

Artificial Intelligent Related Drone (AiR Drone) Competition Rules

(Autonomous Drone Lock and Drop)

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1.0 General Information

- 1.1 Team members - Each team consists of 2 Students and 1 Supervisor.
- 1.2 The team's drone may use any stability or avoidance sensors to improve the research on Drone stability. The mission should be completed without relying on GPS/GNSS data.
- 1.3 The participant should be around the competition field or pit stop during the competition.
- 1.4 If the team is late for 10 minutes after the referee call, the team will be considered a walkover for that attempt.

2.0 During Game

- 2.1 The referee can stop the game anytime if the drone damages the field or injures someone.
- 2.2 Participants cannot fly or hover the drone without the referee's permission.
- 2.3 Participants cannot enter the competition field without the referee's permission
- 2.4 Once the drone crashes, touches the ground multiple times, lands on the ground, or tangles on the net, the attempt is considered to end, and the score will be counted before the drone touch the target object.

3.0 Rules Of The Game

- 3.1 These rules aim to develop a new autonomous drone system using computer vision and machine learning algorithms for indoor environments without relying on GPS/GNSS data.
- 3.2 The physical specification of the drones must abide by the rules below. Otherwise, the drone is not allowed to take part in the competition.
 - The drone's size (including propellers) should be smaller than 100 cm.
 - The drone's weight (when flying) should be less than 3.5 kg.
 - Only electric motors and actuators are allowed. Using fuel-based engines is not permitted.
- 3.3 There is no limitation on the type of drone (airship, helicopter, etc.) 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 decisions made by the game officials are 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

The drone must perform the following steps in order:

- 4.1 **Autonomous Take-off** : The drone takes off from the designated take-off zone.
- 4.2 **Target Identification**: The drone must autonomously detect and lock onto the correct target placed on the platform.
- 4.3 **Target Hit (Physical Contact)**:The drone must **make physical contact with the target** using its body or an attached non-damaging mechanism.The hit must be **intentional and controlled**.

- 4.4 Upon target initial contact with the ground, the official race time shall be recorded. The drone is then allocated a maximum window of 15 seconds to successfully complete its landing sequence.
- 4.5 After hitting the target, the drone which land safely in the designated landing zone will be given bonus score.
- 4.6 The drone must remain airborne during the hit (no landing on the platform to hit) and maintain flight stability after contact.
- 4.7 Contact mechanism must be **non-sharp, non-destructive**, and safe. Any intentional damaging design is prohibited. The drone must not knock down the platform, damage the target structure and endanger people or equipment.
- 4.8 Each team will be given **3** times of attempts; the highest score among the **3 attempts** will be recorded. *(These rules may vary and change depending on the number of participants that participate)*
- 4.9 For this mission, teams will be given a time limit of 5 minutes to complete it. *(These rules may vary and change depending on the number of participants that participate)*

5.0 Arena, Platform & Target Specifications

- 5.1 **Platform Height:** Platform height: **1 meter** from ground level.
- 5.2 **Target Height:** Target height: **1 foot (≈30 cm)** above the platform surface.
- 5.3 **Distance :** Distance from starting point to platform = 1 meter
- 5.4 **Target Arrangement:** Targets will be placed **on top of the platform**.
- 5.5 Target position for each team will be assigned by **random draw (undian)**.
- 5.6 Teams are **not allowed to adjust** target position or platform setup.

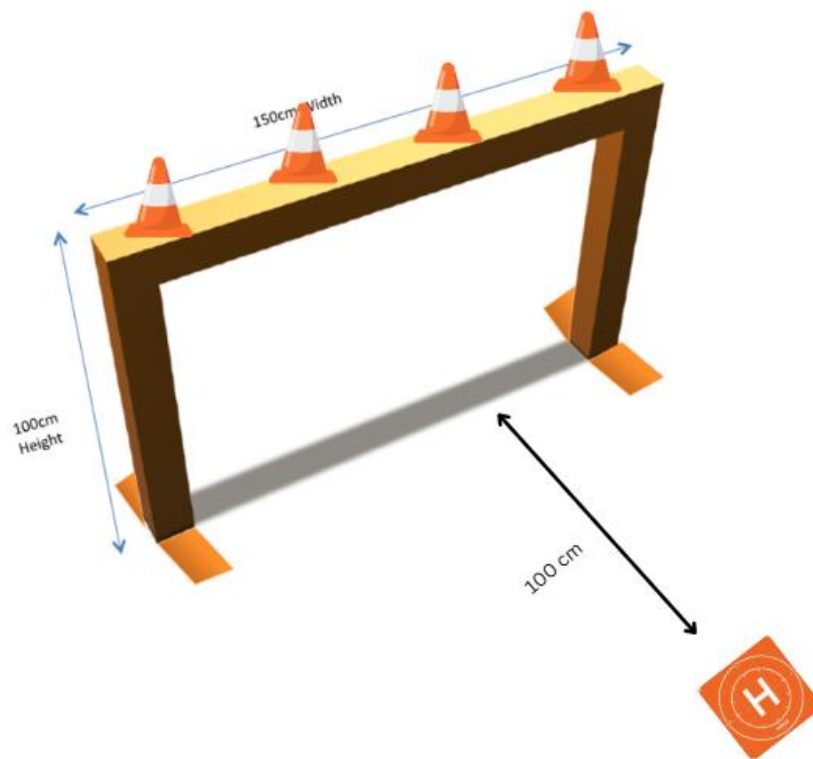


Figure 1: Platform and target object



Figure 2: Target Object

6.0 Level of Autonomy

- 6.1 The autonomy consists of 2 levels: autonomous control with off-board processing and autonomous control with onboard processing. Based on the autonomy level of the drone in a mission element, a coefficient is multiplied by the achieved score of that mission element. The coefficients are defined in the following table:
- 6.2 Participants must acknowledge the technical committee regarding the level of autonomy implemented in their drone.
- 6.3 The technical committee reserves the right to inspect and validate the autonomy level of the participants' drones.
- 6.4 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,

7.0 Method of Scoring

- 7.1 The score of a time trial depends on the performance of drone and the level of autonomy. It will be calculated using the formula below:

$$\textbf{Trial Record} = (\textbf{Trial time}) * \textbf{bonus} / \textbf{Ka}$$

- 7.2 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.

- 7.3 Examples of scoring:

A- An autonomous (offboard) drone completes the track in the 20s and land on the landing pad. The trial record will be:

$$\textbf{Trial Record} = (20) * 0.8 / 1 = 16s$$

C-An autonomous (offboard) drone, completes the track in 40s and land outside of the landing pad. The trial record will be:

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

D- An autonomous (onboard) drone, completes the track in 60s and land outside of the landing pad. The trial record will be:

$$\textbf{Trial Record} = (60) * 1 / 2 = 30s$$

Important notes:

- The drone is passed the platform if it goes though it without major collision with the platform (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).

8.0 Drone Master Selection

- 8.1 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.
- 8.2 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.

8.3 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.

9.0 **Ammendment**

Year	Version	Location	Changes