2025 DTRG Indoor Drone Competition Rules

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Drone Technology Research Group (DTRG.org)
Department of Mechanical and Mechatronics Engineering
University of Auckland

Contact: Dr Nicholas Kay [nicholas.kay@auckland.ac.nz]

1. Introduction

This year's Competition is inspired by the Search and Rescue theme of the IMAV 2025 indoor drone competition. Teams must accurately fly a drone around a circuit, collecting points via a sequence of tasks: obstacle avoidance, object identification, and payload delivery. The aerial manipulation task, involving depositing an object from the ground, has the most points associated with it. This task requires teams to design, build, and operate a delivery system.

All drone equipment is provided by DTRG and flying will be overseen by senior members of DTRG. No prior knowledge or drone pilot experience is required.

The Competition will take place within the flying arena (Figure 1), an 8 x 8 x 3 m netted volume within the Motion Capture Laboratory, room 405.836E. The date of the competition day and weekly training sessions will be posted on DTRG.org.

Prizes will be awarded to successful teams from a prize pool worth a total of more than $500 in drone equipment, including: radio transmitter gear, flight control hardware, and frame parts.

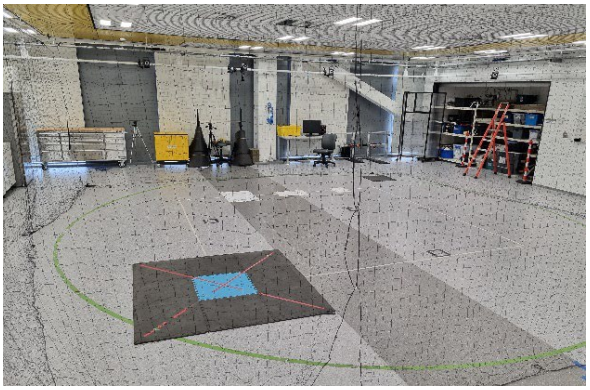

Figure 1: Flying arena. 2024 Course Shown.

2. Competition Slots

Each team will be assigned a 15-minute time slot to set up in the pilots' area, practice if needed, complete a 10-minute competition run, and clear the area. The order of the teams' slots will be drawn by lot at the start of the competition day. The 10-minute competition run will be timed via a countdown timer by the DTRG operation team. The timer is started when the competition team is ready but no later than 4 minutes into the time slot and is paused for events outside the control of the team, such as battery replacements.

Each team will be given 10 minutes immediately before their time slot to attach their payload collection system on a standby drone. All teams and team members must follow all health and safety instructions by the DTRG operation team.

3. Drone Description and Operation

The drone is a GEPRC Crown Cinewhoop (Figure 2), a quadrotor drone with a mass of approximately 500 grams and 250 mm motor-to-motor diameter. It includes a downward-facing camera with video radio transmitter, capable of flying in first person view (FPV). The video feed will be displayed on a monitor and FPV goggles for use by the competing team.

Figure 2: Competition drone

One of the competition tasks involves the deposit of a small object. A separate radio receiver can be used by the competition team if they wish to control a small servo (provided) and attach this to the bottom of the drone. Teams will need to design and construct their sample collection system in their own time. The UoA Maker Space in B402 is the recommended space for this activity. The Maker Space contains 3D printers, a laser cutter, hand tools, and some materials.

During the competition, a designated DTRG member, referred to as the *Pilot Director*, will operate the primary radio transmitter. They will be responsible for starting/stopping motors and always regulating height. A member of the competing team, referred to as the *Pilot Competitor*, will hold a second radio transmitter and be responsible for lateral position and heading control (always forwards). At any time, the *Pilot Director*, can take control of all axes of the drone for safety reasons and repositioning. The *Pilot Competitor* is to verbally direct the *Pilot Director* to control height using only three commands:

- “climb” or “take off”
- “descend” or “land”
- “hold”

The *Pilot Competitor* may also nominate heights (e.g. knee height, waist height, head height) for the *Pilot Director* to fly during one or more of the Tasks.

Battery management is the responsibility of the DTRG operation team. Battery replacement will occur every 2 circuits during the competition.

The competing team may also employ another member, designated as the *Pilot Observer*, who will be positioned beside the *Pilot Competitor*. The *Pilot Observer* may provide advice to the *Pilot Competitor*, and actuate the servo if needed.

4. Competition Details

There is a circuit to be flown around in which there are several tasks to be performed, each of which will generate points for the team, Figure 3. The centreline of the circuit is a 4 x 4 m square, marked out by blue tape on the floor. The borders of no-fly zones are 1 m laterally from the centreline, marked out by red tape on the floor. The *Pilot Director* will take full control of the drone and fly it to the nearest point overhead the centreline before returning lateral control to the *Pilot Competitor* if:

- the centre of the drone enters a no-fly zone, or
- the heading of the drone is more than 45 degrees from forwards, or
- they deem that the drone is flown in an unsafe manner.

The Tasks within the circuit are as follows:

- Task 1: Take-off from the start zone, fly the circuit in a clockwise direction and pass through one of three paths.
- Task 2: Identify the location of a fire in the building.
- Task 3: Collect an emergency equipment package
- Task 4: Deposit the package at the needed room.
- Task 5: Return and land in the start zone.

Teams may choose to pass on any tasks that they are unable or choose not to complete.

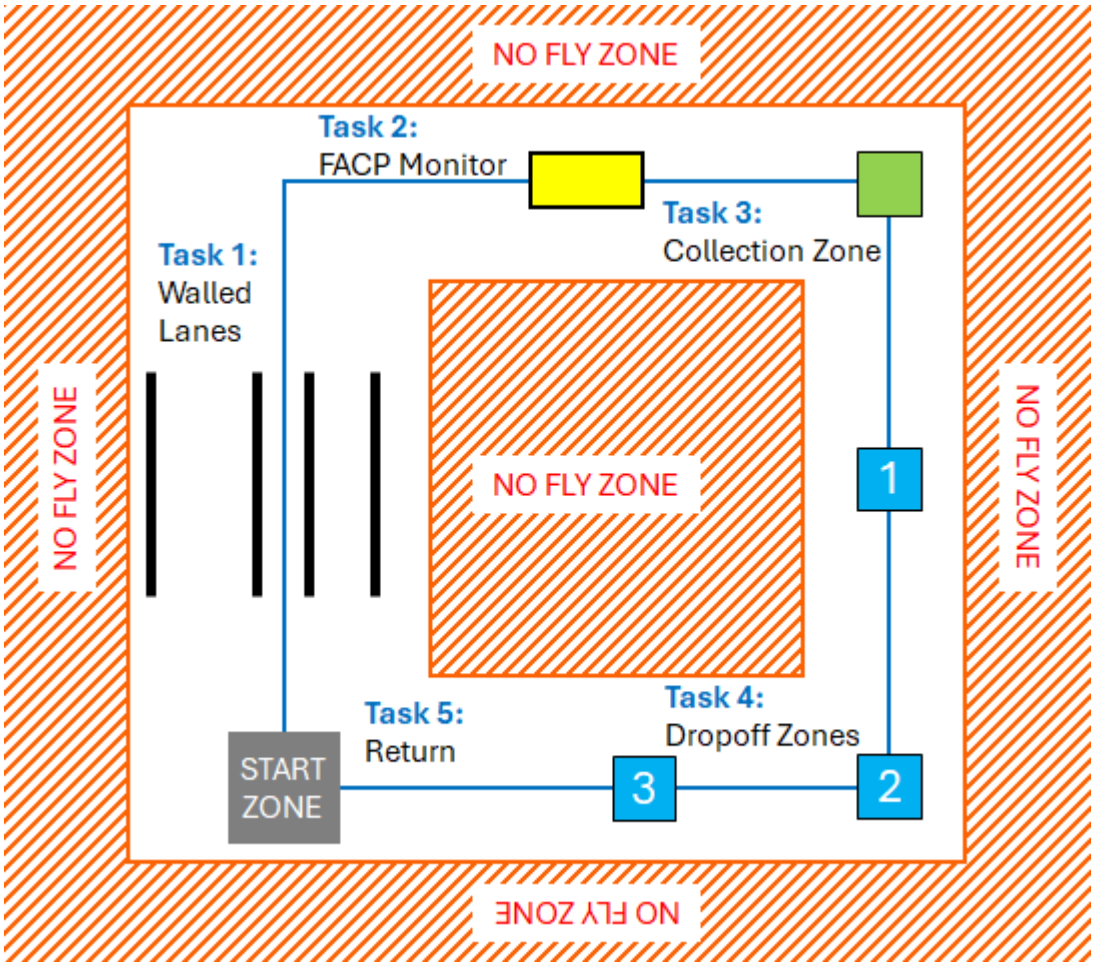

Figure 3: Plan view of the competition circuit.

5. Scoring

Total score

During the competition slot, teams will be allowed to have repeated attempts at the circuit, each time attempting the tasks they choose. The team will only be allowed to score points for each task once during each circuit. The score of a team will be the cumulative score from all the circuits carried out within the allotted time. Each circuit must start from the take-off and landing site. The final score for a team will be determined using the following formula:

$$S = \sum (T_1 + T_2 + T_3 + T_4 + T_5)$$

Task 1: Precision Flying, T_1

	T_1
Wide Lane (4 aircraft widths)	1
Middle Lane (3 aircraft widths)	3
Narrow Lane (2 aircraft widths)	5

- A successful passage occurs when the drone is clear of the end of its lane

Task 2: Object Identification, T_2

	T_2
No identification	0
Successful identification	5

- This task is based on the concept of a building Fire Alarm Control Panel (FACP), which quickly identifies where in a building an alarm has been activated. The simplified version used in this task is shown below. The active alarm will be red. All others will remain off. Only one will be active at any time.

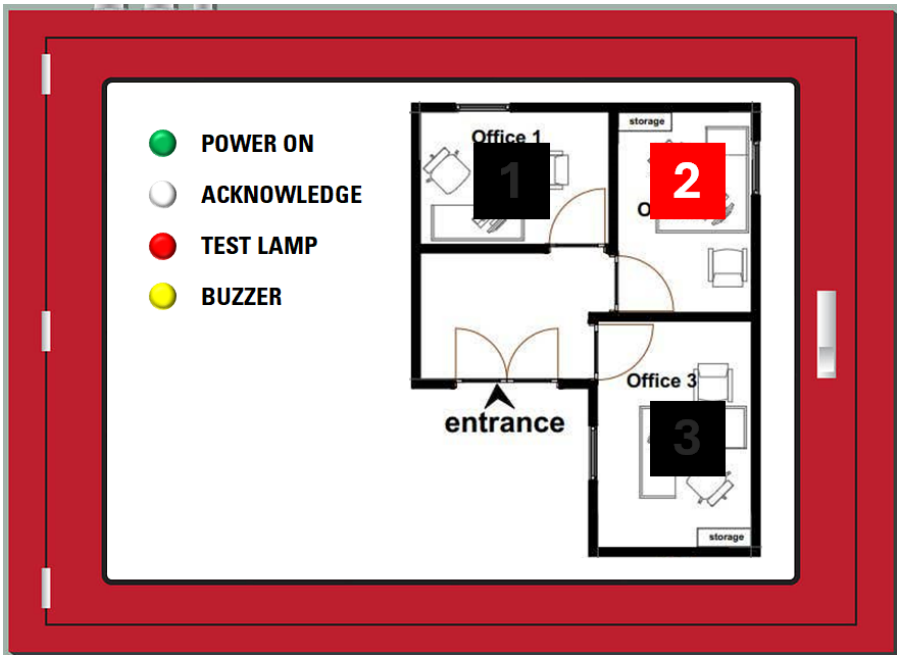

Figure 4: FACP Panel, showing a fire in OFFICE 2.

- This task can only be completed in FPV, using the downwards-facing camera.
- Successful identification requires the correct office to be called out by either the *Pilot Competitor* or *Pilot Observer*.

Task 3: Emergency Equipment Collection, T_3

	T_3
No collection	0
Successful Collection	15

- The sample used for collection is a small box with two bars on top, a groove around the outside, and a small Velcro patch (soft side), see Figure 4(a). It is approximately 100 L x 45W x 20H mm and 50 grams. The sample cannot be modified by the team.
- Successful collection requires the aircraft to leave the collection zone with the payload attached.
- If a servo-actuated system is required, this may be operated by the *Pilot Observer*.
- The FPV monitor may be used by either the *Pilot Competitor* or *Pilot Observer* as necessary if desired.
- Teams who wish to compete in Task 4 but are unable to carry out Task 3 may request that the payload is manually attached at the start of a circuit. However, the team will score 0 on Task 3, and the time shall be included in their run.

Task 4: Emergency Equipment Deposit, T_4

	T_4
No deposit	0
Equipment box is touching or partially within the bounds of the deposit zone	5
Equipment box is fully within the bounds of the deposit zone	10

- The target will comprise of a square mat measuring 600 mm along each edge, situated at ground level.
- The equipment must be deposited at the target indicated by the FACP in Task 2.
- Accuracy will be based on the final position of the payload.
- If a servo-actuated system is required, this may be operated by the *Pilot Observer*.
- The FPV monitor may be used by either the *Pilot Competitor* or *Pilot Observer* as necessary if desired.

Task 4: Return and Land in the Start Zone, T_4

	T_5
Return home and land	1

- The aircraft must land and disarm on the start mat.