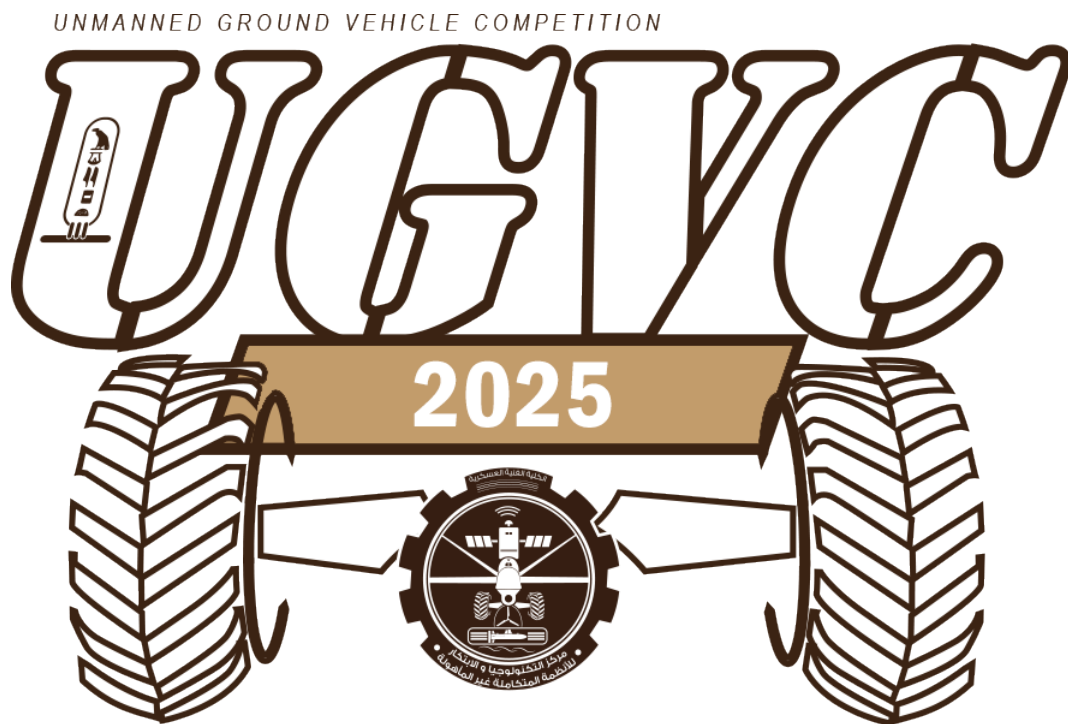


The 9th International Competition of the Military Technical College

Unmanned Ground Vehicle Challenge (UGVC-9)





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1 Overview

1.1 Introduction

The Unmanned Ground Vehicles Challenge (UGVC) provides an opportunity for engineering students from multi-disciplinary branches to realize a product and test its performance in an international competition. The competition awards, named in honor of the co-founder of the Military Technical College, Lt. General Ibrahim Selim, aim to encourage students at all levels of undergraduate and graduate education to participate in teams and gain hands-on experience. Students will experience how to work in an organized team. There will be roles for team members from non-engineering disciplines such as business, management, media, ..., etc.

Students will have the opportunity to realize a challenging product through efficient integration between advanced control theory, machine vision, vehicular electronics, and mobile platform fundamentals to design and build an unmanned ground vehicle. This will be helpful in real-world applications of either civilian or military nature. The primary goal of the competition is to advance engineering education in intelligent vehicles and related technologies. Through a series of technical events over the four-day competition, teams will be challenged to offer their very best to achieve the optimum unmanned vehicle according to the competition rules and guidelines.

During the competition, each team will have a covered workspace. Teams are advised not to leave humidity-sensitive electronics, or other equipment uncovered or unattended. Electricity is available in the workspace. The Arab Republic of Egypt uses a 220V, 50Hz, 15A electrical outlet plugs, usually with two pins as shown in Figure 1.

Any issues not covered by this published document will be addressed on a case-by-case basis by the UGVC Director. If you have any questions and comments, kindly direct them to competition@mtc.edu.eg.

English is the official language of the competition, and each team must submit their deliverables in English.

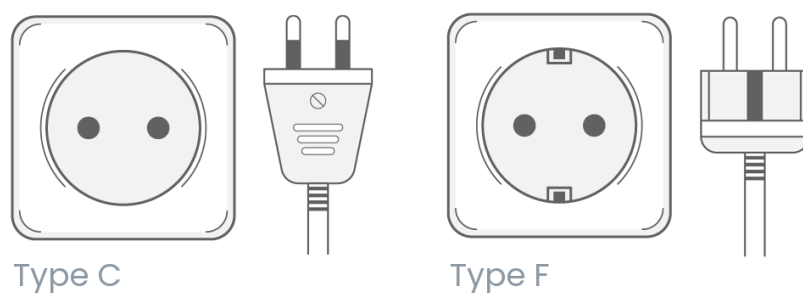


Figure 1: Electrical outlet plugs in Egypt



1.2 Team Members

The competition is open to both graduate and undergraduate students (**minimum 18 years old**). Teams should be associated with a University/Institute/Organization/Research Centers. However, 75% of the participants must be full-time students. The student members of a team are expected to make significant contributions to the engineering development cycle of their UGV. The maximum allowed number of team members to attend the competition event is **ten students and three advisors**. Moreover, faculty, industrial and governmental sponsors are allowed to attend the events.

Each team must participate with only one vehicle in the competition. Also, 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.

Advisors should limit their involvement to academic level advising such as registration, submission of deliverables, communication with UGVC staff, and fall within the duties of the students. During the competition, advisors are not allowed to enter the field.

All team members operating the vehicle must remain in the designated operators' area. Nobody may follow alongside the vehicle to provide feedback to the operators. Members of the judging team, media, non-operator team members, and other spectators may only follow a vehicle at the judges' discretion. Team members following the vehicle may participate as **runners**, or activate an emergency kill switch (in the event of an emergency) but may not otherwise participate in that mission.

1.3 Schedule and Deadlines

UGVC 2025 will be held from **July 26 to 31, 2025**. Prospective teams will undergo a review and down-selection process, meaning that only teams who meet each milestone will be invited to compete in the competition.

Teams are required to register and declare their intent to compete no later than **Friday, March 14, 2025**. More details will be posted competition homepage <http://www.mtc.edu.eg/mtcwebsite/Competition.aspx>.

Teams are also required to submit a Preliminary Design Review (PDR) no later than **Friday, March 28, 2025**. The PDR is a critical milestone in the selection process and will be evaluated by the judges. Only the teams whose PDR meets the necessary criteria will be invited to participate in the challenge. More details about the PDR will be mentioned in Section 2.

Teams are required to submit a Technical Report no later than **Thursday, July 10, 2025**. This report will not affect the eligibility of accepted teams to compete but will be evaluated as part of the Design Task scoring. More details about the report will be provided in Section 6.1.



1.4 Registration

The official source for all information concerning rules, interpretations, and information updates for UGVC is the competition homepage <http://www.mtc.edu.eg/mtcwebsite/Competition.aspx>.

Teams must register, declare their intent to compete, and submit the entry forms no later than **Friday, March 14, 2025** by registering online via the following link <http://ugvc.conferences.eb.eg/>.

The entry fee for each team (maximum of 10 members) is **5000 EGP** for Egyptian teams and **500 USD** for international teams. This fee helps cover the costs of organizing the event. The entry fee is **non-refundable** if a team unable to participate in the challenge. However, if the team is rejected, the entry fee will be refunded. Payment details (including options, deadline, ..., etc.) will be provided online or sent via email to teams that successfully complete the registration.

An additional fee of **500 EGP** for Egyptian teams and **50 USD** for international teams per person will apply for extra team members (up to a maximum of **five members**). This additional fee must be paid on the first day of the competition.

Registered teams will submit their deliverables via a shared Google Drive folder created by the competition board. Each registered team will receive a unique Google Drive link from the board.

During registration, teams must submit a proposal form. The main team advisor is required to sign this form, certifying that all student team members are currently registered for the academic year 2024/2025. The following information must also be provided during registration:

- Team name and vehicle name (if they differ).
- Full names of all team members.
- Photocopy of the national ID (for Egyptian team members).
- Photocopy of the passport (for non-Egyptian team members).
- Personal cell phone number, email address, and home address. (The home address required only for Egyptian team members).
- List of sponsors.

All forms will be available in the competition's Google Drive folders and must be uploaded using the unique Google Drive link assigned to each team.

Egyptian schools are encouraged to participate as a side event, but their participation will not be evaluated. However, they may receive motivational gifts for creative performance, limited to a maximum of three gifts per school. Each vehicle must have a separate team of students and a distinct design report.



1.5 Team Sponsors Allowances

Sponsors of teams are invited to give 15-minute lectures during the competition activities. Additionally, sponsors are permitted to set up an on-site booth, subject to applicable charging fees. Further details will be posted on the competition website.

2 Preliminary Design Review (PDR)

To ensure a fair and competitive environment, all registered teams must pass a preliminary selection process before being accepted into the challenge. This milestone assesses the team structure, resources, and vehicle development progress. Teams are required to submit a Preliminary Design Review (PDR) by **Friday, March 28, 2025**. The PDR must be no longer than **5 pages** summarizing the following:

- **Team overview:** Team structure and organization.
- **Vehicle overview:** Basic design concept, key features, and intended capabilities.
- **Autonomous navigation overview:** Proposed strategies for the Autonomous Navigation Task.
- **Project management plan:** Timeline for remaining work including testing and refinement, resources, and initial budget.
- **Media:** Photos demonstrating the vehicle's current capabilities (e.g., basic movement, obstacle avoidance, lane detection, ..., etc.).

The organizing committee and judges will evaluate submissions based on:

- Clarity and completeness of the report.
- Technical feasibility and innovation of the proposed design.
- Evidence of progress and operational readiness.
- Realistic plan for completion before the competition.

Teams must demonstrate readiness and innovation in their PDR submission to secure a spot in the competition. Only teams whose PDRs meet or exceed the evaluation criteria will be invited to participate in UGVC 2025. The PDR must be submitted in PDF format. Detailed submission instructions will be shared with all registered teams. Teams will be notified of their acceptance status along with brief feedback on their submissions by **Friday, April 25, 2025**.



3 Vehicle Configuration

The designed vehicle must satisfy the following specifications:

- **Design:** The vehicle shall be a stand-alone, off-the-grid, mobile platform. It must be a ground vehicle (propelled by direct mechanical contact to the ground such as wheels, tracks, pods, ..., etc.).
- **Propulsion:** The vehicle must be propelled by electric motors. Internal combustion engines are not permitted.
- **Length:** The length must be between **90 cm** and **200 cm**.
- **Width:** The width must be between **60 cm** and **120 cm**.
- **Height:** The maximum height is **120 cm** excluding the mechanical emergency stop tower (if exist).
- **Speed:** The vehicle speed must be between **2 km/hr** to **10 km/hr**.
- **Emergency stop:** The vehicle must be equipped with **two** emergency stop options: mechanical E-stop and wireless E-stop. Both must be hardware-based and not software-controlled, and must bring the vehicle to a quick and complete stop when activated.
 - **Mechanical E-stop:** It must be visible, easy to identify, and safely accessible, especially during vehicle motion. It must be positioned at the center rear of the vehicle at a height between 60 cm and 120 cm above the ground. It can be mounted on the vehicle chassis, or on a special tower.
 - **Wireless E-stop:** The wireless e-stop must have a minimum range of **150 m**. During the challenge, the wireless e-stop will be held by the judge.
- **Lights:** The vehicle must have a clearly visible indicator light that remains solid whenever the vehicle power is ON. This light must be bright enough to be easily visible during the day, as the challenge will be held at noon. As the vehicle enters the autonomous mood, the light must switch from solid to flashing, and returns to solid as soon as the vehicle exits the autonomous mode.
- **Light/Laser pointing device:** The vehicle must be equipped with a light or a laser pointer. This device must be activated when the vehicle successfully detects and recognizes a given image of a person while navigating autonomously, as part of the challenge.



4 Autonomous Navigation Task

The purpose of this task is to demonstrate the vehicle's autonomous navigation capability in an outdoor cluttered course. The vehicle must navigate within pre-defined lanes, avoid the surrounding obstacles, navigate to specified waypoints, and maintain a speed between 2 km/hr to 10 km/hr. Teams will be ranked based on the best **net time** to complete the course. If a vehicle does not finish the course, a team will be ranked based on the longest **net distance** traveled. **Net time and distance** are the final scores given by the judges after accounting for penalties (if exist). Penalties will be applied for obstacle collisions, lanes' crossing, waypoint navigation errors, and image detection performance. More details on penalties can be found in Section 4.3.

Vehicles must be **autonomous**, as they cannot be remotely controlled by a human operator **during the challenge**. All computational power, sensing and control equipment must be carried on-board the vehicle. However, remotely controlled operation is permitted during the transition from the waiting area to the field.

It is important to note that **each team must pass the Qualification Stage to compete in this task**.

4.1 Qualification Stage

Each vehicle must pass the Qualification Stage to compete in the Autonomous Navigation Task by meeting the following criteria:

- **Dimensions:** The vehicle must comply with the dimensions' ranges outlined in Section 3.
- **Mechanical E-stop:** The vehicle must come to a complete stop when activating the mechanical e-stop. Additionally, the e-stop location must comply with the specifications outlined in Section 3.
- **Wireless E-stop:** The vehicle must come to a complete stop when activating the wireless e-stop from a distance of 150 meters.
- **Lights:** The vehicle's lights must be solid when power is ON, and must be flash when entering the autonomous mode.
- **Speed:** The vehicle will be tested to drive over a distance of 15 meters (between two lanes) twice: one at the nominal speed, and the other at maximum speed. The vehicle's speed must remain between 2 km/hr and 10 km/hr as outlined in Section 3. For the maximum speed test, the vehicle can be remotely operated, while in the minimum speed test, the vehicle must operate autonomously.



- **Lane detection:** The vehicle must demonstrate its ability to detect the lanes. The vehicle will have to drive over a distance of 15 meters between two lanes without crossing them.
- **Obstacle avoidance:** The vehicle must demonstrate its ability to detect and avoid obstacles.
- **Waypoint navigation:** The vehicle must navigate to a given waypoint with a maximum error of 1.5 meters.
- **Image detection:** The vehicle must demonstrate its ability to recognize a given image of a person. When the image is recognized, the vehicle activate its pointing device.

During the Qualification Stage, the vehicle must operate in autonomous mode, except for the maximum speed test, where it may operate in either autonomous or remotely operated mode.

If the vehicle fails to meet **any** of the qualification requirements, it will not qualify to compete in the task. In this case, the team may fine-tune its vehicle and reattempt qualification without penalty. Teams may reattempt as needed until the final qualification deadline, after which no further attempts will be permitted.

4.2 Course Details and Description

The task will be on an asphalt pavement. It is a rectangular track with approximately 160 meters long, with a varying width between 3 and 6 meters, with a turning radius not less than 1.5 meters. The outer borders (lanes) of the track will be a solid white lines, approximately 8 cm wide. However, not the entire course is bounded by these white borders. Part of the course is unbounded, as it is designated for waypoint navigation and image detection tasks. If the vehicle cross any of the borders (in the bounded sections), its run will be ended. Figure 2 shows a layout of the course.

The first 15 meters of the course is straight, and the vehicle must complete this distance in a maximum of 30 seconds (resulting in the minimum speed of 2 km/hr). If not, the vehicle run will be ended.

Teams should expect randomly placed obstacles along the course, with the difficulty increasing as the vehicle advances. Obstacles will be marked in different colors (e.g., red, white, orange, green, black, ..., etc.). Additionally, teams should expect to encounter solid white circles on the course, which must be avoided. These circles simulate potholes with a 60 cm diameter. It is important to note that there will always be a minimum passage width of 1.5 meters between any obstacle and the border. If the vehicle touches any obstacle or any white circle, its run will be ended.

Prior to the challenge, teams will be provided with the coordinates of three waypoints, and the vehicle has to navigate to these points in order, with a maximum allowable error of 1.5 meters. As mentioned, these waypoints will be in an unbounded region. The second waypoint will guide the vehicle to the location of the image detection task, and the third waypoint will guide the vehicle

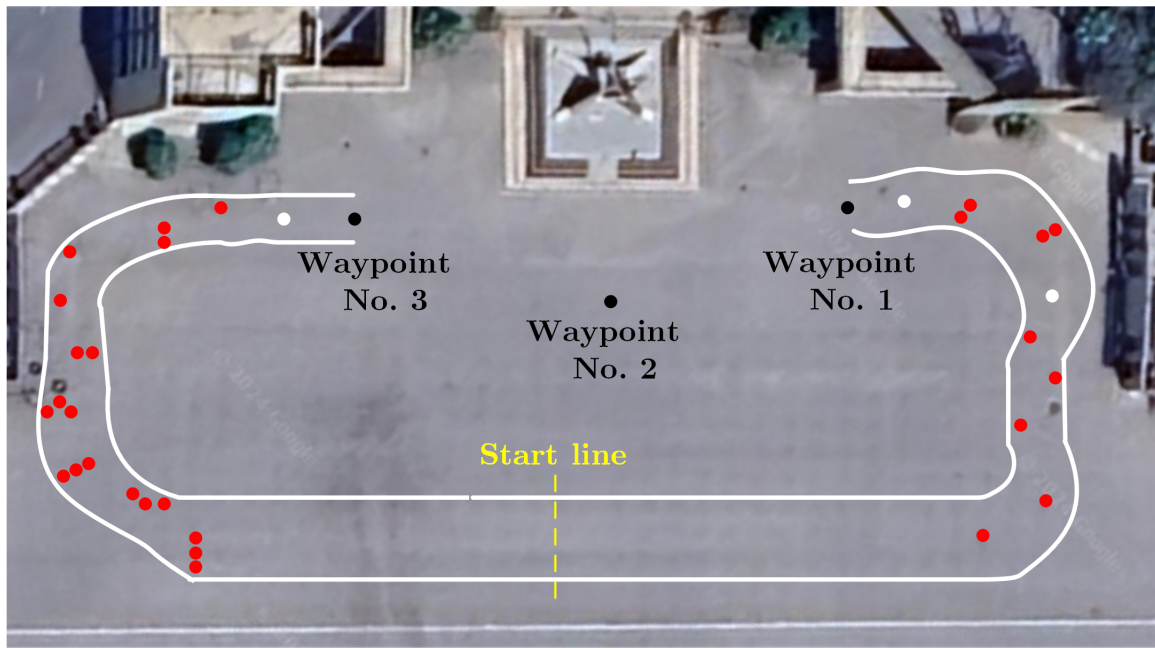


Figure 2: Layout of the course

back onto the track, as shown in Figure 3. Note that, in this part of the course, the environment is obstacle-free. More details on the scoring of the waypoint navigation stage will be mentioned in Section 4.3.

Prior to the challenge, teams will be provided with a given image of a person. When the vehicle reaches the second waypoint, it will encounter several dummies, each with a different face. The vehicle must stop, search for the predefined image of the person, and activate its pointing device once it recognizes the correct face. The maximum allowed time for this task is 1 minute. Afterward, the vehicle must leave the second waypoint and continue navigation to the third waypoint. More details on the scoring of the image detection stage will be mentioned in Section 4.3.

In all cases, the maximum allowed time to finish the course is 8 minutes.

4.3 Scoring and Penalties

Table 1 outlines the scenarios encountered during the Autonomous Navigation Task and their associated penalties in time or distance, depending on the scoring method. The table also indicates whether the vehicle's run continues or ends for each scenario. Following Table 1, a description of all possible scenarios are provided for further clarification.

- **Border crossing:** The vehicle fully crosses the borders of the course. The total distance will be measured from the starting line to the farthest point where the final part of the vehicle crossed the edge of the border.
- **Obstacle collision:** The vehicle collide with an obstacle causing it to move. The total distance



Table 1: Scoring and penalties details for Autonomous Navigation Task

No.	Scenario	Time Penalty	Distance Penalty	Note
1	Borders crossing	—	3 m	The run will end
2	Obstacle collision	—	3 m	The run will end
3	Partial border crossing	8 sec	3 m	The run will continue
4	Obstacle touching	8 sec	3 m	The run will continue
5	E-stop request	—	3 m	The run will end
6	Blocking the track	—	3 m	The run will end
7	Successful waypoint navigation	—	—	The run will continue
8	Successful navigation with error	8 sec	3 m	The run will continue
9	Partial waypoint navigation	10 sec	5 m	The run will continue
10	Failed waypoint navigation	—	15 m	The run will end
11	Successful image detection	—	—	The run will continue
12	Successful detection with delay	10 sec	5 m	The run will continue
13	Failed detection and continue	10 sec	5 m	The run will continue
14	Failed detection	—	15 m	The run will end

will be measured from the starting line to the point of collision with the obstacle.

- **Partial border crossing:** Part of the vehicle cross the boundary. Each partial crossing throughout the course will incur a penalty.
- **Obstacle touching:** The vehicle makes slight contact with an obstacle without causing it to move. Each touch crossing throughout the course will incur a penalty.
- **E-stop Request:** The vehicle is stopped by a student (via mechanical e-stop) due to concerns over potential damage or getting stuck, and the team want to end the run.
- **Blocking the track:** The vehicle stops and blocks the course for more than 1 minute.
- **Successful navigation:** The vehicle successfully navigates all three waypoints within the specified error margin of 1.5 meters.
- **Successful navigation with error:** The vehicle successfully navigates to the waypoint, but the error between 1.5 meters to 2 meters. The mentioned penalties in Table 1 applies for each waypoint with an error.



- **Partial waypoint navigation:** The vehicle reaches some waypoints but fails to reach others within the allowed margin. The mentioned penalties in Table 1 applies for each missed waypoint.
- **Failed waypoint navigation:** The vehicle fails to reach any waypoint and becomes stuck in the unbounded region for 1 minute.
- **Successful image detection:** The vehicle detects the image within the 1 minute limit and activates the pointing device. Then, it moves to the third waypoint.
- **Successful detection with delay:** The vehicle detects the image after the 1 minute limit but and activates the pointing device. Then, it moves to the third waypoint.
- **Failed detection and continue:** The vehicle fails to detect the image within 1 minute, and continues to the next waypoint.
- **Failed detection:** The vehicle fails to detect the image entirely within the 1 minute limit and does not continue towards the next waypoint, i.e., the vehicle stuck in the detection location.

4.4 General Rules and Regulations

- The task consists of five heats, in which each qualified team may perform up to two runs per heat if time permits.
- During the run, only one student is allowed to follow the vehicle. All other team members and faculty advisors must remain outside the course area.
- Teams will be called to the starting line by the judge. Each team has one minute at the starting line to prepare the vehicle and notify the judge when it is ready. If the team is not ready within this time, the run is canceled and counted as a completed run, after which the next team will be called to the starting line.
- The judge will start the vehicle using a single touch, such as pressing a remote control button, hitting the Enter key on a keyboard, clicking a mouse, ..., etc. The judge will also carry the wireless E-stop during the run.
- A run will continue until one of the following events occurs:
 - The vehicle successfully completes the course.
 - The judge activates the wireless E-stop.
 - The team activates the mechanical E-stop.



- The vehicle fully crosses the course borders.
 - The vehicle collides with an obstacle, causing it to move.
 - The vehicle remains stationary in the waypoint navigation area for 1 minute.
 - The vehicle stays in the image detection location for over 45 seconds without moving to the next waypoint.
-
- A team has completed multiple runs across different heats, the judge will consider only the best result from those runs for scoring and teams ranking.
 - Teams that finish the course will be scored based on their **net time** taken to complete the course, which is the time taken to finish the course minus any penalties (if applicable).
 - At the end of the challenge, if two or more teams have the same net time, the team with the **least penalties** will be ranked higher.
 - If two or more teams have the same net time and an equal number of penalties, the team with the **smallest vehicle dimensions (width + length + height)** will be ranked higher.
 - Teams that do not finish the course will be scored based on their best **net traveled distance**, which is the maximum traveled distance covered minus any penalties (if applicable).
 - At the end of the challenge, if two or more teams have the same net distance, the team with the **least penalties** will be ranked higher.
 - If two or more teams have the same net distance and an equal number of penalties, the team with the **smallest vehicle dimensions (width + length + height)** will be ranked higher.
 - The judges have the right to disqualify any vehicle that poses a safety hazard, causes damage to the course, or violates safety requirements during the competition.

5 Remotely Navigation Task

This task evaluates the team's ability to remotely operate their vehicle in a cluttered environment. The vehicle must navigate a defined course with various obstacles and small ramps, efficiently progressing from start to finish. The task highlights the operator's situational awareness, decision-making skills, and the vehicle's responsiveness to remote commands.

During the task, the operator will remain inside a designated control station, and the vehicle will be remotely driven using onboard cameras. The operator will rely on the camera feeds as they will not have direct visual contact with the vehicle.



The course layout is similar to the one used in the Autonomous Navigation Task. Teams will be given a maximum of **5 minutes** to complete the course. Teams will be ranked based on the best **net time** to complete the course. If a vehicle does not finish the course, a team will be ranked based on the longest **net distance** traveled. **Net time and distance** are the final scores given by the judges after accounting for penalties (if exist). Penalties will be applied for obstacle collisions and lanes' crossing. More details on penalties can be found in Section 5.1.

5.1 Scoring and Penalties

Table 2 outlines the scenarios encountered during the Remotely Navigation Task and their associated penalties in time or distance, depending on the scoring method.

5.2 Communications Equipment

Wireless communication methods used by teams shall adhere to all UGVC communications standards and regulations. The **2.4 GHz** band is the **only** band allowed (other bands are not allowed). Teams are required to power down communications equipment at the event sites while not competing, so as not to interfere with other teams.

Both omnidirectional and directional antennae are allowed, but communications equipment must not rely on the team's ability to watch and track the vehicle firsthand. If a team wishes to steer a directional antenna they may:

- Steer it manually from inside the control station/tent, with no visual feedback on position.
- Use a mechanized antenna mounted outside that is controlled via an electronic signal from the command station or operates autonomously.

Table 2: Scoring and penalties details for Remotely Navigation Task

No.	Scenario	Time Penalty	Distance Penalty
1	Partial border crossing	5 sec	3 m
2	Complete border crossing	10 sec	6 m
3	Obstacle touching	5 sec	3 m
4	Obstacle collision	10 sec	6 m
5	E-stop request	—	6 m
6	Blocking the track	—	6 m



- Place someone outside to manually turn the antenna to point at the vehicle. Since they can see the vehicle, they are not allowed to communicate with operators inside the control station.

Antenna height is limited to 3 meters. Antenna bases must be located within 5 meters away from the control station/tent and shall adhere to all applicable regulations. Any ropes or wires used for stability purposes only may be anchored within 10 meters of the command and control station/tent. All teams should bring at least 10 m of the antenna cable to deal with this scenario. Lighter-than-air devices are not allowed for communications at UGVC.

5.3 General Rules and Regulations

- The task consists of one heat, in which each team can perform **one** run only.
- During the run, only one student is allowed to follow the vehicle. All other team members and faculty advisors must remain outside the course area.
- Teams will be called to the starting line by the judge. Each team has one minute at the starting line to prepare the vehicle and notify the judge when it is ready. If the team is not ready within this time, the run is canceled and counted as a completed run, after which the next team will be called to the starting line.
- The judge will also carry the wireless E-stop during the run.
- A run will continue until one of the following events occurs:
 - The vehicle successfully completes the course.
 - The judge activates the wireless E-stop.
 - The team activates the mechanical E-stop.
- Teams that finish the course will be scored based on their **net time** taken to complete the course, which is the time taken to finish the course minus any penalties (if applicable).
- At the end of the challenge, if two or more teams have the same net time, the team with the **least penalties** will be ranked higher.
- If two or more teams have the same net time and an equal number of penalties, the team with the **smallest vehicle dimensions (width + length + height)** will be ranked higher.
- Teams that do not finish the course (as the 5 minutes ended) will be scored based on their best **net traveled distance**, which is the maximum traveled distance covered minus any penalties (if applicable).



- At the end of the challenge, if two or more teams have the same net distance, the team with the **least penalties** will be ranked higher.
- If two or more teams have the same net distance and an equal number of penalties, the team with the **smallest vehicle dimensions (width + length + height)** will be ranked higher.
- The judges have the right to disqualify any vehicle that poses a safety hazard, causes damage to the course, or violates safety requirements during the competition.

6 Design Task

The Design Task emphasizes the critical role of thoughtful engineering and innovation in the development of autonomous vehicles. By requiring teams to submit a detailed design report and deliver a presentation, this task provides an opportunity to showcase their technical expertise, design approach, and problem-solving strategies. It encourages teams to demonstrate not only the functionality of their vehicle but also the innovative features, engineering principles, and collaborative efforts that shaped its design. This task highlights the importance of effective communication and documentation, which are essential components of engineering success.

The task is divided into three parts: a written report, a technical presentation, and vehicle evaluation. Teams must submit a comprehensive technical report by **Thursday, July 10, 2025**. During UGVC, each team will deliver a technical presentation, which will be followed by a discussion with a panel of judges. After the presentation, judges will conduct an evaluation of the vehicle based on specific criteria, which will be detailed later. The total score for this task will be the sum of the scores for the written report, the technical presentation, and the vehicle evaluation. The final score will be determined by averaging the independent scores given by each judge.

6.1 The Technical Report

The design report is intended to provide readers with a comprehensive understanding of the vehicle's design, covering its architecture, hardware and software components, and their interaction to compete in the challenge. Also, it is essential to highlight the main innovations and the intelligent features integrated into the vehicle. As mentioned, the deadline for the report submission is **Thursday, July 10, 2025**. A penalty of 20 points will be applied for each day the report is late. The report must not exceed **15 pages**, and should be submitted in PDF format. The main outlines of the report are listed below, while Table 3 shows the scoring criteria of the report.

1. Title page:

- University/faculty name.



- Team name.
- Vehicle name.
- A photo of the vehicle (The real vehicle or CAD model).
- Team leader name and email address.
- Date of submission.

2. Introduction:

- Overview: briefly introduce your team.
- Team organization (including the names all team members, their academic departments, their level, and their role inside the team.)
- Design process: software tools, budget management, and safety measures.

3. Main technical innovations: how the innovations contribute to the success of the task and/or differentiate your design.

4. Mechanical design:

- Overview: the vehicle design philosophy (lightweight, modularity, durability).
- Materials selection.

Table 3: Scoring of the technical report

No.	Criteria	Maximum points
1	Contents of title page	50
2	Team organization	50
3	Design process	50
4	Technical innovations	200
5	Mechanical design	200
6	Electronic and power design	200
7	Software design	300
8	Simulation and to-date testing	150
9	Future work	50
10	Reference and Appendices (if exist)	50
TOTAL		1300



- Chassis.
- Suspension system.
- Manufacturing and assembly.

5. Electronic and power design:

- Overview.
- Main components.
- Power distribution.
- Sensors, motors, main controller, and motor controllers.
- Emergency stop systems.
- Cooling/Ventilation system.

6. Software design:

- Overview: a brief description of system architecture.
- Core functionalities:
 - Mapping, lane detection, and obstacle avoidance.
 - Waypoint navigation.
 - Image detection and recognition.
- Auxiliary systems:
 - Motors control.
 - Vehicle monitoring.
 - Sensor fusion.
- System integration.
- Software testing and bugs tracking.

7. Simulation and to-date physical testing.

- Key testing scenarios used in simulation.
- Visual results, such as graphs, plots, or images from testing.
- Description of the real time testing environment and conditions.
- performance metrics: actual main specifications of the vehicle.
- Challenges encountered during testing, and risk management.



8. Future work: planned improvements until the start of the challenge.
9. References.
10. Appendices (if exist).

Notes:

- **Consistency in style and formatting:** Ensure that section headings, subheadings, and content formatting are consistent throughout the report (e.g., font size, indentation, numbering). This will help maintain a professional and organized appearance.
- **Appendices:** The appendices are not included in the 15-page limit of the report.
- **Use of diagrams and charts:** Including block diagrams, flowcharts, and other visual aids is highly encouraged in the report. This can help clarify complex concepts, enhance the presentation of technical designs, and support the analysis of results. Be sure to properly label and reference them within the text.

6.2 The Technical Presentation

The technical presentation is an important aspect of the design task where teams will present their vehicle's design and functionality to the judges. The goal is to effectively communicate the key aspects of your vehicle's design, highlight the innovations, and demonstrate its capabilities. The presentation should be engaging, clear, and concise, while also addressing the technical details of the vehicle's architecture, hardware, software, and testing.

It is important to note that **not all judges may have read the team's technical report**. Some judges may already be familiar with the details in the report, while others may not. Therefore, the presentation should not assume that the judges have prior knowledge of the technical content. Be sure to provide a clear and concise explanation of the vehicle's design, innovations, and functionalities without relying on prior reading of the report. Focus on highlighting your design successes, overcoming challenges, and any updates since the report was written.

Note: Part of the evaluation is your salesmanship skills. You need to convince the judges why they should **buy** your vehicle. This can be achieved by effectively demonstrating its value, innovation, and potential for success.

The presentation must be delivered by one or more students, and must not exceed **15 minutes**. A penalty of 10 points will be applied for each extra minute. will be applied for each additional minute beyond this limit. The scoring criteria for the technical presentation are outlined in Table 4. The following details provide an explanation for some of the key criteria used to evaluate the technical presentation:



- **Logical organization:** Clear structure and flow of the presentation.
- **Clear explanation of the technical innovations:** Ability to clearly explain design innovations and their impact.
- **Use of graphic and visual aids:** Effective use of visuals (diagrams, charts, images) to support the presentation.
- **Articulation and eye contact:** Clarity of speech and maintaining eye contact with the audience and judges (not reading notes or facing the screen).
- **Salesmanship:** Ability to present the vehicle's value, innovations, and potential success in the challenge.
- **Response to questions:** Ability to respond confidently and accurately to the judges' questions.

While the designated presenters are responsible for delivering the presentation, other team members (excluding advisors) may assist during the discussion period that follows the presentation. Faculty advisors are not permitted to participate in either the presentation or the discussion.

The presentation will take place in a designated room equipped with a computer and a connected projector. Teams may also use their personal laptops if preferred. Additionally, the vehicle must be present in the room during the presentation for the judges' evaluation.

Table 4: Scoring of the technical presentation

No.	Criteria	Maximum points
1	Logical organization	100
2	Clear explanation of the technical innovations	150
3	Mechanical design	150
4	Electronic and power design	200
5	Software design	200
6	Use of graphic and visual aids	100
7	Articulation and eye contact	100
8	Salesmanship	100
9	Response to questions	100
TOTAL		1200



6.3 Vehicle Evaluation

After finishing the technical presentation and the oral discussion, judges will evaluate the vehicle itself based on the following guide shown in Table 5.

Table 5: Scoring of the vehicle evaluation

No.	Criteria	Maximum points
1	Packing and the efficient use of space	50
2	Safety	50
3	Accessibility of components	50
4	Ruggedness	50
5	Serviceability and modularity	50
6	Overall appearance	50
TOTAL		300