Al Driverless - Intelligent Driving for Circular Road Test

I. Scope of Competition

1. Participating groups: primary school group, junior high school group, high school group (including technical secondary school and vocational high school).

2. Primary school group contestants must be between 6 and 13 years old (on September 1 of the competition year) and be primary school students; participating teams must have at least one instructor who is 20 years old (on September 1 of the competition year).

3. At least one contestant in the junior high school group must be between 12 and 16 years old (as of September 1 of the competition year) and be a junior high school student; each participating team must have at least one instructor who is 20 years old or older (as of September 1 of the competition year).

4. One of the contestants in the high school group must be aged 16-18 (on September 1 of the competition year) and be a high school student. If the contestant has not received school education, he/she must apply to the organizing committee for eligibility.The participating team must have at least one instructor who is 20 years old (on September 1 of the competition year).

5. Number of participants: 2-3 people/team.

6. Instructor: One instructor who is 20 years old or above (as of September 1st of the competition year).

7. Each person can only participate in one event and one team.

II. Competition Theme

The theme of this session is "Smart Driving Test Around the Field Road Test". Smart Driving Test Around the Field Road Test refers to the task of implementing the around-the-field road test of unmanned driving test through graphical programming or Python programming. In the "artificial intelligence era" with deep learning as the breakthrough, unmanned driving has been given unprecedented attention. Internet companies, traditional car manufacturers, emerging startups, and various capitals are competing for it. The industry generally believes that unmanned driving is one of the ultimate scenarios for the implementation of artificial intelligence. Many AI robots also have unmanned driving capabilities. This project can vividly simulate the main links and technologies of unmanned driving such as identifying lanes, road signs and positioning, and judging violations.

The purpose of this competition is to test young people's understanding and mastery of artificial intelligence and AI robots, and to stimulate the interest and exploration of AI robot technology among young people in my country through a competition that is scientific, innovative, interesting, competitive and changeable.

III. Competition Process

1. Registration: Participants shall register in the manner and time specified by the local organizing committee. Successfully registered contestants are eligible to participate in the local trials.

2. Local selection: According to the quota given by the National Organizing Committee, the local shortlisted contestants will be determined and reported to the National Organizing Committee within the prescribed time.

3. National Finals: The first, second and third prizes will be determined on site by the shortlisted contestants. Contestants who are shortlisted but fail to arrive at the finals will be deemed to have forfeited and will not be awarded.

IV. Competition Environment

1. Programming system: graphical or Python programming software.

2. Programming computers: Participating teams should prepare and bring all equipment, software and laptops required during the league. Each team can only bring one laptop into the venue and ensure that the laptop has sufficient power during the game (mobile charging devices can be brought by themselves).

3. Prohibited devices: USB flash drives, mobile phones, tablet computers, walkie-talkies, etc.

V. Competition Venue

1. The size of the flat ground mat of the WRO venue in each age group is 240cm*240cm, and the maximum error of each dimension shall not exceed +/-5mm.

2. The height of the boundary fence is 15 ± 0.5 cm.

3. The competition adopts the method of patrolling by cameras. The competition path is a double yellow line with a black background, and the width of the yellow line is 2 cm. There are three types of paths in the competition path: straight road, 90° curve, and "S" curve. During the patrol process, the task can be completed by patrolling single yellow line, double yellow line, etc.

4. The playing mats must be printed with a matte finish or overlay (no reflective colour). The material of the playing mats should not be too soft (e.g. no mesh banner material).

5 If the setup is different in local or national competitions (table size, borders, floor mat material, etc.), the competition organizer must notify the participating teams in advance.



Site Map

As shown in the picture is a schematic diagram of the competition venue. Various task models are scattered on the complete 240cm*240cm venue.Some mission stickers are fixed to the field membrane using adhesive stickers. During the entire competition, the fixed mission stickers or models cannot be moved. Some mission models are placed directly on the field and can be moved according to the mission.

Some tasks will be randomly selected on site, and the participating teams should write the control program on site according to the content announced before the game.

The tasks described below are just simulations of certain situations in people's lives in modern society. Do not compare them with real life.

1. Start and end area

The start and end areas are shown in the figure below. When the car starts to depart, it starts from the start and end area in the direction of the green arrow; after completing all tasks on site, it returns to the start and end area. That is, after recognizing the end parking sign, it enters the start and end area.



Start and end area diagram

2. Slope bridge

The slope bridge is a prop for the on-site task. The placement area will be announced before the game. The car will pass through the bridge in the slope fixed-point start task.



Slope Bridge

3.Sidewalks

The sidewalk is the task area, and some of the selected tasks will be placed in front of the sidewalk for execution.



Sid

-0 0 0 Stopping Parallel Reverse and parking parking starting on a hill Stop at the end Reverse parking Side parking Slope parking sticker sticker sticker Side parking sticker Reverse parking sticker

4、Basic task logos and stickers

5. Task ID of additional tasks (published when extracting, the following is an example)



Traffic light sign



Roadblocks

6. Environmental conditions

(1)The competition venue may be different from the team's own training ground. Teams should adjust their robots to adapt to the environment of the venue. The floor plan of the venue is posted on the table with a raised frame (length * width * height: 240cm * 240cm * 15cm). The robot competition venue is usually susceptible to interference from uncertain factors, such as the surface of the venue may be textured or uneven, the frame may be cracked or rough, and the lighting conditions.

(2)There may be sudden light interference at the competition venue (such as flash lights from the audience, etc.), and the participating teams should be prepared to deal with such interference. The organizing committee will also try to reduce external light interference.

(3)All dimensions are allowed to have an error of $\pm 5\%$ from the regulations.

VII. Competition Rules

(1). Robot requirements

1. Before starting the "mission", the minimum size of the robot must be within 30 cm \times 30 cm \times 20 cm. After starting the robot, the maximum size must be within 30 cm \times 30 cm \times 30 cm.

2. Each team has one and only one robot.

3. The robot controller must be "cleared", that is, there cannot be any programming program in the controller.

4. The robot must be a detachable modular structure, an omnidirectional robot with four independently controlled wheels, or a traditional robot with ordinary wheels, and the construction size must meet the requirements of Article 1.

5. Each robot uses at least one vision module, and the vision module must be an independent and detachable module.

6. .Each module cannot be connected with screws, but only with pluggable building blocks. Each robot uses only one AI control system as the control core.

7. The robot must operate autonomously. Remote control, manual control, or data transmission to the robot (such as by sensors, connecting wires, wireless, etc.) is not allowed.

8. The saturation voltage of each robot battery: The primary school group shall not exceed 9V, and the junior and senior high school groups shall not exceed 12V.

(2).Competition tasks

The competition task is carried out in two rounds, each round lasts for 3 minutes. At the beginning of each round, the contestants start from the starting and ending areas. The car needs to complete the unmanned route, complete basic tasks and additional tasks on the route, and finally arrive at the starting and ending areas and stop.

After the competition begins, the contestants make the car complete 9 basic tasks, including starting, right-angle turning, parking and starting at a fixed point on a slope, driving on an "S"shaped curve, passing through a speed and width limit gate, side parking, reversing into a garage, and arriving at the starting and ending areas, as well as additional tasks drawn on site.

Notes on crossing the line during tracking: During the process of completing tasks other than those with special notes, if you cross the solid yellow line in the venue, 5 points will be deducted, as shown in the figure below. From the end of the previous task to the start of the next task, 5 points will be deducted for each time the solid yellow line is crossed during the tracking process.



Description of tasks for each group: The tasks that each group needs to complete are shown in the following table.

Group	Task	Remark
Primary School Category	Complete 5 basic tasks, and draw 2 additional tasks of different categories on site and place them randomly on the route Complete 7 basic tasks,	Before the competition is debugged, the referee will draw the tasks of each group on site
Junior High School Group	draw 2 additional tasks of different categories on the spot, and place the position on the route before the game.	and announce the task location and direction. During the official competition, the tasks of each group will be consistent with the
High School Category	Complete 9 basic tasks, draw 2 additional tasks of different categories on the spot, and place the position on the route before the game.	tasks and task locations and directions during the debugging.

1. Basic tasks:

1. Departure

The robot starts from the starting and ending area and completely leaves the starting and ending area. That is, the robot's vertical projection completely leaves the starting and ending area, then the starting task is completed and 10 points are awarded.

2. Stop and start at a fixed point on a slope (This task consists of 2 tasks, Task 1: Stop at a fixed point on a slope; Task 1: Start at a fixed point on a slope.)

Pass the bridge deck and complete the ramp fixed-point parking and starting tasks. The task of stopping and starting on a slope includes the following three actions:

Action 1: Go uphill and stay still for 2 seconds in the uphill or bridge area (the robot's vertical projection is completely in the uphill or bridge area), then you will get 10 points;

Action 2: When the vehicle is stationary, the brake lights are on, which is worth 5 points.

Action 3: Start on a slope with the brake lights off and successfully pass the bridge, 10 points;



Completion status indication

Failure status indication

3. Complete a right-angle turn

Successfully completing a right-angle turn will earn you 15 points, and if you cross the yellow line during the movement, the mission will fail.





Completion status indication

Failure status indication

4. Complete the "S" curve track

Successfully complete the "S" curve driving task; 20 points will be awarded for completing the action.



Completion status indication

Failure status indication

5. Parallel parking

Identify the parking sign and complete the parallel parking task, get 5 points; the robot completes the parallel parking action and the vertical projection is completely within the yellow line area of the parallel parking space, which means 20 points.



Identify the "Park Parking" sign



Completion status indication



Failure status indication

6. Reversing into a parking space

Identify the reverse parking sign and get 5 points; if the robot completes the reverse parking action and the vertical projection is completely within the yellow line area of the reverse parking space, it will get 20 points.



Identify the "Reverse into Garage" sign



Completion status indication



Completion status indication

7. Speed and width limit gates

The robot adjusts the angle and drives through the speed and width limit gate without touching any part of the speed and width limit gate during the process to complete the task and get 10 points.

8. Arrive at the finish area

Successfully reach the start and end area (vertical projection is completely within the start and end area) and stop. 15 points for successful completion of the task



Completion status indication



Failure status indication

2. Additional tasks:

There are three categories to be drawn on site, and each category has multiple tasks to be drawn. Task requirements and corresponding props are released on site. The referee draws the corresponding number of tasks according to the group before debugging and randomly arranges the positions. Complete the task according to the corresponding requirements of the drawn task, and get 20 points for each completed task.

1. Building sign recognition (option task on-site release, 3 options in total) For example: bridges, schools, charging stations, etc.

Charging Station

The location is selected on the spot, and the sign is recognized to stop and wait for charging. After 3 seconds of successful charging, the voice broadcast "Charging successful" is played. 20 points are awarded for completing the task, and 5 points are deducted for crossing the yellow line during exercise.





Completion status indication

Failure status indication

2. Traffic sign recognition (optional tasks will be released on site, with 3 options in total)

For example: pay attention to pedestrians, red light traffic, tunnels, etc.

Traffic light passing

Check the status of traffic lights and complete the passage according to traffic rules. You will get 20 points for smooth passage and 5 points will be deducted for crossing the yellow line during the movement.



Completion status indication



Failure status indication

3. Road obstacle identification (option task released on site, 3 options in total, this prop is a three-dimensional obstacle, not a sign)

For example: roadblocks, pedestrians, animals, etc.

Clearing Roadblocks

20 points for clearing the roadblocks and passing smoothly. (Note: You can cross the yellow line in this task)



Identifying Roadblocks



Completion status indication

Group	Primary School Category	Junior High School Group	High School Category
On-site programming	90 minutes	90 minutes	90 minutes
Game Complete	3 minutes	3 minutes	3 minutes

Note: 1. On-site programming time: The start and end time for all contestants in each group to perform on-site programming. During this time, contestants can perform site debugging and program adjustment. 2. Competition completion time: The start and end time for the last robot of each participating team to complete the competition. If the competition is not completed within the specified time, the competition will be forced to end.

(4). Robot operation

8. The robot must be stationary in the start and end areas before starting. It is allowed to start by "pressing a button" or "giving a sensor signal". After successful start, the robot must run autonomously.

9. After entering the competition venue, the participating teams have 1 minute to prepare for the competition. After the preparations are completed, the participating team members will place the robots at the starting position and signal the referee to start the competition. Participants who are not ready within 1 minute will be disqualified from this round of competition and will not have any results, but will not be affected from participating in the next round of competition.

10. If a robot's structure falls off within the time limit for completing the task, the team members may ask the referee to help retrieve the fallen part without affecting the normal operation of the robot.

11. Wireless, infrared and other remote control devices are not allowed.

12. There is no pause during the time limit for task completion.

13. During the competition, robots cannot be replaced, and the software and hardware of robots cannot be changed, but batteries can be replaced.

14. Each team will play two rounds, and a draw will be held on site to determine the order of the competition.

(5) End of the competition

1. Complete the task within the specified time.

2. Complete unfinished tasks within the specified time.

3. The robot's overall projection completely crosses the yellow line for more than 5 seconds during its movement (except when completing the obstacle removal task).

4. The possibility that the robot suddenly stops while moving and does not move for 10 seconds.

5. The robot flips sideways or overturns while walking.

6. The robot did not move along the specified mission route.

7. While the robot is moving, the contestants intentionally touch the robot or model.

8. The robot start and end area cannot be started within 30 seconds.

9. The robot is not stationary when starting from the starting area.

(6) The robot is not stationary when starting from the starting area.

1. The participating team is more than 5 minutes late.

2. After the robot is started, it is remotely controlled manually.

3. A contestant intentionally damages the competition venue.

4. The contestants did not follow the referee's instructions.

VII. Scoring Criteria

Task	Score
Mission: Departure	
Leaving the start and end area	10
Task: Stopping and starting at a fixed point on a slope	
1. Successfully complete the slope fixed-point parking	10

2. Turn on the brake lights	
3. Successfully complete the slope fixed-point start	
Mission: Right-angle turn	
1. Successfully complete the right-angle turn task	15
Mission: "S" curve track	
1. Successfully complete the "S" curve driving task	20
Mission: Parallel parking	1
1. Identify parking signs	5
2. Complete the parallel parking task	20
Task: Reverse parking	
1. Identify the reverse parking sign	5
2. Complete the task of reversing into the warehouse	20
Mission: Speed and width limit gate	
1. Successfully pass through the speed and width limit gate task	10
Mission: Arrive at the finish line	
1. Successfully reach the finish area	15
Tasks: Additional tasks	
1. Each time you successfully complete a task	20
The number of times the solid yellow line is pressed during the completion process	task

1. During the exercise, if you press the solid yellow line when	-5 points/time
the rules do not specifically state that you can press it	

Bonus Points	
0 restarts	20
1 restart	15
2 restarts	10
3 restarts	5
4 restarts	0
Time for this round	
Total score	
Notes: 1. If only part of the tasks are completed within the competition time, the score will be calculated based on the tas	specified ks actually
completed. 2. The total score of the two rounds of competiti	ion is the
competition score. The one with the higher score will be ranked t	first. If the
scores are the same, the one who takes less time will be ranked first.	

IX. Related Notes

1. Each player is limited to one event. Duplicate or false registration is strictly prohibited. Once discovered or reported, the player will be disqualified. Failure to participate in the competition within the competition time will be deemed as a waiver.

2. These rules are the basis for refereeing. The referee has the final say during the competition. Any matters not specified in the rules shall be decided by the referee team.