2021 International Competition of Autonomous Running Robots
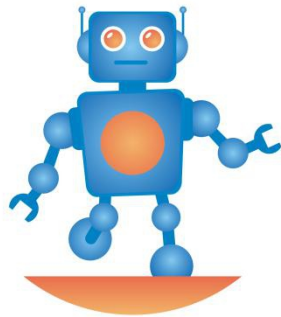
Running-Robot 2021

Performance Competition-Rescue Competition

Rules and Arrangements

V1.0

Contents

Chapter 1: Competition Rules

1. Participating teams and participating robots

Those who are willing to participate in the grid individual event should organize their own teams and register with the competition organizing committee to participate in the competition.

Each participating team should have no more than 6 people (5 team members and 1 instructor).

The robots participating in the grid individual event must be robots that can perform upright walking and other action tasks in a complex environment, according to specific environmental conditions, autonomously and intelligently (that is, taking actions without human intervention). "Robot walking upright" refers to the robot simulating human beings, using only the soles of the feet (without other parts) to touch the ground and support the entire body to walk and move on the track.

Participating robots can be small-footed robot platforms and development boards provided by the competition organizing committee or submitted to the competition organizing committee for approval.

The built-in small-footed robot platform must meet the following conditions: 1. The height of the robot must not exceed 45cm; 2. The robot must be a biped humanoid robot, not a wheeled or other form of robot; 3.

The robot needs to report to the competition organizing committee for preparation, confirmation and approval.

2. Competition scenes and tasks

Robot rescue mission is one of many application scenarios of robots. In the event of some disasters, robots can replace humans in entering complex post-disaster terrain for early detection and later rescue missions.

The scene of this competition will simulate a complex urban terrain, requiring the robot to search for and rescue targets after entering the track, avoid obstacles on the way, and leave the track with the rescue target.

3. End conditions of each round of competition and calculation of points

In the game, when one of the following conditions is met, the current round of the game is over:

- After the robot reaches the end.

- When the actual time reaches 10min.

- Other situations where the game cannot continue. (If the robot has a temporary failure that cannot be repaired)

The results of each round of competition are calculated in two dimensions: primary and secondary.

- Primary dimension: score

The total score of each group is determined by the completion of the task. The score is the most important evaluation index, and the full score is 100 points. The score will be composed of the following parts:

1. Get off the track (full score 20 points)

    a) The robot successfully walked upright within 10 minutes, and left the track after passing the finish line, earning 20 points.

    b) If the task mentioned in para (a) is not completed, 0 points will be awarded

2. Take the rescue target or interference target away from the building (full score 30 points)

    a) If at the end of the game, the robot takes the rescue target away from the building where it was originally located, 30 points will be awarded. The removal means that the target is out of physical contact with the building.

    b) At the end of the game, if the robot takes the interference target away from the building where it was originally located, 10 points will be awarded. The removal means that the target is out of physical contact with the building.

c) If no target is taken away from the original building at the end of the game, 0 points will be awarded.

d) If multiple targets are taken away from the building, the score will be calculated only once, and the one with the highest score will be calculated.

3. Bring the target object to the end point (full score is 50 points)

a) If the robot successfully walks upright within the 10 min time limit, and when leaving the track after passing the finish line, while carrying the target object (whether it is a rescue target or an interference target), it will score 50 points. Carrying is defined as physical contact between the object and the robot, and both of them are outside the finish line.

b) If the task mentioned in above para (a) is not completed, it will get 0 points.

- Secondary dimension: time

The final game time is the end time minus the start time. Among them, the start time is the time when the referee announces the start of the game, and the end time is calculated separately for each group when the following situations occur:

a) When the robot walks upright and exits the track after passing the finish line. The definition of the robot leaving the track is that the robot does not have any physical contact with the track body.

b) When the actual time reaches 10 min.

Time unit is accurate to the second.

This competition requires robots to be better and faster to complete the required rescue mission. Among them, the score will be the most important evaluation indicator, and the team with the highest score will win. Secondly, among all robots with the same total score, the one with the shorter game time wins. Once again, if the total score and the time spent in the game are the same, the team that takes the shorter time to complete the subtask with a higher percentage of points wins.

Chapter 2: Match Schedule

1. Order of play

Participants decide the order of the game by drawing lots before entering the field.

2. Pre-match preparation

First use the program to randomly generate the track. The generation process ensures that the urban distances of the optimal path for each participating group to reach the correct goal and reach the end point are equal. Random factors include: (1) starting point position; (2) target object type; (3) The location of the target object and the interfering object; (4) The orientation of all "buildings"; (5) The location of obstacles; (6) End position.

- Each participating team, according to its own schedule, enters the preparation area in advance before the start of the competition, completes all preparations such as robot debugging, confirmation of the only (robot) "operator", and reports "ready" to the referee.

- After receiving the "Ready" report, the referee will inspect the participating teams and participating robots to confirm that the participating teams are "Ready". If the requirements are not met, the referee has the right to request the team to prepare again.

- 10 minutes before the start of the game, if the referee cannot confirm that it is "ready", the game will be withdrawn.

3. Enter the game

- The "ready" team will enter the competition area with the robot. The operator places the robot at the starting point and signals that the referee is ready.

- The referee announced the "start of the game" and activated the timing device at the same time. The operator can start the robot after announcing the start of the competition. If the operator starts the robot first, he will be warned by the referee; if he starts the robot again, he will be disqualified from the competition.

4. In the game

- From the start to the end of the game, only the operator can enter the field and operate the robot according to regulations. During the game, no one else can operate the robot in any way. If you violate it, you will be disqualified.

- The operator is responsible for ensuring that all his operations comply with the rules of the game. If any operation does not comply with the rules of the competition, it will be disqualified from the competition.

5. Competition is over

- The referee declared "the game is over" according to the rules and stopped the timing device. At this time, the timing device displays the total time to complete.

- After the competition, the referee is responsible for calculating the score and filling out the score report according to the rules. The participating team confirms its own score report, and the participating team takes its own robot and leaves.

6. Tournament system description

Each team has two chances to compete and the best result among them will be taken as the final result. After the competition, all teams will be ranked according to their final results.

7. Other instructions

- If there are any changes to the competition rules, the organizing committee will notify the participating teams as soon as possible.

- During the game, the referee has the right to make a ruling. If you have any objections, please raise it to the chief referee.

- The organizing committee is responsible for finalizing all objections and resolving all disputes.

Attachment - Game Scene

1. Competition scene summary

The playing field is a 9 x 9 square field. The size of each square is 30cm x 30cm (as shown in Figure 1). As shown in the picture, there are 9 "buildings" in the gray square, that is, there may be places to be rescued. Barricades will be randomly distributed in the blank space in the middle of the track. The type and number of barricades are fixed, but the location is uncertain. The start and end points will be randomly generated at any grid point on the periphery of the track (the figure is only an example). Among them, the starting point and the common edge of the track are called the starting line, and the end point and the common edge of the track are called the finish line.
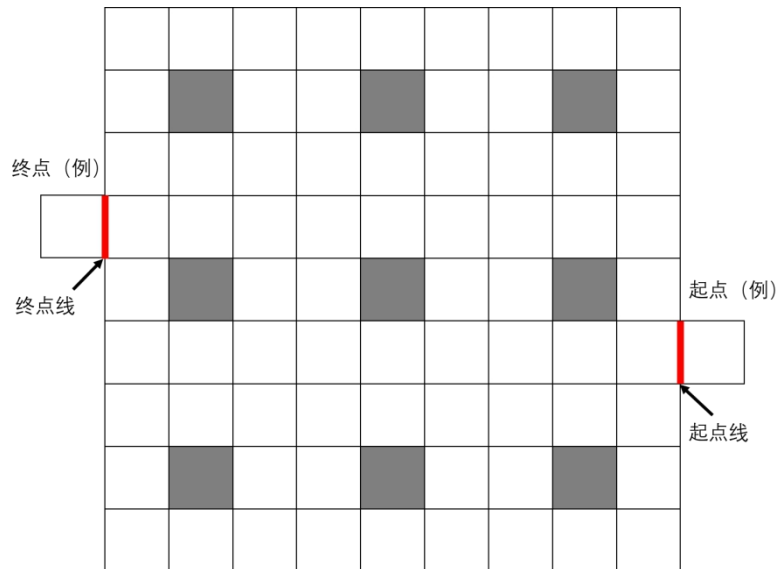

Figure 1: Overall indication of the race track

The main surface of the track is white. There is a circle of fence

advertisements around the track, the fence is about 50 cm from the track boundary, and there is a LOGO; there are ground advertisements on the center of the track.

The static friction coefficient of the robot feet is about 0.1 (each team can add anti-slip materials on the robot feet as needed).

2. Task description

The robot needs to enter a grid maze as shown in Figure 1 to search for the rescue target, avoid obstacles and leave the track with the rescue target. The searched target will be placed on the starting point sign in the form of a picture. The robot needs to enter the city, plan a route, avoid various obstacles, accurately find the corresponding target in several buildings and take it out of the site according to the pictures on the sign.

3. Introduction to the elements in the venue

3.1 Starting point sign

The billboard will randomly replace the pictures of one of the 10 pre-determined animal species. The pictures are randomly selected from the corresponding gallery. The height of the center of the billboard picture is 30 cm (H), and the size of the billboard is 20 (A) cm * 15 (B) cm. The schematic diagram is shown in Figure 2.
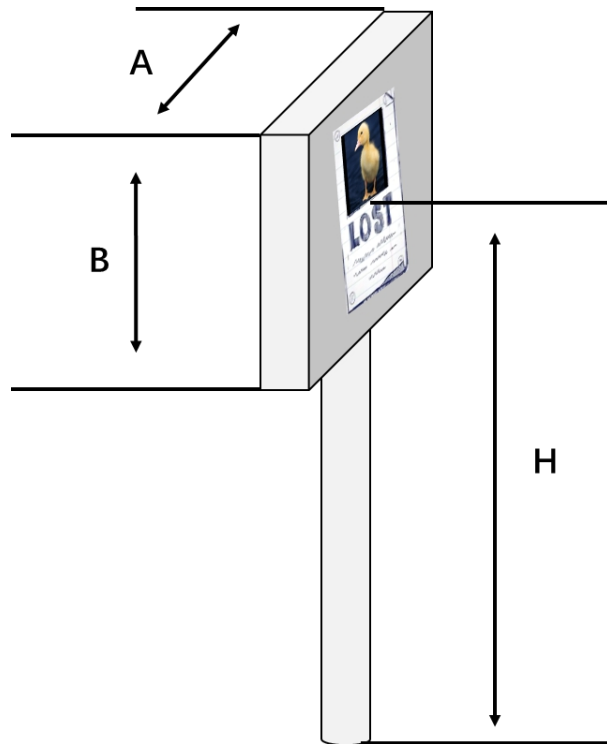
Figure 2: Starting point sign

3.2 Rescue goal

There are a number of small rubber toys with a size not exceeding 7 x 7 cm in the venue. Among them, it is divided into rescue targets and interfering objects. It is defined as follows:

Rescue target: the same kind of target as shown on the billboard in 3.1.

Interfering object: An object of a different kind from the rescue target. It may be other small rubber toys, or it may be small balls or other geometric objects of similar color and size.

Among them, the type of rescue target in the track is one, and the number is one. There are no more than 3 types of interfering objects

(including 3 types), and the number is 5.

3.3 "Building"

The venue is composed of a number of cylinders made of plexiglass material, simulating buildings in the track. The diameter of the cylinder is 30 cm (W) and the height is 20 cm. There are three-sided partitions on it to block the field of vision outside the front. The partitions are 24 cm long, 11.53 cm wide, and 10.5 cm high.

Randomly place or not place the rescue targets or interfering objects described in 3.2 in the central area of the partition. For a schematic diagram, see Figure 3.
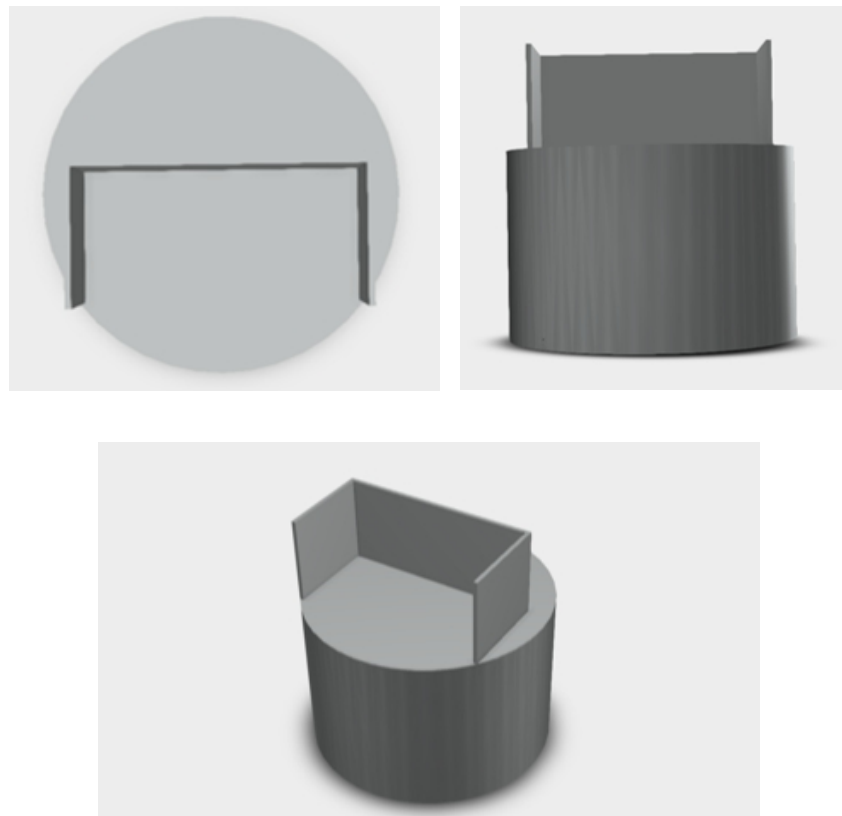

Figure 3: Building sketch

3.4 Road barriers

Road obstacles consist of a variety of randomly generated obstacles. The robot can decide its own strategy to pass obstacles or go around obstacles. All obstacles will not affect the score.

3.4.1 Landmine

Obstacle description: Several cylindrical mines are randomly placed on the road; the mines will be completely fixed on the track. The distance between the two centers of the mine (W) ≥ 10 cm. The mine has a diameter (D) of 2 cm and a height (H) of 10 cm. See Figure 4.
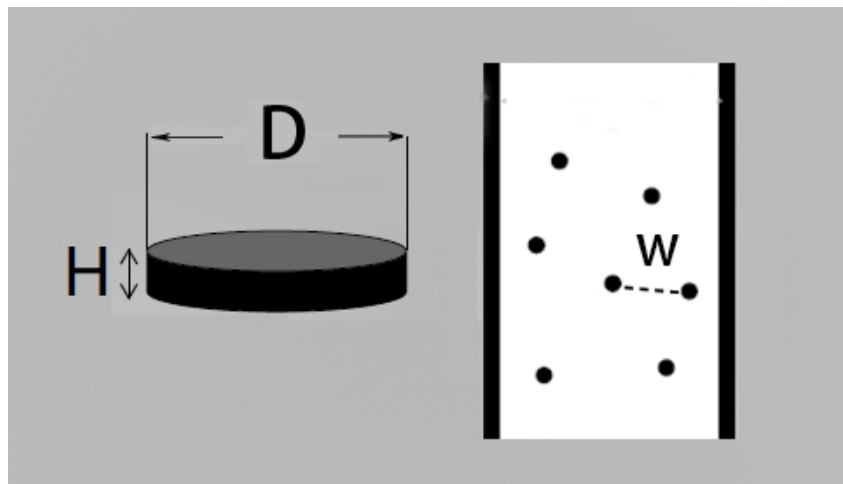

Figure 4: Minefield section

3.4.2 Section across the baffle

Obstacle description: The baffle will span the center of the grid. The length (L) is 30cm, the height (H) is 10cm, and the thickness (T) is 4cm. See Figure 5.
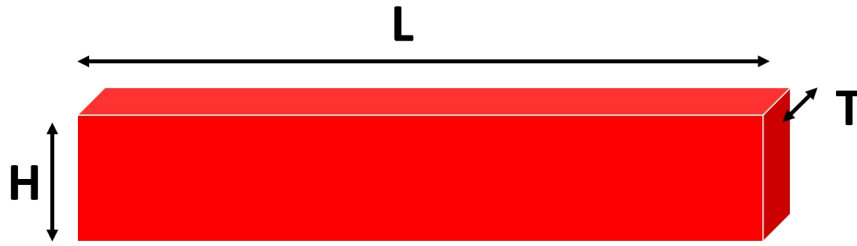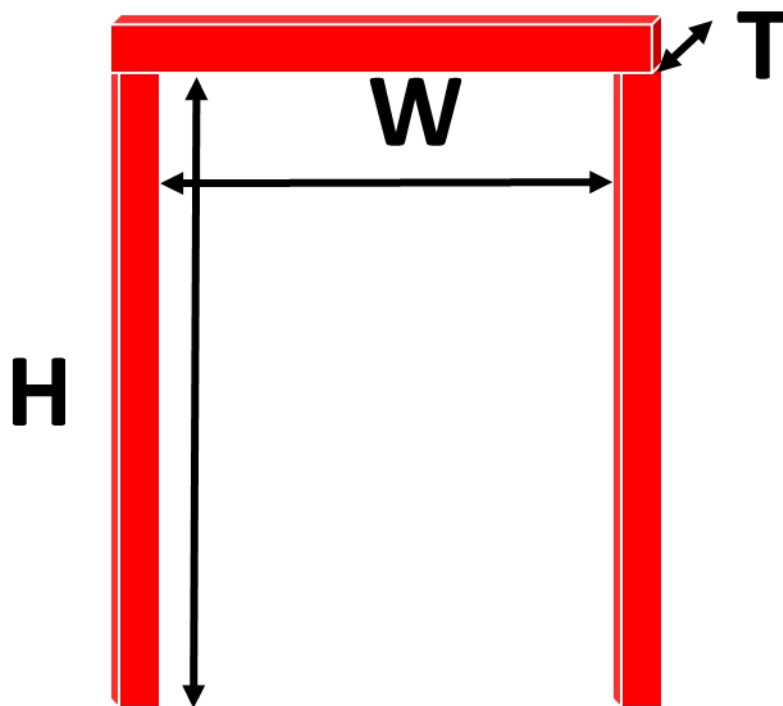
Figure 5: Section across the baffle

3.4.3 Crossing the door section

Road surface conditions: door inner height (H) 62 cm, inner width (W) 30 cm, door frame width (T) 3 cm. The distance between the door frame

and the edge of the track is random.

Figure 6: Barrier gate

3.4.4 Roads blocked

Blocking is performed on the left or right half of the road, requiring the robot to pass through a narrower road. That is equivalent to the road width at random grid points will become 15cm.

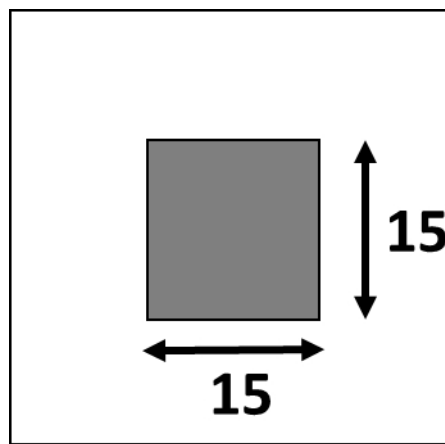### 3.4.5 Pothole in the road

There will be a 15cm x 15cm pothole in the center of the road.

Figure 7: Schematic diagram of the pothole