**Robotics Association of Nepal [RAN]**

**Talchikhel**

**Lalitpur, Nepal**

**Yantra International Robotics Competition 2025: Creating Robotics Industry of Nepal by 2045**

**Yantra 10.0 : Mission Niryan**

**Theme**

The Niryan project is centered around the idea of exploring underwater environments using technology and innovation. It challenges participants to design underwater drones capable of navigating, detecting, and rescuing submerged objects while overcoming obstacles. This theme emphasizes problem-solving beneath the surface, where visibility is low, movement is restricted, and real-time decisions are critical. By engaging in this project, participants not only learn about robotics and underwater navigation but also develop essential skills like critical thinking, teamwork, and creativity.

**Introduction and Background**

The Niryan Projectis an educational underwater robotics competition that challenges participants to design and operate a manually controlled Remotely Operated Vehicle (ROV) to detect and retrieve submerged metallic boxes in a pool-based arena filled with obstacles. Inspired by real-life underwater missions such as search and rescue, marine exploration, and equipment recovery, the project provides a hands-on platform to learn about robotics, electronics, and underwater navigation. As underwater robotics becomes increasingly important in fields like environmental monitoring, disaster response, and offshore engineering, Niryan aims to make this complex domain more accessible to students and enthusiasts through interactive gameplay and mission-based learning. It not only encourages creativity and problem-solving but also builds teamwork and technical skills in a fun and controlled environment.

**Objective**

The main objectives of this competition are:

* To design and develop a functional underwater ROV (Remotely Operated Vehicle) capable of detecting and retrieving metallic objects from the pool environment.
* To simulate real-world underwater search and rescue missions that enhance learning through hands-on robotics challenges.
* To provide participants with practical experience in underwater navigation, manual control systems, and problem-solving under pressure.
* To encourage innovation, teamwork, and critical thinking among students by applying engineering principles in a competitive setting.
* To build an immersive, safe, and modular game environment where participants can test and demonstrate their underwater robotics skills.

**Concept and Task Competition**

The core concept of the Niryan competition revolves around an underwater robotics challenge where participants must operate a manually controlled ROV to search, identify, and retrieve metallic objects submerged in a pool. These objects are placed at various depths and hidden among different types of underwater obstacles to simulate a realistic and challenging rescue scenario.

The main task of the competition is for each team to maneuver their ROV through the underwater arena, avoid or navigate around obstacles such as ropes, nets, hoops, and stones, locate the metallic boxes using the onboard camera, and successfully collect and return them to the designated drop-off zone within a set time limit.

Participants are evaluated based on their drone's ability to complete the task efficiently, their control accuracy, time management, and ability to avoid obstacles. The competition aims to develop technical competency in underwater robotics while promoting teamwork, creativity, and real-world problem-solving skills.

**Dimension and Fabrication of Robot**

The underwater robot (ROV) must be compact, neutrally buoyant, and robust enough to operate effectively in a controlled aquatic environment. The recommended dimensions for the ROV are as follows:

* Length: 30–45 cm
* Width: 25–35 cm
* Height: 20–30 cm
* Weight: 2–4 kg (should be adjusted for neutral buoyancy)

Fabrication Details:

* **Frame Material**: The body of the ROV is constructed using PVC pipes or acrylic sheets, which are lightweight, non-corrosive, and easy to fabricate. These materials ensure structural integrity while maintaining buoyancy and minimizing drag underwater.
* **Buoyancy System:** Foam blocks or small sealed air compartments are strategically placed to achieve neutral buoyancy, allowing the ROV to remain suspended in water without sinking or floating uncontrollably.
* **Thruster Mounts**: Custom mounts are designed on the frame to hold the waterproof brushless motors. These provide propulsion in both horizontal and vertical directions.
* **Electronics Housing:** A waterproof container (such as an acrylic or PVC sealed box) is used to enclose the microcontroller, ESCs, relay modules, and power distribution components. All cable entry points are sealed with glands or epoxy resin to prevent water ingress.
* **Tool Arm – Electromagnetic Gripper**: Instead of a traditional servo gripper, the ROV uses an electromagnetic pickup system to collect metallic objects. The electromagnet is mounted at the front and controlled via a relay module connected to the microcontroller. When activated, the electromagnet attracts metallic boxes, making retrieval easier and more efficient.
* **Camera Mount**: A waterproof FPV camera is fixed at the front or top of the ROV, providing real-time visual feedback to the operator for precise navigation and object detection.

**Team Specification**

**Specification of the arena and items placed on the arena**

The arena is custom-built to simulate a realistic underwater mission environment with dimensions:

* Length: 14 feet
* Width: 8 feet
* Height: 4 feet

#### **Object Placement and Zones:**

* 3 Metallic Objects: Randomly placed within the arena for free search and retrieval.
* 1 Object in Close Environment: Placed within a partially enclosed space simulating a confined underwater site. This requires the ROV to enter and retrieve with careful maneuvering.
* 1 Object in Far Corner: Positioned in the farthest corner of the arena, accessible via a defined path. The ROV must follow this route to complete the pickup mission.

#### **Obstacles:**

To make the game more realistic and challenging, the arena has:

* Ropes: Act as underwater entanglements.
* Stones: Represent natural underwater terrain.
* Nets: Act like debris that the robot must avoid.

**Bot Verification**

* All participating teams must present their underwater robot for a verification check by the organizers before the competition.
* Verification will take place either one week or 2–3 days before the event. Teams must visit the Robotics Association of Nepal (RAN) office for this purpose.
* For teams residing outside the Kathmandu Valley, flexible arrangements will be made to accommodate remote verification.
* Robots that are not verified within the specified time frame will be disqualified from the competition.
* Once a robot has been verified and approved, no further modifications to its design are allowed.

**Operation of The Game**

**Setup Phase:**

* The underwater arena is prepared with metallic objects and obstacles placed according to the chosen difficulty level.
* The underwater bot is placed at the designated start point within the pool.
* A visual monitor is connected to the bot’s camera to provide the live feed for navigation.

Initiation:

* Once the game begins, the timer is started, and the player takes control of the bot using the wired joystick or manual controller.
* Navigation must be carried out solely using the FPV camera feed, with no direct line of sight.

**Search and Retrieval:**

* The player maneuvers the bot through the arena, locating metallic objects.
* Upon approaching an object, the electromagnet is activated using the controller to pick it up.
* The player then guides the bot back to the drop-off zone and deactivates the electromagnet to release the object.

**Obstacle Avoidance:**

* Throughout the mission, players must skillfully avoid obstacles such as ropes, stones, and nets.
* Contact with these will result in penalties as per the scoring system.

**Completion:**

* The game concludes when the player retrieves all required objects or when the time limit expires.
* Points are tallied based on successful retrievals, early completion, and obstacle penalties.

**Gameplay Overview**

* Players operate a manually controlled underwater bot equipped with a camera for real-time navigation.
* The goal is to search, locate, and retrieve metallic objects placed randomly and strategically inside the arena.
* The bot uses an electromagnetic gripper to collect metallic items.
* The entire mission must be completed by navigating only through the bot’s camera feed—no direct view of the bot is allowed.
* The arena includes realistic underwater obstacles like ropes, nets, and stones to increase the challenge and simulate rescue missions.
* The game starts from a designated starting zone and ends when all objects are retrieved or the time runs out.
* Each object collected and returned to the drop-off zone increases the score.
* Obstacles must be avoided; hitting them will result in penalties.
* Each level or round can have different difficulty levels by adding more obstacles, placing objects in tighter spots, or reducing time limits.
* The game encourages quick thinking, precise control, and problem-solving under pressure.

**Score System and Penalties**

* +10 Points for each metallic object successfully retrieved and dropped in the drop-off zone.
* +5 Points for completing the mission before the allotted time ends.
* -5 Points for each collision with obstacles (ropes, stones, or nets).
* No points awarded for objects retrieved but not placed in the drop-off zone.
* Disqualification if the bot is operated outside the rules (e.g., direct viewing, unauthorized modifications post-verification).

**Sanction During the Competition Day**

* A disqualified team will not be allowed to continue in the competition, will lose the chance to move to the next round, and will forfeit any awards or recognitions.
* Teams must arrive and complete registration before the closing time, which will be communicated a day before the event
* Exceptions may be granted if teams notify the organizers in advance via email.
* Disrespectful behavior toward participants, coaches, the public, or the organizing team will be reported and may lead to expulsion of the member or disqualification of the team.
* Damage to the arena, facilities, or other teams’ equipment may result in similar disciplinary actions.
* If a team receives multiple sanctions, the organizers may call a meeting. If it is found that the team repeatedly ignores the rules, the team or specific members may be disqualified from the competition.