INTERNATIONAL DESIGN COMPETITION ROBOCON 2025

Theme for IDC ROBOCON 2025: Enterprising Spirit, Go Ahead !

Background: －“taking the train to Nanjing”

Shanghai Jiao Tong University (SJTU) , which is the host university of IDC2025, is one of the famous institutions of higher learning with the longest history and reputation at home and abroad. It is a national key university directly under the Ministry of Education and jointly built with Shanghai Municipality. After 128 years of unremitting efforts, Shanghai Jiao Tong University has become a domestic first-class and internationally renowned university, and further defined the vision on constructing a “comprehensive, innovative and international” world-class university.

Students of Shanghai Jiao Tong University are rich in the spirit of patriotism and the sentiment of serving the nation. The most famous patriotic school protection movement in history －“taking the train to Nanjing” took place at Shanghai Jiao Tong University. In May 1947, more than 2,800 students from Shanghai Jiao Tong University traveled by bus to the train station to Nanjing to petition for the rights of the university, its faculty and students. Forbidden to buy tickets, the students pieced a locomotive found in a garage and 35 carriages together to make a train to Nanjing. However, the government ordered the railroad workers to dismantle the tracks in front of the train to prevent the students from traveling. The students had no choice but to dismantle the rear railroad tracks and join them to the front railroad tracks to make their way to Nanjing. In desperation, the then mayor of Shanghai renegotiated with the students and met all their justifiable demands. The vigorous movement to protect the school ended in a victory for the students.

Onsite Mode

1. Game field

   The overview of the contest field is shown in Fig. 1.

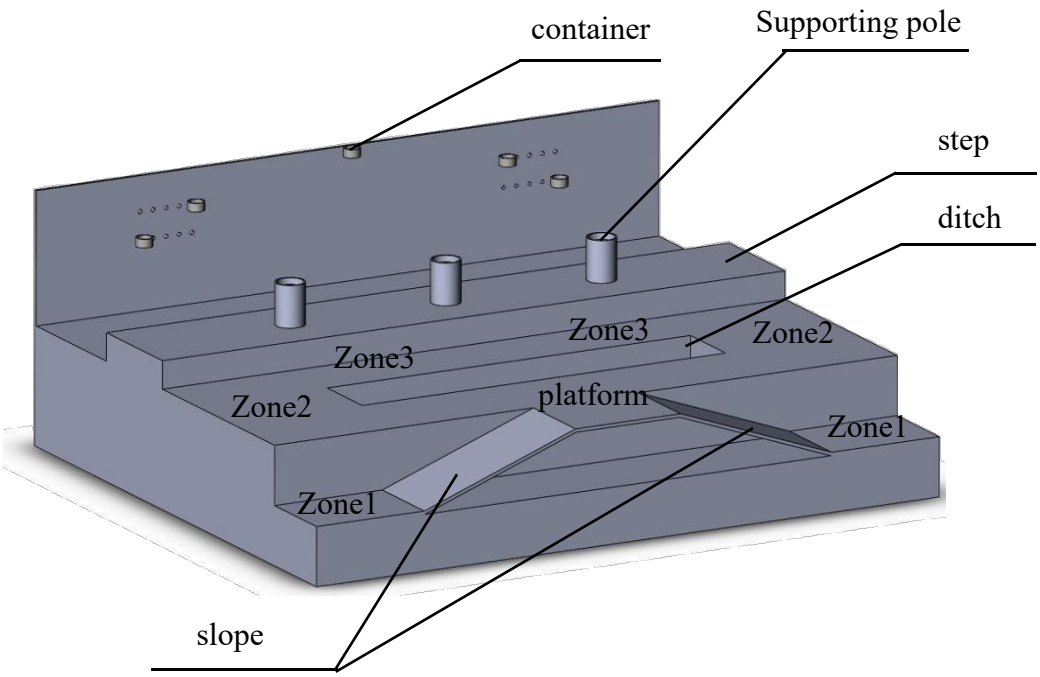

Fig. 1 Overview of contest field

1. Building and mission robots

   Each team is required to make two robots, building and mission robots.

   - Building robot

     There are some obstacles,e.g, deep ditches, steps and slopes in the contest field. The robot should build the bridge across the deep ditches and the steps to pave for the mission robot. Meanwhile, it needs to clear some obstacle on the moving path. And the building robot is of freedom-of-degree, width and height limitations.

   - Mission robot

     The mission robot moves on the road simulating the railroad built by the building robot, and collect the flag and then put it on the specific position.

2. Control methods

We provide many different controlling methods. The robots can be controlled with Wifi, RF controller, Raspberrypi 4B etc, when it finishes the task there will be different task score.

Online Mode

1. Field description

The Field is the same as the game field of the onsite mode as show in Fig.1.

(next contents are as same as what required in RoboCon2024)

Part 1: Overview of required software

- ROS (Robot Operating System) for creating and controlling robot software
- Gazebo for simulating robots in a virtual environment
- CAD software (SolidWorks is preferred) for designing the robot You

may try many time to build the software to run.

Part 2: Designing the Robot and Generating URDF format

1. Designing the Robot

• Use CAD software like SolidWorks to design your robot.

• Ensure that all parts are properly dimensioned and compatible for simulation.

2. Generating URDF (Unified Robot Description Format):

• Export the CAD model to a format compatible with URDF generators (e.g., STL files from SolidWorks).

• Use a tool like .sw_urdf_exporter for SolidWorks or similar in other software to generate the URDF file.

• Validate the URDF file to ensure there are no errors in the robot's structure or syntax.

Part 3: System Requirements and installation

System requirements :

•Ubuntu Linux (recommended version 20.04 LTS) as the host operating system.

•Sufficient disk space (at least 10GB free) and a stable internet connection.

Installation links :

• ROS installation : https://wiki.ros.org/noetic/Installation/Ubuntu

• Gazebo installation :

https://classic.gazebosim.org/tutorials?tut=ros_installing&cat=connect_ros

Part 4: Simulating in Gazebo

1. Setting Up the Simulation Environment: Load the provided world description file into

Gazebo to set up the simulation environment.

2. Launching the Simulation: Use ROS to launch the robot model in Gazebo:

roslaunch your_robot_package gazebo.launch

3. Testing and Validation: Perform initial tests to ensure your robot interacts correctly with the virtual environment. Check for mobility and interaction with simulated objects.

Competition Rules and Guidelines

Robot Design (20 score): Participants must use the same robot design for the online mode as used in the offline competition. Ensure to generate a URDF file for your robot.

Simulation (20 score): All robot simulations must be conducted using ROS on the Gazebo platform.

World Setup (20 score): A world description file will be provided to all participants. This file must be used to import your robot into the Gazebo environment.

Competition Task (20 score): path-building: the building robot must build something needed for the mission robot to overcome these difficulties, including the ditch, the slope and the steps Mission completion: the mission robot runs on the

path built by the bridge-building robot, and get the ball then put into different containers to complete the mission and get different scores and appeals

Offline Mode(Onsite Mode)

The contest field includes many functions and requirements.

Start Zone: Zone1 is the starting zone for the mission robot

Zone2: there are one or more blocks putting here for the building robot to make a bridge-like railway over the ditch

Zone3: where rests two building robots

Supporting pole: there are 3 poles on the step, and 2-3 balls with different diameter and weight to denote different appeals

Container: there are 3 containers with different heights to denotes different difficulties to realize the appeals

Rules and regulations

The mission robot must move from Zone1 to the platform through the slope, this is the first step to get its first score.

And at same time the building robot runs from the Zone3 to the Zone2 where puts one or more bridge block with 4mm thickness, and pulls the block to cover the ditch to make a railway-like path, the robots will get its second score. At this step, the building robot can grab the bridge block to prevent his opposite team from building the bridge successfully only if the block is put on the Zone2.

Then the mission robot move on this path to overcome the ditch, and the mission robot will get its third score. If the building robot can not put the block on the ditch, the second score will be zero. And if the mission robot does not run on the ditch, the third score will be reset to zero. What to be mentioned is that the platform, Zone2 is wide enough to run for the mission robot.

The building robot should put a bulk in triangle or other shape closely attached to the slope, and let the mission robot runs onto and runs down from the slope, then the

mission robot gets its forth score. At this step, the mission robot and the building robot may be blocked or hindered by opposite team.

The mission can get the balls denoting different appeals from the poles at it runs down the step and put them into containers, then get the fifth score according to height it puts the balls in. To simplify score calculation, we may use balls of same diameter and weight. At this step, the mission robot and the building robot may be blocked or hindered by opposite team.

The mission robot get the balls and put the balls with AI, and the building robot identify the step and put the bulk to assist the mission runs onto the step, you will be get the double or higher score. How to get the balls is the challenge for students, you can design what you want to realize your idea.

The total score = 30% ×Score of online mode + 70% ×Score of offline mode

Design Regulations for IDC RoboCon2025

Each team must complete online virtual design with ROS/Gazbo and design two robots, that is, the building robot and the mission robot to complete offline contest.

No glue. Any kind of glue is allowed to use to design the robot.

Total Specifications

We provide 5 DC motors and two servos to design the robot. They must run under 12VDC;

Each team can use the acrylic plate not thick than 4mm to design the robots, with the total area less than 400mm×400mm;

Each team can use the 3D print material to design the robots with the total weight less than 100g;

Only the material we provide can be used.

Different control method, e.g., Radio Frequency control, Bluetooth control, Wifi Control and AI control on Raspberrypi 4B is preferred;

Match Setup and Robot Configuration

•**Pre-Match Configuration**: Teams are allowed to select which side of the field to begin with coin-guessing method;

•**Preparation Time**: Teams can prepare their machines prior to each round in Zone1 and within a 2-minute. The robot can not be touched once it starts.

•**Field Adaptability**: There is no adaptability test time for each team prior to formal contest, you should test the robots comprehensively in turn after the contest field is there.

Special Contest Rules

•**Golden Ball Law**: Once the team puts 5 balls into five different containers, that is, there is one ball in each container, he will win this contest.

Fair Play

1. **Referee commission:** We will establish a judging panel to ensure fair play;
2. **Irreversible Scoring**: Once points are scored, they cannot be nullified by defensive actions of the opposing team, although further scoring attempts can be defensively blocked.
3. **Non-Aggressive Conduct**: Any form of aggressive behaviour including damaging, overturning, pushing, or lifting an opponent's robot is strictly prohibited.
4. **Contest Field Integrity**: Participants must not damage the contest field or any control equipment. Violations may lead to disqualification.
5. **Accidental Damage**: In instances of accidental damage as judged by the referees, teams may be allowed to repair their robots and a rematch may be scheduled.
6. **Human Interaction**: No direct physical interference with the robots or any field elements by any human is permitted during matches.
7. **Retrieval of Items**: Components or objects that exit the arena boundaries must not be reintroduced manually during ongoing rounds.
8. **Prohibited Devices**: The use of nets or any devices designed to entangle or trap opponents is forbidden. Defensive strategies that do not involve such mechanisms are allowed.
9. **Judgment Post-Match**: After the allotted time expires, the referee will declare the winner based on the accumulated scores.

10.Safety Compliance: Machines deemed dangerous by the judges are not allowed, and all safety rulings by the judges are final and must be adhered to without delay.

11. Surveillance and Monitoring: All robots may be subject to random checks during and after matches to ensure compliance with all rules, including size, weight, and material restrictions.

12. Pre-Match Checks: Before each match, robots must pass a pre-match inspection by the judges to ensure they meet all competition specifications and safety standards.

13. Sportsmanship: Teams are expected to always conduct themselves in a sportsmanlike manner. Unsportsmanlike conduct, such as taunting, rude gestures, or inappropriate comments, will be penalized.

14. Signal Integrity: Teams must not attempt to interfere with the control signals of opposing teams, whether through electronic jamming or other means. **Safety Guidelines**

1. **Part Machining**: the students are prohibited to use lathe machines to make all kinds of mechanical parts
2. **Electric Shock**: the students are prohibited to use the power supply without any safety fuse, and avoiding over-heat of mobile power supply or rechargeable batteries; 3. **Burning avoiding**: the students should use the soldering gun carefully to avoid burning. And the soldering gun is not allowed to plug into power supply when it is not used, and you should unplug it.

There may be slightly changed, then we will renew it as soon as possible.