# RCAP CoSpace Autonomous Driving Challenge Rules 2024

## U19

These are the official rules for CoSpace Autonomous Driving Online Challenge 2021. This rule book is released by the RoboCup Asia-Pacific CoSpace Technical Committee. English rules have priority over any translations. Changes from the 2023 rules are highlighted in red.

## PREFACE

The RCAP CoSpace Autonomous Driving Challenge focuses on path planning in a smart city. For this challenge, teams are required to program autonomous vehicles to navigate through a smart city in both real and virtual environments (CoSpace).

The CoSpace Autonomous Driving Simulator is the only official platform for the CoSpace Autonomous Driving Challenge. This simulator allows programs to be developed using a graphical programming interface (GUI), Python or C language. The same program for the virtual robot in the virtual environment can be downloaded on to a real robot in the real environment. Participating teams can contact support@cospacerobot.org for CoSpace Auto-Driving Simulator download, help and assistance.

Figure 1: CoSpace Auto-driving Challenge

www.robocupap.org

# OVERVIEW

## Technical Interview (Optional):

Judges are interested in determining students' understanding of the robotics AI and coding skills. Each team member must be prepared to answer questions about the technical aspects of their involvement in preparing the CoSpace Autonomous Driving Challenge. The duration is about 10 – 15 minutes.

Teams may be asked to have second interview if judges consider it is necessary. Teams must show authenticity and originality with regards to the AI and code.

## Individual Team challenge (Compulsory):

Each team will take part in the individual team challenge.

## SuperTeam Challenge (Compulsory):

At the RoboCup Asia-Pacific Competition, teams will also take part in a SuperTeam Competition.

SuperTeams comprise of two or more participating teams. The SuperTeams are given a short period of time for collaboration at the competition venue. During this time, each SuperTeam must leverage on individual teams' strength and work together to create a new AI to solve a new task. SuperTeams are encouraged to express their friendship and cooperation and to demonstrate what they have learnt from each other.

The SuperTeam Challenge is a special program for the RCAP Finals and is not obligatory for regional events.

## Awards

Depending on the number of teams entering the competition, there will be awards (trophies and certificates). The Organizing Committee can adjust the award type (trophy or certificate) if needed.

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# CHAPTER 1: GENERAL RULES

## 1 CoSpace Autonomous Driving Challenge (Hybrid Challenge) Description

The RCAP CoSpace Autonomous Driving Challenge (Former CoSpace Grand Prix) focuses on path planning in a smart city. For this challenge, teams are tasked to make their own real robots (autonomous vehicles), code both real and virtual robot and finally, take part in the autonomous driving challenge in CoSpace. (both REAL_WORLD and VIRTUAL_WORLD).

### 1.1 Make a Robot

1.1.1 Teams are required to assemble a real robot using the standard robot maker kit.

### 1.2 Code a Robot

1.2.1 There are two types of robots used in the Auto-driving challenge. A team must program the REAL_ROBOT in the REAL_WORLD and the VIRTUAL_ROBOT in the VIRTUAL_WORLD to complete the Auto-driving mission.

### 1.3 The Challenge

1.3.1 The CoSpace Auto-driving challenge consists of robot travelling in REAL_WORLD and VIRTUAL_WORLD. The maximum duration for the Auto-driving challenge is 8 minutes.

1.3.2 A challenge begins with REAL_ROBOT in REAL_WORLD while VIRTUAL_ROBOT is on standby in VIRTUAL_WORLD. When REAL_ROBOT passes the “REF_TELE” gate of the referee box (refer to section 3.2), VIRTUAL_ROBOT will be activated (Teleportation) to travel in VIRTUAL_WORLD. REAL_ROBOT stops until the end of journey.

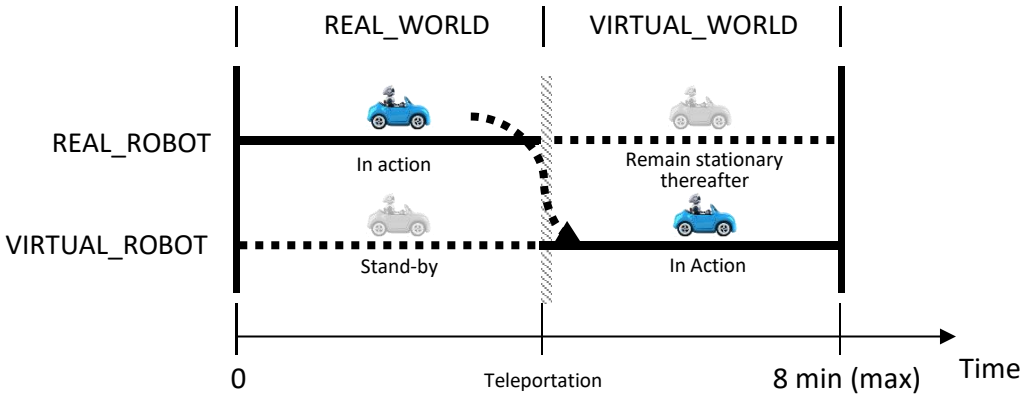


Figure 2: CoSpace Auto-driving process

## 2 Team

### 2.1. Team Members

2.1.1 A CoSpace Auto-driving team should consist of 2 to 4 members. Each participant can only register for one team.

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

2.1.3 Teams with all student members aged 13 to 19 year old can participate in this category. If a team has mixed ages (i.e. both U12 and U19 members), they will be allowed to compete in U19 category. Age is as specified on 1st July in the year of the competition.

2.1.4 Every team member including team captain needs to carry out a technical role for the team (strategy planning, programming, etc.), which should be identified at registration. Each member will need to explain his/her technical role and should be prepared to answer questions regarding the technical aspects of their involvement during preparation for the CoSpace Auto-driving Challenge.

### 2.2 Responsibility

2.2.1 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.
- coding for both real and virtual robots in both real and virtual worlds.
- uploading the correct code to both REAL_ROBOT and VIRTUAL_ROBOT.
- communication with CoSpace Technical Committee and Organising Committee for all CoSpace Autonomous Driving Challenge related matters.

2.2.2 As the space around the competition fields is limited (and crowds can often result in accidents that damage the robots), only the team captain is allowed to operate the real robot, based on the stated rules and as directed by the referee. Other team members (and any spectators) within the vicinity of the real world are to stand at least 150 cm away from the real world while their real robot is active, unless otherwise directed by the referee.

## 3 Referees

### 3.1. Official

3.1.1 A referee is an official who manages the CoSpace Auto-driving games and makes sure that the CoSpace Auto-driving rules are followed.

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

### 3.2. The Referee Box

3.2.1 The organiser will provide a Referee Box that acts as the digital referee for robot in REAL_WORLD. It communicates with the CoSpace server throughout the whole competition. The referee box consists of the "REF_STAT" gate and "REF_TELE" gate.

3.2.2 Once the REAL_ROBOT passes "REF_STAT", the game clock begins. Once the REAL_ROBOT passes "REF_TELE", the team's VIRTUAL_ROBOT will be activated, and the virtual run will be started. It is the organiser's responsibility to ensure the referee box is in good working condition.

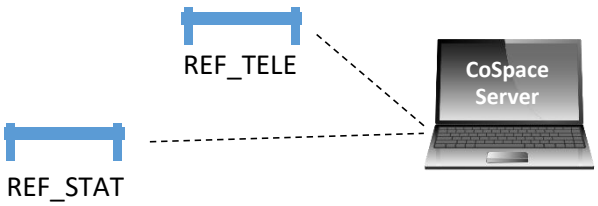


Figure 3: Referee Box

## 4 Human Interference

4.1.1 Except for resetting REAL_ROBOT as permitted by the referee, human interference during the game is not allowed.

4.1.2 In any case, only the team captain is allowed to communicate with the referee.

## 5 Interruption of a Game

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

## 6 Conflict Resolution

### 6.1. Referee

6.1.1 During the CoSpace Auto-driving challenge, the referee's decisions are final.

6.1.2 At the conclusion of a game, the referee will ask the captain to sign the CoSpace Auto-driving result sheet. Captains are given a maximum of 1 minute to review the result and sign. By signing it, the captain accepts the final result on behalf of the entire team. In case of further clarification, the team captain should write their comments on the result sheet and sign it.

6.1.3 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.

6.1.4 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 6.4. This should not interrupt the following games. The referee should follow the instruction given by the chief judge.

### 6.2. Rule Clarification

6.2.1 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 Committee.

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

### 6.3. Special Circumstances

6.3.1 Under special circumstances, such as the occurrence of unforeseen problems or malfunctions of the robot, rules may be modified by the Organizing Committee Chair in conjunction with available Technical Committee and Organizing Committee members, if necessary even during a tournament.

6.3.2 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 in 6.3.1, it will be considered as an endorsement.

### 6.4. Complaint Procedure

6.4.1 Rule issues are not to be discussed during the run. Referee decisions are binding for the CoSpace Auto-driving 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).

6.4.2 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. The chief charge should inform the referee concern about the final decisions.

6.4.3 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.

## 7 Documentation

### 7.1. Poster

7.1.1 Teams are required to submit the Team description Paper (TDP) prior to the event. (https://2024.robocupap.org/download/RCAP2024_TDP_Template.pdf)

### 7.2 Team Presentation Video

7.2.1 Each team is required to submit a team presentation video 3 weeks before the competition. The highlighted videos will be showcased in RCAP Academy YouTube Official Channel (youtube.com/rcapacademy). Template & guidelines will be given by the Technical Committee.

## 8 Code of Conduct

### 8.1 Fair Play

8.1.1 CoSpace Auto-driving 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.

8.1.2 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.

**8.2 Behaviour**

8.2.1 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.

8.2.2 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.

8.2.3 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.

8.2.4 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.

8.2.5 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.

8.2.6 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.

### 8.3 Penalty

8.3.1 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 Auto-Driving Simulator, and direct or indirect control of the behaviours of the RCAP CoSpace Auto-Driving Simulator, such as the scaling of the simulation window is strictly prohibited.

8.3.2 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 8.3.1 for the first time.

8.3.3 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.

### 8.4 Sharing

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

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

8.4.3 RCAP CoSpace Autonomous Driving sharing furthers the mission of RoboCup Asia Pacific as an educational initiative.

### 8.5 Spirit

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

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

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

## CHAPTER 2: FIELDS

## 9 REAL_WORLD (real arena)

### 9.1 REAL_WORLD Dimension

9.1.1 The dimensions of the REAL_WORLD are 180cm x 240cm.

9.1.2 The floor may be either smooth or textured and may have steps and/or gaps of up to 3 mm. It can also be printed on a canvas.

9.1.3 The REAL_WORLD will be placed so that the floor is level.

## 9.2 REAL_WORLD Layout

9.2.1 The REAL_WORLD may consist of any of black guidelines, obstacles, and mysterious tasks.

9.2.2 Guidelines

- The guideline can be black, white or any other distinct colours.
- The guideline (1.8 -2 cm wide) may be made with standard electrical insulating tape or printed onto other materials.
- The guideline forms a path to guide REAL_ROBOT in REAL_WORLD.
- Straight sections of the black guideline may have gaps with at least 5 cm of straight line before each gap. The length of a gap will be no more than 20 cm.

Figure 4: Sample of black

9.2.3 Ramps/Bridges

- There could be ramps/bridges to allow the robots to “climb” up to and down from different levels. Ramps will not exceed an incline of 25 degrees from the horizontal.

9.2.4 Obstacles

The obstacles can be cylinders or cubes. The size, design and colour of obstacles can be varied.

9.2.5 Mysterious Tasks

In REAL_WORLD, there may be mystery tasks that will only be released on the competition day.

9.2.6 Waypoints on REAL_WORLD

The real robot must pass all waypoints in the REAL_WORLD.

Typical REAL_WORLD layout:

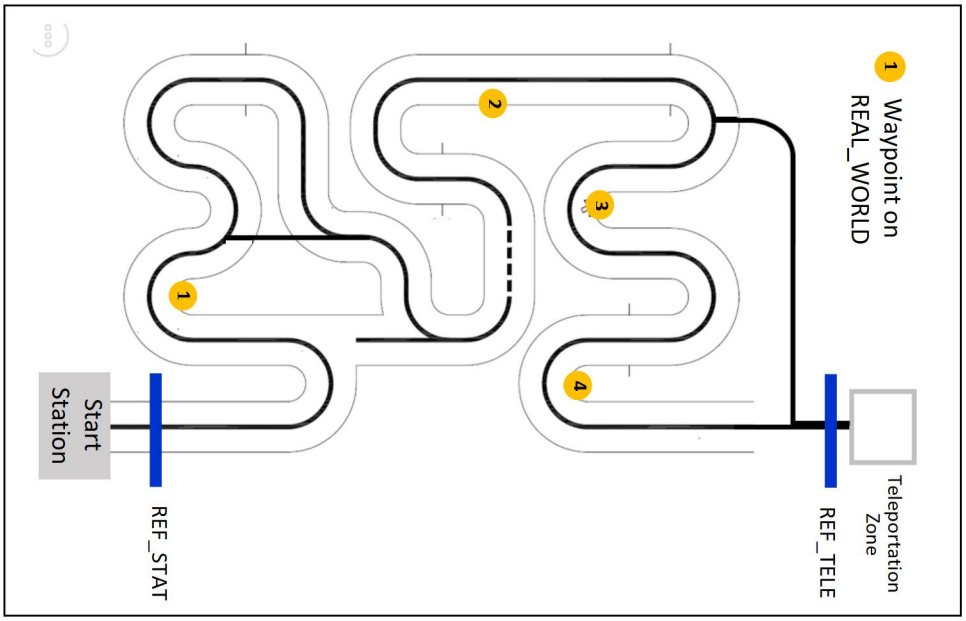


Figure 5: Real Field Layout

### 9.3 Environmental Conditions

9.3.1 The environmental conditions at a tournament will be different from the conditions at home. Teams must come prepared to adjust their robots to the conditions at the venue.

9.3.2 Lighting and magnetic conditions may vary in the CoSpace Auto-driving field.

9.3.3 The field may be affected by unexpected lighting interference (e.g. camera flashes from spectators). Though organizers and referees will do their best to minimize external lighting interferences, teams should also prepare their robots to handle such interferences.

## 10 VIRTUAL_WORLD

### 10.1 VIRTUAL_WORLD Layout

10.1.1 The VIRTUAL_WORLD may consist any of black/white guidelines, obstacles, gantries, waypoints, detour markers, or mysterious tasks. The surface colour will not distract the robot's detection or movement.

10.1.2 Black/White Guidelines

- There will be black line on light road or white guideline on dark road.
- The black/white guideline forms a path to guide the virtual robot.
- Straight sections of the black/white guideline may have gaps with at least 5 cm of straight line before each gap. The length of a gap will be no more than 20 cm.

Figure 6: Black / white guideline

10.1.3 Obstacles

The virtual obstacles can be walls, buildings, cylinders, or cubes. The size, design and colour of obstacles can be varied.

10.1.4 Gantries

Gantry is an overhead assembly on which certain signs or signals are posted. Gantry will not block the road. The design and colour of gantries can be varied.

Figure 7: Example of a gantry

10.1.5 Waypoints

The virtual robot needs to pass all waypoints in the virtual environment. The size of waypoint is not fixed. It is orange in colour.

Figure 8: Waypoint

### 10.1.6 Detour Markers

There are some colour markers in virtual VIRTUAL_WORLD to help robots to make decision at junctions. The marker can be of any colour.

Figure 9: Sample of detour markers

### 10.1.7 End Markers

This is the terminal point of the Black/White guideline.

Figure 10: Termination marker

### 10.1.8 Finish Lines

The mission is completed when VIRTUAL_ROBOT passes the finish line. The finish line will be indicated by the following symbols.


Figure 11: Finish Line

Typical VIRTUAL_WORLD layout:


Figure 12: VIRTUAL_WORLD Layout

# CHAPTER 3: ROBOT

## 11 REAL_ROBOT

Teams are required to have their own Standard Robot Platform for the challenge.

### 11.1 REAL_ROBOT Construction

11.1.1 The basic design of the REAL_ROBOT consists of a battery holder, a chassis, motors, electronics, controllers and sensors. Teams should follow the instruction manual to complete the necessary mechanical mounting and electrical connections. The REAL_ROBOT has the following configuration:

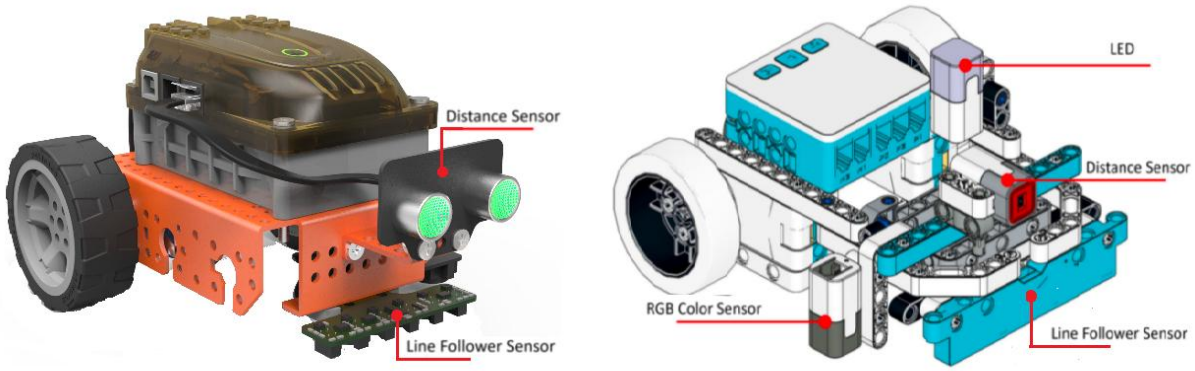


Figure.13 REAL_ROBOT Configuration

11.1.2 It is team's responsibility to ensure the real robot is in good working condition to avoid any issues caused by the real robot during the real game. The robot should be fully charged.

11.1.3 Teams should have sufficient batteries for the games. Organiser will NOT provide batteries.

11.1.4 Teams are not allowed to change the motors, controllers, sensors, layout, and structures of the assembled real robot in this challenge.

11.1.5 It is encouraged to make the robot carry a small flag with a team name and team ID.

### 11.2 REAL_ROBOT Control

11.2.1 The 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.

11.2.2 REAL_ROBOT must be started manually by the team captain.

## 12 VIRTUAL_ROBOT

### 12.1 VIRTUAL_ROBOT Configuration

12.1.1 The VIRTUAL_ROBOT configuration is as follows:

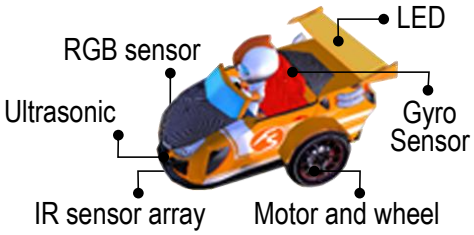


Figure 14: Virtual robot

## 13 Robot Coding

### 13.1 Coding for REAL_ROBOT

13.1.1 Teams can use GUI or C to program the REAL_ROBOT to complete the task in REAL_WORLD.

13.1.2 Teams need to calibrate the sensors of the REAL_ROBOT based on lighting conditions of the field for better performance.

### 13.2 Coding for VIRTUAL_ROBOT

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

# CHAPTER 4: GAMEPLAY, JUDGING AND AWARD

## 14 Gameplay

### 14.1 Release of Task

14.1.1 The Organising Committee will announce the tasks for both real and virtual challenges in the competition hall.

### 14.2 Submission of 1st AI

14.2.1 The chief judge will announce the time for AI submission of the first AI in the competition hall.

14.2.2 Each team must submit their first AI strategy which is created during the programming period (we'll call it AI_1) to the chief judge.

### 14.3 Start of Each Round of Game

14.3.1 5 minutes before each run, team captains must report to the referee at their respective game stations.

14.3.2 The 1st run will use the AI_1 submitted at the end of the coding session. No re-submission of AI_1 is allowed.

14.3.3 Starting from the 2nd run onwards, teams are allowed to submit a revised version of their AI to the referee if they wish to make a change to the previous AI. This has to be done 5 minutes before each run.

11.3.4 The referee will continue to use the AI_1 or the previous version of AI if there is no submission of revised AI received 5 minutes before the run. The referee must confirm the correct AI to use with the team captain.

14.3.5 No modification of AI is allowed once the run begins.

### 14.4 Real Run

14.4.1 The team captain will upload the programs to the REAL_ROBOT, place the REAL_ROBOT in the initial station in REAL_WORLD as instructed by the referee.

14.4.2 It is the team captain's responsibility to ensure that the correct program is uploaded.

14.4.3 Team captains must be present during the full length of the real run.

14.4.4 Teams will be given 2 minutes for last-minute calibration and testing of the REAL_ROBOT on the real field before the start of the real run.

14.4.5 The Team captain will need to follow the referee's instruction to place the real robot at the designated "START" station. Refer to figure 5.

14.4.6 The team captain will manually start the REAL_ROBOT. The clock begins when the robot passes the "REF_STAT" gate.

14.4.7 REAL_ROBOT is required to pass all waypoints in any order and complete any mystery tasks between the "START" and "END" stations. Refer to figure 5.

14.4.8 The real robot does not need to stop for a period at the waypoints when it passes them. Teams are encouraged to make use of colour makers to plan the best path unless the path is specified by the referee.

14.4.9 A lack of progress occurs when:

(a) the team captain declares a Lack of Progress
(b) the robot loses the black line without regaining it back
(c) a robot does not follow the indicated direction
(d) a robot fails to complete the mysterious task.

14.4.10 If a Lack of Progress occurs, the referee will instruct the team captain to remove the real robot from the track and re-located to the place which 30cm behind from the position where "Lack of Progress" occurs.

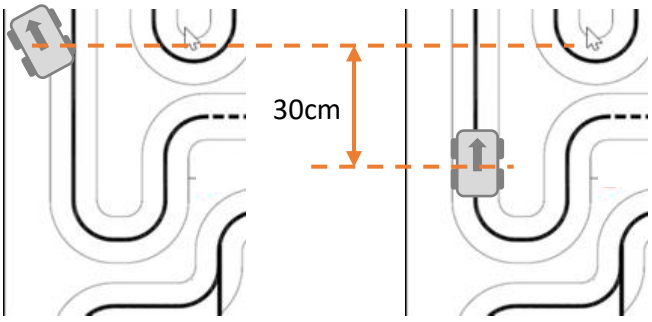


Figure 15: Re-location of real robot after Lack of Progress

14.4.11 After the real robot is placed on the re-start line, the referee must confirm the placement and instruct the team captain to continue the run.

14.4.12 After a Lack of Progress, the team may reset the power supply (turn the robot off and on) and subsequently restart the program. The team is not allowed to change the program, give any information about the field to the robot, or repair the robot.

14.4.13 There will be maximum of 3 re-starts allowed each run. The number of the re-starts will not be considered as further penalty in any form.

14.4.14 When REAL_ROBOT passes the REF_TELE gate, it should stop and VIRTUAL_ROBOT should be activated. The game clock continues. If the REAL_ROBOT fails to move to the REF_TELE gate, the VIRTUAL_ROBOT will not be activated.

### 14.5 Virtual Run

14.5.1 The referee will upload the programs onto the CoSpace server and place the VIRTUAL_ROBOT in the initial station in the VIRTUAL_WORLD.

14.5.2 It is the team captain's responsibility to ensure that the correct program is uploaded.

14.5.3 Team captains must be present during the virtual run.

14.5.4 The VIRTUAL_ROBOT will be activated only when the REAL_ROBOT passes the REF_TELE gate.

14.5.5 VIRTUAL_ROBOT is required to pass all waypoints or gantries successfully in any order. VIRTUAL_ROBOT is required to stop at each waypoint with LED flashing for 2 seconds. The VIRTUAL_ROBOT must move away automatically afterwards.

14.5.6 The VIRTUAL_ROBOT should avoid all obstacles.

14.5.7 Teams are encouraged to make use of Detour Markers to plan the best travel route.

14.5.8 When VIRTUAL_ROBOT reaches the "Finish" line, the game ends.

## CHAPTER 5: JUDGING AND AWARDS

### 15.1 Ranking

The teams are ranked as follows:

| | Situation | Rank |
|---|---|---|
| Tier 1 | • REAL_ROBOT passes all waypoints.<br>• VIRTUAL_ROBOT passes all waypoints.<br>• VIRTUAL_ROBOT reaches the finish line. | • The team rank is determined by the game time at the finish line in the VIRTUAL_WORLD. |
| Tier 2 | • REAL_ROBOT passes all waypoints.<br>• VIRTUAL_ROBOT is not able to passes all waypoints (regardless of whether it reaches the finish line or not) | • The total travelling time for the VIRTUAL_ROBOT to reach the last waypoint will be recorded.<br>• The team rank will be determined based on the number of waypoints passed followed by the game time. |
| Tier 3 | • REAL_ROBOT is not able to passes all waypoints in REAL_WORLD even after 3 re-starts. | • The team rank will be determined based on the number of waypoints pasted in the REAL_WORLD. The team passes more waypoints will be considered to have better ranking.<br>• In any case, teams will be given a chance to run in VIRTUAL_WORLD.<br>• If two teams have passed the same number of waypoints regardless of actual position of waypoints in the REAL_WORLD, then the team having better performance in VIRTUAL_WORLD is considered to have better ranking. |

### 15.2 Awards

Depending on the number of teams entering the competition, there will be awards (trophies and certificates). The Organizing Committee can adjust the award type (trophy or certificate) if needed.

RCAP CoSpace Technical Committee

**Contact us:**

Rule clarification: cospace@robocupap.org
Technical support: support@CoSpaceRobot.org

## Appendix 1: Preparation of Technical Interview

1. What kind of strategy / methodology / AI algorithm was used to control robot?
2. How did you use the above-mentioned method to solve the problem? Please explain in detail.
3. What was the major issue you need to consider during the implementation?
4. Can the algorithm be able to adapt to other map or scenarios?
5. What was the most innovative idea in your program?
6. Have you considered other algorithms? If yes, why did you select the current method instead of others? What was your evaluation criteria?