The 8th International Competition of the Military Technical College (ICMTC 2024)

Lt. General Ibrahim Selim Award For Innovation

Details, Rules, and Format

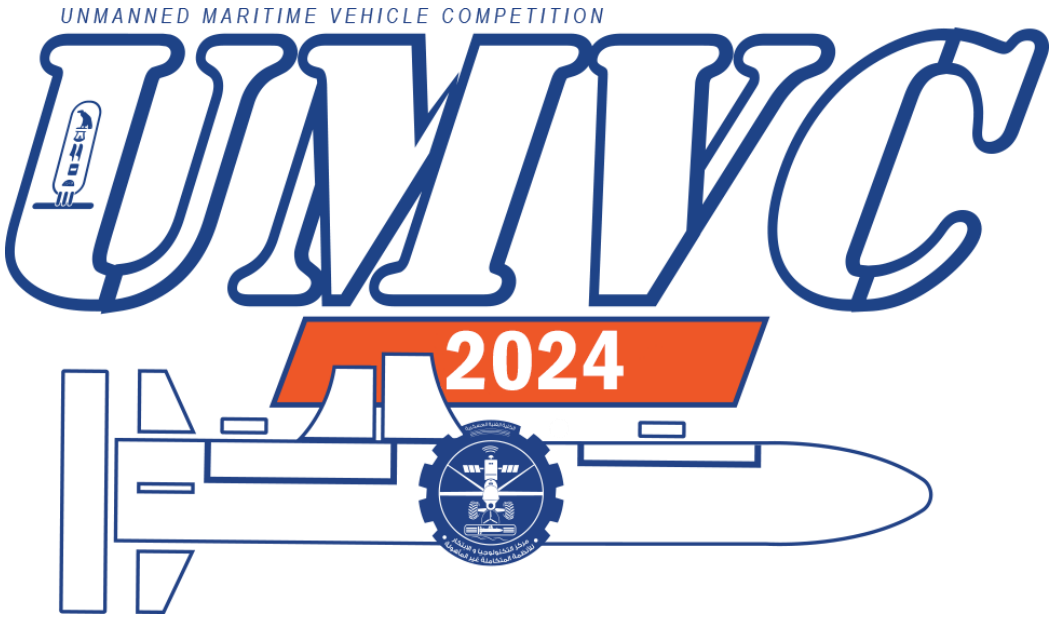
Student teams are invited to compete and demonstrate their vehicles at the Unmanned Maritime Vehicle Challenge held at the Military Technical College in

Kobry El-Kobba, Cairo, Egypt, on July 27th – August 1st , 2024

December 7th, 2023

The 8th International Competition of the Military Technical College

Unmanned Maritime Vehicle Challenge (UMVC -7)



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Glossary

AI	Artificial Intelligence
Amp	Ampere
cm	Centimeter
CP	Cathodic Protection
DC	Direct Current
e-Kill	Electronic Kill
ID	Identification
Kg	Kilogram
MB	Mega Bytes
ML	Machine Learning
MTC	Military Technical College
ROV	Remotely Operated Vehicle
RSSI	Received Signal Strength Indicator
S	Seconds
TDP	Technical Design Presentation
TDR	Technical Design Review
UMVC	Unmanned Maritime Vehicle Competition
V	Volt
VR	Virtual Reality

1. Objective

UMVC is an international competition that aims to build and enhance a community of innovators capable of making substantive contributions to the Remotely Operated Vehicle (ROV) domain.

Such vision is achieved by providing a venue and mechanism, whereby practitioners of this technology come together at the event to share knowledge, innovate, and collaboratively push the envelope of ROV systems.

2. Competition Contact Point

Kindly direct your comments and questions to: *competition@mtc.edu.eg*
We encourage participants to communicate with us only through the email system.

3. Competition Venue Overview

The competition will be held at the swimming pool of the Military Technical College; located at MTC campus. The swimming pool measures roughly 50m by 25m and water depth ranges from 1.5m to 6m. The pool is generally free from obstacles with crystal clear water.

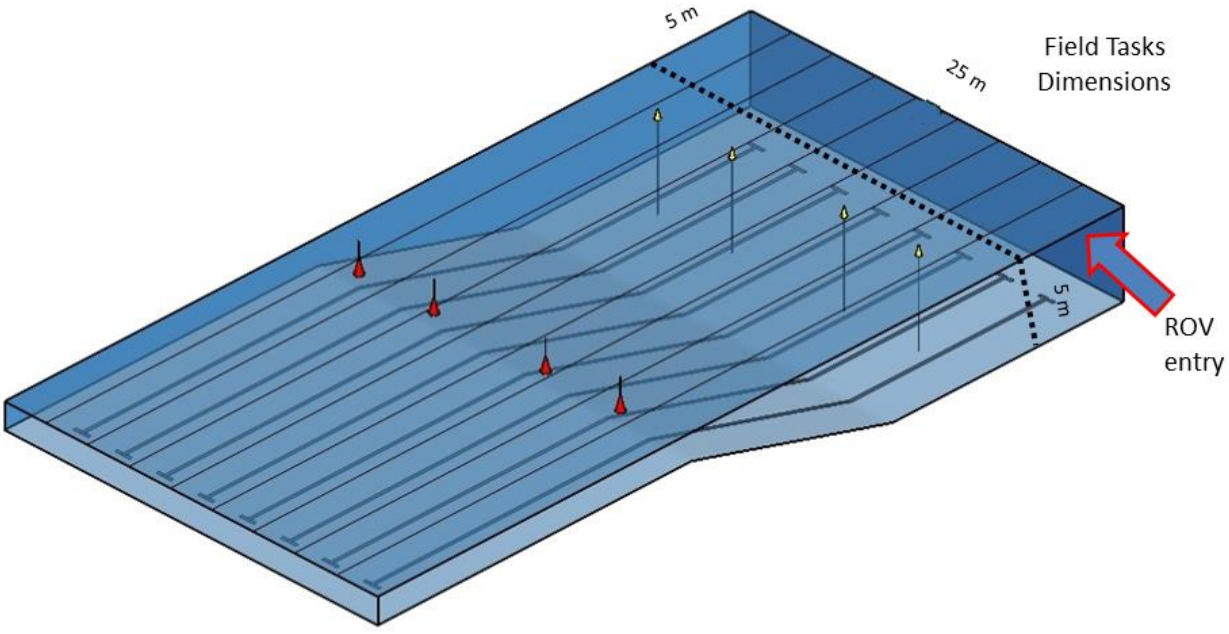

Figure 1: MTC swimming pool

During the competition, each team will be provided with a covered workspace. Teams are advised not to leave humidity-sensitive electronics, or other equipment uncovered or unattended.

Electricity (one outlet) is available in the workspace. The Arab Republic of Egypt uses a 220V 50Hz 15A electrical outlet plug. Usually two round pins.

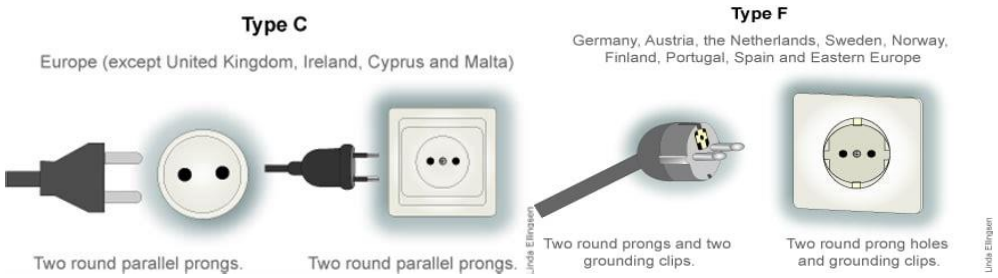

Figure 2: Electrical outlet plugs

4. Participation and Eligibility Requirements

Teams should be associated with a University/Institute/Organization/Research Center. However, 75% of the participants must be full time students **(minimum 18 years old)**. The student members of a team are expected to make significant contributions to the engineering development cycle of their ROV. Please consider that a minimum of 3 team members are needed for UMVC operations, and the maximum allowed number of team members to attend the competition event is 7 plus 3 supervisors. Moreover, faculty, industrial and governmental sponsors are allowed to attend the events.

Each team must participate with only one vehicle in the competition. Each team must designate a student team member as their Team leader. The team leader is the only person allowed to speak for the team, request vehicle deployment, run start, run end, or vehicle retrieval.

5. Registration Information

- The official source for all information concerning rules, interpretations, and information updates for UMVC is the World Wide Web home page at: *http://www.mtc.edu.eg/mtcwebsite/Competition.aspx*
- **Teams' registrations will be online via the following URL**: http://umvc.conferences.ekb.eg/
- Teams' entry forms also will be submitted online no later than **March 15th 2024**.

- An entry fee of **5000 EGP** for residents (**500 USD for internationals**) per team (maximum 10 members) is payable upon submission of an entry form (Registration). This fee contributes towards the cost of putting on the Demonstration Event. It is non-refundable in the event that a team cannot participate in the Demonstration Event
- Entry fee payment **date** and **options** will be posted online or emailed to the successfully registered teams later.
- An extra fee of **500 EGP** for residents (**50 USD for internationals**) per person for any extra team members and up to 5 members is payable on registration day (first day in the competition).
- **Any payments will be refunded ONLY in case of rejected teams.**
- Team proposal form must be submitted **online through UMVC website** no later than **March 15th 2024.** The main team supervisor must sign the team proposal form, and certifies that all student team members are currently registered in academic year 2023/2024.
- Registered teams will submit their future deliverables on a shared google drive created by the competition board. Competition board will provide each registered team with their google drive shared link.
- Teams deliverable via shared google drive include the following team information that must be provided after registration **immediately**:
    - Name of the team (and name of the vehicle, in case it's different).
    - Team members' full names.
    - Photocopy of the national ID (for Egyptian team members).
    - Photocopy of the passport (for non-Egyptian team members).
    - Personal cell phone no., email and address.
    - List of sponsors.

- **All forms will be available on the competition google drive and are to be uploaded using the assigned google drive link for each team.**

6. Team Sponsors Allowances

- 15 minute lectures during the competition opening ceremony.
- Exposure to the best of unmanned systems society.
- On-site booth (charged).

7. Team Deliverables

In addition to the competition filed tasks, each team must document their efforts leading up to the competition by writing a Technical Design Report (TDR), authoring Introductory Video, and preparing a Technical Design Presentation (TDP). All elements of the competition will be conducted in

English. Each registered team will receive an invitation to a google drive with team deliverables instructions, which will be provided at a later point.

7.1. Technical design report (TDR)

Each team is required to submit a TDR that describes the design of their vehicle, and it should consist of the following sections:

1. Introduction about the ROV design approaches.
2. Subsystem description.
3. Detailed drawing of the whole system.
4. Algorithms and codes (optional).
5. Safety precautions.
6. Item list and budget.

- Judges will be assessing each team's overall level of readiness to undertake the UMVC competition.
- The technical design report will be uploaded or submitted by mail through the contact person in each team.
- The technical design report should not exceed 25 pages including graphs and appendices if available. Teams should show a description of the vehicle, the team management, time plan and how they will accomplish the required missions of the competition (A technical design report template is posted on the competition website).
- While teams are not required to demonstrate any working systems/subsystems as part of the TDR package, such evidence will be considered by the judges in the down-selection process.

The best teams, that will pass the TDR package assessment stage, will be invited to attend and compete in the competition events.

7.2. Team introductory video

Each team must submit an introductory video (max.5 minutes/ 250MB). Please follow the official instructions available in your team google drive, which will be provided upon registration.

7.3. Technical design presentation (TDP)

The team will present to a committee of university staff and field judges the design, specifications, cost, in addition to a full function test of the system (dry test). Static Assessment is an opportunity for teams to introduce themselves, their vehicle, and special features and/or strategies for the competition. It is also an

opportunity for judges to inspect the vehicle, and interview team members about the presentation and their contribution to the engineering development cycle.

Planned Presentation Breakdown:

- 20-minute oral presentation with visual aids (a PowerPoint file and a poster board).
- 5-minute question and answer session.
- 5-minute judges' inspection of the vehicle.

After the design presentation, teams should make themselves available for a team photo, and optional video interview for archival purposes. This video interview will not be judged.

7.4. Innovation

We highly encourage all teams to innovate in all possible areas, and their efforts will be evaluated by UMVC judicial board. Each team is required to submit an innovation report that describes the innovation in their vehicle.

- Introducing new capabilities in one or more of the following categories, or any other field of choice, will be rewarded during the team TDP:
  - Sealing
  - Propulsion
  - Dynamic positioning
  - Underwater communication
  - Control
  - Image processing
  - Autonomous systems
  - Energy Efficiency
  - Artificial Intelligence(AI), Machine Learning(ML)
  - Virtual Reality(VR)
  - Underwater guidance using acoustic waves RSSI
  - Stealth materials
  - Biomimicking
  - …Etc.
- Publishing a paper for the presented innovation compliant with the scientific research papers guidelines and referencing, will be rewarded with 25 extra points.
- In addition to the gained points, special recognition in the form of certificates will be awarded to exceptional performers. Further details will be announced later.

8. Competition Rules

The official source for all information concerning rules, interpretations, and information updates for UMVC is the World Wide Web home page at: *http://www.mtc.edu.eg/mtcwebsite/Competition.aspx*

Rule 1 Judges' decisions are final.

Rule 2 One student member of the team must be designated as the "team leader". The team leader, and only the team leader will speak for the team during the competition run.

Rule 3 No team member is allowed to enter the arena at any time (this includes wading, swimming and diving as well as floats, boats, etc.). Competition officials will be responsible for recovering lost vehicles. All teams recognize that by entering the competition, they risk damage to or the loss of their vehicle. The judges, officials, hosts, and sponsors can take no responsibility for such damage or loss.

Rule 4 The officials will suspend the competition / competitors at any time they deem that it is required by safety or security considerations. (Please refer to safety instructions provided on-site)

Rule 5 Preparation period: The vehicle may remain, or be placed on the dock, but not in or touching the water. A team may waive any portion of the 5-minute-long preparation period and start the performance period. Once the performance period starts, the team forfeits any remaining time in the preparation period.

Rule 6 Performance period: When the officials signal the start of the performance period, the team may ask to have their vehicle deployed into the water and released to perform the mission. Only tournament officials may recover any faulty vehicle. This is to prevent unsafe actions in an attempt to speed the deployment and recovery processes.

Rule 7 The mission ends when any of the following occurs:

- The performance period time limit ends.
- The judges' order the end of the mission.
- The team leader requests the end of the mission.
- The vehicle breaches the surface outside the surface marked area.

Rule 8 Any bonus will be rewarded only in case of attempting all performances (at least 50% of performance period under water)

8.1. Vehicle requirements

- **Buoyancy:** The vehicle shall be neutrally buoyant and remain submerged underwater for at least 30 minutes.
- **Communication**: The vehicle can send or receive any control information while in submerged underwater mode (to and from Operators Control Station).
- **Deployable**: The vehicle must be deployable from the deployment point (dock).
- **Energy source**: The vehicle can be surface powered by a suitable DC power supply that ensure crossing the pool safely without malfunction (minimum required tether length is 25m).
- **Kill Switch**: The system must have a red button located at the operator control station that, when actuated, must instantaneously disconnect power from the ROV.
- **e-Kill Switch**: In addition to the physical kill-switch, the vehicle may have at least one remote kill switch that, when actuated, must instantaneously disconnect power from all motors and actuators. If the remote kill switch system is turned off, vehicle must instantaneously disconnect power from all motors and actuators.
- **Propulsion**: Any propulsion system may be used. However, all moving parts must have a shroud.
- **Power levels**: All ROV subsystems (Thrusters if any) must be DC operated.
- **Remote-controllable**: The vehicle must be remote-controllable (tele-operated) to be brought back to the dock. If the remote controller is turned off, vehicle power must be instantaneously disconnected.
- **Safety**: All sharp, pointy, moving or sensitive parts must be covered and marked.
- **Towable**: The vehicle must have a tow harness point installed at all times.
- **Weight**: The ROV weight must be 25 Kg or less **(excluding the tether)**, and it will be assessed according to Table 1 in section 11.3.
- **Size**: The vehicle size will be assessed according to Table 2 in section 11.3.

8.2. Interference

- Interference with course elements will result in a penalty.
- Any vehicle entangled in, dragging, pushing or damaging competition elements or the landscape is interfering.
- Any vehicle leaving its assigned course is interfering.

9. Network

9.1. Software security

Our intent is for students to develop skills in systems engineering by accomplishing realistic missions. We have a zero-tolerance policy for any deliberate attempts at sabotaging other teams, or the competition network. Any attempts (successful or not) to hack any of the software systems or other teams' vehicles will result in disqualification of the team.

9.2. Team deployed network

Each team is responsible for deploying their own 'network' solution for communication with their vehicle. There is no restriction on the actual communication mechanism (e.g., underwater modems, cellphone, 802.11xx wireless, etc.). Each team must provide a base station that can bridge the communication between their vehicle and the wired RJ-45/cat5 Ethernet network of the competition.

10. Evaluation Schemes and Penalties

As mentioned earlier, the TDR package is a milestone. This implies that it will be evaluated separately and its score will be added to the scores earned in the event tasks.

The score is weighted as follows:

No.	Item	Score
1	Technical Design Report (TDR)	100
2	Introductory Video	50
3	Innovation Report	150
4	Technical Design Presentation (TDP)	100
5	**Static Assessment: (200 point)** - Technical accomplishment - Craftsmanship	 50 25

No.	Item	Score
	- Team uniform	25
	- water test	100
6	**Field Tasks: (900 point)**	
	1- Airplane wreck recovery challenge	300
	2- Underwater structure challenge	300
	3- Maritime archeology expedition challenge	300

All the scores of the individual tasks for each team will be summed (as well as bonus points and penalties) and compared against other teams' total scores to identify the winners as well as the order of all teams.

10.1. Evaluation scheme of TDR milestone

The TDR package milestone aims to show the readiness of the teams to undertake the UMVC- ROV competition. Accordingly, the evaluation will be based on the completeness of the TDR package and the progress-to-date of the final system as well as the way the teams are representing their progress. Since the TDR is a competitive milestone, the TDR Packages will be judged against other teams' submissions by the judges.

10.2. Evaluation scheme of TDP

Scoring for this task will be assessed on the following equally weighted categories:

- Team structure, organization, and management.
- Core ROV design and to explain its functionality (it is required to bring your ROV).
- Suitability of ROV design to competition tasks.
- Response to questions.
- Overall quality of presentation.

10.3. Evaluation scheme of ROV field tasks

In addition to every task performance time, there will be 5 minutes to set up the ROV system and 5 minutes to dissemble the ROV and exit from the competition area. The performance period will begin after the set up time. During the preparation period the vehicle may remain on the swimming pool dock, but not in or touching the water.

The total score of the task will be the earned score minus deducted one. Score will be earned for completing all tasks within the designated period. Score will be deducted for ROVs overweight or size, touching the obstacles and team members' interventions.

The penalty of touching each of the obstacles is 5% of the earned score per each obstacle touched. If the same obstacle is touched in the return path, it will be considered a touch with another obstacle and the team will be penalized for it too.

Teams will be penalized 10% of the total points in that task for every team members' intervention. The task clock will continue to run during an intervention. Multiple intervention penalties in a single task will incur multiple penalties.

The max penalized points could reach up-to 50% of the total earned score per mission.

Weight constraints: The bonuses and penalties of ROVs overweight are shown in the Table 1.

Size constraints: If the largest dimension of the ROV and all its equipment is less than50 cm, the team will receive +25 bonus points. If the largest dimension of the ROV and all its equipment is larger than 50 cm and less than 60 cm, the team will receive +15 bonus points. If the largest dimension of the ROV and all its equipment is larger than 60 cm and less than 70 cm, the team will receive +10 bonus points. If the largest dimension of the ROV and all its equipment is larger than 70 cm and less than 80 cm, the team will receive +5 bonus points. If the largest dimension of the ROV and all its equipment is larger than 80 cm and less than 100 cm the team will receive no bonus points, but can still compete in the product demonstration. If the largest dimension of the ROV and all its equipment is larger than 100 cm the team will not be permitted to join the competition. Table 2shows the bonuses and penalties regarding the ROV size constraints assuming "x" represents the largest dimension of the ROV and all its equipment.

Table 1 Weight constraints of ROVs

ROV Weight	Bonus	Penalty
ROV > 30 kg	-	Disqualified
ROV < 30 kg	Bonus of (1 point) for every 1 kg less than 30 kg up to 20 points. Example: - ROV weighs 20 kg: 10 bonus points. - ROV weighs 10 kg: 20 bonus points. - ROV weighs 8 kg: 20 bonus points. All measured weights will be rounded to the nearest whole number	

Table 2 Size constraints of ROVs

ROV Size	Bonus	Penalty
x>100 cm	-	Disqualified
80cm<x<100cm	No bonus points but the team can compete	-
70 cm < x < 80 cm	+5 bonus points	
60 cm < x < 70 cm	+10 bonus points	-
50 cm < x < 60 cm	+15 bonus points	-
x < 50 cm	+25 bonus points	-

If more than one team have finished all the tasks within the time frame with equal score, those teams will be ordered according to how fast they finished the task. There will be a time bonus which will be calculated from the remaining time period of the task.

Calculating the remaining time depends on achieving the following conditions:

- Completing the entire task.
- The ROV return to the surface under its own power and is grabbed by one of the team members before the performance time ends.
- The mission ends when any of the following occur:
  - The performance period time limit ends.
  - End of the mission by the judges.
  - The team leader requests the end of the mission.

11. General Notes

11.1. Time allocation during field performance

The allocated time varies between different missions.

Pre-Start Time: To maximize in-water time for each team, teams should be physically present with their vehicle, in a ready state, at least five minutes before the start time. Organizers will utilize this time to conduct a safety check of your system.

Dock Time: The first five minutes of the allocated time is for docking. Dock time begins when receiving a signal from the main judge. If the vehicle is still at the dock when the dock time runs out, in-water time will automatically start.

In-Water Time: For every mission, a certain limit will be announced for the in-water performance time following the designated dock time. During in-water time (performance time), teams may attempt as many 'runs' as desired. The in-water time keeps running, even when vehicles are being bought back to the dock (towed or under their own power, intervention will be penalized as mentioned).

The mission time will automatically end as soon as one of the following occurs:

- The in-water time runs out.
- The team leader requests termination of the run.
- The technical director or a judge orders termination of the run.

Note: TDs and Judges rarely order termination of a run but they can do so at their discretion for safety or competition rule violations.

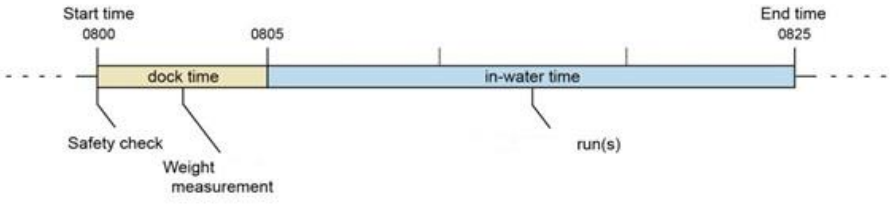

Figure 3: Example breakdown of mission time

At the end of the mission time, vehicles must be brought back to the dock, under their own power. In case of catastrophic system failure, UMVC staff may manually tow the vehicle back.

11.2. Deadlines and competition program

11.2.1. Deadlines

No.	Item	Due date
1	Competition Rules	7th December 2023
2	Missions Details	30th January 2024
3	Submission of Team's Proposal and Entry Forms	15th March 2024
4	Submission of TDR and Introductory Video	26th April 2024
5	Submission of Innovation Report	24th May 2024
6	Acceptance from the Technical Committee	1st July 2024
7	Competition	27th July – 1st August 2024

11.2.2. Competition schedule

No.	Activity	Date
1	On-site Registration and Opening Ceremony	27th July 2024
2	Presentation and ROV competition tasks	28 – 31 July 2024
3	Results announcement and awards	1st August 2024