# NIRYAN: UNDERWATER SEARCH & RESCUE

## Official Competition Rulebook

*"Creating Intelligence Robotics Industry in Nepal by 2045"*

### 1. Competition Theme

During the monsoon, floods often cover roads and houses in Nepal. Rescue teams need to find people in the water, give them first aid, mark where they were found and recover important objects from below the surface. Small remotely operated vehicles (ROVs) can do much of this work from the bank.

**Niryan** is set in a flooded town built inside a (Approx) 12 ft × 8 ft × 4 ft tank. Each team builds an ROV and pilots it through a fixed sequence of rescue tasks: first at the surface then underwater.

### 2. Objectives

- Introduce students to underwater robotics: buoyancy, waterproofing, thrust and remote control.
- Build skill in piloting by camera and in picking up and placing objects accurately.
- Apply robotics to flood rescue and recovery work.
- Encourage planning, teamwork and communication between pilot and co-pilot.
- Promote safe practice with electricity near water, and clear engineering documentation.

### 3. Team Challenge / Competition Overview

**Mission:** In a 8-minute run, the team pilots its ROV from the start zone through six tasks in a fixed order: four surface tasks worth 150 points, then two underwater tasks worth 150 points.

**Team Challenge:**

1. Design, build and test an ROV that meets Section 5, with one camera, a pick-up mechanism of the team's choice and a way to save a still image from the camera feed.
2. During the run, complete the tasks in this order: (1) Flooded Street Crossing, (2) Survivor Rescue, (3) First-Aid Delivery, (4) Last-Seen Flagging, (5) Open-Site Black Box Recovery to Bin, (6) Enclosed Black Box Recovery.
3. A team may skip a task by telling the referee, but may not go back to a task once it has moved on.
4. The pilot drives by the camera feed only. The co-pilot may watch the arena and guide the pilot by voice. Teams must deal with buoy gates, an optional low bridge, a 60 cm hoop, tight underwater spaces and the time limit.
5. The run ends when time expires, when the team calls "finish", or when the referee stops the run.

### 4. Team Specification

1. Each team must consist of upto 4 members.
2. Teams may represent schools, colleges, institutions, or independent groups.

3. Each team may register a maximum of one (1) ROV.
4. Each team must nominate one team leader as the official contact person.
5. A participant may be a member of only one team.
6. During a run, up to three team members may be at the arena: the pilot, the co-pilot and, for wired ROVs, the tether handler. Mentors and coaches may teach and advise but must not build, program or pilot the ROV.

## 5. Robot Specification

### 5.1 Robot Type and Locomotion

1. Permitted robot type: underwater ROV or Surface ROV(remotely operated vehicle) moved by thrusters (propellers), controlled through a tether or wirelessly.
2. Wheels, tracks, legs, poles, or ropes pulled from outside the tank are prohibited. The ROV may rest on the tank floor, but must not drive along it.
3. The ROV must be neutrally or slightly positively buoyant: with all power off it must float or rise slowly, never sink. Any added weights must be fixed securely and must not fall off into the water.
4. Any pick-up method is allowed: electromagnet, permanent magnet, hook, gripper or other, as long as it does not damage the props or arena. The black boxes and last-seen flags have a hook loop and a steel plate; survivors and the first-aid kit have a steel plate.
5. All propellers must have guards or ducts so that fingers cannot touch a spinning blade.

### 5.2 Size and Weight

1. Robot length: upto 50 cm.
2. Robot width: upto 50 cm.
3. Robot height: upto 50 cm.
4. Measured with every attachment fitted, in the configuration used during the run, excluding any tether. The ROV must pass through a 50 cm diameter hoop in at least one orientation.

### 5.3 Control and Autonomy

1. Robot control mode: remote-controlled by a human pilot, either wired (tethered) or wireless. Depth-hold, heading-hold and other stabilisation aids are allowed, but every movement toward a task must be commanded by the pilot.
2. Permitted controllers: any (Arduino, ESP32, Raspberry Pi, STM32 or similar).
3. Permitted sensors: any (for example pressure/depth, IMU and leak sensors).
4. Permitted communication systems: any wired or wireless link.
5. The pilot drives using its feed, and the pilot station must be able to save a still image (capture button, screenshot or screen recording) for the photo tasks.
6. During a run only the pilot may operate the controls. The co-pilot may watch the arena and speak to the pilot but must not touch the controls. The tether handler, if any, may only feed out and take in slack.

### 5.4 Power System

1. Permitted battery types: LiPo, Li-ion, LiFePO4 or sealed lead-acid, or an isolated low-voltage DC supply at the pilot station. No mains-voltage (230 V AC) equipment may be connected to the ROV or tether.
2. Maximum operating voltage: 12 V DC nominal (13.8 V maximum) anywhere on the ROV, tether and control station.
3. Maximum number of batteries: 2 packs (one main pack and one spare). Spares may only be swapped between runs.
4. Batteries must be securely mounted and protected against short circuits.
5. Batteries on board the ROV must be inside a sealed enclosure. LiPo packs must be charged and stored in fire-safe bags, away from the arena; charging at the arena is prohibited.

### 5.5 Mechanical and Electronic Construction

1. Ready-made robots: not allowed. Commercial ROVs and complete ROV kits are prohibited.
2. Ready-made electronic modules and development boards: allowed (motor controllers, thrusters, cameras, sensors, enclosures and connectors may be bought).
3. The robot must have an accessible emergency power switch: at the pilot station for wired ROVs; on the ROV, plus a stop command from the controller, for wireless ROVs.
4. Sharp edges, hazardous components, liquid leakage, or harmful materials are prohibited. Nothing may leak into or contaminate the water.
5. A tether, if used, must be with strain relief at both ends so that pulling it does not pull on any connector or seal.
6. Each team must be able to show how the electronics are sealed (enclosure, cable glands or potting).

## 6. Robot Verification / Homologation

1. All robots must undergo verification before the competition.
2. Verification will take place at the Robotics Association of Nepal (RAN) office between 7 and 2 days before the competition.
3. Teams must demonstrate: size and weight; a power-off float test; a 2-minute submerged leak test; the emergency power switch; battery mounting; propeller guards; the camera feed and still-image capture; and that the pick-up mechanism grips and releases on command.
4. Only verified robots are permitted to participate.
5. No modification is allowed after verification except repairs approved by the organizers. A repaired ROV may be re-inspected before its run.
6. A ROV that fails any check may be fixed and re-verified within the verification window. A ROV that is not verified, or that is changed without approval, will be disqualified.

## 7. Arena Specification

### 7.1 General Arena Requirements

1. Arena dimensions: 12 ft × 8 ft inside, with a water depth of 4 ft).
2. Arena surface material: water-tight tank or lined pool with a flat, light-coloured floor, filled with clean fresh water at room temperature.
3. Boundary markings: the tank walls are the arena boundary. Surface zones are marked with yellow floating rope; underwater zones are marked with yellow tape or painted lines on the floor.
4. Starting zone: 60 × 70 cm).
5. Target zones: the Rescue Zone (Red and Green halves), the two Last-Seen Rings, the Recovery Shelf and the Evidence Bin, as listed in 7.2.
6. Normal indoor lighting. The pilot station stands at least 1 m behind the start wall, behind an opaque screen, so the pilot cannot see the tank. The co-pilot stands at the tank and may watch the arena. Organizers will keep water clarity and lighting the same for every run as far as possible.

### 7.2 Arena Layout and Components

**Arena Description:** The start zone and flag dock are on the start wall. The Rescue Zone is in the north-west corner, divided into the Red Rescue Zone (west half) and the Green Rescue Zone (east half). The Flooded Street runs through the middle of the tank: three buoy gates followed by an optional low bridge. The red-tag survivor floats in the north-east and the green-tag survivor in the south-east, each inside a Last-Seen Ring. The first-aid kit starts at the First-Aid Station in the south-west corner. Underwater, the black-box site lies against the south wall: the enclosed black box inside the Hoop Enclosure and the open-site black box on the floor just outside it. The open-site box goes to the Evidence Bin at the east end; the enclosed box goes to the Recovery Shelf, 1 ft below the surface in the south-west.

**Obstacles and Objects:**

| Item | Size / weight |
|---|---|
| Red-tag survivor | ≈ 25 cm figure, ≤ 300 g |
| Green-tag survivor | ≈ 25 cm figure, ≤ 300 g |
| Last-seen flags (2) | 12 cm float, ≤ 100 g |
| First-aid kit | 15 × 10 × 6 cm, ≤ 150 g |
| Open-site black box | 25 × 18 × 15 cm, ≤ 1 kg in water |
| Enclosed black box | 25 × 18 × 15 cm, ≤ 1 kg in water |

| | |
|---|---|
| Buoy gates (3) | Two 10 cm floats per gate, 54 cm between centres |
| Bridge (optional) | 15 cm wide beam, 60 cm span |
| Hoop Enclosure | 70 × 70 × 60 cm frame |
| Rescue Zone | 90 × 70 cm, split at x<br>45 |
| Last-Seen Rings (2) | 30 cm diameter |
| Recovery Shelf | 60 × 60 cm platform |
| Evidence Bin | 40 × 40 × 25 cm, open top |

**Starting and Finishing Conditions:** Before the run the team places the ROV in the water inside the start zone, touching the start wall. All objects are in the positions above. The run starts on the referee's signal and the 8-minute clock starts at the same moment. The run finishes when the clock reaches 8:00, when the team calls "finish", or when the referee stops it.

**Arena Diagram (Approximate):**

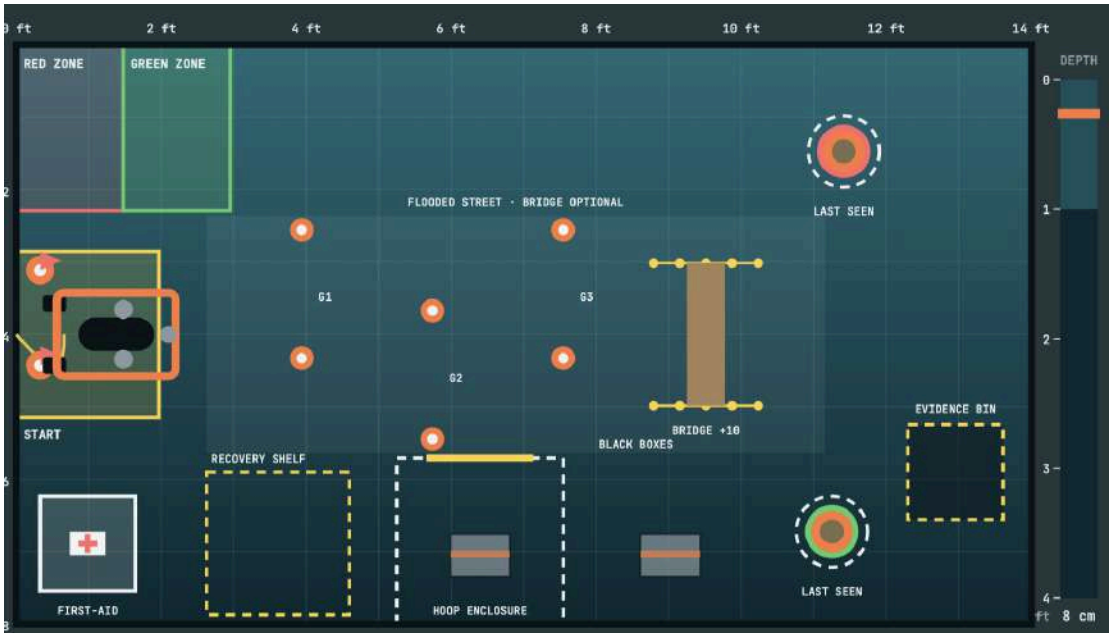



*Figure 1: Arena layout*

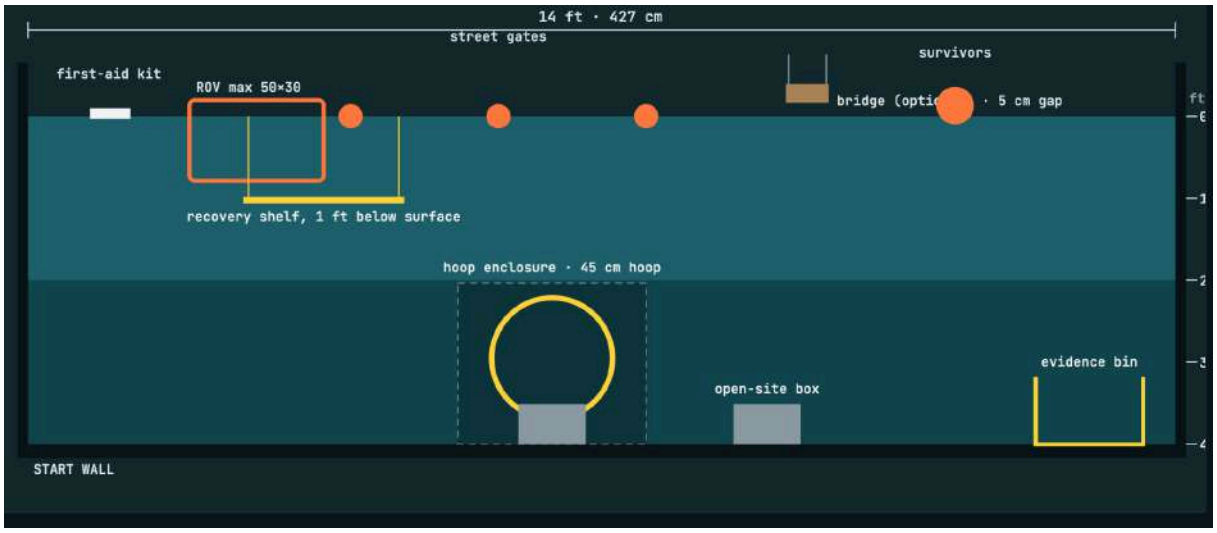



*Figure 2: Arena in Depth*

**General run rule**

1. Each team gets two runs of 8 minutes. The better of the two run scores counts as the team's final score.
2. Before each run the team has 1 minute to set up. After the run it has 1 minute to remove the ROV. Organizers reset all props between runs.
3. Tasks must be done in the order 1 to 6. Within a task, its items may be done in any order (for example, either survivor first). A team moves to the next task when it tells the referee, or when it starts scoring in the next task. A task that has been left cannot be scored later.
4. Each scoring item is awarded only once per run. Gates, the bridge, lifts, latches and photos score at the moment they are achieved. Other objects score according to where they are when the team moves on from that task, or at the end of the run for Tasks 5 and 6: an object is "in" a surface zone when more than half of it lies inside the zone, "on" the shelf when it rests on the shelf, and "in" the bin when it rests inside the bin. To earn points for delivery or movement tasks, objects must be transported by the ROV mechanism and not drifted, coasted, or pushed passively.
5. A collision is any contact between the ROV (or an object it is carrying) and a prop that is not its current target, or the tank wall. Contact with the floor and contact by a tether are not collisions. Continuous contact counts as one collision.
6. Two referees judge each run: a surface referee and an underwater referee who watches through the tank wall or an underwater camera. Scores are written on the official score sheet and read to the team leader after the run.

**Surface tasks (150 points)**

**Task 1. Flooded Street Crossing (30, +15 bridge bonus).** Drive through the three buoy gates in the middle of the arena.

- 10 points per gate passed completely without touching either buoy.
- Bridge bonus (optional): +15 for passing completely under the bridge, between the guide ropes, without touching the beam. Teams may instead go around the bridge with no penalty.

**Task 2. Survivor Rescue (45).** Move the red-tag survivor into the Red Rescue Zone and the green-tag survivor into the Green Rescue Zone. 22.5 points per survivor in its own zone; 10 points if it ends in the other half of the Rescue Zone.

**Task 3. First-Aid Delivery (35).** Take the first-aid kit from the First-Aid Station and deliver it inside the Rescue Zone. 35 points if the kit is inside the Rescue Zone (either half); 15 points if it is within 30 cm of the Rescue Zone.

**Task 4. Last-Seen Flagging (40).** Take each flag from the flag dock and leave it in a Last-Seen Ring. 20 points per flag inside a ring (one flag per ring); 10 points if it is within 30 cm of a ring.

**Underwater tasks (150 points)**

**Task 5. Open-Site Black Box Recovery (65).**

- Photo: 15 points for a clear saved still image showing the full box in its original resting position, taken before the box is touched. The pilot calls "photo" and the judge checks the image after the run.
- Lift: 15 points for controlled lifting of the box clear of the floor using the ROV mechanism.
- Delivery: 35 points if the box is carried and rests inside the Evidence Bin at the end of the run.

**Task 6. Enclosed Black Box Recovery (85).**

- Photo: 15 points for a clear saved still image showing the full box inside the Hoop Enclosure, taken before the box is touched.
- Retrieval: 25 points for gripping or hooking the box while the ROV is inside the Hoop Enclosure and bringing it out through the hoop.
- Delivery: 45 points if the box is carried and rests on the Recovery Shelf at the end of the run.

### 8.2 Penalties and Negative Marking

Penalties are subtracted from the run score. A run score cannot fall below 0.

| Code | Violation | Penalty |
|---|---|---|
| P1 | Collision with a prop (not the current target) or the tank wall, per separate contact | −5 |
| P2 | Moving a prop out of its marked position (buoy dragged, bridge beam or ring knocked away). The prop is not reset. | −10 (plus P1) |
| P3 | Knocking an already scored object out of its target area | That object's points are lost |
| P4 | Scoring an item out of the task order, or returning to a task that has been left | Not counted |
| P5 | Starting before the referee's signal | −10 |
| P6 | Not ready when the 2-minute setup ends | −5 per extra 30 s; run forfeited (0) after 2 extra minutes |
| P7 | Reset: the ROV is lifted from the water and returned to the start zone; the clock keeps running (one reset per run) | −10 |

| | | |
|---|---|---|
| P8 | A second reset in the same run | Run ends; points scored so far stand |
| P9 | Touching the ROV in the water by hand without calling a reset | −10 per touch |
| P10 | Tether handler steering, pulling or dragging the ROV with the tether | −20 per occurrence |
| P11 | Collision with or disturbing random floating debris / objects | −10 per occurrence; run ends on the third |
| P12 | Co-pilot touching the controls | −20 per occurrence |
| P13 | A team member touching a prop or object in the arena during the run | −20; the object stays where it is |
| P14 | Anything released into the water (parts, weights, oil, dye) | −20; run stopped if the water is contaminated |
| P15 | Black-box photo taken after the box was touched | 0 for that photo |
| P16 | Run time reaches 8:00 | Run ends; score taken at that moment |
| P17 | Damage to the arena or props caused by the ROV's design or unsafe driving | −30; possible disqualification |
| P18 | Safety violation during a run (exposed wiring, missing emergency switch, battery fault, mains equipment) | Run stopped; 0 for that run |
| P19 | Unverified ROV, or changes after verification without approval | Disqualification |
| P20 | Unsporting behaviour (see Section 11.2) | Warning, then −10, then disqualification |

**9. Score Summary**

| **Round / Challenge** | **Maximum Points** |
|---|---|
| Task 1 – Flooded Street Crossing | 30 |
| Task 2 – Survivor Rescue | 45 |
| Task 3 – First-Aid Delivery | 35 |
| Task 4 – Last-Seen Flagging | 40 |

| | |
|---|---|
| **Surface subtotal** | **150** |
| Task 5 – Open-Site Black Box Recovery | 65 |
| Task 6 – Enclosed Black Box Recovery | 85 |
| **Underwater subtotal** | **150** |
| **Total** | **300** |
| Bridge bonus (optional, Task 1) | +15 |
| **Maximum with bonus** | **315** |

**Final Score Calculation:**

Run score = points earned (including the bridge bonus) − penalties (minimum 0).

Final score = the higher of the team's two run scores. Teams are ranked by final score. The bridge bonus is the only bonus.

**10. Tie-Breaker**

If two or more teams achieve the same final score, the following criteria will be applied in order:

1. Higher underwater points in the counted run.
2. Shorter time to the last scoring action in the counted run.
3. Fewer penalty points in the counted run.
4. Higher score in the other run.
5. Final decision by the judges / organizing committee.

**11. Sanctions on Competition Day**

**11.1 Absence and Delay**

1. Teams must report to the competition area at the announced reporting time.
2. Teams that are not ready after the announced notice period may be considered absent.
3. A team that is not at the arena when called has a 1-minute grace period. After that its run is recorded as 0. Delays during setup are handled by penalty P6.
4. A run may be rescheduled only for reasons outside the team's control (power cut, arena fault, referee decision). A ROV failure is not a reason to reschedule.

**11.2 Misconduct and Violations**

1. Disrespectful behavior toward participants, judges, organizers, or spectators may result in sanctions.
2. Deliberate damage to the arena, equipment, or another team's robot is prohibited.
3. Unauthorized assistance, interference, or manipulation of competition equipment is prohibited.
4. Sanctions are applied in this order: a warning, then −10 points from the current or next run, then disqualification. Serious misconduct may lead to immediate disqualification.

**12. Safety Rules**

1. All robots must pass a safety inspection before participating.
2. Robots must have an accessible emergency power switch.
3. Batteries must be handled, charged, and stored safely.

4. Sharp edges, exposed dangerous wiring, and hazardous materials are prohibited.
5. Only authorized team members may enter the arena.
6. Teams must follow instructions from referees and safety officials.
7. Water and electricity: the maximum voltage is 12 V DC nominal; no mains equipment may touch the water or a tether; all mains equipment at the pilot station must be plugged into an RCD-protected outlet; propellers must be guarded; nobody may put their hands in the water while thrusters are powered.
8. The organizers may stop any robot or match if a safety risk is identified.

**13. Technical Documentation Submission**

Each team must submit a technical document before the announced deadline. The document must include:

1. Team name, team members, and institution (if applicable).
2. Robot overview and design concept.
3. Mechanical design, structure, drawings, and photographs, including how the ROV is made to float level.
4. Fabrication process and materials used, including how the electronics are waterproofed.
5. Electronics, sensors, actuators, and power systems, with a wiring diagram showing the emergency switch.
6. Software architecture and control algorithms.
7. Communication system (wired or wireless) and any stabilisation (depth or heading hold).
8. Working principle and strategy for completing the competition challenge, including the pick-up mechanism.
9. Testing, troubleshooting, and performance results, including leak tests.
10. Safety measures incorporated into the robot.
11. Innovation and potential real-world applications.

**Submission Requirements:**

- File format: PDF.
- Maximum document length: 15 pages.
- Submission deadline: [date and time to be announced].
- Submission method: [email address / online form to be announced].
- File naming format: TeamName_Niryan.pdf.

**14. Judging and Rule Changes**

1. Judges and referees will evaluate teams according to the scoring criteria specified in this rulebook.
2. All scoring decisions must be recorded using the official score sheet.
3. Teams may raise questions or objections through their nominated team leader.
4. Any appeal must be submitted within 15 minutes after the run result is announced.
5. The decisions of the judges and organizing committee will be final, subject to the announced appeal procedure.

6. The organizers reserve the right to clarify, modify, or update competition rules before the event.
7. Any official changes will be communicated to all participating teams, with a new version number on this rulebook. Rule book is subject to change please refer to the latest version.

**15. Registration fee (per team)**

| Category | Fee(NPR) | Window |
|---|---|---|
| Normal | NPR 4000 | Opening of registration |
| Late | NPR 5500 | registration closes |

**How to register**

1. Fill in the online registration form at yantra.ran.org.np with team details.
2. Pay the fee and upload the payment receipt(For Nepali Participants).

**16. Awards & Certificate Policy**

**16.1 Awards**

| **Award** | **Cash prize** | **Additional benefits** |
|---|---|---|
| Winner | NPR 50,000 | Participation Certificate, Winner Certificate and feature in Yantra Media |
| Runner-up | NPR 25,000 | Participation Certificate, Winner Certificate and feature in Yantra Media |
| Other Participants | To be announced | Winner Certificate and feature in Yantra Media |

**16.2 Certificate policy**

1. Certificates of Excellence or Achievement go to all award winners.
2. Certificates of Participation go to all participating teams.
3. Teams disqualified for breaking the rules are not eligible for any certificate.

**Note: Prizes are subject to applicable government taxes**

**17. Contact Details**

**Lead, Yantra Niryan :** Anuj Chaudhary, 9817432137, Robotics Association of Nepal
**Lead, Yantra:** Kiran Khatri, 9766387092, Robotics Association of Nepal
**Milan Tamang**, Vice-President, Robotics Association of Nepal Managing Director, Yantra X: Intelligence & Entrepreneurship Festival: 9860059600
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**** Some of the rules and regulations, and minor gameplay are subject to change as required in future ***