NRC ROBOCUP SINGAPORE COSPACE CODING CHALLENGE

Primary, Secondary

RESCUE CHALLENGE

Version: 3 May 2023

Organiser:

Sponsored by:

Supported by:

RoboCup Singapore CoSpace Coding Challenge Rules 2023
(Rescue Category)

These are the official rules for CoSpace coding challenge (Rescue Category) 2023. This rule book is released by the RoboCup Singapore CoSpace Technical Committee. English rules have priority over any translations.

PREFACE

The theme for NRC RoboCup Singapore CoSpace Coding Challenge (Rescue Category) 2023 is ENVIRONMENTAL SUSTAINABILITY.

In RoboCup Singapore CoSpace coding challenge (rescue category), teams are required to solve 5 individual tasks commonly used in environmental sustainability challenge, such as

- Navigation challenge
- Smart sensing challenge
- Recognition challenge
- Path planning challenge
- Sorting challenge

The 5 tasks are designed to lead students on:

- How to use different type of sensors
- How to solve common problems in environmental sustainability challenge, such as path planning and resource sorting.

There are two age groups.

- The primary age group is for students with little experience with robotics and coding. Novice teams are also welcome.
- The secondary age group is for students with foundation of robotics and coding, such as application using different sensors.

With the foundations built-up, students are able to complete the RCAP CoSpace rescue challenge missions.

Contact us:

Rule clarification: cospace@robocupap.org

Technical support: support@cospacerobot.org

Contents

CHAPTER 1: GENERAL RULES

1 Team

1.1. Team Members

1.1.1 A CoSpace coding team should consist 1 to 2 members. Each participant can only register for one team.

1.1.2 All team members must be at the right age for the respective age group.

- Primary age group: Teams with all students aged 8 to 12 year old can participate in this category.
- Secondary age group: Teams with all student members aged 13 to 16 year old can participate in this category. If a team has mixed ages (with both Primary and Secondary members), they will be allowed to compete in Secondary category.

1.1.3 Every team member need to carry out a technical role for the team (strategy planning, programming, etc.), which should be identified at the registration. Each member will need to explain his/her technical role and should be prepared to answer questions on the technical aspects of their involvement in preparing the CoSpace Coding Challenge.

1.1.4 Each team must have a captain. The captain is responsible for communication with referees during the game.

1.2 Responsibility

1.2.1 The team members are responsible for

- verifying the latest version of the rules prior to the competition. If any rule clarification is needed, please contact the CoSpace Technical Committee.
- checking updated information (schedules, meetings, announcements, etc.) during the event.
- communication with CoSpace Technical Committee (TC) and Organising Committee (OC) for all CoSpace Rescue Challenge related matters.

2 Referees

2.1.1 A referee is an official who manages the CoSpace Rescue games and makes sure that the CoSpace Rescue rules are followed.

2.1.2 The referee receives and uploads the teams' virtual programs, as well as running the game.

3 Interruption of a Game

3.1.1 In principle, a game will not be stopped during the challenge unless the referee needs to discuss an issue/problem with the OC/TC.

4 Conflict Resolution

4.1 Referee

4.1.1 During a gameplay, the referee's decisions are final.

4.1.2 At conclusion of game play, the referee will ask the captain to sign the score sheet. Captain should be given maximum 1 minute to review the score sheet and sign it. By signing it, the

captain accepts the final score on behalf of the entire team; in case of further clarification, the team captain should write their comments in the score sheet and sign it.

4.1.3 A violation of the rules may result in disqualification from the tournament or the round at the discretion of the referee, officials, organizing committee and general chairs.

4.1.4 In case the team refuses to sign the scoresheet after the game, they should be advised to file a complaint following the procedure in section 4.4. This should not interrupt the following games. The referee should follow the instruction given by the chief judge.

4.2 Rule Clarification

4.2.1 It is the team's responsibility to verify on the official website the latest version of the rules prior to the competition. If any rule clarification is needed, please contact the CoSpace Technical/ Organizing Committee.

4.2.2 If necessary, a rule clarification may be made by members of the CoSpace Technical/ Organizing Committee, even during a tournament.

4.3 Special Circumstances

4.3.1 In special circumstances, such as the occurrence of unforeseen problems or malfunction of a robot, rules may be modified by the RCAP CoSpace Rescue Organizing Committee Chair in conjunction with available Technical Committee and Organizing Committee members, even during a tournament if necessary.

4.3.2 If any of the team captains/members/mentors do not show up to the team meetings to discuss the problems and the resulting rule modifications described at 4.3.1, it will be considered as an endorsement.

4.4 Complaint Procedure

4.4.1 Rule issues are not to be discussed during the run. Referee decisions are binding for the CoSpace Rescue challenge. A team may protest by executing the following complaint procedure. The procedure is automatically invoked if a referee decides to abort the run for any reason (e.g. field damage, lighting failures, burning robots).

4.4.2 To initiate the complaint procedure, the team leader of the challenging team has to contact a member of the Technical Committee within 10 minutes of the end of the run. The member of the Technical Committee will then invoke a team leader conference in consultation with the Organizing Committee. The following parties will participate in this conference: the referees of the run, Organising Committee members, and the Technical Committee (counselling). The situation shall be resolved by unanimous consent or by vote of the Organising Committee members.

4.4.3 All teams are reminded that while this is a competition, the league is also about cooperative research and evaluation, as such, complaints should be handled in a fair and forthcoming way.

5 Code of Conduct

5.1 Fair Play

5.1.1 CoSpace coding challenge is built upon the foundation of fairness, respect, and friendship. Team members should be mindful of other people and their robots when moving around the tournament venue.

5.1.2 Mentors (teachers, parents, chaperones, translators, and other adult team members) are not allowed in the student work area. They are not allowed to be involved in the programming of students' robots.

5.2 Behaviour

5.2.1 Prior to the Challenge, team leaders and mentors are required to sign and acknowledge that they fully understand and are aware of the rules as well as Code of Conducts for the Challenge. All participants are responsible for their own actions.

5.2.2 During challenge, participants are to follow the directions of the referee. Failure to do so will result in a WARNING (Yellow Card). Subsequent infractions will result in an automatic DISQUALIFICATION (Red Card) of the round. Disqualification as a result of deliberately distract the competition is FINAL and appeals will not be entertained in any form. The status of Yellow/Red Cards will be recorded.

5.2.3 WARNING (Yellow Card) procedure

- A WARNING can be issued at the sole discretion of the lead referee; however, assistant referee will be consulted. If no objection is raised, WARNING will be issued.
- A WARNING will be issued for the following disruptive behaviours and activities including but not limited to:

  (a) Not following referee's instructions

  (b) Disturbing other participants and/or competition staffs (including referees).

  (c) Speaking loudly, shouting, using any kind of profanities or making sound that resembles profanity.

  (d) Sabotaging other teams belongings or equipment

  (e) Entering competition area when other teams are competing.

  (f) Entering other teams' area without explicit permission.

  (g) Engaging in disorderly conducts such as fighting, physical scuffles, running around competition and/or team area.

  (h) Harassing referee

  (i) Mentor interference with robots or referee decisions.

5.2.4 DISQUALIFICATION (Red Card) procedure

- A DISQUALIFICATION can be issued at the sole discretion of the lead referee; however, assistant referee will be consulted. If no objection is raised, DISQUALIFICATION will be issued.
- An immediate DISQUALIFICATION can only be issued jointly by the lead and assistant referee. A DISQUALIFICATION will be issued for the following cases:

  (a) Teams have collected two consecutive WARNINGS during competition period. A competition period is defined as the start to end of duration of competition.

  (b) Teams that cause a deliberate interference with real robots or damage to the real-world setup.

  (c) If one team copies a program from another team, both teams will be disqualified.

5.2.5 Once the RED CARD is issued, the team will be disqualified from the current run. If team receives 2 RED CARDS, it will be disqualified from the whole entire competition.

5.2.6 All immediate DISQUALIFICATION will be reviewed by the Chief Judge and the Organising Committee. Infractions that resulted in immediate DISQUALIFICATION will be reviewed and additional sanctions such as bans from future competitions will be considered.

5.3 Penalty

5.3.1 The following are strictly prohibited.

(a) During the game, using third-party software, self-written code, or any other tools to retrieve additional system information is strictly prohibited.

(b) Any other behaviours that affect the normal operation of the RCAP CoSpace Rescue Simulator, and direct or indirect control of the behaviours of the RCAP CoSpace Rescue Simulator, such as the scaling of the simulation window is strictly prohibited.

5.3.2 A DISQUALIFICATION from the current match can be issued at the sole discretion of the CoSpace Chief Judge and CoSpace Technical Committee if teams offend the rules 6.3.1 for the first time.

5.3.3 A DISQUALIFICATION from the entire competition can be issued at the sole discretion of the CoSpace Chief Judge and CoSpace Technical Committee for repeat offenders.

5.4 Sharing

5.4.1 Teams are encouraged to share their codes and strategies with members after the competition.

5.4.2 Any developments may be published on the RCAP Academy Channel or CoSpaceRobot.org after the event.

5.4.3 CoSpace coding challenge sharing and presentation furthers the mission of RoboCup Asia Pacific as an educational initiative.

5.5 Spirit

5.5.1 It is expected that all participants (students and mentors alike) will respect the RoboCup mission.

5.5.2 The referees and officials will act within the spirit of the event.

5.5.3 It is not whether you win or lose, but how much you learn that counts!

CHAPTER 2: FIELDS

6 Arena

6.1 Dimensions

6.1.1 The dimensions of VIRTUAL_WORLD are 270cm x 360cm.

6.2 Floor

6.2.1 VIRTUAL_WORLD

- The VIRTUAL_WORLD is a 3D simulated environment. The floor is not restricted to white or light colour.

6.3 Boundary

6.3.1 VIRTUAL_WORLD

- There will be no boundary for VIRTUAL_WORLD. Teams are required to keep the robot within the virtual arena based on the dimensions given. There will be an indication of the boundary for audience.

Figure 1: Typical VIRTUAL_WORLD Layout

CHAPTER 3: ROBOT

7 Robot

7.1 ROBOT Configuration

The CoSpace Coding Challenge (Rescue Category) uses a Standard Platform. The ROBOT has the following configuration:

- 3 Ultrasonic sensors
- 1 Gyro sensor
- 2 Colour (RGB) sensors
- 2 DC motors
- 1 LED for status indication
- 1 GPS sensor (Secondary Only)

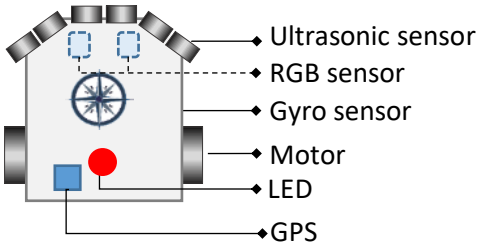

Figure 2: ROBOT configuration

7.2 ROBOT Control and Programming

7.2.1 Teams can use GUI, Python or C to program the VIRTUAL_ROBOT to complete the task in VIRTUAL_WORLD.

7.2.2 ROBOT must be controlled autonomously. The use of a remote control, manual control, or passing information (by sensors, cables, wirelessly, etc.) to the robot is not allowed.

CHAPTER 4: CHALLENGE TASKS

8 Challenge Tasks

All teams are required to complete 5 individual tasks.

8.1 Primary Age Group

8.1.1 Task 1: Navigation – Ultrasonic sensors

By utilizing the three ultrasonic sensors, participants can program the CoSpace Rescue robot effectively explore every corner of the field and identify reusable resources. This is also the foundation for solving problems like mazes.

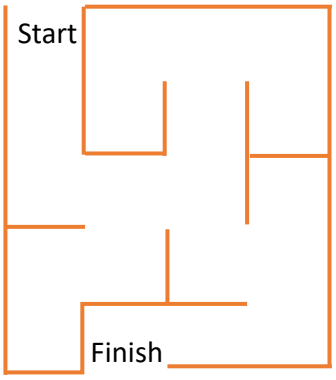

Figure 3: Task 1 example (Primary)

8.1.2 Task 2: Recognition – Colour sensors (RGB)

The CoSpace Rescue robots are equipped with two colour sensors (RGB). The recognition of colours can be seen as a fundamental application of pattern recognition, and by mastering this skill, participants can program the CoSpace Rescue robot identify and utilize reusable resources and stations more efficiently.

Figure 4: Task 2 example (Primary)

8.1.3 Task 3: Smart Sensing – Compass Sensor

In the process of robot search, accurate positioning of the robot and efficient arrival at the search target is a core issue. CoSpace Rescue robots are equipped with a Compass sensor to obtain the direction information of the robot and enable the robot to quickly reach the target area through directional positioning.

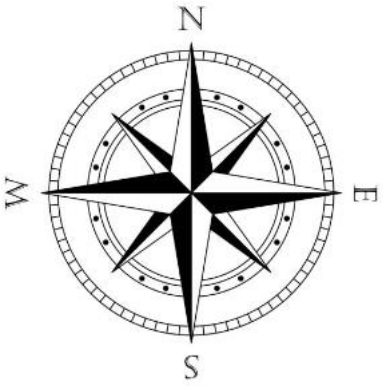

Figure 5: Task 3 example (Primary)

8.1.4 Task 4&5: Open Challenges

In the primary school group competition, participants will also encounter more comprehensive problems, such as basic path planning, comprehensive application of multiple sensors, and so on. Participants need to complete the environment sustainability challenge using ultrasonic, RGB and Compass sensors.

8.2 Secondary Age Group

8.2.1 Task 1: Navigation

Participants need to efficiently navigate the field by using sensors comprehensively. For example, by combining ultrasonic and colour sensors, robots can complete maze tasks and pass through multiple specific colour stations as required.

8.2.2 Task 2: Path Planning

In the secondary school group competition, the system provides real-time GPS coordinate information for robots, allowing participants to perform more accurate path planning based on the robot's location information, and thus complete efficient field searches.

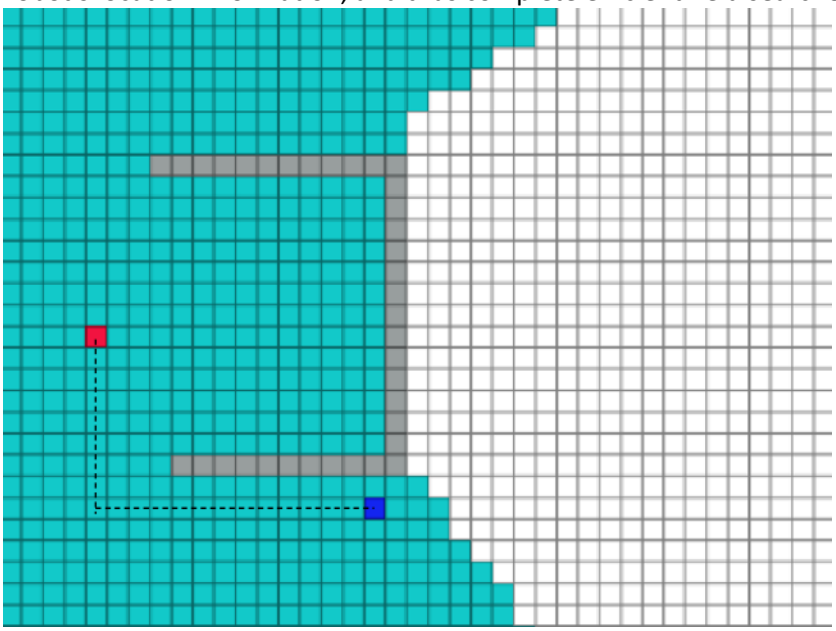

Figure 6: Task 2 example (Secondary)

8.2.3 Task 3: Sorting Challenge

In resources sorting task, one of the core issues is the ability to analyse and identify targets. Analysing and identifying targets is a core issue in search tasks, participants are required to use multiple sensors in a flexible manner to identify reusable resources and recycling stations on the map.

Figure 7: Task 3 example (Secondary)

8.2.4 Task 4&5: Open Challenges

In the secondary school group competition, participants will also encounter more comprehensive problems, such as GPS usage, path planning, comprehensive application of

multiple sensors, and so on. Participants need to complete the environmental sustainability missions using all sensors mounted on the robot.

8.3 SuperTeam Challenge

- SuperTeam is the combination of 2 – 3 teams from different schools.
- In SuperTeam Challenge, teams have to develop and program strategies for both real and virtual autonomous robots to navigate through the real and virtual worlds to solve the environment sustainability challenge while competing with another team's robot that is searching and collecting objects in the same real and virtual worlds.

CHAPTER 5: GAMEPLAY, JUDGING AND SCORING

9 Gameplay

9.1 Release of Task

- The Organising Committee will announce the tasks in the competition hall.

9.2 AI Submission

- The chief judge will announce the time for submission of the AI in the competition hall.
- Each team must submit 5 individual codes for 5 individual tasks which is created during the programming period to the chief judge.
- The code file name format should follow the name convention given below:
  - Task1: TeamName_Task1
  - Task2: TeamName_Task2
  - …

9.3 Virtual Run

- 5 minutes before each run, team captains must report to the referee at their respective game stations.
- The referee will upload the programs and place the VIRTUAL_ROBOT in the starting position of each task.
- It is the team captain's responsibility to ensure that the correct program is uploaded.
- Team captain must be present during the virtual run.
- Referee will complete all 5 tasks. Team captain is required to acknowledge the result by signing on the scoresheet.

10 Judging and Scoring

10.1 Scoring

The weightage of each task is as follows

<u>Primary Age Group</u>

- Task 1: Navigation challenge – 10%
- Task 2: Recognition challenge – 15%
- Task 3: Smart sensing challenge – 15%
- Task 4: Open challenge I – 30%

- Task 5: Open challenge II – 30%

Secondary Age Group

- Task 1: Navigation challenge – 10%
- Task 2: Path planning challenge – 15%
- Task 3: Sorting challenge – 15%
- Task 4: Open challenge I – 30%
- Task 5: Open challenge II – 30%

The overall score of 5 tasks determines the rank of the CoSpace coding challenge.

11 Awards and Prizes

The awards will be given to top three teams of each age group.

Winners will be able to receive the following prizes:
1st Place: $300, Trophy for each team and Medals for each participant
2nd Place: Medals for each participant
3rd Place: Medals for each participant

All participants will also receive certificates of participation.

The Organiser reserves the right to amend the prizes without prior notice.