

REVISION:

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2022.01.24	V1.0	FIRST RELEASE.

# RoboMaster North America Online Challenge-Intelligent Transportation

## 1. Introduction

As we all know, autonomous driving is the product of the deep integration of the automotive industry with next-generation information technologies such as artificial intelligence, the Internet of Things, and high-performance computing. Among the many types of vehicles for autonomous driving applications, buses are currently the most applicable vehicles due to their fixed routes and concentrated work tasks. As the most representative public transportation, the integration of autonomous driving will have a profound impact on them. This youth online challenge activity uses virtual simulation robots to simulate the public transportation system (roads, traffic lights, bus stop signs, etc.) in the city, allowing students to participate in the experience of the operation of autonomous driving, and expand students' cognition of cutting-edge autonomous driving issues. Contestants participating in the activity need to use coding knowledge to use various technologies such as target detection, route recognition, and automatic control based on visual images to complete the automatic driving task of the bus.

Graphical programming language is used in this activity, and the DJI Education Hub Platform Desktop version (Please download at <https://edu.dji.com>) is used to carry out the activity. It is recommended to familiarize yourself with DJI Education Hub Desktop and Robotic Simulator before the activity.

## 2. Robot and Participants Lineup

### a. Robot Lineup

The robot used in this activity is the S1/EP robot in the DJI Robotic Simulator. The DJI Robotic Simulator provides the complete simulated robot to the players, and the players do not need the physical robot for the challenge.

**Table 2-1 Robot Lineup**

Robot Type	Quantity
S1/EP (Simulator)	1

## b. Participants

This challenge project is an individual project, which consists of a participating player and an instructor (optional) to form a team.

During the challenge, the contestants are to write programs to make the S1/EP robot automatically complete a series of tasks. After completing the tasks, the system will automatically calculate the final score of the contestants according to the running process of the robot. (Note: Players are allowed to manually control and run the robot after the event starts, and the system will not calculate the score when players manually control the robot.)

## 3. Specifications

(1) Contestants need to prepare a PC that can be connected to the Internet and install DJI Education Hub Desktop version and DJI Robotic Simulator for this event.

(2) This activity requires contestant to practice and compete on DJI Education Platform using DJI Education Hub Desktop version and DJI Robotic Simulator (<https://edu.dji.com>).

(3) This challenge requires the contestants to use graphical programming to operate and control the virtual robot in Warrior form.

(4) This challenge has a minimum performance requirements for computers in order to minimize impact of poor computer performance on the results of the activity. The minimum computer requirements are shown in Table 3-1 and Table 3-2.

**Table 3-1 Laptop Minimum Requirements**

Type	Specifications
CPU	Intel® Core™ i5 7200U (7 <sup>th</sup> Generation 3.1GHz 2 Core 4 Threads) or above
Memory	4GB and above
Graphic Card	Intel® HD Graphics 620
Operating System	Windows10 64bit or Windows7 64bit

**Table 3-2 Desktop Minimum Requirements**

Type	Specifications
CPU	Intel® Core i3 4360 (4 <sup>th</sup> Generation 3.7GHz 2 core 4 threads) and above

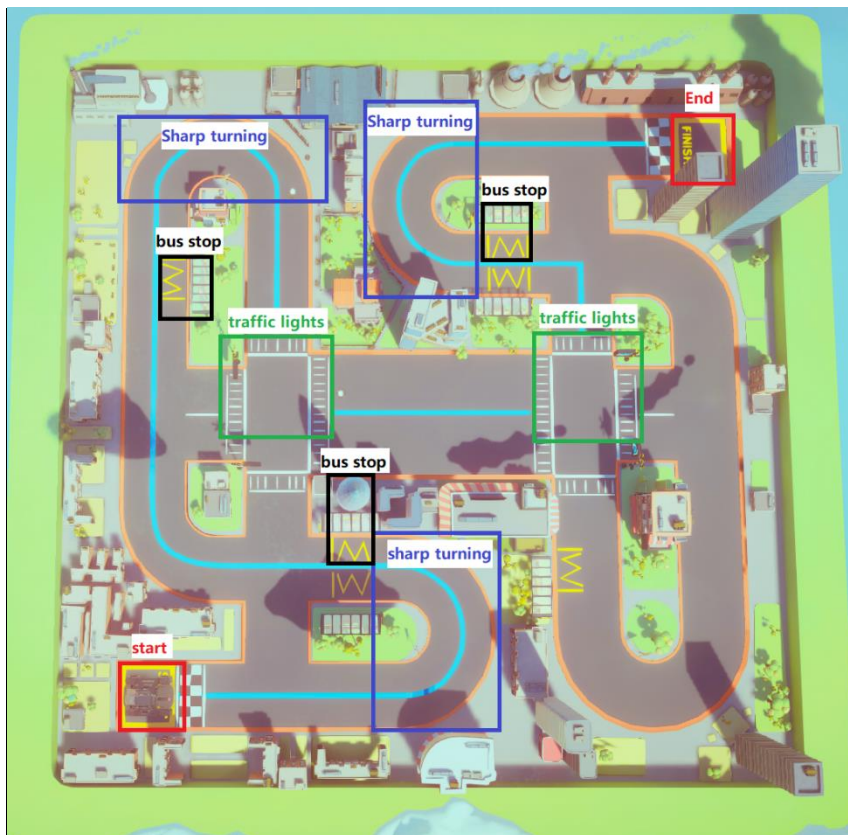
Memory	4GB and above
Graphic Card	Intel® HD Graphics 4600
Operating System	Windows10 64bit or Windows7 64bit

## 4. Activity Venue

### a. Activity Map

The smart transportation activity venue is a rectangular area with a side length of 4 meters x 4.5 meters. The site mainly includes roadside elements such as roads, sharp turning sections, bus stops, traffic lights, starting stations, ending stations, and urban buildings. As shown in Figure 4-1 below, where:

- 3 sharp turnings;
- 3 bus stops;
- 2 traffic lights;
- 1 start and 1 ending point; (The robot starts at the start point which is at bottom left of the map and ends at endpoint point which is at top right of the map) ;



**Figure 4-1 Top view of the Challenge Scenario**

## b. Sharp Turn

Figure 4-2 below is an enlarged detailed view of the sharp turn section in the Activity venue. Each sharp turn section has an intersection sign. The sharp turn angle is 180 degrees, and the entire map has a total of 3 sharp turn sections. At a sharp turning intersection, the contestant needs to make the front and rear lights of the robot equipment stay on in red and keep sounding the alarm. (Note: The alarm sound is represented by the note "1C" provided in the platform).



Figure 4-2 Schematic diagram of the sharp turn area

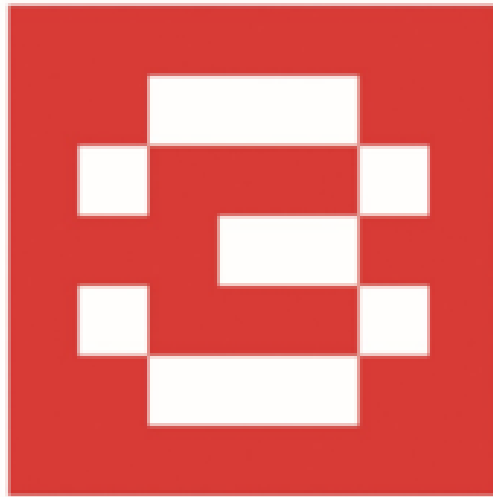
## c. Bus Station

Figure 4-3 below is an enlarged view of a bus stop in the Activity venue. A bus stop consists of a parking area and a bus stop sign. The parking area is represented by a yellow line (the M-shaped mark in Figure 4-3 below). At the bus stop, the contestant needs to make the robot stop in the parking area of the bus stop, and complete the pick-up and drop-off of the passengers at the stop.



**Figure 4-3 Schematic diagram of bus stop area**

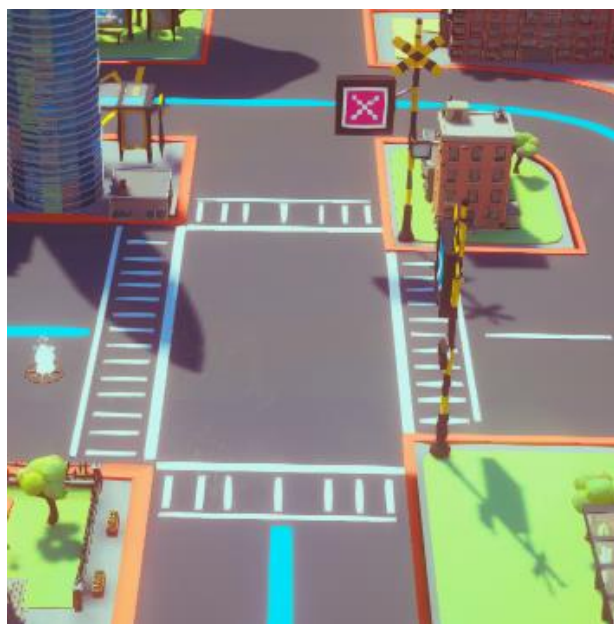
The stop sign is a number marker (Figure 4-4 below), and the number on the marker represents the number of people getting on and off at this station; there are 3 bus stops in the entire map.



**Figure 4-4 Schematic diagram of bus stop**

**d. Traffic light intersection**

Figure 4-5 below is an enlarged view of the traffic light intersection in the Activity venue. Traffic lights appear at two intersections in the map, where the red marker "X" represents the red light (impassable); the blue marker "A" represents the green light (passable).



**Figure 4-5 Schematic diagram of a traffic light intersection**

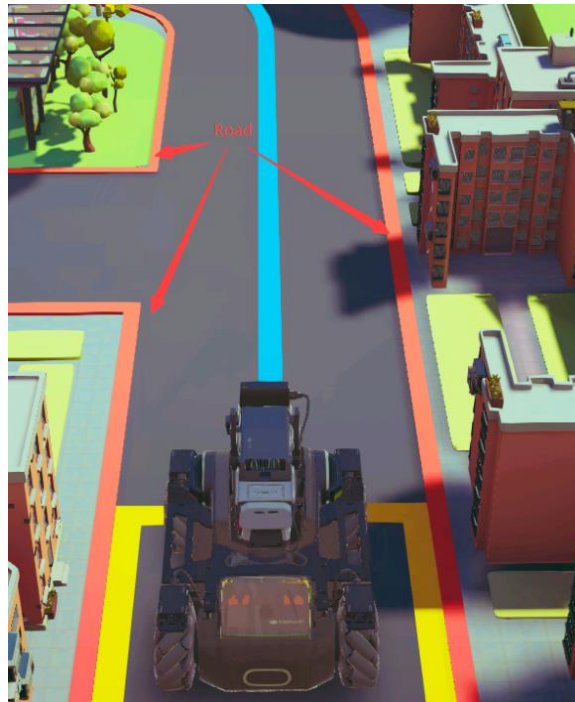
At the intersection of traffic lights, the players need to control the movement of the robot correctly according to the traffic rules. The players need to be careful not to run red lights when the marker shows red marker “X”.



**Figure 4-6 Red Light Diagram**

### **(5) Road**

Figure 4-7 below is an enlarged view of the road in the Activity venue: including the orange curb, the blue line in the middle of the road, and the black road surface. In the entire activity venue, players need to regulate their driving and do not allow the robot to press on the orange curb on the side of the road. At the same time, players can use the blue lines to guide the robot driving.



**Figure 4-7 Road**

## **5. Missions**

Tasks in this activity are divided into main tasks and subtasks. The main task requires the contestants to write a program to make the robot traverse the entire city road from the starting point to the diagonally opposite end point. The subtasks are divided into four tasks: sharp turn task, bus stop task, traffic light task and road task.

### **a. Sharp Turn Task**

At a sharp turning intersection, the contestant should keep the red lights on the front and rear of the robot's body on, and keep sounding the alarm. The Sharp Turn task details are as follows:

- In the semi-circle entering and leaving the sharp turn, keep the red lights on the front and rear of the robot body always on.
- In the semicircle entering and exiting the sharp turn, keep the robot playing the note "1C" sound.

### **b. Bus Station Task**

At the bus stop, the contestant should make the robot park in the parking area of the bus stop, and complete the pick-up and drop-off of passengers at the stop. The Bus Station task details are as follows:

- At the bus stop, make the robot park in the parking area, and the parking time is not less than 5s.



- At the bus stop, make the robot play the note "2C" according to the number of people getting on and off the bus, and use the number on the bus stop digital marker to determine the number of people getting on and off; (the frequency of audio playback should not exceed 1Hz) Note: The number of people getting on and off at each bus stop is random, not a fixed number (can be either 1 or 2 or 3 or 4).
- Figure 4-4 shows the schematic diagram of the bus stop digital marker.

### **c. Traffic light tasks**

At the intersection of traffic lights, players need to be careful not to run red lights, and they need to control the movement of the robot correctly according to the traffic rules. The details of traffic light tasks are as follows:

- When there is a red light (red marker "X") at the traffic light intersection, the vehicle should stop in front of the pedestrian crossing. When there is a green light at the traffic light intersection, the vehicle can pass the traffic light intersection normally.
- Figure 4-6 above shows a schematic diagram of a red light at a traffic light intersection.

### **d. Road Task**

During the whole activity, the contestants need to regulate the driving and movement of the robot. The robot must not press on the orange curb on the side of the road. The contestants can use the blue lines to guide the robot driving.

## **6. Scoring Details**

### **a. Judging Rules**

- This activity is completely automated by coding to complete all the scoring. No manual control.
- During the duration of this activity, players can use PC to log in to the DJI Education platform using DJI Education Hub Desktop Version at any time to participate in this activity. There is no limit to the number of logins and no limit to the number of coding, and no limit to the number of submissions.
- During the normal stage of this activity, after the player has programmed the robot to leave the starting point, the score calculation and detection will be carried out. When the player resets the scene or the robot reaches the end point, the score calculation and detection of this round will stop.

- The organizing committee of this event has the right to interpret the rules of the event. When there is a behavior that obviously affects fairness, the organizing committee has the right to re-correct the results of the competition to ensure the fairness of the event.

## b. Scores

The tasks of this activity are divided into main task and subtasks. The score has the main task score and the subtask score. The score details are as follows:

**Table 6-1 Score Details**

No	Tasks	Description	Score
1	Main Task	Refer to 5.	Score based on time taken to go from start to finish: 1. If you do not pass the finish line, no points will be deducted and no points will be added. 2. When passing the finish line, if it does not exceed 3 minutes, add 2 points for every 1 second earlier.
2	Sub Task 1: Sharp Turn Task	Refer to 5a. Sharp Turn Task	At sharp turn: 1. The red light on the front and rear of the fuselage is always on, add 20 points. 2. Sound alarm, add 25 points.
3	Sub Task 2: Bus Stop Task	Refer to 5b. Bus Stop Task.	At bus stop: 1. Parking in the parking area, plus 20 points. 2. Parking in the parking area for more than 5 seconds, add 15 points. 3. The correct number of people broadcast while in the parking area, add 20 points.
4	Sub Task 3: Traffic Light	Refer to 5c. Traffic Light Task.	At traffic light: 1. If bus run a red light, 35 points will be deducted. 2. If pass intersection normally according to traffic rules, no points will be deducted and no points will be added.
5	Sub Task 4: Road	Refer to 5d.	1. Press the curb of the road once, deduct 1 point per press. 2. In the entire field, continuously pressing the curb of the road will deduct the points of continuous pressing (1 point deducted every two seconds).

This activity is divided into 2 categories: Student and Mentor. The tasks included in each group are as follows in Table 6-2.

**Table 6-2 Task list for each group**

No	Group	Task
1	Student	Main Task, Sharp Turn subtask, Bus Stop subtask, Road subtask, Traffic light subtask
2	Mentor	Main Task, Sharp Turn subtask, Bus Stop subtask, Road subtask, Traffic light subtask

**c. Ranking**

After each player runs the program and gets a score, the player can submit the score to the system for ranking. The system will use the highest score submitted by the player during the entire event as the final score and use that score for ranking. The priority of ranking determination is as follows:

- Activity score.
- When the activity scores are the same, rank by time taken.

**7. Precautions**

- During the activity or review period, all players are prohibited from influencing other players' activities or ratings in any way.
- Failure to participate in this event during the event time will be deemed a forfeit.
- During the event, any matters not stated in the rules will be decided by the event organizing committee.
- These rules are the basis for the implementation of adjudication work. In the process of activities involving cheating, acting on behalf of others, etc. that affect the fairness and justice of the activities or cause disputes, the organizing committee has the final ruling power.