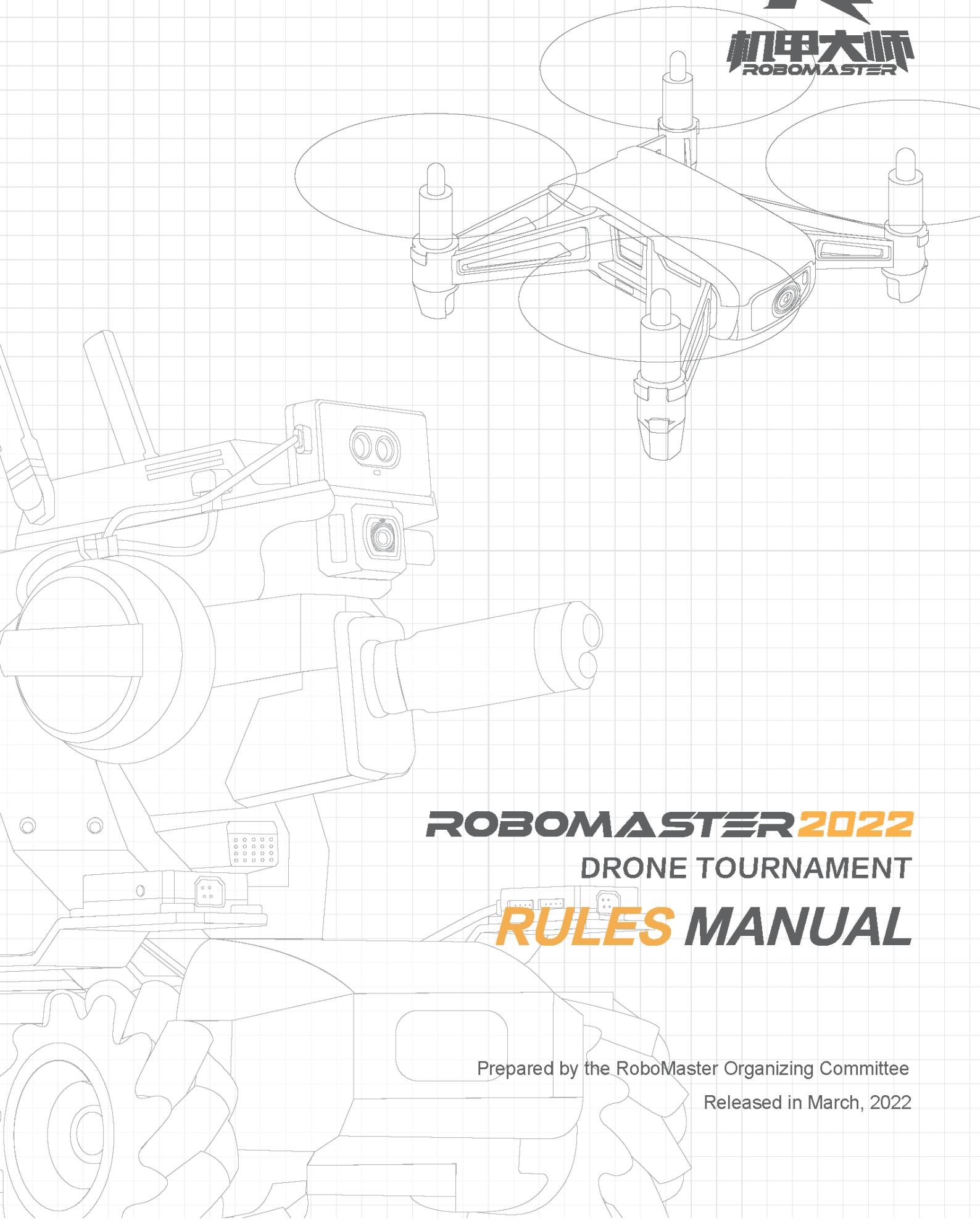
V1.0



ROBOMASTER 2022
DRONE TOURNAMENT
RULES MANUAL

Prepared by the RoboMaster Organizing Committee

Released in March, 2022

Intellectual Property Statement

The RoboMaster Organizing Committee (hereinafter referred to as "the RMOC") encourages and advocates for technological innovation and open source technology and respects the intellectual property of participating teams. All rights related to the intellectual property developed during the competition are owned by the individual teams. The RMOC will not be involved in the handling of intellectual property disputes within teams. The participating teams must properly handle all aspects of intellectual property rights among internal school members, company members and other members of the team.

While using the RoboMaster Referee System and other supporting materials provided by the RMOC, teams should respect the owners of all intellectual property. Teams are also prohibited from engaging in any behavior that violates intellectual property rights, including but not limited to reverse engineering, replication or translation.

With regard to any behavior that may infringe upon the intellectual property rights relating to educational materials provided for the competition by the RMOC or co-organizers, the intellectual property rights owners are entitled to hold the infringing parties responsible in accordance with law.

Relevant suggestions for open source materials can be found via this link:

https://bbs.robomaster.com/thread-7026-1-1.html.

Release Notes

Date	Version	Changes
2022.03.03	V1.0	First release

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1. Introduction

The core form of RoboMaster 2022 Drone Tournament is that drones are remotely controlled to complete maze challenges. Participants will be ranked based on the completion of the challenges and the time taken to complete them. For more details, please refer to “3 Competition Rules“.

1.1 Team Category

Teams are divided into primary category, junior category, and senior category. There are two sets of competition rules - beginner and advanced levels - each corresponding to a different level of difficulty. The beginner level applies to the primary and junior categories, while the advanced level applies to the senior category. Each team shall consist of up to two participants and one supervisor, with one participant to be the captain. Each member is allowed to join one team only and cannot span the categories.

1.2 Competition Equipment

For the competition, each team will need one programmable drone and will only be allowed to have one backup drone. Participants are required to bring their own drones (including batteries), computers, and routers. Other Battlefield Components will be provided by the RMOC. A participating drone must meet the following specifications:

Aircraft model: Four-axis programmable drone

Aircraft wheelbase: Maximum 120mm

Flight time: At least 7 minutes

Takeoff weight: Less than 120g (including protective guard and battery)

Protection design: Fully enclosed protective guard to ensure flight safety

Battery type: Lithium battery

Programming language: Graphic programming, Python

Aircraft lighting: A programmable RGB indicator

Display module: Dual-color screen with a minimum resolution of 8*8

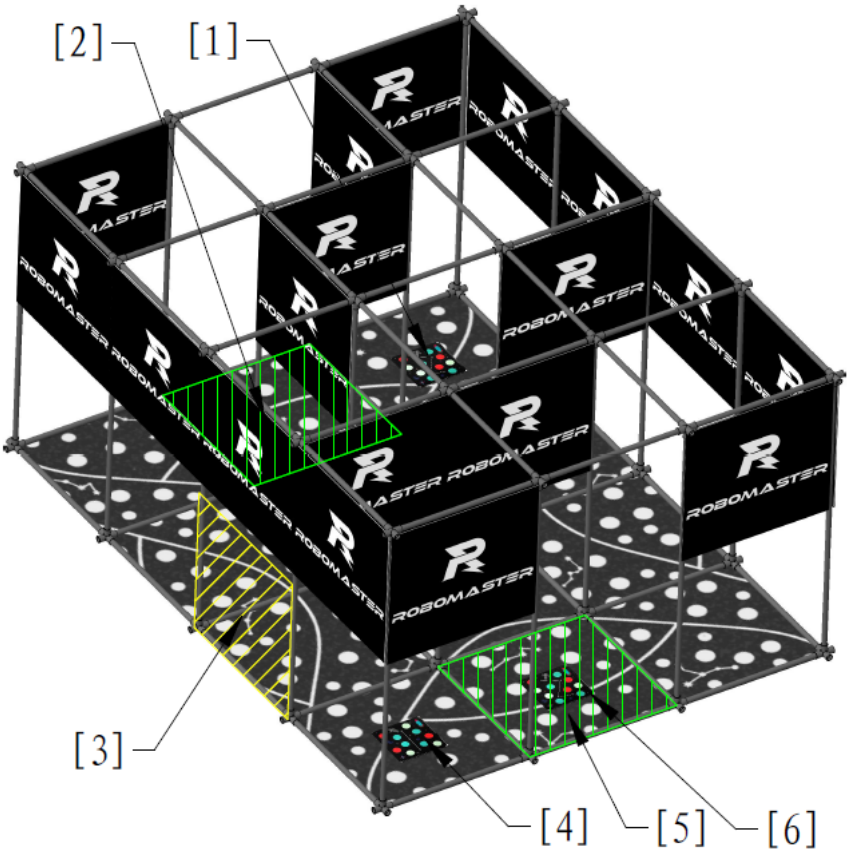
Positioning solution: Vision positioning

Sensor: Fixed height with infrared red or barometer, downward vision camera, forward vision obstacle sensing.

An equipment inspection center will be set up at the registration site, where participants can have their drones inspected for compliance with the requirements. Technical staff from the RMOC will determine if a participant’s equipment meets the competition requirements. If the requirements are not met, the RMOC reserves the right to disqualify the equipment.

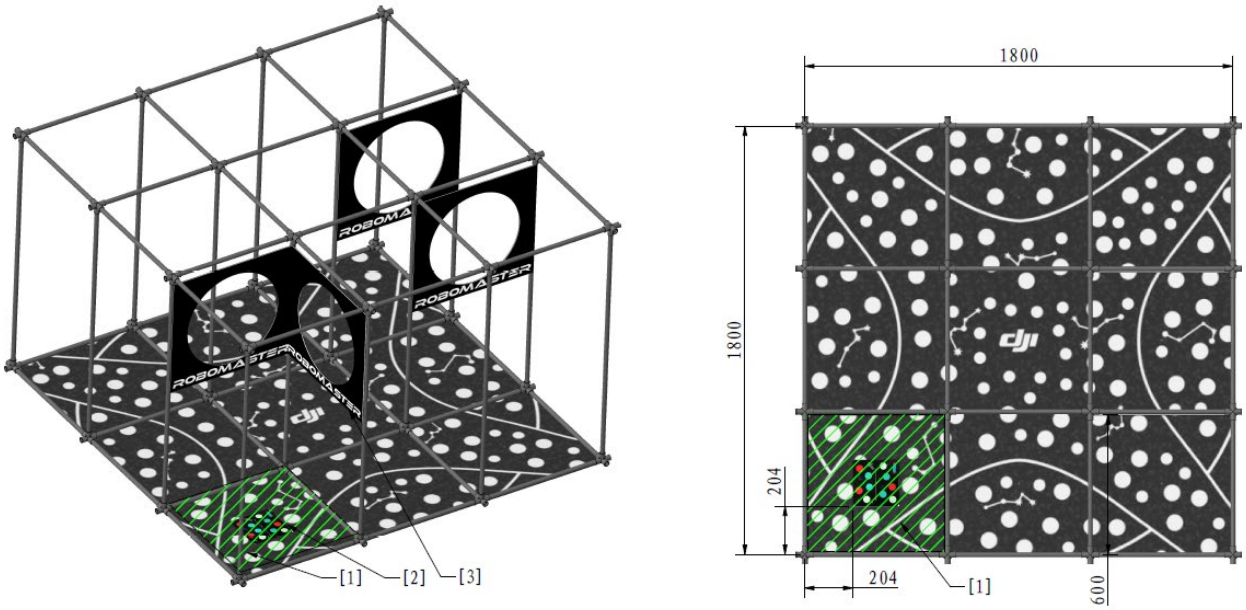
2. Competition Area

The competition area is made up of several 60cm x 60cm grid squares. The site for the beginner level consists of a 4 x 3 maze and a 3 x 3 obstacle zone (which includes 4 vertical obstacle hoops). The site for the advanced level consists of a 5 x 5 maze and a 3 x 3 obstacle zone (which includes 6 obstacle hoops comprising 4 vertical and 2 horizontal hoops). Each obstacle hoop has a diameter of 45cm, and the walls of the competition area are 120cm high.



[1]	Hidden mission point	[2]	Maze start point	[3]	Wall penalty zone
[4]	Hidden mission point	[5]	Maze end point	[5]	Challenge card

Figure 2-1 Beginner's 3 x 4 maze



[1] Start point for obstacle zone [2] Challenge card [3] Obstacle hoop

Figure 2-2 Beginner's 3 x 3 obstacle zone

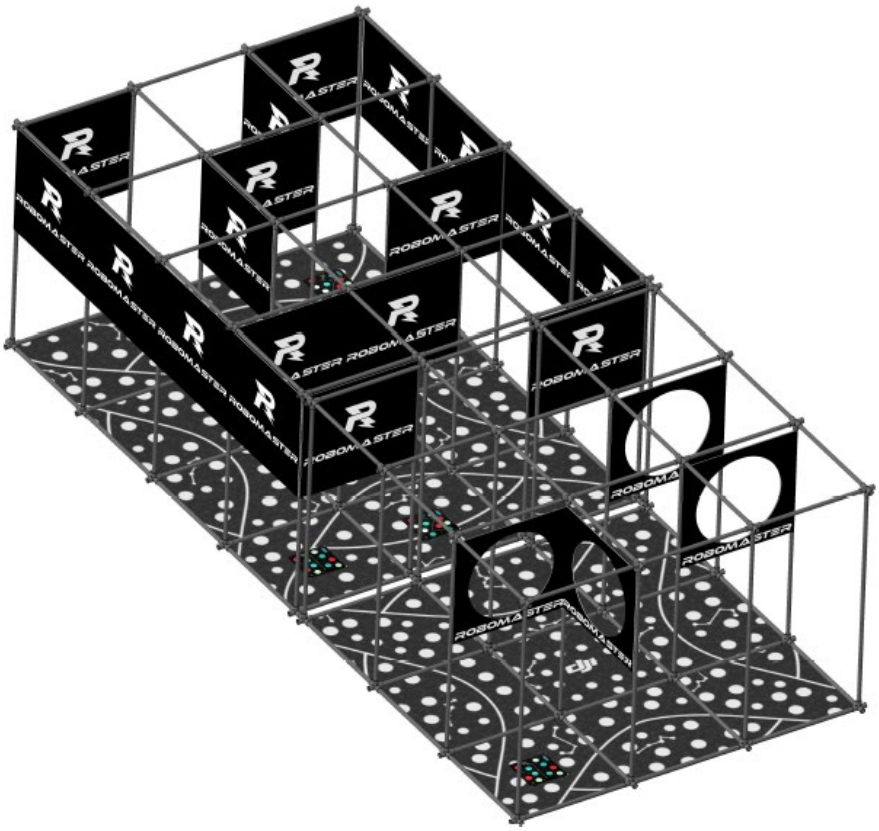
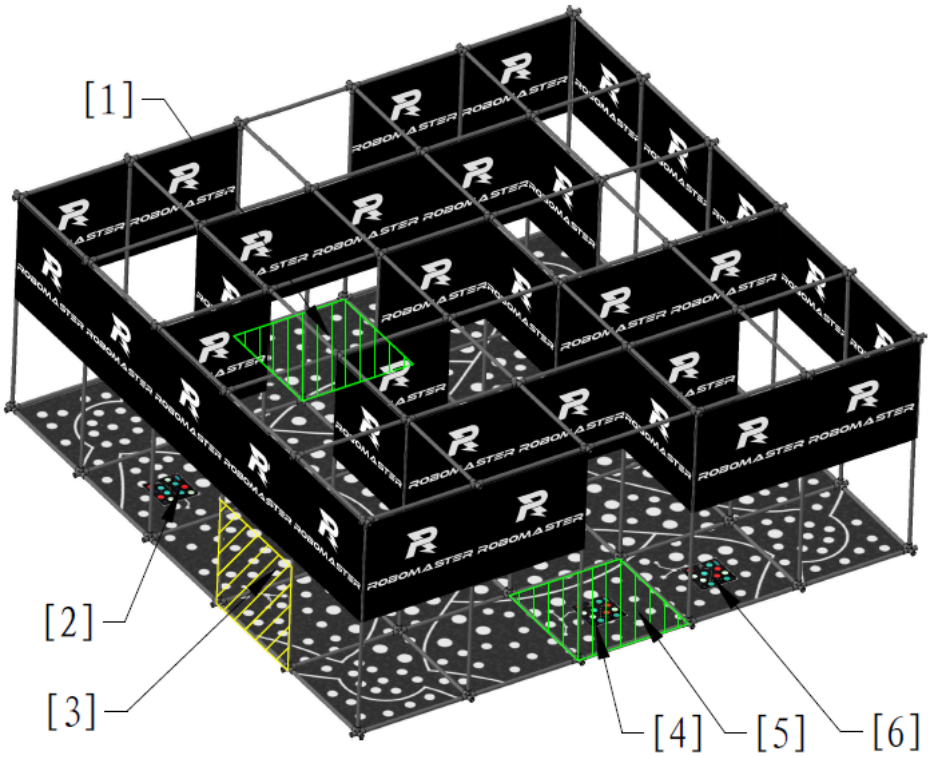
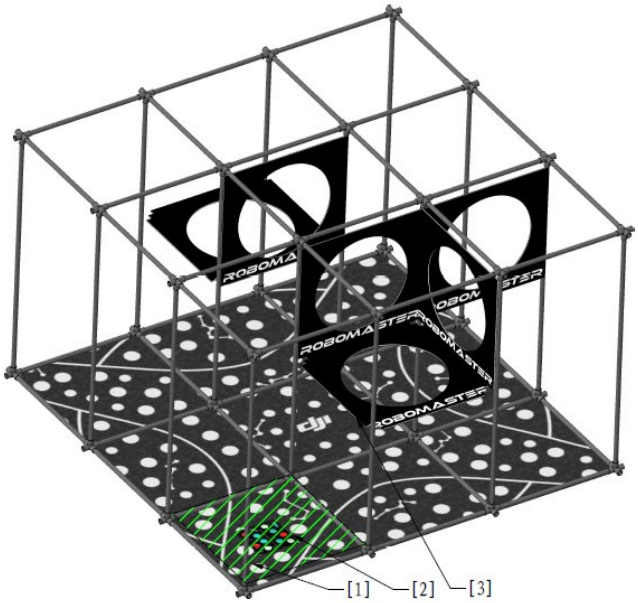


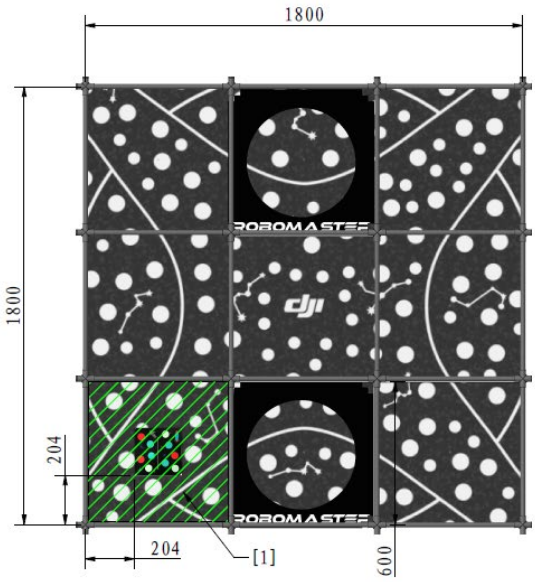
Figure 2-3 Complete setup of beginner's competition site



[1]	Maze start point	[2]	Hidden mission point	[3]	Wall penalty zone
[4]	Challenge card	[5]	Maze start point	[5]	Hidden mission point

Figure 2-4 Advanced Level's maze





[1]	Start point for obstacle zone	[2]	Challenge card	[3]	Obstacle hoop

Figure 2-5 Advanced Level's 3 x 3 obstacle zone

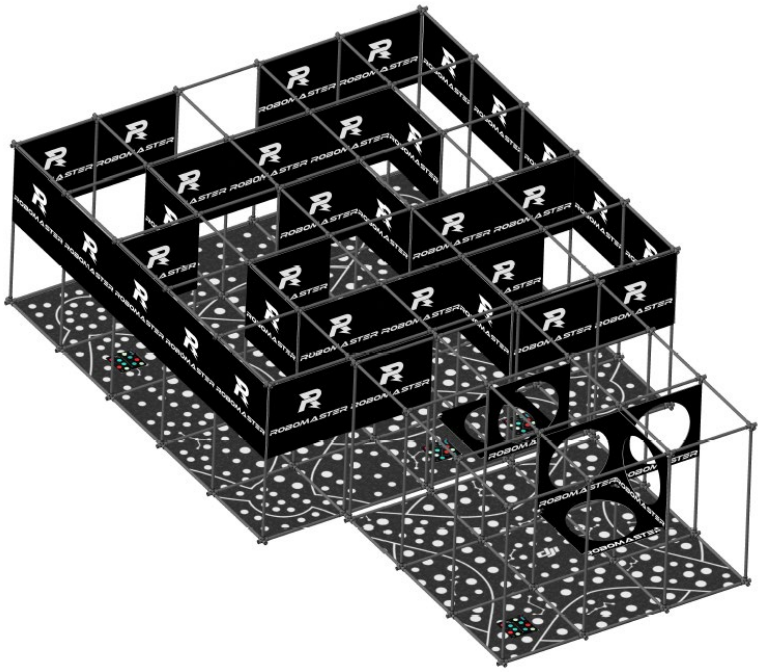


Figure 2-6 Complete setup of Advanced Level's competition site

3. Competition Rules

3.1 Missions

The competition is made up of two parts: the first is the obstacle challenge, and the second is the maze challenge.

For the obstacle challenge, the participating team is required to program the route, operate the drone to take off from the start point of the obstacle zone (where a challenge card is placed with the ID 7) and fly through the obstacles set up on the site. The obstacles need not to be overcome in any particular order. For each obstacle tackled, the drone will need to change the color of its LED to indicate an obstacle has been overcome. After successfully completing the obstacle challenge, the drone will arrive at the maze start point and begin the second part of the competition.

The maze challenge is comprised of two missions: “exploration” and “navigation”. For the “exploration” mission, the drone will take off from the start point (where a challenge card is placed with the ID 8) and look for the “hidden mission points” in the maze, while the participant also has to plan the fastest route out of the maze. When it reaches the end point of the maze, the drone will have to flash its LED three times in red to indicate the mission is successful. The participant will then advance to the “navigation” stage of the competition. For this mission, the drone has to navigate to the start point of the maze from the end point as quickly as possible. Once the end point is reached, the drone will need to shine its LED in constant blue to indicate the mission is completed.

Apart from the special lighting when completing a mission, the drone is required to maintain its LED in constant green during the normal flight.

The hidden mission points are random placed outside the shortest route of the maze. When the drone locates a hidden mission point, it needs to hover within the grid square where the mission point is located and detect the challenge card ID (ranging from 1 to 2, or 5 to 6). The drone must show the ID digit correctly for 1 second using its display module. Then the hidden mission is deemed completed. The participant has only one chance to earn extra points with one hidden mission in one round of competition.

If a programming error occurs during the competition, the participant may request the referee to restart or end the competition.

Once a match is restarted, all points earned from previous missions will be set to zero and the drone will have to complete the missions and earn points again. During the obstacle challenge and the “exploration” mission of the maze challenge, the drone can only restart at the start point of the maze. In the “navigation” mission of the maze challenge, the drone may restart either at the start or end point of the maze. The timing will not stop during the restart of a match.

If the participant requests to end the competition, all points earned from previous missions will be retained.

A participating team may place up to 2 challenge cards at the start point or end point of the maze to assist in the drone positioning. The IDs of the challenge cards shall not be the same as those of the hidden mission points, and

cannot be stuck on the floor using adhesives.

3.2 Scoring

3.2.1 Timing Rule

Each round of competition lasts for 7 minutes. At the start of the competition, the referee will give a signal and start timing. The referee needs to record the total challenge time as well as the individual duration for the "obstacle" challenge in the first part, and the "exploration" and "navigation" missions in the second part. The competition will end if any of the following conditions is met:

- The drone finishes the "navigation" mission of the maze challenge.
- The 7-minute time limit of the competition is up.
- The participant requests to end the competition.

The drone will be deemed to have completed the obstacle challenge when it has entered the grid square of the maze start point from the obstacle zone.

The drone will be deemed to have completed the "exploration" mission when it hovers within the grid square of the maze end point and flashes its LED three times in red at a frequency of 1Hz. The flashing of the LED is included in the mission time (the timing stops once the flashing ends). If the drone has yet to complete the mission when the competition has ended, the mission time shall be deemed as 7 minutes.

The drone will be deemed to have completed the "navigation" mission when any part of the drone enters the grid square of the maze start point and its LED is in constant blue, at which point the referee will stop the timing.

3.2.2 Mission Scoring

Table 3-1 Mission Scoring

Completed mission	Score
One hidden mission completed	20 points/mission
The obstacle challenge completed	40 points
"Exploration" mission of the maze challenge completed	40 points
"Navigation" mission of the maze challenge completed	40 points

- If the competition ends when the drone is in the process of completing the obstacle challenge, the points earned shall be calculated as follows:

A drone is deemed as having overcome an obstacle if its whole body has passed through an obstacle hoop. Assuming "N" is the total number of hoops and "n" represents the number of hoops passed through by the drone, the points obtained would be: 40* (n/N), where N for the advanced level competition is 6, while for the beginner's

competition it is 4.

- If the competition ends when the drone is in the process of completing the "exploration" or "navigation" mission of the maze challenge, the points earned shall be calculated as follows:

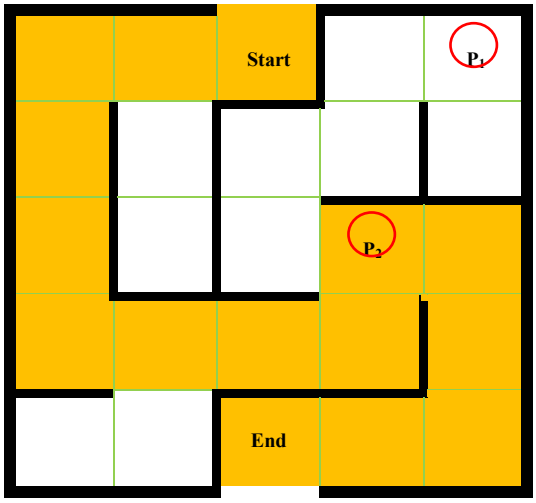
Assuming P1 is the grid square where the drone is when the competition ends; P2 is the grid square on the shortest route of the maze that is closest to P1; and "L" is the shortest route of the maze from the start point to the end point. A route is the number of squares travelled by the drone from one grid square to another. If the drone lands between two squares, the route shall be calculated in the manner that generates a higher score.

"Exploration" mission score = the shortest route from the start point to P2/L*40

"Navigation" mission score = the shortest route from the end point to P2/L*40

The scores shall be rounded off to the nearest whole number.

Example:



When one round of the competition ends, the drone lands on P1. The yellow squares represent the shortest route of the maze from the start point to the end point. The shortest route L from the start point to the end point of the maze is equal to 14 grid squares. P2 is the point on the shortest route that is closest to P1. In the example, the distance from P2 to the start point is 9 and to the end point the distance is 5.

If the drone has not completed the "exploration" mission, the score shall be calculated as follows:

- "Exploration" mission score =9/14*40 = 25.7, to be rounded up to 26.
- No points earned from the "navigation" mission.

If the drone has completed the "exploration" mission but not the "navigation" mission, the score shall be calculated as follows:

- "Exploration" mission score = 40
- "Navigation" mission score = 5/14*40 = 14.3, to be rounded down to 14.

3.2.3 Time Bonus Points

If a drone completes the “navigation” mission within “t” seconds, it will receive extra bonus points to be calculated as follows: Time bonus points = (“t” seconds - time spent completing the mission) * 5 The value of “t” for the advanced level competition is 120, and for the beginner’s competition it is 90.

3.2.4 Penalties

1. If a drone remains outside the perimeter of the competition site for more than 5 seconds, all its points will be set to zero, and the drone will have to restart the mission with the timing still continuing.

2. If a drone flies above and remains higher than the maze wall for more than 5 seconds, all its points will be set to zero, and the drone will have to restart the mission with the timing still continuing.

3. If a drone moves onto another grid square by flying over a maze wall, all its points will be set to zero, and the drone will have to restart the mission with the timing still continuing.

4. If a drone flies through a wall penalty zone, all its points will be set to zero, and the drone will have to restart the mission with the timing still continuing.

5. In the obstacle challenge, if a drone fails to switch its LED after overcoming an obstacle, no points will be given.

6. In the “exploration” mission, if a drone fails to flash its LED three times in red at the frequency of 1 Hz, five points will be deducted;

7. In the “navigation” mission, if a drone fails to shine its LED in constant blue once reaching the end point of the maze, five points will be deducted;

8. A participating team will be solely responsible if they fail to show the correct lighting after finishing the “exploration” or “navigation” mission therefore causing the referee to stop the timing late.

3.2.5 Ranking Rules

Participants in the competition shall be ranked according to the following rules:

1. To be ranked based on scores first.

2. If any two teams have the same scores, the team that completed the “navigation” mission faster will rank higher.

3. If the two teams have the same completion time for the “navigation” mission, the team that completed the “exploration” mission faster will rank higher.

4. If the two teams have the same completion time for the “exploration” mission, the team that completed the obstacle challenge faster will rank higher.

5. If the two teams have the same completion time for the obstacle challenge and are ranked among the top five,

an additional match shall be held with a new maze setup. If the teams are not among the top five, they shall share the same ranking.

4. Competition Process

4.1 Sign In

After the teams sign in, the order of entrance will be determined by drawing lots.

4.2 Commissioning

Before the start of the competition, each team will be allocated some time to perform commissioning. The commissioning time for each team will be decided by the RMOC according to the number of participating teams. In principle, each team must be given at least 5 minutes to commission their equipment. During this period, team members may test their drone in their own commissioning area, and then in the order of the commissioning requests of all teams, enter the site and perform the test.

4.3 On-site Programming

After the referee has announced the location of the obstacle challenge, the player is required to program the route for the drone independently within 25 minutes. When the programming is completed, the participant shall save the program, unplug the power source, and take the drone to the Inspection Area to be inspected and stowed away.

4.4 Inspection

To ensure the drones of all teams meet the standard specifications, each team is required to complete a Pre-match Inspection in the order of their on-site registrations. After completing the Pre-match Inspection, the captain of the team is required to sign and confirm the inspection results, then hand over the drone and programming equipment to be stowed away by the competition staff. When all the teams have completed their inspections and surrendered their drones and programming equipment, the referee will announce the location of the maze challenge.

4.5 Staging Area

Teams must arrive at the Staging Area 10 minutes before the match. The competition staff will verify the details of the team members and supervisors, and release their drones and programming equipment after checking the details are correct and true. Team members are not allowed to modify their program after their drone and programming equipment are returned to them.

4.6 One-Minute Preparation Period

Team members may clean the walls or floor of the competition site, place the challenge cards used to assist their drone in positioning, and activate their drone and programming equipment. However, they are not allowed to modify their drone's program. In the last 10 seconds of the one-minute preparation period, team members shall power on their drone and place it on the grid square of the start point of the obstacle zone. Then all team members are required to leave the site.

4.7 Seven-Minute Round

Once the referee signals the start of the competition, one team member shall start the drone. After the drone is activated, team members are not allowed to operate the drone in any manner without the referee's permission.

4.8 Match Results Confirmation

Within 5 minutes after the end of each competition, the team captain must go to the Referee Area to confirm the results.

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