İTÜROBOT 2023

15. INTERNATIONAL ITU ROBOT OLYMPICS

Scenario: Search and Rescue Category Rules

Istanbul Technical University Robot Olympics 2023

Scenario: Search and Rescue Category Rules

Competition Description:

1) Scenario: The Search and Rescue category is a competition that involves robots performing search and rescue tasks such as climbing stairs, closing valves, and various detections with a camera, in environments such as houses, apartments, or factories.

Task Description:

2) After the robot, prepared by the competing team, is placed at the starting point on the track, it must autonomously reach the beginning of the stairs, climb the stairs autonomously, read the first sign at the top, switch to remote (manual) control mode, perform various tasks, be brought to the descent point by an operator, switched back to autonomous mode, descend the stairs and reach the finish line.

Success Criteria:

3) In this category, the success criteria are:
    - The robot autonomously completing the path from the starting point to the stairs.
    - The ascent or descent of the stairs being performed autonomously by the robot.
    - The robot detecting the first sign at the top (sign type and writing on it).
    - The robot must perform at least one search and rescue task (pressing an emergency button, closing a gas valve, etc.).

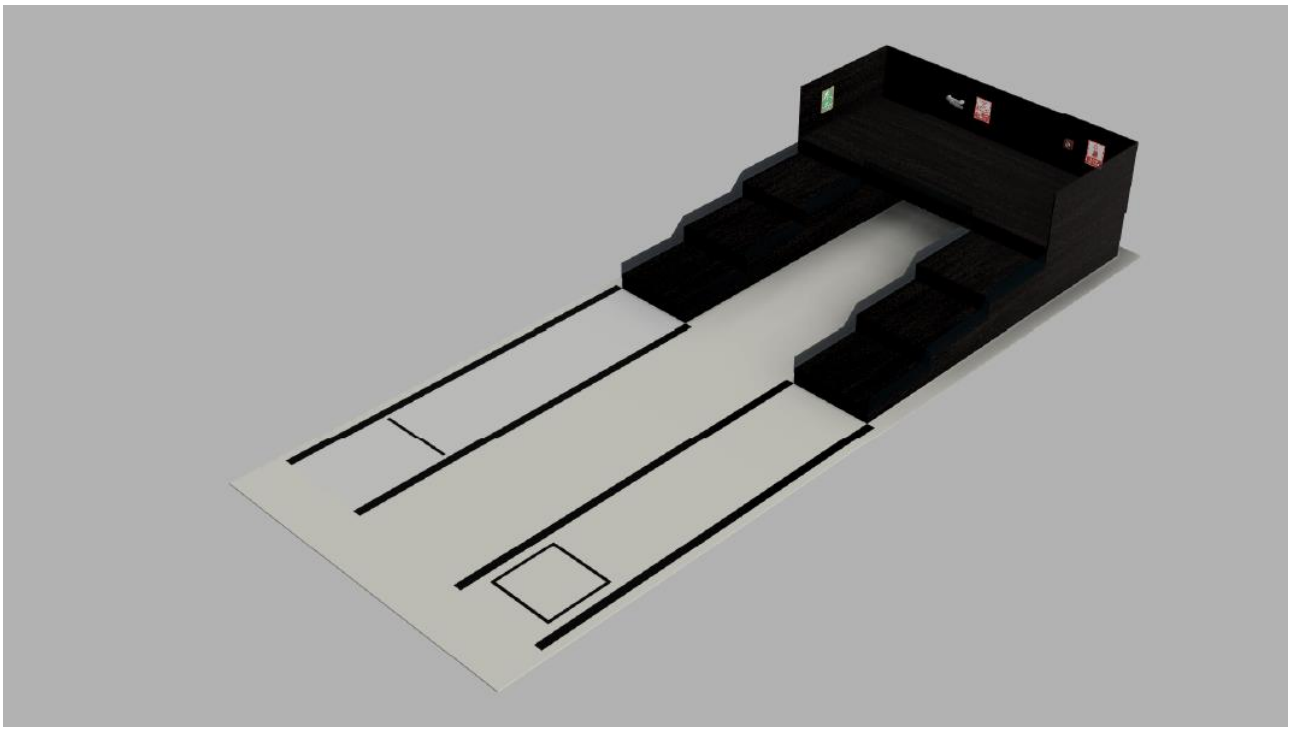
Robot Features:

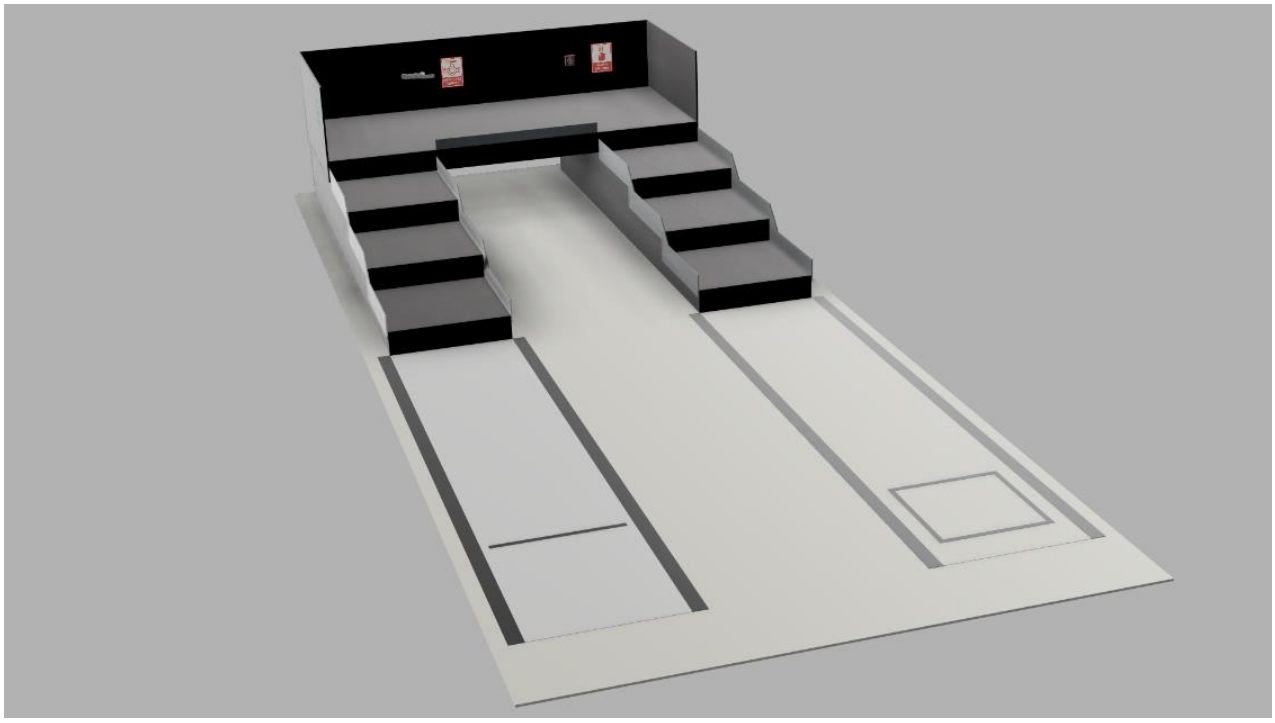
4) Each competing team will participate in the competition with one robot.
5) The robot dimensions cannot exceed 35 cm in width, 35 cm in length, and 30 cm in height.
6) There is no weight restriction for the robot.
7) Robots cannot use any system that will damage the track. Robots that damage the track will be disqualified.
8) Competitors must bring a ground control station alongside their robot to the competition track. The ground control station is a computer that can communicate bidirectionally with the robot and belongs to the competitor. It should include an interface or various windows to monitor the robot's camera and be used to control the robot via a terminal and gamepad.
9) The robot must have warning lights that indicate the working mode it is in. When the robot is in autonomous mode, the green light must be on, and when it is in remote (manual) control mode, the red light must be on.
10) The warning lights must be on the top of the robot, visible from the outside, and distinguishable in bright environments.
11) The robot must have a manipulator (robot arm, mechanism, or design solution that can complete these tasks) to push a button and close a valve.

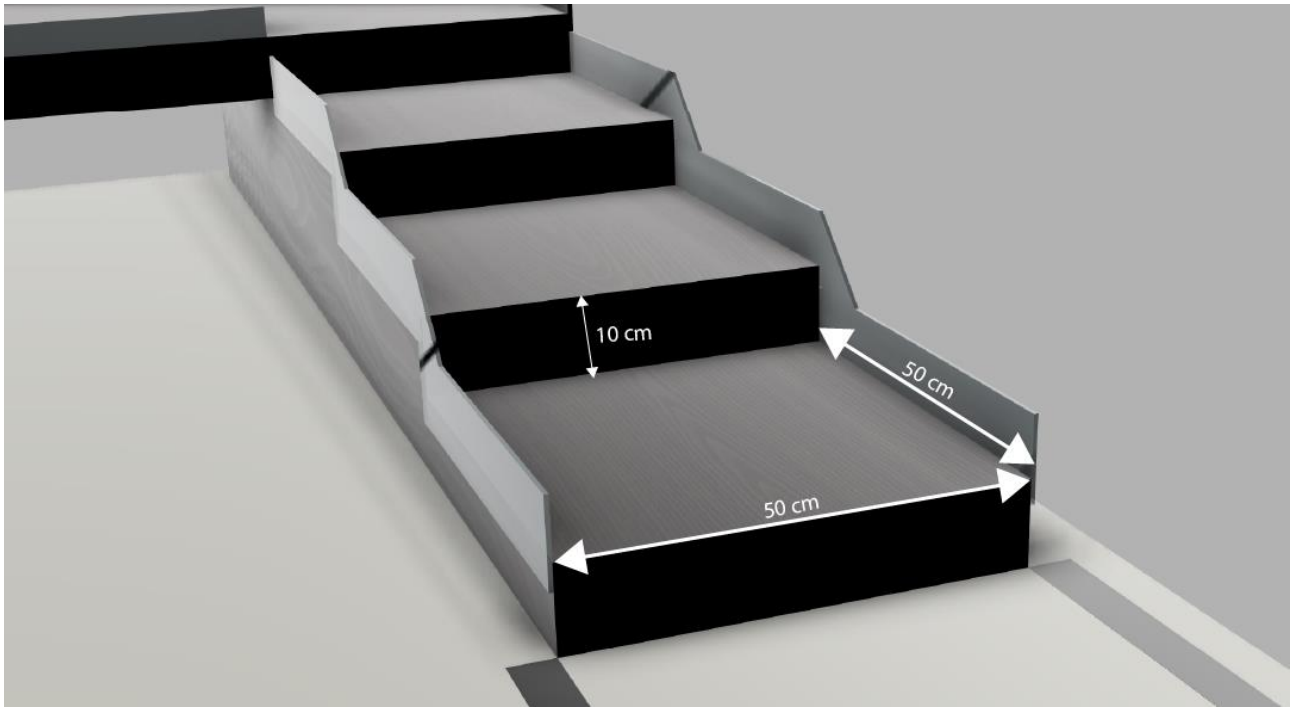
Track Features:

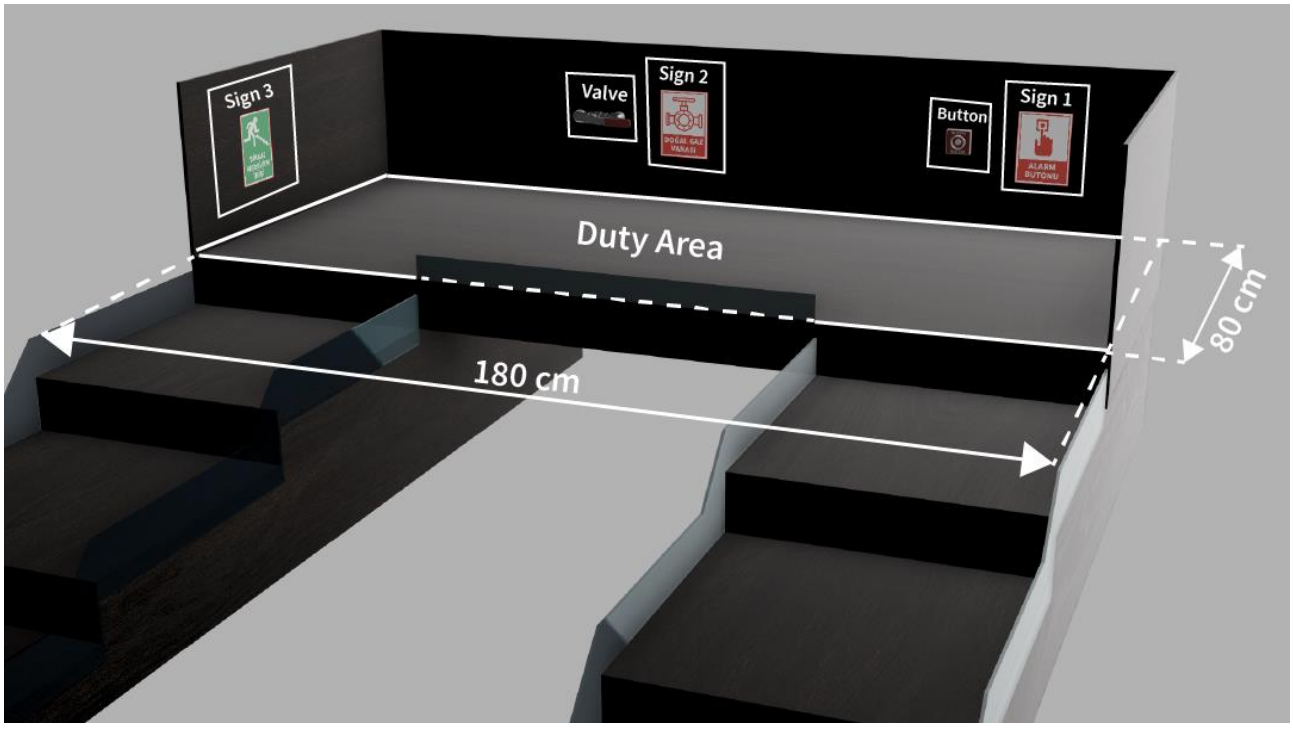
12) The height of all steps on the stairs is 10 cm.
13) There are a total of 8 steps on the course, with 4 steps going up and 4 steps going down.
14) The length and width of the steps are 50 cm.
15) There is no gap between the steps.
16) The responsibility will not be accepted if a robot falls from one of the steps to outside the course.

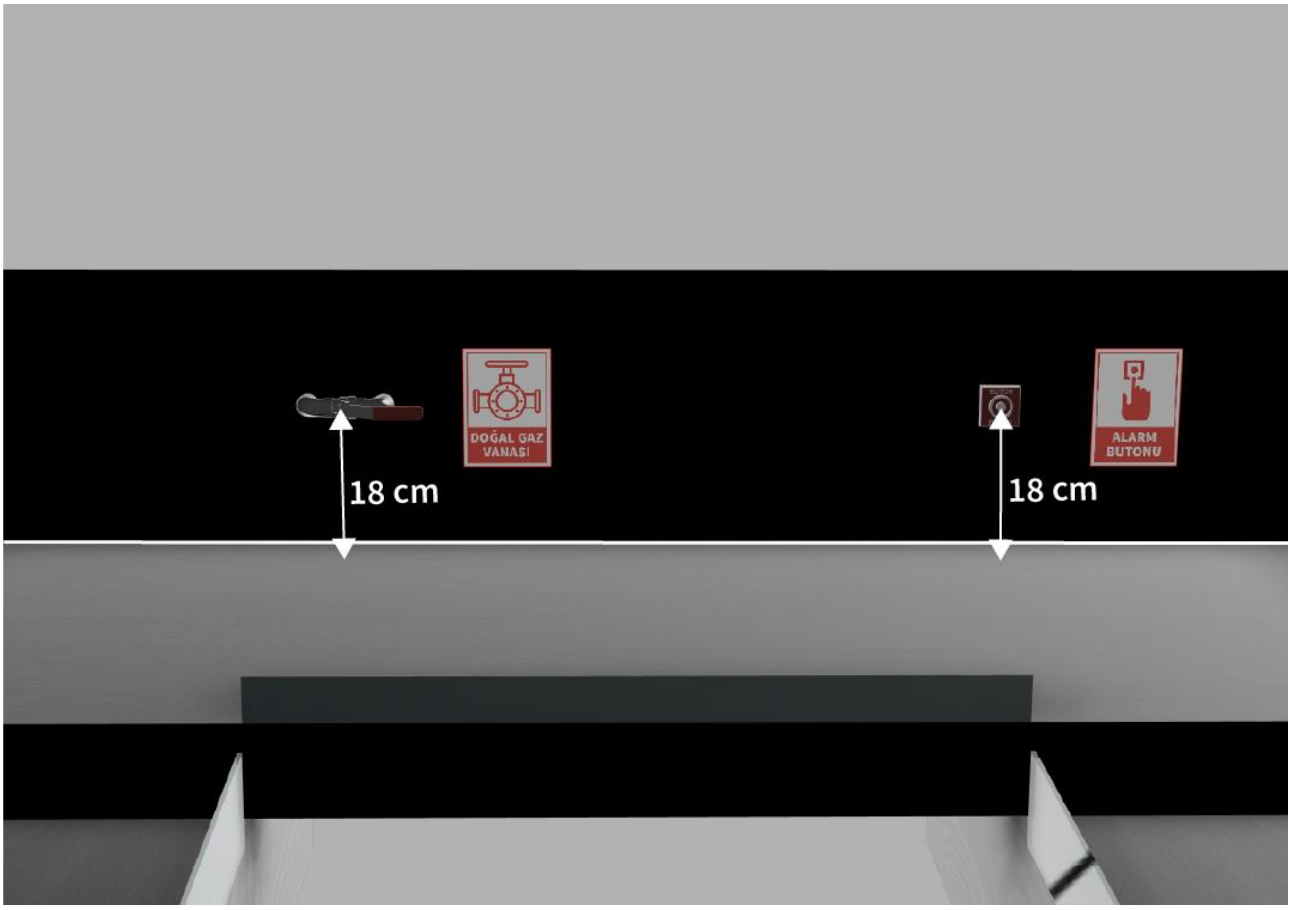
17) The contestant cannot physically interfere with the robot during the race. If found to do so, that race will be invalidated.
18) The rectangular frame on the right (ascend) side of the stairs on the course is the starting area for the robot. Its length and width are 42 cm.
19) The horizontal line on the floor of the descending stairs is the finish line.
20) The area reached after the last step of the ascending stairs is called the task area.
21) The task area has a width of 80 cm and a length of 180 cm.
22) The distance between the center of the button and the base of the task area is 18 cm.
23) The distance between the center of the valve and the base of the task area is 18 cm

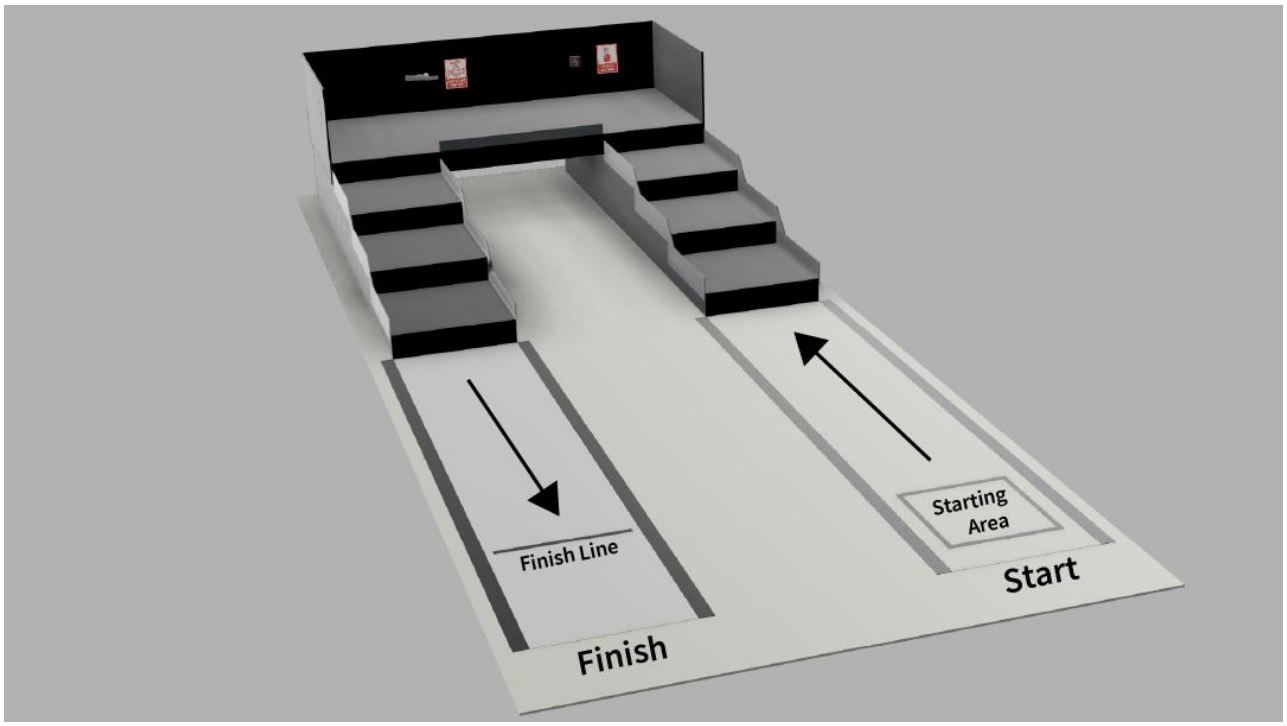





10 cm
50 cm
50 cm


Sign 3
Valve
Sign 2
Button
Sign 1
Duty Area
180 cm
80 cm


DOĞAL GAZ VANASI
ALARM BUTONU
18 cm
18 cm


Finish Line
Finish
Starting Area
Start

Signboard Specifications to be Read:

24) The width of the signboards is 11 cm and their height is 15 cm.

25) There are 3 different signboards in the track, and their designs are as follows.

26) The signboard located on the far left (1st signboard) is located next to the alarm button and its name is "Alarm Button Signboard".

27) The signboard located in the middle (2nd signboard) is located next to the alarm button and its name is "Natural Gas Valve Signboard".

28) The signboard located on the right (3rd signboard) is located next to the alarm button and its name is "Caution Stair Descent Signboard".

29) 

30) The signboards have been added to this section after this paragraph in their actual sizes.


ALARM
BUTONU


DOĞAL GAZ
VANASI


DİKKAT
MERDİVEN
İNİŞİ

Emergency Button Specifications:

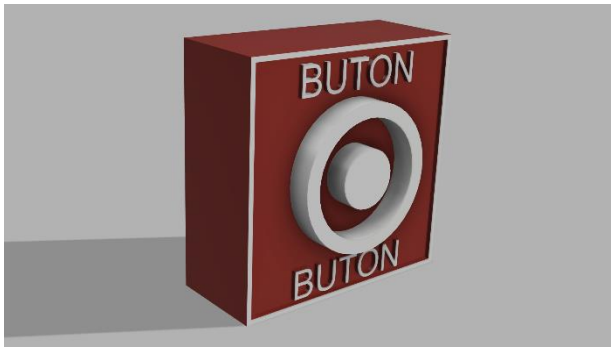
31) The width and length of the button box is 5 cm.

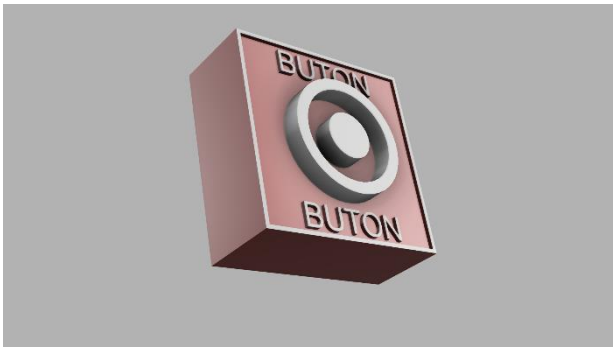
32) The depth of the button box is 2 cm.

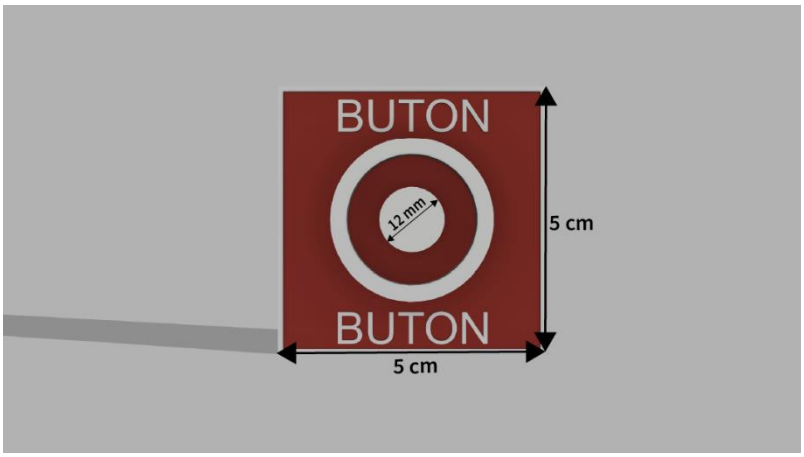
33) The button diameter is 12 mm.

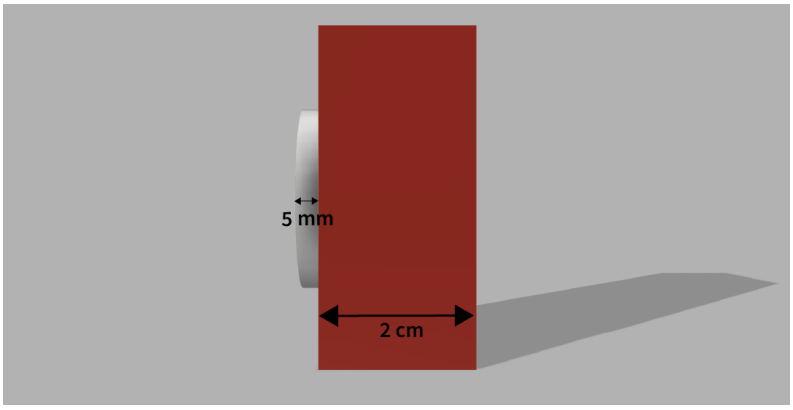
34) The button has a protrusion of 5 mm.

35) The button design and its measurements on the design are as follows:







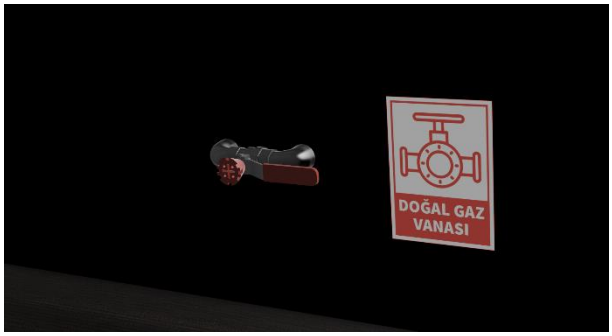


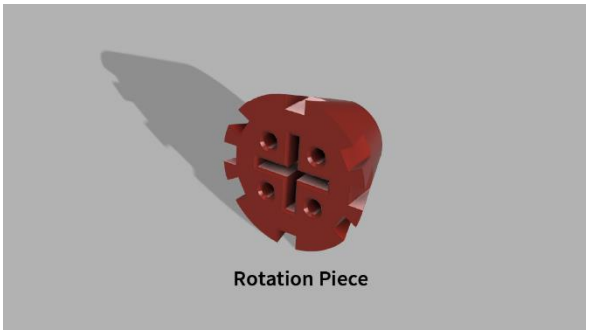
Natural Gas Valve Specifications:

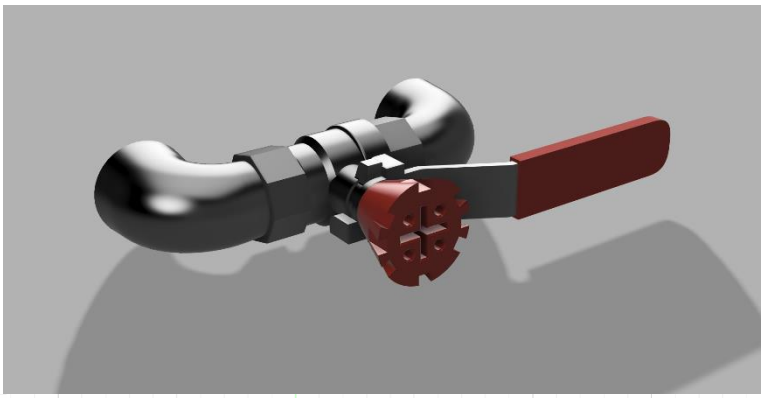
36) A rotating part has been added to the valve at its rotating center to facilitate the rotation process for the manipulator.

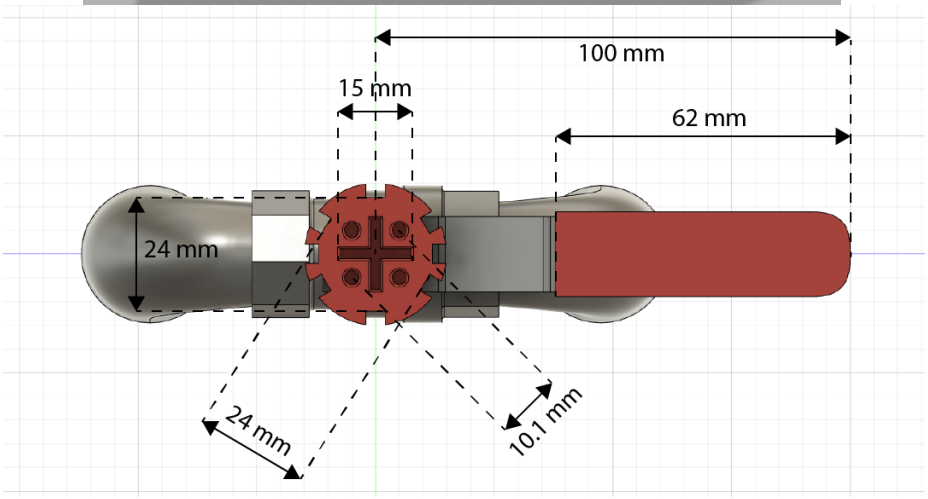
37) The lever, which is parallel to the ground, needs to be rotated 90 degrees clockwise to close the valve.

38) The valve and its measurements are shown in the following pictures:









Competition:

39) Each robot races in turn.
40) The race time for the robots cannot exceed 10 minutes.
41) After placing the contestant robot at the starting point, the referee starts the contestant robot with the start command, and the time starts counting.
42) The robot autonomously approaches the beginning of the ascending stairs.
43) The robot autonomously starts climbing the stairs.
44) After the robot reaches the task area, it must detect the "Alarm Button" signboard in front of it.
45) The confirmation of this detection will be made by showing the referees the camera images on the screen at the control station, where the signboard is detected and the indicators (marks) indicating its type are shown.
46) After the referees confirm the detection, the robot is commanded to switch from autonomous mode to remote control mode through the control station.
47) After switching to remote control mode, the robot must press the alarm button with its manipulator.
48) After pressing the alarm button, it must detect the "Natural Gas Valve" signboard. It must detect the signboard and show its type to the referees by displaying the camera images on the screen at the control station.
49) After the referees confirm the detection, the robot must go to the natural gas valve, and the operator must close the valve.
50) While the valve is open, it must face towards the ascending stairs, parallel to the ground. The robot must turn the valve 90 degrees clockwise so that it is perpendicular to the ground (facing upward).

51) After closing the valve, it must detect the "Caution! Stairs Descent" signboard. It must detect the signboard and show its type to the referees by displaying the camera images on the screen at the control station.
52) After this process, the robot operator brings the robot to a point on the descent stairs where the robot can descend (determined by the operator), informs the referees, and then the robot is put into autonomous mode upon the referees' command. The operator must not interfere with the control station after this move.
53) After switching to autonomous mode, the robot must descend from the descent stairs to the ground.
54) Finally, after reaching the ground, it must autonomously pass over the finish line completely.
55) When it completely passes the finish line, the time stops, and the competition is completed.

Scoring:

56) Scoring will begin when the robot is pulled back from the track.
57) The robot with the highest score will be placed at the top.
58) In case of a tie, the robot with the shorter time will be placed at the top.
59) Autonomous movement of the robot from the starting point to the stairs without deviating from the track is worth +10 points.
60) Autonomous movement of the robot from the bottom of the stairs to the finish line (passing it) without deviating from the track is worth +10 points.
61) Autonomous movement of the robot to ascend all the steps of a staircase is worth +30 points.
62) Autonomous movement of the robot to descend all the steps of a staircase is worth +30 points.
63) To validate the reading of a signboard, the name of the recognized signboard and its probability must be displayed on the screen of the location control station and shown to the referee. Points will be awarded based on the referee's approved observations.

64) Correctly identifying and distinguishing a signboard using image processing techniques is worth +40 points.

65) Pressing a button is worth +40 points.

66) Turning a valve is worth +40 points.

67) If the robot switches to manual (remote) control during the tasks that it is supposed to perform autonomously, it will receive 0 points for those tasks.