Artificial Intelligent Related Drone (AiR Drone) Competition Rules

(Emergency Delivery and Tower Inspection)

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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 touch on the ground.

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 Details of Visual Navigation

4.1 The QR codes in the crossroads of the field contain a sequence of directions with this format (for example): "N,E,E,S,0". The N,E,W,S characters correlate to the cardinal (geographical) directions to reach the target positions. In this example, the 'N' is the direction to the correct path for target position 1, 'E' is the direction to the correct path for target position 2 , 'E' is the direction to the correct path for target position 3 and 'S' direction to the correct path for target position 4. In other words, if the drone follows the direction of the **first character** in the sequence, after several crossroads, it will reach target position **1** (second character for target position two and …).

4.2 The last number indicates whether this is a target position (1,2,3,4) or not (0). If the crossroad is not located at a target location (destination), the last character in the sequence would be 0 (for example "N,W,N,W,0") and if it is located at the end of a path (a target position), the last character would indicate the target location (for example in target position 3 "S,W,N,W,3").

Figure 1: A Sample Of QR Codes Containing The Directions

4.3 In the fig. 2 a simplified example is shown with only 2 target positions. The drone can reach the first target position by following the first character in the sequence (red arrow), and following the second character (blue arrow) will guide it to the second target position.

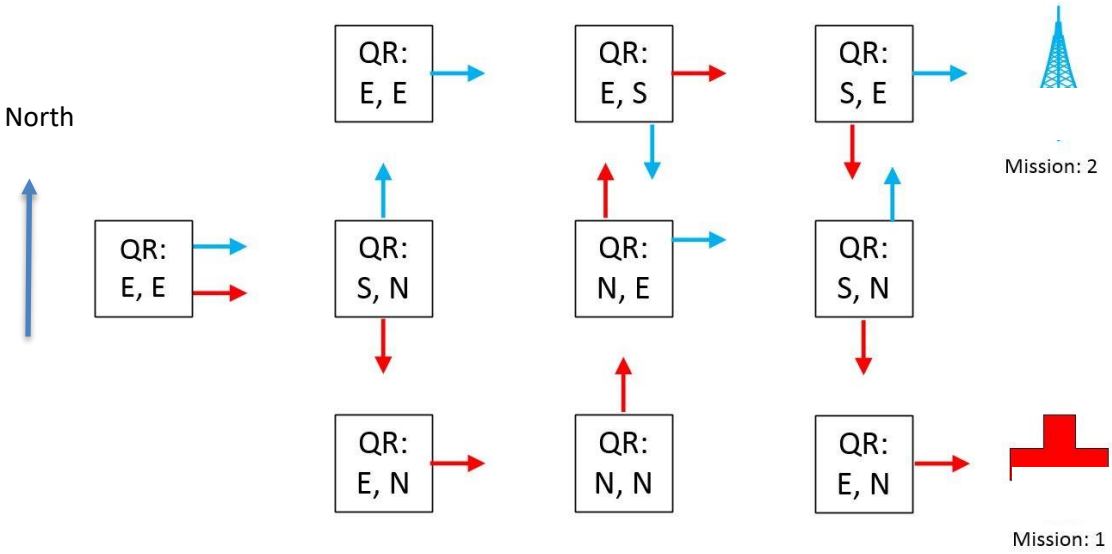

Figure 2: Navigation Using The QR Contents

5.0 Mission Element

Number	Mission element	Score
1	Navigating to destination	2 points for reaching a QR code (to the next target position)
2	Collision avoidance	3 points for each gate (while following the path)
3	First aid kit delivery	5 points for the first aid kit drop in the "+" circle

4	Pole Scan (Victim)	5 points for reading each QR code
5	Searching for victims	5 points for reading each QR code that contains victim information
6	Return and land at the starting point	5 points for landing on the landing pad

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)	3	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,

NOTE:

6.5 The participant teams can use their custom marker for mission elements, but a -1 point penalty will be calculated in the score of that mission element (for each marker).

7.0 Method of Scoring

A mission's score depends on the drone's performance and the level of autonomy. It will be calculated using the formula below:

$$Mission\ Score = \sum(S_i * Ka_i)$$

In this formula, "i" is the mission element number, S_i is the achieved score, Ka_i is the level of autonomy in the mission element.

8.0 Mission: Emergency Delivery and Tower Inspection

8.1 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)*

8.2 For this mission, teams will be given a time limit of 20 minutes to complete it. *(These rules may vary and change depending on the number of participants that participate)*

8.3 Participants are allowed to do multiple tries within the time limit.

8.4 Before the game starts, the participant should tell the referee the mode chosen, either **autonomous (off-board process) or autonomous (in-board process)** mode.

8.5 If a team withdraws or a drone crashes after the game starts, only points for scanned QR codes and avoided obstacles will be counted.

8.6 If the team's drone malfunctions in an attempt, different drones can be used in the next attempts.

8.7 No team members can engage or maneuver (except ON and OFF) the drone once the game starts.

8.8 The drone should be able to deliver an Emergency Kit Box (+-80gram) refer **Figure 3,** after delivering the drone will fly and scan the number of victims at the dedicated location and scan the pillar in another mission, then return and land at the "H" mark.

8.9 Delivery destination is marked on the ground. While hovering, the drone should drop the packages on the marker ("+ "landmark). The first bump of the packages on the ground will be counted as the drop location. The distance between the center marker and the place where the drone releases the package will define the score of this section.

8.10 If the package is dropped outside the marker ("+ "landmark), the team will not score any mission element.

8.11 However, if the drone cannot release the package automatically, the participant can choose to land at the cross symbol, while one of the team members can remove it manually, but 3 points will be subtracted from the score.

8.12 After the package drop, the drone should scan the victim at a dedicated location. The participant should tell the referee the quantity of victims.

8.13 Participants also must show the scanned QR code to the referee during or after the run.

8.14 **Collision avoidance:** There are several obstacles (in 2 colors) in the environment, and the drone must identify and avoid them by changing their altitude according to their color. Crossing each detected obstacle without any collision will result in a score.

The obstacles are colored gates, 1.5 m wide, 1m high, and 10cm thick (**Figure 4**). The color of the gates would be yellow and red. The drone should go through yellow gates and above red gates to get a score of this mission element.

8.15 **Tower :** Light yellow with dimension: 30cm L x 30cm W x 200cm H

8.16 The field example shown in ***Figure 6*** and the location of the goal and finalized path of the drone will be decided during the competition day

8.17 The location of the obstacle will be decided on the competition day

8.18 If the score cannot determine the winner, the fastest time for the team to finish the mission will be counted.

8.19 Participants have the option to choose to carry the packages.

8.20 Participants have the option to choose to put the obstacle

8.21 Participants have the option to select the mission that they want to do.

8.22 Participants can land and change the battery after finishing each mission (Mission 1- deliver first aid, Mission 2 - tower inspection and Mission 3 – Victim), game time move in the process.

8.23 The path will be decided before the game start.

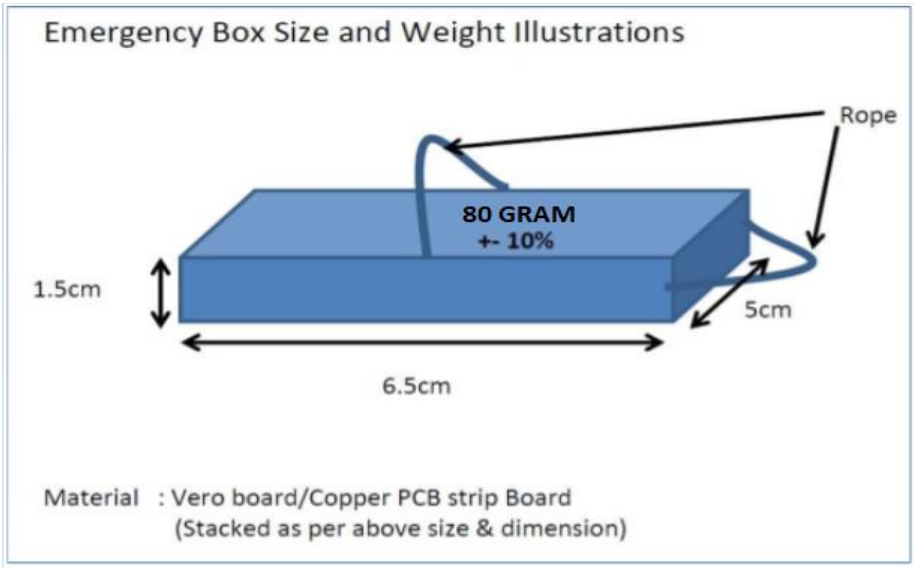

Figure 3: Emergency Box Size and Weight Illustration

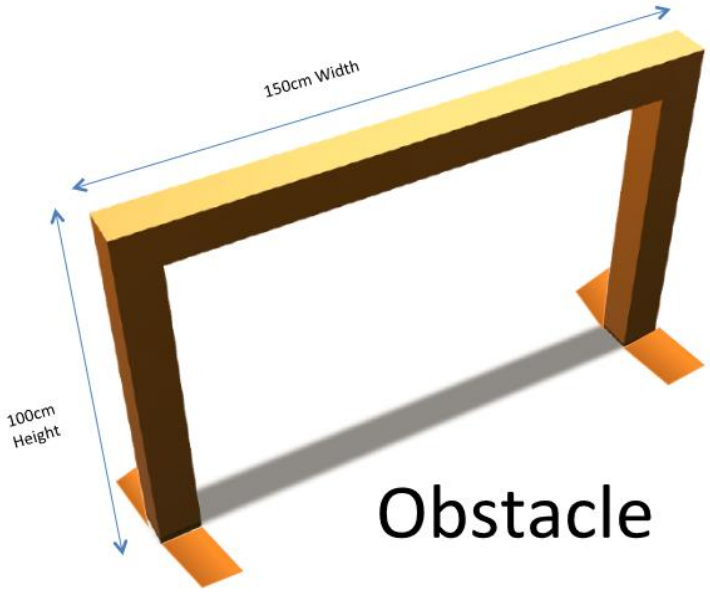

Figure 4: Obstacle Size Illustration

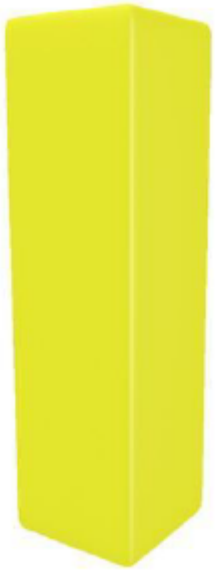

Figure 5: Tower with Dimension: 30cm L x 30cm W x 200cm H

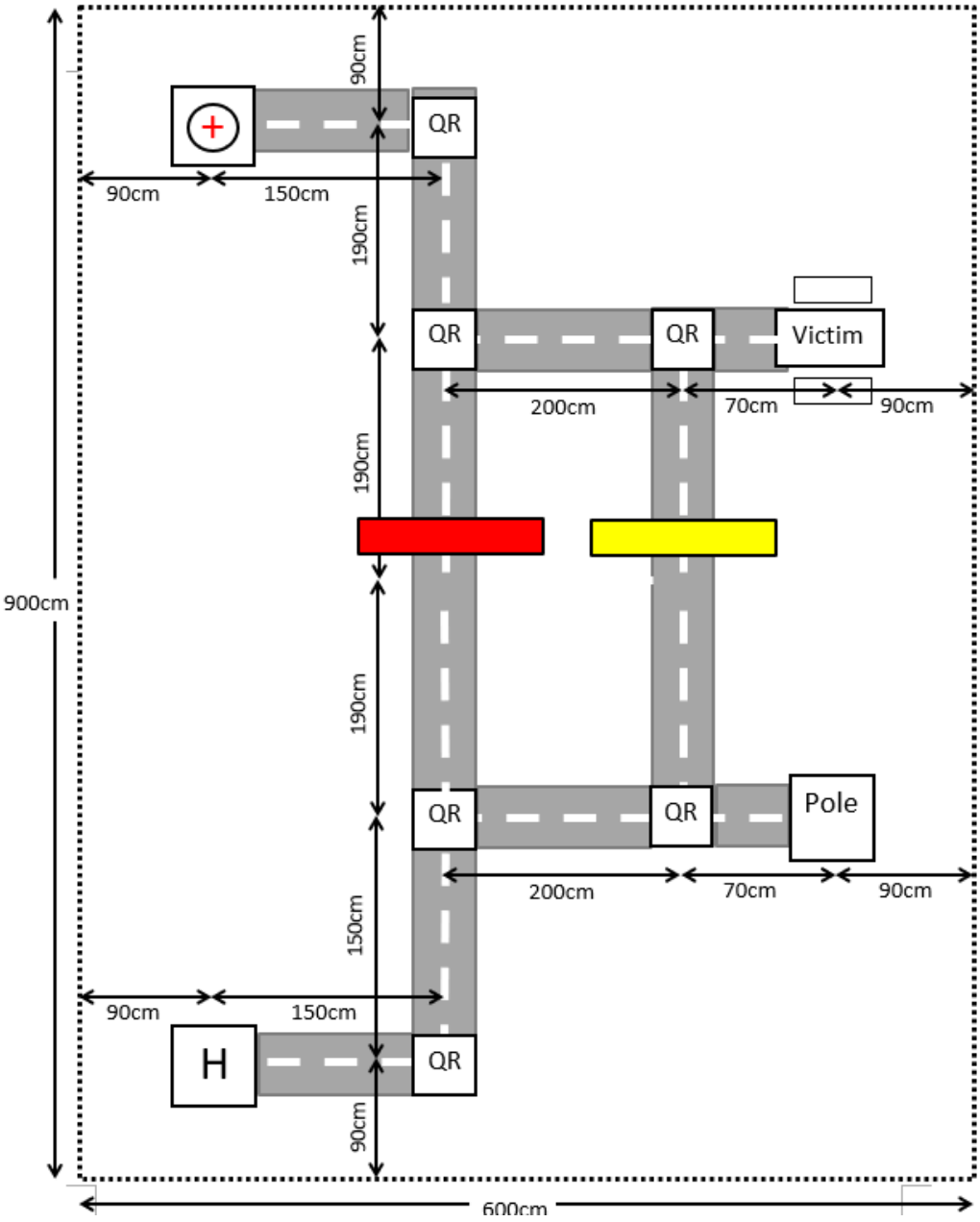

Figure 6: Competition Map Example

9.0 Ammendment

Year	Version	Previous	Changes
2024	1.2		Grammar and format
2025	1.3		Level of autonomy