last gate or lands. The order of passing gates is important and any incorrect order will result in a halt in progress of the track (last correct gate is considered) until the drone comes back and enter the missed gate.
- 4.3. If a team was not able to finish the competition, the time of landing and the last reached position in the correct order will be recorded. Teams will be ranked based on their recorded time (see the “method of scoring” section). Referees have the right to rule out any attempt if any suspicious activity or an unfair attempt is found and also to stop any dangerous run.

5.0. Field of Play

- 5.1. Field of play is a simple field consist of take-off pad, landing pad, and a track to help drones find their way.
- 5.2. Gates are colored **Magenta** to make the detection easier for the teams. The track is consists of some curved or straight lines (5cm wide) and they lead to a gate's position in the correct order. The track's color would have a strong contrast with the color of the floor.
- 5.3. The line passes continuously under the gates, and before each round of the competition, the technical committee determines the location of the gates. The teams can use their own markers with a maximum dimension of 20cm*20cm to figure out the correct direction to pass the gates (one marker for each gate is allowed). The marker should be placed on the guiding line and the maximum distance between the center of the marker and the closest point of the gate is 50cm.

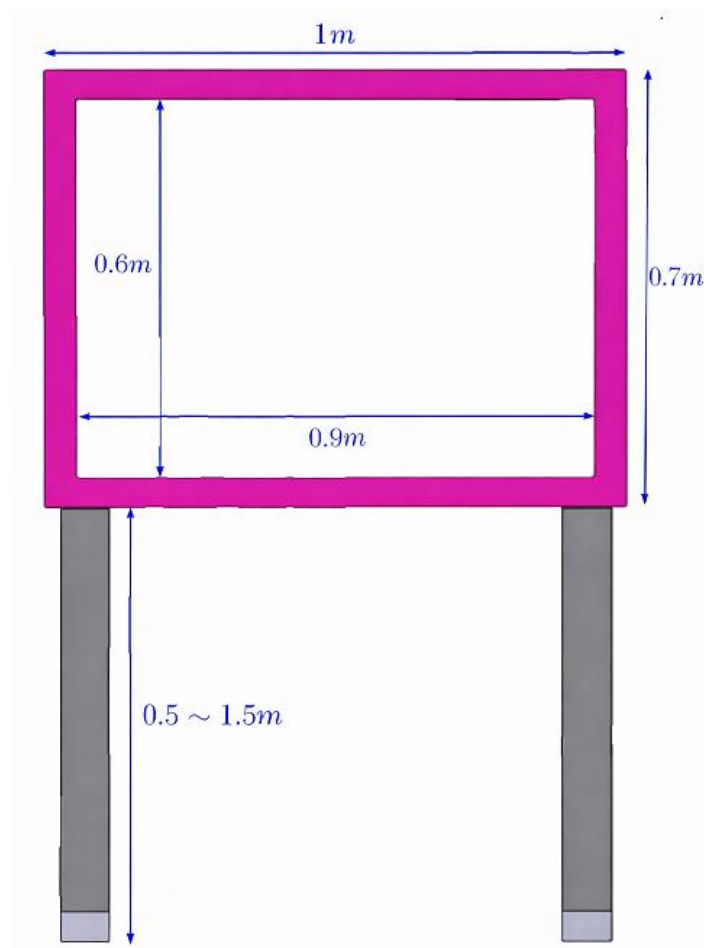


Figure 1: The gates and their dimensions

- 5.4. Starting pad and finish pad (takeoff and landing) is a 0.5m x 0.5m square pad with a blue H mark on it. The location and number of gates, position of take-off and landing pads will be decided by referees on the competition days. The drone should takeoff from the pad, follow the race track and land on the pad to finish the race.
- 5.5. It is possible to skip the landing on the pad (land anywhere on the floor) but in this case, the team will miss the landing bonus points (see the “method of scoring” section). The level of autonomy should be consistent in each trial and the teams cannot change it during flight (from FPV to Autonomous or vice versa).
- 5.6. The number of gates (4,5, or 6), their location and the number of laps (1,2, or 3) will be decided on the venue, but There will be a minimum 2m clearance between the gates and the

length of the track will not be more than 50m. Also, Some (random) visual features will be added on the ground which can be used for optical flow sensors. As an example, a schema of a possible track is illustrated in Fig. 3.

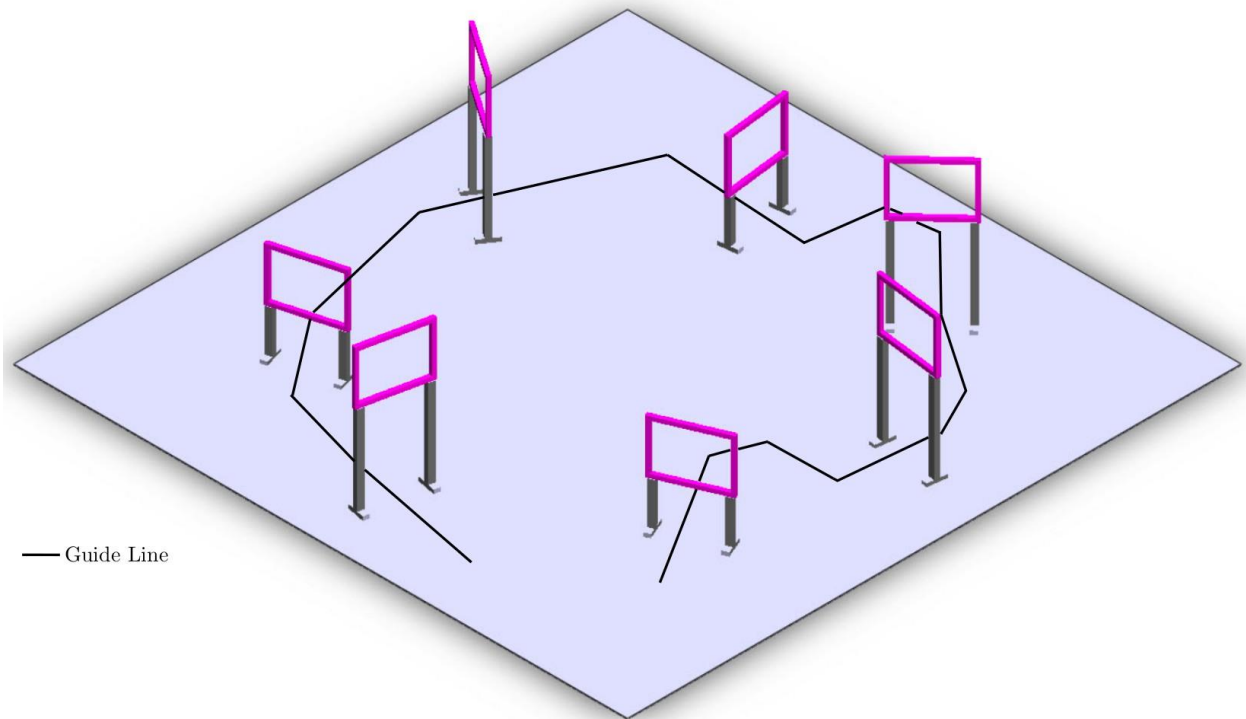


Figure 2: An example of a possible track

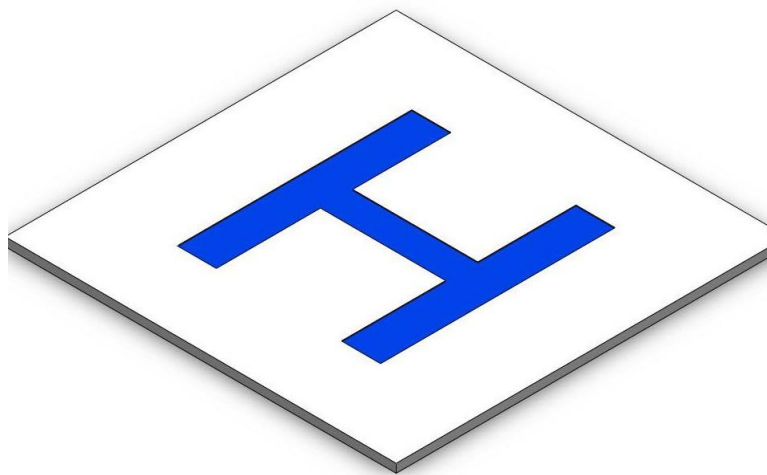


Figure 3: The landing pad

6.0. Number of Drones

- 6.1. A single drone competes in each attempt. Teams are allowed to use different drones for different attempts.

7.0. Level of Autonomy

- 7.1. The autonomy consists of 2 levels: autonomous control with off-board processing and autonomous control with onboard processing. Based on the level of autonomy of the drone during competition, the competition time will be divided by the ka coefficient. The level of autonomy should not be change during the competition but it can be different in different trials.
- 7.2. Participants must acknowledge the technical committee regarding the level of autonomy implemented in their drone.
- 7.3. The technical committee reserves the right to inspect and validate the autonomy level of the participants' drones.
- 7.4. The coefficients are defined in the following table:

Level of autonomy	Ka (Coefficient)	Comments
Autonomous (off-board Process)	1	Control and navigation of the drone is performed autonomously, and some processes are done using a computer outside of the drone itself. Example : Tello, Parrot Bebop, Hula, LiteBee and etc
Autonomous (on-board Process)	2	Control and navigation of the drone is performed autonomously, and all of the processes are done using a computer inside the drone itself. It is capable of reaching its destination even if the router or external computer used for monitoring is shut down. Example : Coex, Matrice 300,

8.0. Method of Scoring

8.1. The score of a race (time trial) depends on the performance of drone and the level of autonomy. It will be calculated using the formula below:

$$\textbf{Trial Record} = (\textbf{Race Time} + n * 40) * \textbf{bonus} / \textbf{Ka}$$

8.2. In this formula, **n** is the number of remained gates (if the track is not completed), “**Race Time**” is the time recorded between a start and finish in an attempt (in seconds), and **Ka** is the autonomy factor.

8.3. The bonus coefficient will be considered 0.8 if the drone lands on the landing pad after finishing the track. if the drone lands outside of the landing pad or doesn't complete the track, it will be equal to 1.

8.4 Examples of scoring for a track with 4 gates and 2 laps:

A- An autonomous (offboard) drone completes the track in the 200s and land on the landing pad.

The trial record will be:

$$\textbf{Trial Record} = (200 + 0 * 40) * 0.8 / 1 = 160s$$

C-An autonomous (offboard) drone, passes through 3 gates in the 150s and land outside of the landing pad. The trial record will be:

$$\textbf{Trial Record} = (150 + 1 * 40) * 1 / 1 = 190s$$

D- An autonomous (onboard) drone, passes through 2 gates in the 100s and land outside of the landing pad. The trial record will be:

$$\textbf{Trial Record} = (100 + 2 * 40) * 1 / 2 = 90s$$

Important notes:

- The drones should at least enter the second gate to be eligible for scoring (passing less than 2 gates has no score). In the case of failure, the maximum trial record (500s) will be considered for the team.
- The drone is passed the gate if it goes through it without major collision with the gate (crashing). minor collision is acceptable if the drone is still airborne.
- The teams are not allowed to add external marker to the field.
- The teams will be ranked based on best final record (lower is better).

9.0. Drone Master Selection

- 9.1. The Drone Master Award is given to the team with the highest total score from all Air Drone challenges. Points are awarded based on medal rankings: 3 points for a Gold medal, 2 points for a Silver medal, and 1 point for a Bronze medal.
- 9.2. If two or more teams have the same total score, the tie is broken by the team with the higher achievement in the Emergency Delivery and tower inspection.
- 9.3. If the tied teams did not participate in the Emergency Delivery and tower inspection, the tie is broken based on the highest achievement in the Autonomous Race.

10.0. Amendment

Year	Version	Changes
2026	2.0	Competition Replace Autonomous Line Follower