LAND SEARCH RESCUE

İTÜ ROBOT OLİMPİATLARI 26

OTOKON

Search and Rescue Category Rules

Competition De nition

1. The Search and Rescue category is a simulation of tasks performed by robots in hazardous post-disaster environments such as houses, apartments, or factories. These tasks represent the adaptation of stair climbing, navigating through challenging terrain conditions, overcoming obstacles, closing valves, and victim detection using vision/temperature sensors into the competition environment.

Task De nition

1. After the robot prepared by the competitor team is placed at the starting point of the track, the robot must reach the start of the stairs, climb the stairs, perform various tasks after reaching the top, be brought to the descent point by the operator, descend the stairs, and reach the nish line.

Success Criteria

1. In this category, the success criteria are;
   a) Performing stair ascents and descents,
   b) Detecting the rst signboard at the top area (type of sign and text on it),
   c) And it is required to perform at least one search and rescue task (correctly detecting the number of boxes in the emergency zone, closing the gas valve, or victim detection).

Robot Features

1. Each competing team will participate with one robot.
2. The robot dimensions must not exceed 35 cm width, 35 cm length, and 30 cm height.
3. There are no restrictions on the robot's weight.
4. Robots cannot use any system that could damage the track. Robots that damage the track will be disqualied.

5. Competitors must bring their ground control stations along with their robots to the competition track. The ground control station is a computer capable of bidirectional communication with the robot and belongs to the competitor. It should allow monitoring the robot's camera and controlling the robot via an interface, terminal, and joystick.

6. The robot must have a manipulator (robot arm or another design solution capable of completing this task) to be able to close the valve.

Track Features

1. The height of all steps on the stairs is 10 cm.
2. There is a 40 mm thick gravel ground on the road leading to the stairs.
3. The gravel on the road to the stairs is not xed.
4. There are a total of 8 steps on the track: 4 steps for ascending and 4 for descending.
5. There is a rectangular wooden obstacle made of hard wood material located in the upper task zone. The height of the wooden obstacle is 5 cm, and its width is 10 cm.
6. The wooden obstacle is xed to the competition track surface. It is not possible for the robot to push or drag the obstacle; the robot is required to climb over the obstacle to pass.
7. The length and width of the steps are 50 cm.
8. There is no gap between the steps.
9. Responsibility will not be accepted if the robot falls o the track from any step.
10. The area marked by a rectangular frame on the road to the right stair (ascending) is the robot starting area. The length and width are 42 cm.
11. The horizontal line on the ground path of the descent stairs is the nish line.
12. The area reached after the last step of the ascent stairs is called the task area.
13. The task area is 80 cm wide and 180 cm long.
14. The distance from the center of the valve to the oor of the task area is 18 cm.

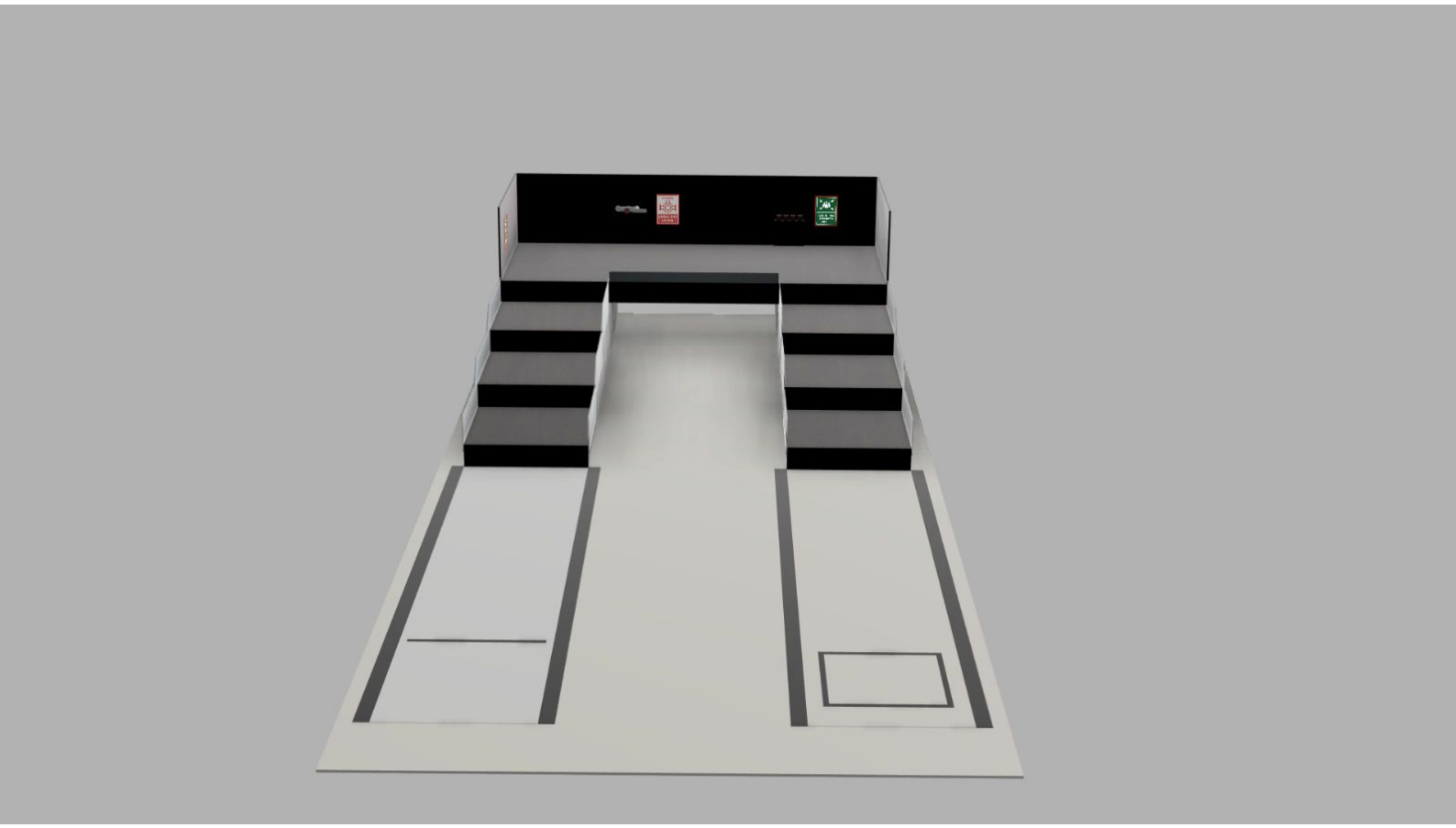

Figure 1: Overall view of the track

Figure 2: Close-up view of the task area

Figure 3: Measured view of the task area

Figure 4: Close-up photo of the valve and boxes

Figure 5: Measured photo of the valve and boxes

Figure 6: Position of the heat source

Features of the Signs to be Read

1. The width of the signs is 11 cm and the height is 15 cm.

2. There are 3 di erent signs on the track, and their designs are as follows.

3. The sign on the far left below (1st sign) is located next to the alarm button and is named "Emergency Assembly Area Sign".

4. The sign in the middle below (2nd sign) is located next to the alarm button and is named "Natural Gas Valve Sign".

5. The sign on the far right below (3rd sign) is located next to the alarm button and is named "Caution Stairs Descent Sign".

6. A heat source simulating the heat of a live victim will be located on the right side of the 'Dikkat Merdiven nisi' sign on the track (in the area between the sign and the wall corner). The position of the heat source is visualized in Figure 6.

Natural Gas Valve Features

1. A rotating piece has been added at the center of rotation of the valve to facilitate the turning process from the perspective of the manipulator.

2. To close the valve, the lever, which is parallel to the ground, must be rotated 90 degrees clockwise.

3. The valve and its dimensions are shown in the images below.

Emergency Area Features

1. The size of the boxes to be counted is 3 cm x 3 cm x 6 cm.
2. The height of the platform where the boxes are placed is 15 cm.
3. The colors of the boxes are given below with their RAL codes:
   - Red: RAL 3001
   - Blue: RAL 5010
   - Green: RAL 6029
   - Yellow: RAL 1023
4. The number and color of the boxes will be randomly selected and will be di erent for each competitor.

Competition

1. Each robot competes one at a time.
2. The competition duration for each robot cannot exceed 10 minutes.
3. After placing the robot at the starting point, the competitor starts the robot upon the referee's "start" command, and the timer begins.
4. The robot is remotely controlled to reach the start of the ascent stairs.
5. The robot is remotely controlled to climb the stairs.
6. After reaching the task area, the robot must detect the "Emergency Assembly Area" sign located in front of it.
7. The detection must be con rmed by showing the camera images on the ground control station screen, indicating the detection and type of the sign, to the referees.
8. The robot must detect the number of boxes placed on the platform.
9. The robot must display the detected number on the ground control station screen.
10. After referee approval, the robot must detect the "Natural Gas Valve" sign. The robot must show the detected sign and its type to the referees on the ground control station screen.
11. After the referees con rm the detection, the robot must be guided by the operator to the natural gas valve and close it.
12. In the open state, the valve lever is directed towards the ascent stairs side, parallel to the ground. The robot must rotate the valve 90 degrees clockwise to bring it into a vertical (upright) position.
13. After closing the valve, the robot must proceed towards the exit zone, rst detect the heat source (victim) to the right of the 'Dikkat Merdiven nisi' sign, and report it to the referees.
14. After heat detection, it is required to detect the 'Dikkat Merdiven nisi' sign. It must detect the sign within the camera footage on the ground control station screen and show its type to the referees.
15. The robot must descend to the ground through the descent stairs.
16. Finally, after descending, the robot must completely cross the nish line.
17. Once fully crossed, the timer stops and the competition is completed.
18. The desired output is given as an example in the link.

Scoring

1. Scoring will begin after the robot is removed from the track.
2. The robot with the highest score will rank higher.
3. In case of a tie, the robot with the shorter time will rank higher.
4. Advancing from the starting point to the stairs without leaving the path is worth +10 points.
5. Advancing from the bottom of the descent stairs to the nish line without leaving the path is worth +10 points.
6. Climbing all the steps of a staircase is worth +30 points.
7. Descending all the steps of a staircase is worth +30 points.
8. Successfully overcoming the wooden obstacle in the task zone and passing to the other side is evaluated as +10 points.
9. To validate the detected signs, the recognized sign name and probability must appear on the camera images on the ground control station screen and be shown to the referee. Only then will the points be awarded.
10. Correctly detecting and distinguishing the sign using image processing techniques is worth +40 points.
11. Correctly detecting and displaying the **total number of boxes** is worth +40 points.
12. Correctly detecting and displaying the **number of boxes of each color** is worth +20 points. If all colors are not detected and displayed, no points will be awarded.
13. Rotating the valve is worth +40 points.
14. Detecting and reporting the heat source (victim) is evaluated as +40 points.