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# AI Autonomous Driving

League  
Junior/  
Challenge

Participation  
1 Person 1 Robot

Construction  
On  
Site

## 1. Game Description

AI autonomous driving is category driving between two lanes without leaving the lane using 4-wheel driving robot. It must run stable without leaving the lane using camera. Technical ability such as image processing and programming, and ability to solve while adjusting to the site situation will be considered. **This game is played face-to-face only.**

## 2. Robot

**2-1. Types of robot** 4-wheel drive travelling robot

**2-2. Construction of robot (on-site production)**

All machine part except robot controller must be produced (soldering available) on site. Size must follow the rule and available to measure by measuring machine.

**2-2-1. Standard of robot**

**2-2-1-1. Size of robot**

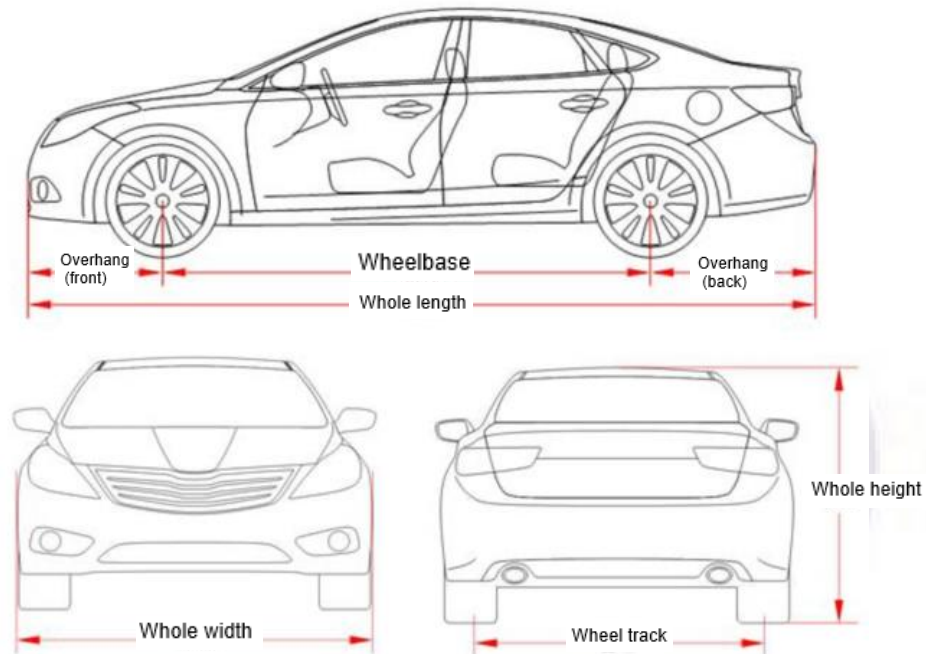
- 1) Size** Within 18cm x 20cm x 25cm (W(whole width) x L(whole length) x H)
- 2) Wheel track** The wheel track of the axis of each wheel must be at least 10cm.



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**Figure 1<Definition of each parts>**

#### **2-2-1-2. Size measurement of robot**

- 1) Self-measurement: Participant are allowed to measure their robot when producing or practicing .
- 2) Official measurement: Judge will measure the size of the robot before the game starts.
- 3) Way of measuring: Size must be measured with the robot turned on, using the measuring machine. Participant cannot object to the judgement.
- 4) Modification time: If over-sized, the participant is allowed to modify for 1 minute on the recording place of the playfield. If the participant can't modify within the limited time, they will be disqualified for the trial. **Only the modification in hardware is allowed, and the change in software is not allowed.**
- 5) If the sizes changes when going through the timer with the one measured before starting, the participant may be disqualified.

#### **2-2-2. Sensor of robot Camera**

#### **2-2-3. Motor of robot 1 servomotor and 1 DC motor**

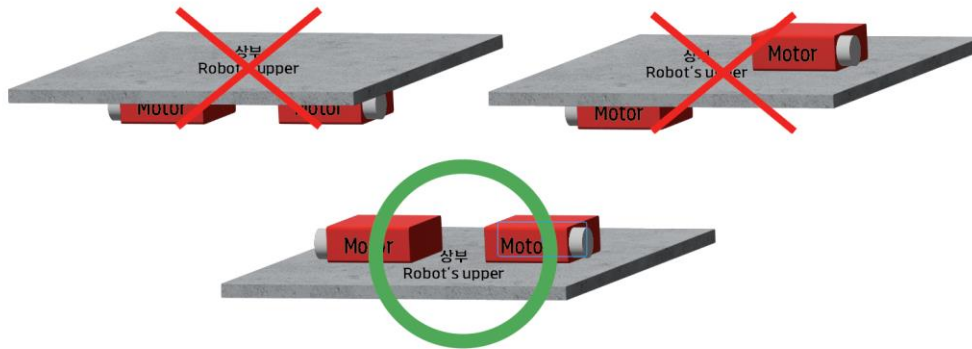
**2-2-3-1. Position of installation of motor** Motor of the robot must be installed on the body of the car.

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#### <Position of installation of the motor>

**2-2-4. Controller of robot** 1 Arduino is allowed to use, and the Arduino made using the circuit opened by Arduino is allowed. However, the Arduino that has changed from the original circuit is not allowed.

Ex) Arduino-typed board with Arduino Uno, Arduino Nano, Arduino Mega, Motor driver, Bluetooth

(i.e. motor driver, Arduino typed board with Bluetooth)

**2-2-4-1. Other controllers** Other controllers except Arduino (i.e. raspberry pie, controllers connected to the notebook) is not allowed. However, driver and shields to control camera and motors are allowed.

#### 2-2-5. Power of robot

**2-2-5-1. Composition of power** Autonomous movable independent power must be used, and combustion engine is not allowed to use.

**2-2-5-2. Capacity of power** No limitations on current and voltage level.

**2-2-6. Drive of robot** No limitation

**2-3. Programming and controlling** Robots must be programmed to move automatically, and no extra controlling is allowed except starting.

**2-4. Disconnection between motor horn and wheel** Wheel and tire doesn't need to be disconnected, and they are must not be connected in advance.

### 3. Competition site

**3-1. Official competition site** Playfield approved by International Robot Olympiad Committee.

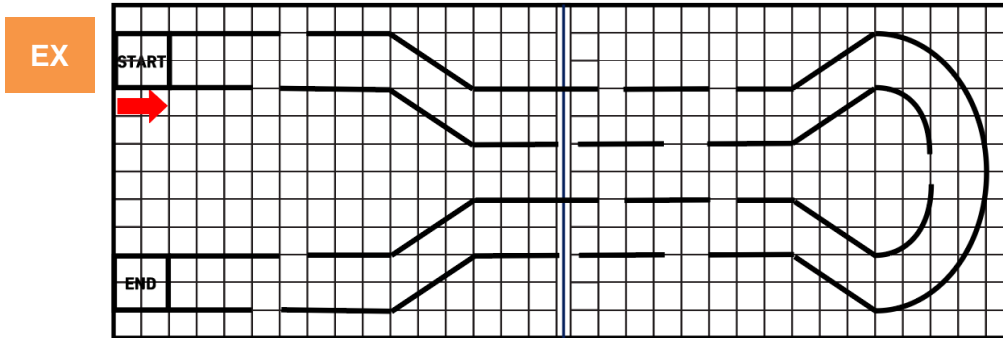
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**3-2. Size and composition** The size of playfield has to be 160cm X 120 cm (error  $\pm 10\%$ ) and is connected with more than two blocks.



<Example - Connection using a bridge, arrangement, mission, and line will be opened on the day. >

**3-2-1. Allowable range of error in the stadium** The slope under  $2^\circ$  (error  $\pm 10\%$ ) and a gap or bump under 3mm (error  $\pm 10\%$ ) is allowable.

**3-2-2. Outer wall of field** Outer wall of the playfield for camera filtering of the robot is one-colored, and is 30cm (error  $\pm 10\%$ ).

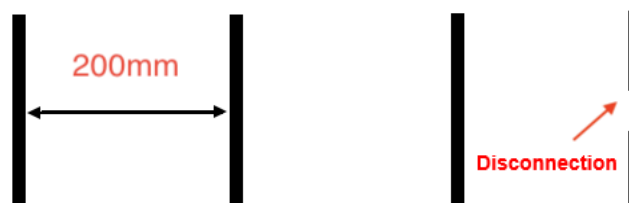
**3-3. Playfield** Covered with a matte coated pet paper, and there may be an advertisement or a logo of the host.

**3-3-1. Mission map** Checkered map with 10cm interval is used, sticked on the field with sheets and tapes. Also, distance points will be written on the checkered patterns based on starting point to record score.

**3-3-2: Line** 2cm width (error  $\pm 10\%$ ) **yellow line**.

**3-3-3. Formation of lane** Lane is constituted of two parallel lines, and the width of the lanes is 200mm (error  $\pm 10\%$ ). The lane may be curved depending on the mission.

**3-3-4. Disconnection of lane** There may be disconnection in lane to figure out the ability to detect lines.



<Example of lane width and disconnection>

**3-3-5. Timer attachment** A timer to measure time record will be attached at the starting

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point and finishing point. Exact position and way may differ based on the mission, and extra structure (bridge shaped) connected to the playfield may be used.

#### 4. Competition progress

**4-1. Way of game process** Game is processed by record, and the chance is given twice. Rectifying time will be given between each chances.

**4-2. Robot production and practicing time** At least 2 hours will be given for producing robot and practicing, and will be noticed on the day.

**4-3. Assignment of playfield** Depends on number of participants and level of difficulty.

**4-4. Production and practicing** Participant can practice on the playfield until production and practicing time noticed, but cannot before playfield assignment.

**4-5. Production and end of practicing** When time for production and practicing finishes, the participant must stop the robot and go back to their seat following staff and referee's instruction.

**4-6. 1<sup>st</sup> trial** 1<sup>st</sup> trial will start right after the production and practicing time (or after lunch).

**4-6-1. Preparing competition** All participants must bring their robots and wait in line following instruction of staff and referee.

**4-6-2. Stand by after competition** All participants should not go back to their seat, but must wait in line after their trial until all participant finishes their trial.

**4-7. Modification** Time for modification will be given to all participant after 1<sup>st</sup> trial for robot modification and practicing. Modification time will be noticed on the day.

**4-8. 2<sup>nd</sup> trial** 2<sup>nd</sup> trial will be held right after the modification.

**4-8-1. Preparing competition** All participants must bring their robots and wait in line following instruction of staff and referee.

**4-8-2. Stand by** All participant must go back to their seat after their trial.

#### 5. Match

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**5-1. Performing mission** Drive following the designated course. Each grid gives 1 point.

**5-2. Acquiring score** Score will be acquired by the distance the robot stopped. If course finishes, time record will be acquired.

**5-2-1. Point deductions** 1point will be deducted if the robot is on the line when seen above.

**5-2-2. Point unacceptable** The points earned while operating on the line will not be accepted.

**5-3. Start** Start by referee's start sign. It is considered starting as the timer starts.

**5-3-1. Not started** Announced when the robot doesn't start in 5 counts. 2 more chances will be given.

**5-3-2. False start** Announced when starting before referee's start sign. Another chance will be given.

**5-3-3. Restart** If not starting twice, or unfaithful starting once happens, chance for restart will be given. Maximum of two chances will be given for restart. (When restarting after unfaithful start, only one chance will be given for restart.)

**5-4. Arrival** Robot must arrive to the line or crossroad where timer is attached (robot must stop at the line or crossroad with the timer) and will be considered arrival as the timer stops.

**5-4-1. Destination mission** It is considered as success of destination mission when robot stops at the destination for more than 3 counts of referee.

**5-5. Limited time** The total competition time is maximum of 2 minutes.

**5-6. Mission open** Driving course of robot will be opened at the site as a mission paper.

EX

Example Mission



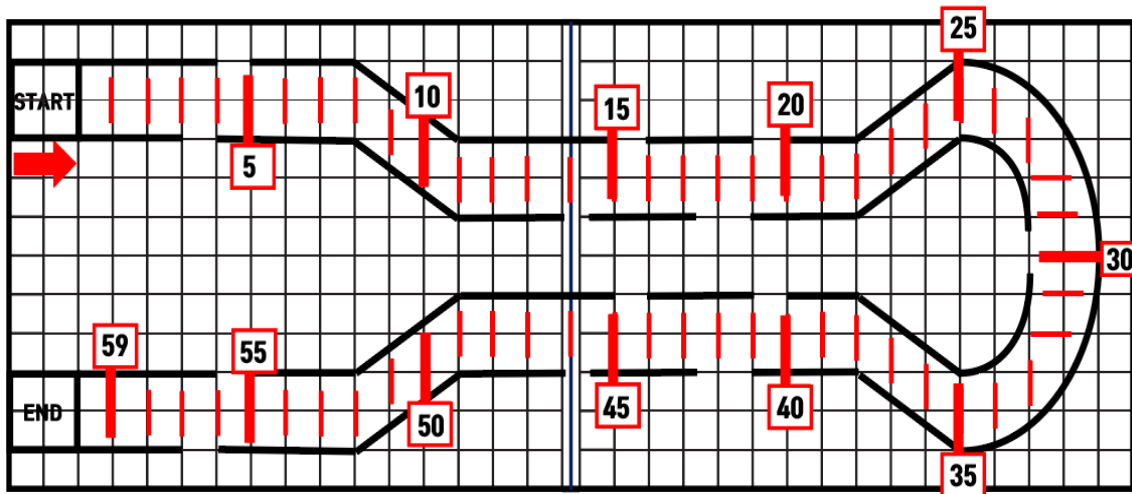
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2022 International Robot Olympiad Committee

## AI Autonomous Driving



1. 1points when robot goes through the red line.
2. Counting starts at the moment when getting out of the starting point, and counted as returning when the robot goes above the returning point.
3. If robot at least touches the red line, it is counted as earning point.

**\*This mission map is not allowed to be brought outside till the end of the competition.**

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### 5-7. Finish of competition

**5-7-1. Robot arrival** If robot goes through the finishing line before the limited time and as the timer stops, the competition finishes, and time the robot went through the line and mission points will be accepted as a record.

**5-7-2. Time over** If robot doesn't go through the finishing line within the limited time, the points when time limit finishes will be accepted as a record.

**5-7-3. Robot stop** When robot doesn't move while competition, referee gives 10 count. If the robot doesn't move while counting, robot stop will be declared, and the points when robot stops will be accepted as the record.

**5-7-4. TKO (Technical Knock Out)** When moving ordinarily is impossible, referee may declare TKO conforming to robot stop without 10 counts. (i.e. when moving the same places repetitively, when blocked by a structure or obstacle and not moving, when moving out of the playfield (falling from the playfield), etc.)

**5-7-5. Lane out** When the robot doesn't exist between the lines constituting the lane. If robot totally gets out of the lane, the game finishes, and the score till the announcement will be accepted.

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**5-8. Game over due to disqualification** When violating game rules or interrupting game, game will finish as disqualification, and the record of the trial will not be accepted.

**5-8-1. Robot touch** If the participant touches the robot without an acceptance of referee or staff, robot touch may be declared, and the trial will be disqualified.

**5-8-2. Robot modification while competition** Adding, removing, exchanging or modifying component of the robot during the competition is not allowed, and if holding extra components, tools, or batteries while waiting for purpose of modifying robot, the trial will be disqualified.

**5-8-3. Tuning sensor** When trying to tune sensor before competition, the trial will be disqualified.

**5-8-4. Defaulting assigned playfield** When playing or practicing at other's playfield except the assigned field, the participant will be disqualified.

**5-8-5. False start** When starting false for twice at the trial, the participant will be disqualified.

**5-8-6. Not started** If not starting for three times at the trial, the participant will be disqualified.

**5-9. Rematch** When accident such as blackout or trouble in timer happens, rematch may occur as a decision of referee.

**5-10. Decision of referee** Referee has authorization to control all situations and participants at all times during the competition. Judgement of the competition result is referee's own authorization and referee has authorization for the final judgement.

## 6. Competition record

**6-1. Recording items** Driving points, arrival time record, destination mission at the arrival point.

**6-2. Points per course** Points are counted after referee's finishing declaration at the point where the robot stops. The highest point is accepted among spots that the front wheel touches.

**6-3. Time record** Time counted on the timer at the starting point and finishing point will be acknowledged as the time record. (Robot stop, robot falling, TKO, lane out will not be acknowledged as time record.)

**6-4. Final record** Better record among 1<sup>st</sup> trial and 2<sup>nd</sup> trial will be considered as the final record.

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**6-5. Priority of record** Group will be divided by number of succeeded target mission, and the ranking will be decided by comparing driving record, and when arrived at the finishing point, the one who succeeded the finishing mission takes the priority.

**Course driving point > Number of deductions > Availability of time record > Availability of finishing line mission success > Comparison on time record**

**6-5-1. Priority on trial** If tied at the same trial, record of another trial will be compared.

**6-5-2. Priority when tied** Better score among 1<sup>st</sup> or 2<sup>nd</sup> trial will be acknowledged, but when tied, the participant with better score on the 1<sup>st</sup> trial takes the priority.



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