2024TIRT Autonomous Vehicle Racing

Competition Regulations

2024.0628版

A. Origins of the Project ：

ShaYangYe is committed to advancing robotics education and promoting industry collaboration, with the aim of establishing Taiwan as an international stage for robotics competitions. Since 2018, we have collaborated with the Taoyuan City Government to organize the INTERNATIONAL ROBOTIC FESTIVAL IN TAOYUAN for six consecutive years. This pioneering event brings together four major robotics competition fields: land, sea, air, and maker. Over the past six years, it has attracted over 12 million participants both online and offline, with teams from 20 countries participating and a total of 9,400 teams from domestic and international regions. Our goal is to connect robot training and competitions with relevant industries, expand the international perspectives of Taiwanese participants, and create a cross-domain international robotics extravaganza that shines in Taoyuan and the world!For the 2024 INTERNATIONAL ROBOTIC FESTIVAL IN TAOYUAN, in order to promote Taiwan's robotics industry and self-made brands, we are planning a series of events, including the TIRT Autonomous Vehicle Racing Competition. This competition combines diverse control systems to showcase Taiwan's technological prowess in intelligent manufacturing. Furthermore, it serves as a link to the TIRT International Competition and Conference!

B. Objectives of the Project :

1. By organizing competition activities and facilitating learning exchanges, we aim to provide domestic and international teams with opportunities to observe and learn about programming, mechatronics integration, and knowledge sharing, thereby inspiring students' motivation to learn.

2. By incorporating diverse open control systems, we plan to design different competition targets that foster the development of students' creativity, design skills, integration abilities, and programming capabilities.

C. Guiding Organization：

Taoyuan City Government, Taoyuan City Council

D. Host Organization ：

Department of Economic Development, Taoyuan

E. Executing Unit ：

SHAYANGYE Cultural & Educational Foundation

F. Participants:

1. Students from high schools, vocational schools, and colleges/universities across the country (including master's and doctoral students) are eligible to participate.
2. Participants must have a valid student status recognized by the Ministry of Education.
3. International teams of the same age are also allowed to participate (proof of valid student status in their respective countries is required).

TIRT Official website.

G. Competition Event

Autonomous Vehicle Racing

H. Competition Categories

1. High School Category: Limited to high school students, with a maximum of 3 team members per team.
2. College/University Category: Limited to college/university students (including master's and doctoral students), with a maximum of 3 team members per team.

I. Event description and schedule planning ：

1. Registration Method: Visit the official TIRT website (https://www.tirtpointsrace.org/)
2. Registration Period: From May 1, 2024, to October 28, 2024 (subject to adjustment based on team registrations).
3. Competition Date: November 9, 2024
4. Competition Venue: Taoyuan Stadium (No. 1, Section 1, Sanmin Road, Taoyuan District, Taoyuan City)

I. Other Matters:

The organizers reserve the right to modify the regulations and rules. For any matters not covered in this document, the latest announcements from the organizers on the official competition website shall prevail. If you have any concerns, please contact the organizers at +886-3-3623452, ext. 5338, Mr. Qin.

2024TIRT Autonomous Vehicle Racing

2023.0518版

Competition Rules

A. Eligibility：

The eligibility requirement is for college students.

B. Race Regulations：

Participants are required to operate their 'autonomous vehicles' solely through image recognition. The participating 'autonomous vehicles' must adhere to the specified size regulations for wheeled four-wheeled vehicles, and there are no restrictions on the use of control platforms for programming. The competition is conducted in a racing format, and the winner is determined based on the shortest completion time in terms of seconds.

1. Competition Format Explanation：

a. Each participating team has two opportunities to achieve results on the race track during the competition. The best result from the two attempts will be considered, and the timing will be displayed in real-time on an electronic timer. Before each subsequent race, teams are provided with 60 seconds to make hardware adjustments. During this time, only hardware adjustments such as securing loose parts and cleaning tires are allowed. No adjustments or replacements of microchips, circuit boards, or programming are permitted.

b. The technical evaluation team has the authority to conduct on-site technical inspections of all vehicles. Any violations of the competition rules will result in immediate disqualification from the finals, and the next highest-ranking reserve team will advance as a replacement.

c. Each team's vehicle must complete one lap on the race track from the starting line to the finish line, and the timing recorded by the timer will determine the results. The vehicle must automatically stop within the specified track area after crossing the finish line. Failure to stop within the designated area or crossing the track boundaries after crossing the finish line will result in a failed attempt.

d. At intersections, teams must follow the specified path and are not allowed to take shortcuts. During the competition, teams must complete the checkpoint tasks according to the competition rules. Any collisions with obstacles or going off the track during the race will result in a failed attempt.

e. Calculation of Results：

1) When a participant fails to complete a challenge checkpoint, they will receive distance and time scores at that specific location for reference in the overall competition results.

2) If at least one team completes the race, the rankings will be based on the finishing time in seconds. If there are not enough completing teams to fulfill the number of awarded teams, the farthest distance achieved by an incomplete team will be used to fill the rankings.

3) If no team completes the race, the rankings will be based on the distance traveled by each team as explained above. In case of a tie in distance, the rankings will be determined by the time scores.

f. The timing for track testing and on-site adjustments will be based on the announcements made by the organizers.

2. Vehicle Regulations for the Competition：

a. The dimensions of the vehicle, including the camera module, must not exceed a cubic size of 30cm (length) x 30cm (width) x 30cm (height). The vehicle must be a four-wheeled wheeled-type vehicle, and there is no limitation on the number of transmission motors. If the camera module has a retractable design, its size should not exceed 30cm before and after transformation.

b. The technvehicle must be equipped with a camera module and utilize visual image recognition ology and auxiliary sensing components for the competition. It must also comply with the inspection regulations. Failure to comply with the competition rules will result in disqualification."

c. There are no restrictions on the platform for programming.

d. For special designs, please consult the organizing committee in advance. The inspection results related to special designs will be determined by the organizing committee and the judges.

3. Competition Rules：

a. The total length of the race track, including the stationary checkpoints, does not exceed 110 meters. Each race has a duration of 300 seconds."

b. "All participants must complete the registration and check-in process. The race order is determined according to the method announced by the organizers. Teams should wait at the designated area in the order of their appearance. The next group of participants must be ready in the preparation area within three calls. Once the vehicle has undergone inspection, it must remain in the designated area throughout the competition. No modifications to microprocessors or chips (program) are allowed during the competition."

c. "According to the race order, the referee instructs the participating teams to enter the race area. At any given time, only one team is allowed to compete on the track. Any participant's actions that significantly affect other teams' participants will result in disqualification."

d. "After the roll call by the referee, each team designates one team member to enter the competition area with the vehicle and adjustment tools (excluding devices such as laptops or tablets). Participants have 60 seconds of on-site preparation time. Once ready, the referee announces the start of the race, and participants place their vehicles within the starting area (with no part of the vehicle crossing the timing start line)."

e. "The vehicles must follow the designated track route to reach the finish line. Along the way, participants may need to complete various checkpoint tasks. The timing start line sensor automatically measures the time, and the referee determines the score for each checkpoint task. The vehicle must come to a stop within the designated area at the finish line; otherwise, it will be considered a failure. After the referee confirms the results and records the scores, participants can retrieve their vehicles and return them to the designated area, awaiting the next race."

* Vehicle End Stop: Participants can choose to use either a vision recognition module or any sensor component to determine the stopping point of their vehicle.

f. The competition vehicles must be started using a hardware switch and cannot be activated through external connections (such as computers, tablets, or related devices) to avoid suspicion of modifying the vehicle's program.

g. The vehicle should leave the starting area within 20 seconds; timing begins when the front object of the vehicle crosses the starting line.

h. The vehicle must travel at least 10 meters on the track after activation to be considered for a valid reference score.

i. After all participants have finished the race, the referee team will declare the results and submit them to the organizing committee for approval and public announcement.

4. Failure/Disqualification Criteria and Regulations：

a. In the competition, the following situations during the race are considered as a failure for that particular opportunity (one of the two chances).

1) After the referee calls their name, if a team member fails to enter the competition area within 30 seconds.

2) If the vehicle does not leave the starting area within 20 seconds after the start of the race.

3) If the vehicle fails to complete one lap within 300 seconds after leaving the starting area, the location of the vehicle will be recorded after 300 seconds.

4) If any wheel of the vehicle goes off the track.

5) If the vehicle collides with the designated obstacles (the definition of obstacles will be determined by the referee before the race).

*When a vehicle goes off the track, the referee will instruct the participant to retrieve the racing vehicle (participants must enter the competition area barefoot).

b. If the following situations occur during the competition, it will be considered a failure, and no results will be counted：

1) After completing the registration process and until the official confirmation of finishing, competitors are not allowed to touch the racing vehicle or modify the robot's program without permission from the referee.

2) During or after the competition, if the vehicle fails to pass the on-site technical inspection.

c. Prohibited Items for Participants：

During the competition, if any violation is found by a participating team, the referee has the authority to disqualify the team from the competition. The determination of violations is at the sole discretion of the referee.

d. Supplement：

1) Not allowed to install auxiliary lighting devices and other auxiliary sensors outside the vehicle body; auxiliary lighting can be installed on the vehicle body.

2) Participants are not allowed to make any changes to the hardware circuits and software of their vehicles after entering the competition area and before the start of the race, except for battery replacement. However, they are permitted to manually adjust toggle switches or potentiometers on the circuit board.

3) In the competition venue, except for the referee and one team member, no other participants are allowed to enter the field.

4) Participants are only allowed to bring their vehicles and adjustment tools (excluding devices such as laptops or tablets that may be used for modifying programs) onto the field.

5) Any other interference with the movement of vehicles or cheating behaviors during the competition will result in disqualification of the team, as determined by the referee, and the revocation of awards.

6) Any damage to the track caused by the sensors or parts of the vehicle is not permitted.

7) If participants fail at a challenge checkpoint, they will obtain distance and time scores at that point, which will be used for reference in the final ranking.

e. If the organizers (referee panel) discover any suspicions regarding the vehicle's performance during the competition, they have the right to conduct hardware and software inspections on the vehicle. If any violations of the competition rules are found, the participant will be disqualified.

f. In case of any unforeseen circumstances or situations not covered by the regulations during the competition day, the organizers have the authority to provide an interpretation. The decision made by the head referee shall be final and not subject to appeal.

C. Key Description of Race Track Checkpoints

◆ Vehicle driving, functional road sign recognition (acceleration/deceleration/speed limit/railroad crossing), traffic light signal recognition, etc., must utilize visual image recognition technology. However, for road obstacles (Section 3.9), participants may choose their own auxiliary sensing components for obstacle detection and avoidance.

1. Intersection Traffic Lights ：

a. In this checkpoint, there will be an intersection on the race track. Participants must follow the traffic signals and either stop or proceed according to the signal. Notice signals will be placed next to the traffic lights for the participants to identify. The signals will be placed on the right side of the track in the direction of vehicle travel. Failure to follow the signal rules will result in disqualification for that attempt.

b. When passing through the traffic light checkpoint, participants must stop when the red light is illuminated and proceed only when the green light is illuminated. Failure to pass straight through the intersection when the green light is on will result in disqualification for that attempt.

2. Level Crossing ：

a. A railway crossing checkpoint has been added to the track. When the vehicle passes over the sensor, it triggers the closing of the railway crossing gates, blocking the entire section of the track. After a 10-second delay, the gates will open, and the vehicle must come to a complete stop until the gates are fully open before continuing. Failure to stop and directly crossing the gates will result in disqualification for that attempt. The distance from the sensor to the obstructing barrier is 1 meter (100cm).

b. The track will have markings indicating the presence of a railway crossing checkpoint. The obstacles will be physical three-dimensional props.

3. Watch out for pedestrians：

a. In a certain section of the race track, there will be a 2-3 meter long segment with movable simulated pedestrian obstacles. These obstacles will be placed after a designated sign. The competing vehicles must slow down or come to a complete stop when encountering these moving pedestrian obstacles.

b. During the passage of this section, the competing vehicles must wait for the pedestrian obstacles to pass before proceeding. If they fail to wait for the pedestrian obstacles to clear or collide with the obstacles, it will result in a failure for that attempt.

* Participants are allowed to choose their own auxiliary sensing components to identify and avoid road obstacles.

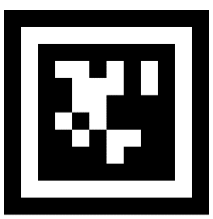
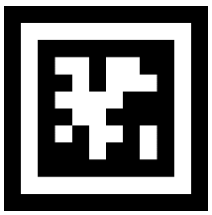
4. dual-lane road：

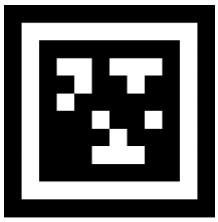
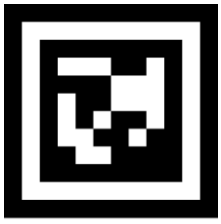
The race track will include a section with a newly added dual-lane segment. The dual-lane segment will have movable obstacles, and vehicles must navigate within the track to avoid these obstacles. It is strictly prohibited to collide with the obstacles, and any collision will result in failure for that attempt. 。

* Participants may choose their own auxiliary sensing components to identify and avoid road obstacles.

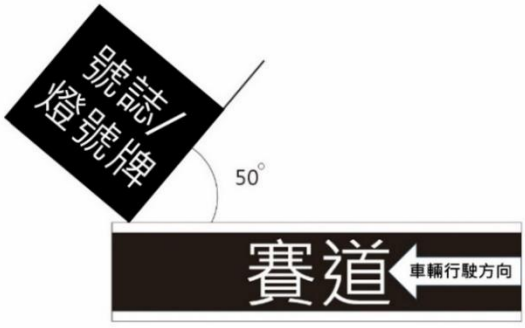
5. Detailed Signal Description：

The road signs used for identification are actual traffic signs, with an added AprilTag below the sign to facilitate easier recognition of the sign and its distance by the participants. The size of the AprilTag is 5cm * 5cm.

Signal Description	Traffic signal image	AprilTag	Description
Railway level crossing with barriers.			Vehicles must stop according to the signage instructions and wait for the barrier to be raised before proceeding.
Watch out for pedestrians			Participants must follow the road signs and wait for pedestrians to pass before proceeding.

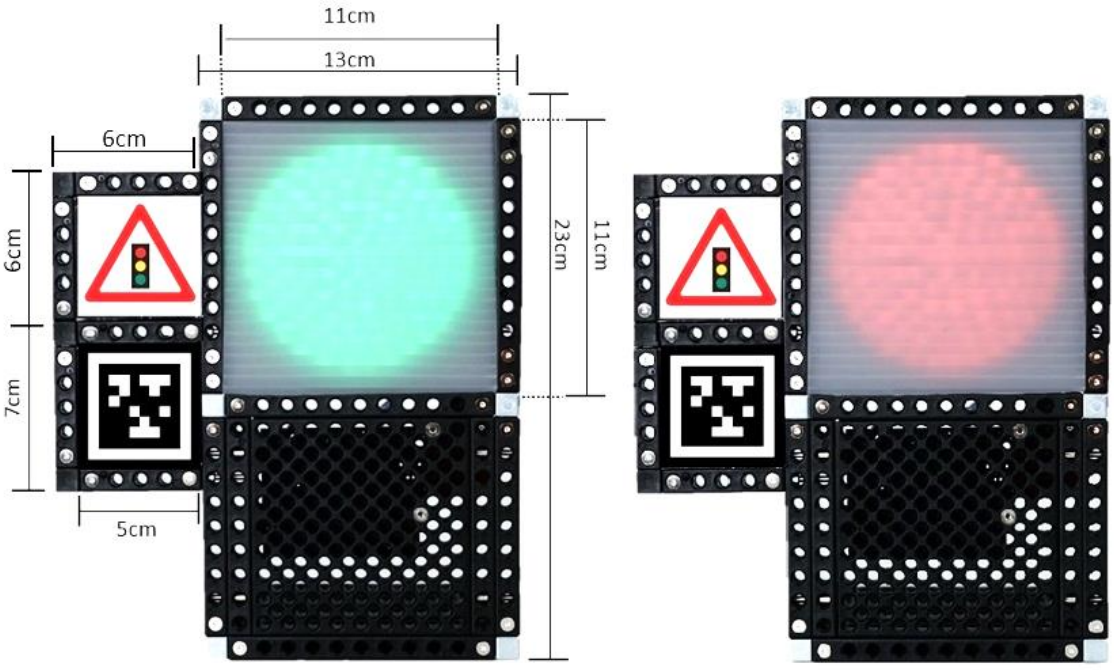
Signal Description	Traffic signal image	AprilTag	description
warning signs			Need to pass through intersections according to traffic lights.
Double Lane Obstacle			Need to navigate around obstacles and continue driving.

6. Explanation of Signal/Light Sign Placement：



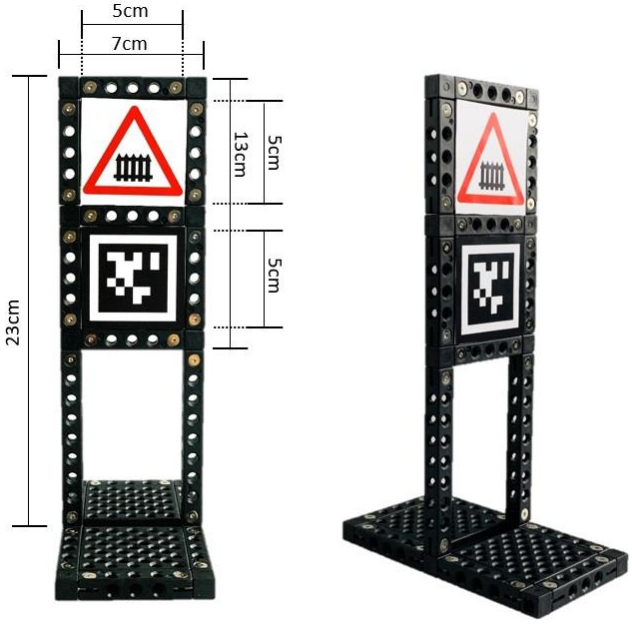
*** Shown in bird's-eye view**

7. Red-Green Traffic Light Physical Diagram：

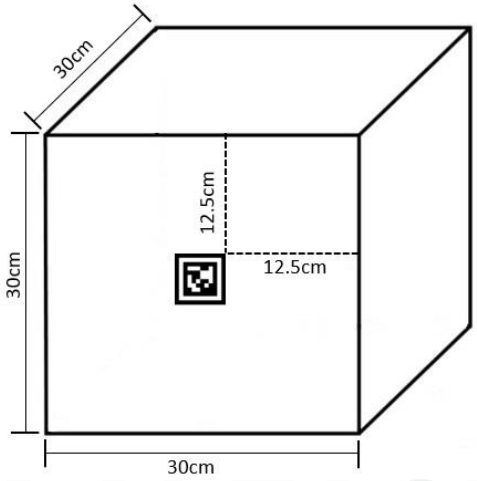


*** The actual brightness and color may vary due to the lighting conditions of the competition venue.**

8. Signal Sign Front/Side View Illustration：



9. Obstacle Diagram：



*** The obstacle is a solid cube.**

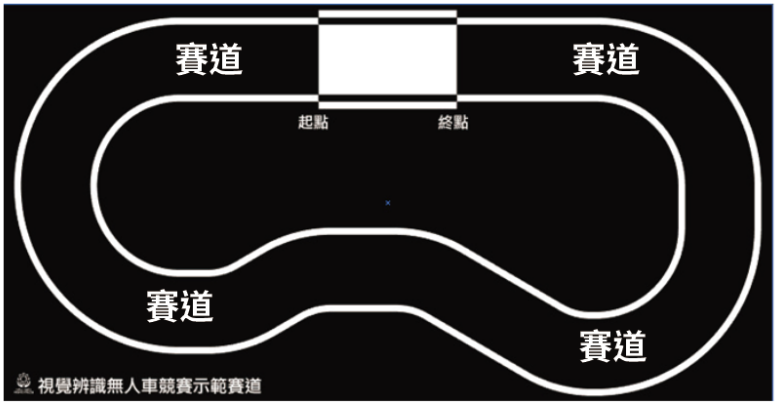
D. Race Track Venue ：

1. Every year, the basic parameters of the race track may be adjusted, including the number and positions of the turns, as well as the overall layout of the checkpoints.
2. The total length of the race track does not exceed 110 meters. The track consists of straight sections, curves, bumpy surfaces, slopes (with a gradient of less than 30 degrees), tunnels, and more. Please refer to the attached description for details.
3. The race track may have different colored sections, and participants must fulfill the corresponding color section requirements according to the competition rules.
4. The race track may have dual lanes in each section or throughout the entire track, and obstacles may be placed, requiring participants to avoid them while progressing.
5. The race track may simulate real roads with sections where the lines are broken or interrupted.

E. Detailed Venue and Track Description ：

1. Illustration of the Race Track Layout ：

虛線內範圍為競賽場地



a. The venue consists of colored blocks and lines, and all the areas shown in the diagram are referred to as the race track. The colors in the venue provide a clear contrast that can be easily recognized by the human eye.

b. The boundaries of the race track may be adjusted due to the specific checkpoints of the competition, but the total length of the track does not exceed 110 meters.

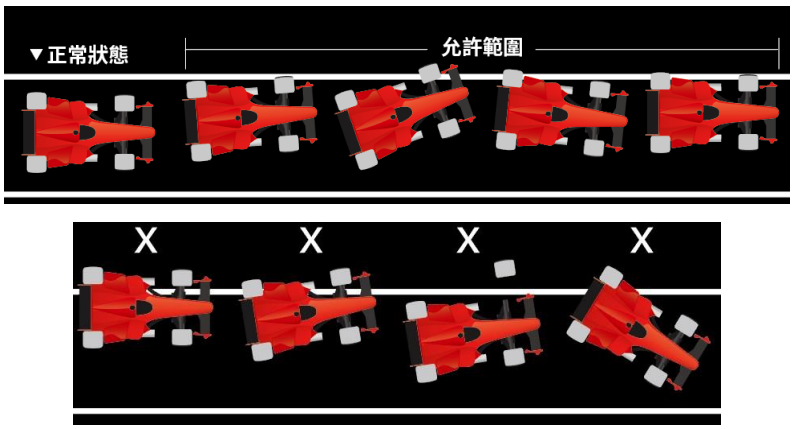
c. The venue may include the race track itself as well as facade objects adjacent to the track.

d. Examples of facade objects adjacent to the track include building models, models of animals/plants, functional road signs (acceleration/deceleration/ speed limit), traffic lights, etc.

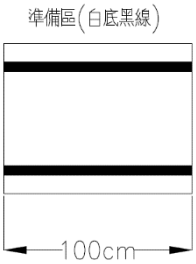
(Figure 4: Illustration of Building or Animal Model)

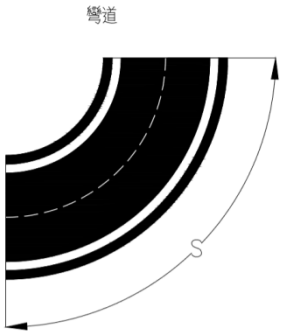
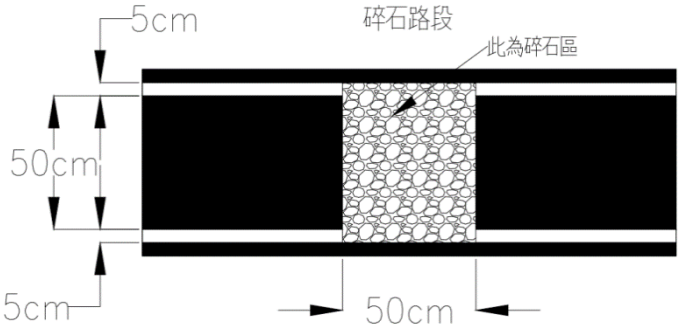
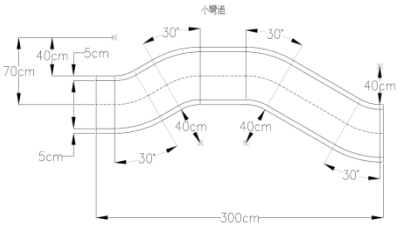
(Figure 5: Illustration of Checkpoint Sign)

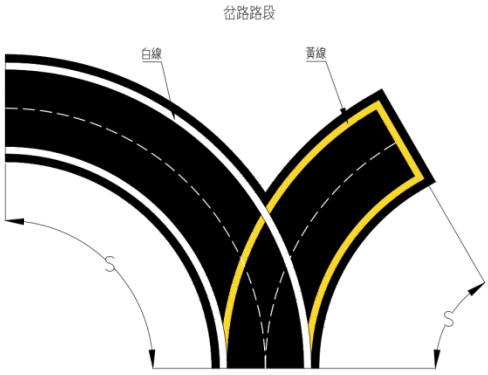
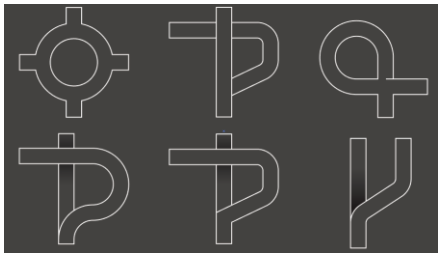
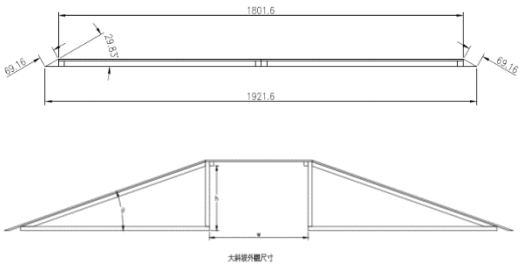
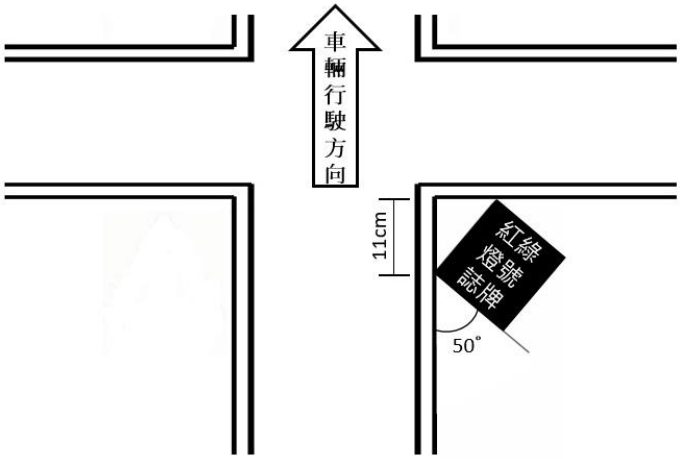
e. In the competition, the vehicle must keep all four wheels within the track boundaries. If any wheel (or all wheels) deviates from the track lines at any point, it will be considered a failure.

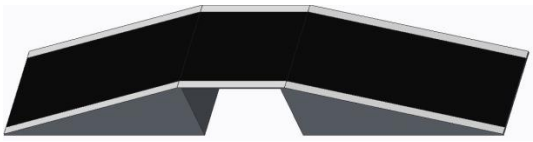
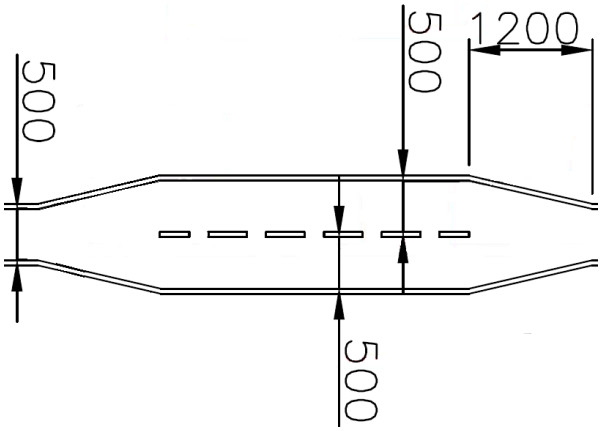


2. Explanation of Track Symbols：

Track Description	diagram
The white background with black lines between the starting point and the finish line is the preparation/arrival zone of the race track.	 
Prior to the start, the participants are required to place their vehicles within the white area (left). Once the race begins, timing starts when any part of the vehicle crosses the starting line (right).	 
When reaching the finish line, the race result is determined by obstructing the timing sensor with any part of the vehicle's body (left); the vehicle's four wheels must be completely stationary within the white area, known as the finish zone (right).	 

Track Description	diagram
The race track is composed of white lines on both sides, with a width of 50±5 mm each. The width of the black racing surface is 500±10 mm.	
The length of the bend on the track does not exceed 2 meters. The bend consists of several segments of arcs, with the radius of each arc ranging from 50 cm or more. ※S is the distance from the center line of the track.	
The race track may have discontinuous sections, which can include shallow beaches, sandy areas, or gravel road segments. The length of these discontinuous sections will not exceed 50cm.	
The race track may contain a series of consecutive bends, with a minimum bend angle of 30 degrees and a maximum bend angle of 90 degrees.	

Track Description	diagram
The race track may have diverging paths with different colored sidelines, requiring participants to judge and drive on the correct route.	
The race track may consist of various types of bends, intersections, roundabouts, or sections with different colored blocks.	
The track may feature consecutive ramps with a maximum angle of 50 degrees. The ramps are connected to the flat track by white base and black lines.	
At the intersection area, traffic signals are placed on the right side of the direction of travel. Please refer to the diagram for specific locations.	

Track Description	diagram
The race track may feature a checkpoint with a slope and a tunnel.	
Checkpoint with dual-lane section, random obstacles will be placed on this segment. Unit (mm).	

F. Reward Mechanism：

Ranking	Bonus (NTD)	Certificate
1st Prize	$12,000	V
2nd Prize	$8,000	V
3rd Prize	$5,000	V
Excellent Work	-	V