

RCAP CoSpace Rescue Rules 2020 (CoSpace Rescue, Category FirstSteps)

These are the official rules for the RoboCup Asia Pacific (RCAP) 2020 CoSpace Rescue Challenge. They are released by the RoboCup Asia Pacific CoSpace Rescue Technical Committee. The English rules have priority over any translations. **Changes from the 2019 rules are highlighted in red.**

PREFACE

In RCAP CoSpace Rescue Challenge, teams have to develop and program appropriate strategies for both real and virtual autonomous robots to navigate through the real and virtual worlds to collect objects while competing with another team's robot that is searching and collecting objects in the same real and virtual worlds.

In the RCAP CoSpace Rescue Challenge, students need to make their own robot, code the robot, and finally take part in the CoSpace Rescue Challenge.

The RCAP CoSpace Rescue Simulator is the only official platform for the sub-league. This simulator allows programs to be developed using a graphical programming interface or C language. Participation teams can contact support@cospacerobot.org for RCAP CoSpace Rescue Simulator download, help and assistance.



Figure 1: CoSpace Rescue FirstSteps Challenge



Contents

PREFACE	1
1 Team.....	4
1.1. Team Members	4
1.2. Team Captain	4
2 CoSpace Rescue Description	4
2.1 Game process	4
2.2 VIRTUAL_WORLD	4
2.3 Competition Setup	5
3 Arena	5
3.1 Dimensions	5
3.2 Floor.....	5
3.3 Boundary	5
4 VIRTUAL_WORLD Layout.....	5
4.1 Markers	5
4.2 Special zones	5
4.3 Obstacles	6
4.4 Traps	6
4.5 Object Collection Boxes	6
4.6 Robot Coordinates	7
5 Objects	7
5.1 Basic Objects	7
6 Robot.....	8
6.1 VIRTUAL_ROBOT Configuration	8
6.2 ROBOT Control	8
6.3 Lighting.....	8
7 Gameplay	8
7.1 Pre-setup	8
7.2 Pre-round Practice	8
7.3 Game Procedure	9
7.4 Scoring	10
7.5 Human Interference.....	11



7.6	Relocation.....	11
7.7	Penalty.....	11
7.8	Interruption of Game.....	12
8	Conflict Resolution.....	12
8.1	Referee.....	12
8.2	Rule Clarification.....	12
8.3	Special Circumstances.....	12
9	Documentation.....	12
9.1	Learning Journal.....	12
9.2	Poster.....	13
10	Judging and Award.....	13
10.1	Technical Interview (International level Games).....	13
10.2	Friendship Tournament.....	13
10.5	Winner.....	13
10.6	Awards.....	14
11	Code of Conduct.....	14
11.1	Fair Play.....	14
11.2	Behaviour.....	14
11.3	Sharing.....	14
11.4	Spirit.....	15
12	APPENDIX A: Competition Setup.....	16
13	APPENDIX C: List of Objects.....	17
14	APPENDIX E: Interview Key Points.....	17



1 Team

1.1. Team Members

1.1.1 A CoSpace Rescue team should consist of 2 to 4 members. Each participant can only register for one team. 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.

- U12 group: Teams with all students aged 7 to 12-year-old can participate in this category.
- U19 group: Teams with all student members aged 13 to 19 year old can participate in this category. If a team has mixed ages (with both U12 and U19 members), they will be allowed to compete in U19 category.

Age is specified as on 1st July in the year of the competition.

1.1.3 Every team member needs 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 Rescue Challenge.

1.1.4 Teams should be responsible for checking updated information (schedules, meetings, announcements, etc.) during the event.

1.2. Team Captain

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

1.2.2 As the space around the competition fields is limited (and crowds can often result in accidents that damage the robots), only 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.

2 CoSpace Rescue Description

2.1 Game process

2.1.1 **For RCAP CoSpace Rescue FirstSteps groups. A game lasts 5 minutes**, with two teams competing in one game. A game consists of only one virtual world.

2.1.2 **For RCAP CoSpace Rescue FirstSteps groups.** A team must program VIRTUAL_ROBOT to navigate and collect objects in VIRTUAL_WORLD.

2.2 VIRTUAL_WORLD

2.2.1 In VIRTUAL_WORLD, VIRTUAL_ROBOT searches for **3** types of objects, RED, CYAN and BLACK objects. VIRTUAL_ROBOT has to collect the objects and deposit them in the collection box to receive points. It cannot collect more than 6 objects at any one time without depositing them in the collection box.

2.2.2 **There is no SUPER or SUPER+ objects for RCAP CoSpace Rescue FirstStep group. Bonus points will be awarded for every set of RED, CYAN and BLACK objects collected and deposited successfully in one single trip to the collection box.**

2.3 Competition Setup

2.3.1 A Team must be able to program VIRTUAL_ROBOT.

2.3.2 Virtual robots must be controlled autonomously.

2.3.3 The use of a remote control to manually control virtual robots is not allowed.

3 Arena

3.1 Dimensions

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

3.2 Floor

3.2.1 VIRTUAL_WORLD

- The VIRTUAL_WORLD is a 3D simulated environment. The floor is not restricted to white or light colour. However, the colour objects, collection box, special zones, etc., can still be distinguished.

3.3 Boundary

3.3.1 VIRTUAL_WORLD

- **For RCAP CoSpace Rescue FirsSteps groups:** VIRTUAL_WORLD will be enclosed by a wall of height 20 cm.

Appendix A shows the sample layout of VIRTUAL_WORLD.

4 VIRTUAL_WORLD Layout

VIRTUAL_WORLD contains various elements as follows:

4.1 Markers

4.1.1 There may be some markers in the virtual world. The makers can be used to help the virtual robot for its localization, guidance, etc. The minimum size of the marker is 2cm x 2cm. The colour and shape of the marker is not fixed.

4.2 Special zones

4.2.1 Certain areas in the virtual world are designated as special zones. RED, CYAN and BLACK objects collected in these areas are worth double points. The special zone is blue in colour as shown in figure 3. The special zones have a minimum size of 30cm x 30cm. The shape of the special zone is not fixed.

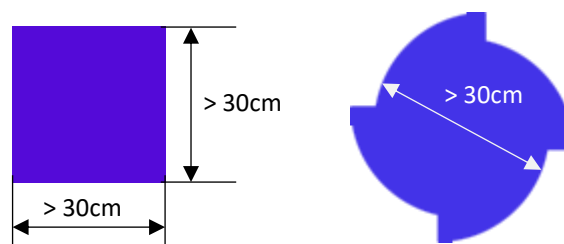


Figure 3: Sample of Special Zones

4.3 Obstacles

4.3.1 Obstacles found in real and virtual worlds can be of any size, any shape with the minimum dimensions of 10cm x10cm.

4.4 Traps

4.4.1 Traps are surrounded by a yellow boundary as shown in figure 4. The minimum size of the trap is 10cm x 10cm. The traps can be any colour. The shape of traps is not fixed. If a robot goes over a trap it will lose any objects it is currently carrying.

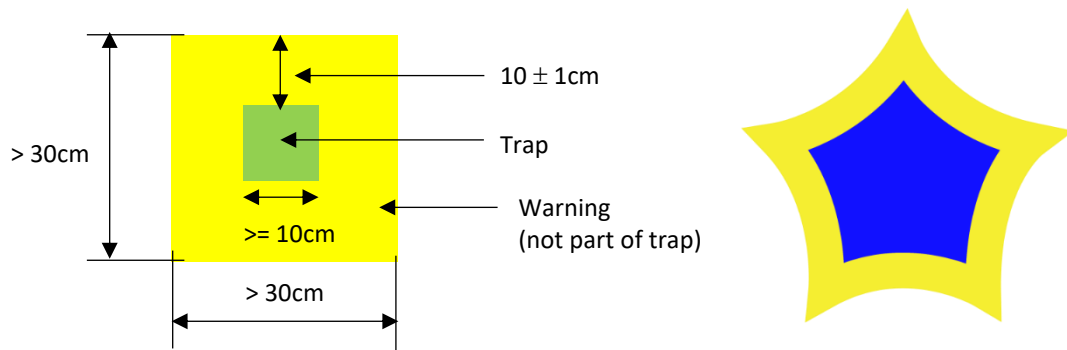


Figure 4: Sample of Traps

4.5 Object Collection Boxes

4.5.1 Figure 5 shows the object collection box. The collection box is ORANGE in colour. The dimensions can be (30 ± 3) cm x (30 ± 3) cm. The collection box can be any shape.

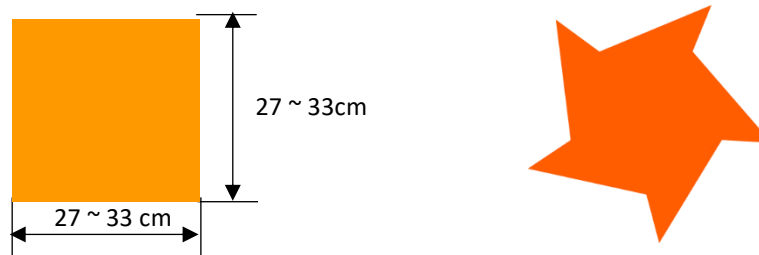


Figure 5: Sample of object collection boxes

4.6 Robot Coordinates

- 4.6.1 For RCAP CoSpace Rescue FirstSteps groups, the system will divide the map into a 3x3 matrix. The CoSpace Server will send the robot its approximate location while the robot is searching in the VIRTUAL_WORLD.

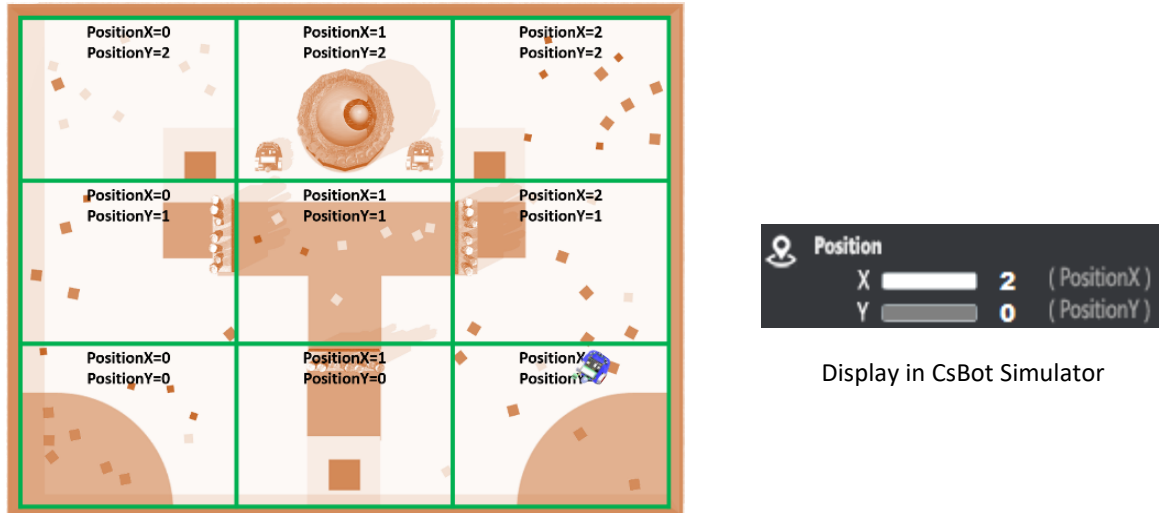


Figure 6: Position system for robot in VIRTUAL_WORLD

5 Objects

5.1 Basic Objects

- 5.1.1 There are THREE types of objects, RED, CYAN, and BLACK located randomly throughout the course. The thickness of each object is less than 2mm. Each type of objects worth different value (refer to section 7.4.2).

- 5.1.2 Colour, size and shape of the objects

Colour, size and shape of the objects will be different. Appendix C shows the details.

6 Robot

6.1 VIRTUAL_ROBOT Configuration

6.1.1. The RCAP CoSpace Rescue Challenge uses a Standard Platform. The basic design of the VIRTUAL_ROBOT consists of a battery holder, a chassis, motors, electronics, controllers and sensors. The REAL_ROBOT has the following configuration:

- 3 ultrasonic sensors
- 1 gyro sensor
- 2 RGB sensors
- 2 DC motors
- 1 LED for status indication
- 1 XBee

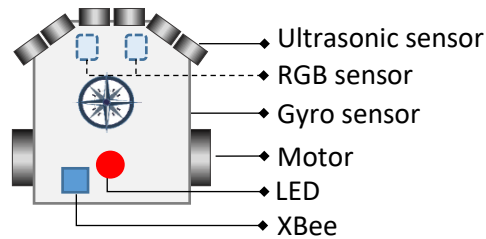


Figure 9: REAL_ROBOT configuration

6.2 ROBOT Control

6.2.1 VIRTUAL_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.

6.2.2 Any pre-mapped type of dead reckoning strategy (movements predefined based on known locations or placement of features in the field) is prohibited.

6.2.3 REAL_ROBOT must not damage any part of the field in any way.

6.3 Lighting

6.3.1 The lighting condition for the virtual worlds could be varied. Teams must be able to perform calibration in order to complete the mission.

6.3.2 For teams using real robot, please note that picture taking by spectators might create IR and visible light into the real-world setup and to the real robots. Whilst efforts will be made to limit this, it is very difficult for organizers to strictly control factors outside of the real world. Teams are strongly encouraged to program their real robots so that sudden changes (e.g. camera flash) do not cause major problems.

6.3.3 Every effort will be made by the organizers to locate the real world away from sources of magnetic fields such as under-floor wiring and metallic objects, however, sometimes this cannot be avoided.

7 Gameplay

7.1 Pre-setup

7.1.1 The layout of VIRTUAL_WORLD will be released to teams prior to the tournament.

7.2 Pre-round Practice

7.2.1 Wherever necessary, teams will have an access to a practice field for calibration. Teams can calibrate their sensors ONLY before a game at the real field. Calibration is defined as the taking of sensor readings and modifying of the real robot's program to accommodate such sensor readings. Calibration can be done in as many locations as desired.



7.3 Game Procedure

7.3.1 A referee is an official who receives and uploads teams' programs as well as runs the games.

7.3.2 At the end of each programming period

- (a) The chief judge will announce the time for program submission in the competition hall.
- (b) 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.

7.3.3 5 minutes before each game

- (a) Team captains must report to the referee at the respective game stations.
- (b) Teams are allowed to change the AI before each game (ONLY ONCE) and submit the revised version to the referee. The referee will continue to use AI_1 if there is no revised AI submission.

7.3.4 3 minutes after the scheduled game time

- (a) If a team has not arrived at the game station 3 minutes after the scheduled game time, the team will forfeit the game. The opponent will gain 500 points and be declared as the winner. Kindly note that the scheduled game time might be delayed.

7.3.5 Pre-match Meeting

- (a) Each team will be assigned a team colour (BLUE or RED). At the start of the game, the referee will toss a coin. The result determines the teams' colour.

7.3.6 Start of Play

- (a) Virtual game
 - The referee will upload the programs to the CoSpace server, place the team's robot in the starting point in the virtual world and start the virtual game.
 - It is the team captain's responsibility to ensure that the correct program is uploaded.
 - Team captains must be present during the full length of the game.



7.4 Scoring

7.4.1 A team will be given 100 points at the beginning of each game.

7.4.2 Collecting objects

A team will gain points by collecting the objects.

To indicate that a robot has collected an object, it must stop and flash the LED for 3 seconds when any one of the color sensor has detected the object.

Object Type	Points in Virtual World	
	Regular Zone	Special Zone
RED	10	20
CYAN	15	30
BLACK	20	40

- (a) A virtual robot cannot collect more than 6 objects at any one time without unloading or depository them in the collection box.
- (b) Objects in the real world will NOT disappear after they are collected. It is team's responsibility to program their robot such that it moves away from the same real object and search for others. Collecting the same objects consecutively will not be counted.
- (c) Objects in the virtual world will disappear after they are collected.

7.4.3 Depositing objects

When a robot deposits objects successfully, the points of the objects deposited will be doubled.

"Robot deposits objects successful" means:

- A robot must stop inside the collection box with the LED steady ON for 3 seconds to indicate the depositing process;
A robot is only considered to be in the collection box when the colour sensor detects the collection box (the colour sensor is in the collection box).
- The robot will exit the collection box autonomously after deposition (the colour sensor is out of the collection box).

7.4.4 Bonus points (only for REAL_WORLD)

- (a) For every ONE set of RED, CYAN and BLACK objects collected and deposited successfully (in one single trip to the collection box) in VIRTUAL_WORLD, 90 bonus points will be rewarded. There will be no SUPER objects generated in VIRTUAL_WORLD.
- (b) For every TWO sets of RED, CYAN and BLACK objects collected and deposited successfully (in one single trip to the collection box) in VIRTUAL_WORLD, 180 bonus points will be rewarded. There will be no SUPER+ objects generated in VIRTUAL_WORLD.

7.4.5 Falling into a Trap



If a virtual robot falls into a trap (refer to section 4.4), all objects that have been collected but not yet placed in the object collection box (refer to section 4.5) will disappear. Therefore, the points awarded for those objects collected will be deducted.

A virtual robot is considered to be in the trap if any one of the robot's color sensor has detected the trap.

7.4.6 Game Points

After each match, following GAME POINTS will be given accordingly.

Game	GAME POINTS
Win	3
Tie	1
Loss	0

7.5 Human Interference

7.5.1 Except for a lack of progress, human interference (e.g. re-locate a virtual robot to any reset point) during the game is not allowed unless permitted by the referee. A violation of the rules may be penalized by disqualification from the tournament, the round or may result in loss of points at the discretion of the referee, officials, organizing committee or general chairs.

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

7.6 Relocation

7.6.1 In virtual game, the team captain can request to relocate the VIRTUAL_ROBOT to a different location for the following case:

- (a) VIRTUAL_ROBOT is looping
- (b) VIRTUAL_ROBOT is not performing well.

Upon team's request, the referee will call "RELOCATE" and relocate the VIRTUAL_ROBOT to a different location but close to where it was with different orientation. However, the robot will be frozen for 10 seconds after relocation. Each team can only call relocation **up to 3 times** in VIRTUAL_WORLD in each game. The referee will keep track of the number of relocations requested.

7.6.2 In virtual game, when a virtual robot is stuck for 10 seconds, the robot will be relocated to a different location but close to where it was with different orientation by the CoSpace server automatically. After relocation, the VIRTUAL_ROBOT will not be frozen for another 10 seconds. The relocation by CoSpace server will not be recorded as in section 7.6.1.

7.6.3 A team may decide to stop a round early if the lack of progress cannot be resolved within the first 5 minutes. In this case, the team captain must indicate to the referee the team's desire to terminate the game. The team will be awarded all points achieved.

7.7 Penalty

7.7.1 It is compulsory for teams to specify the team name in virtual games. Teams will be given a verbal warning if they failed to do so for the first time. The team will be disqualified for the current game if the team fails to add the team name for the second time in a virtual game.



7.7.2 If a virtual robot is hit/attacked by another virtual robot, the attacking robot will be separated from the attacked robot and repositioned at the same location with different orientation (if there is collision), and be frozen for 10 seconds. There will be no point deduction.

7.7.3 If two virtual robots bump into each other, both robots will be separated from each other and repositioned at the same location with different orientation (if there is collision). Both robots will be frozen for 10 seconds. There will be no point deduction.

7.8 Interruption of Game

7.8.1 In principle, a game will not be stopped during gameplay.

7.8.2 The referee can end a game when all objects have been collected by the robots.

7.8.3 The referee can pause a game when the game coordinator/referee needs to discuss an issue/problem with the OC/TC. The game will be called “time-out” in this case.

7.8.4 Teams are not allowed to quit a game 5 minutes after the game started.

8 Conflict Resolution

8.1 Referee

8.1.1 During a gameplay, the referee’s decisions are final.

8.1.2 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.

8.2 Rule Clarification

8.2.1 It is team’s responsibility to verify at the RoboCup Asia Pacific Official website on the latest version of the rules prior to the competition. If any rule clarification is needed, please contact the RCAP CoSpace Rescue Technical Committee.

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

8.3 Special Circumstances

8.3.1 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.

8.3.2 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 8.3.1, it will be considered as an endorsement.

9 Documentation

9.1 Learning Journal

9.1.1 The learning journal submission is required for FirstSteps group only.



9.1.2 Each team must bring a learning journal or any form of documentation describing the information about the team, their preparation efforts in programming and how they prepared for RCAP. The learning journal must be presented during the interview, and may be called upon to help establish the authenticity of a team's performance.

9.2 Poster

9.2.1 Teams will be given some public space to display their poster. The size of the poster should be no larger than A1 (60 x 84 cm). The poster should be brought along to the technical interview. After the interview the poster should be displayed in the location indicated.

9.2.2 The aim of the poster is to explain the technology used in the robots. It should include:

- Team name;
- Team members' names and (perhaps) a picture of the team members;
- Team's country and location within country;
- Team's track record;
- Description of algorithm used for developing the searching and placement strategies;
- Any interesting or unusual features of their programs;
- What the team hopes to achieve in robotics.

10 Judging and Award

10.1 Technical Interview (International level Games)

10.1.1 It is compulsory for all teams to attend the technical interview. Teams may take the "interview key points" for reference while preparing their interview. Refer to Appendix E.

10.1.2 During the interview, students will be asked about their preparation efforts.

For FirstSteps group: Teams are required to bring the leaning journal and give a 5-minute technical presentation. A 5-10 minutes Q&A will also be carried out.

10.2 Friendship Tournament

10.2.1 A friendship tournament will be setup for teams that could not reach the quarter-finals. The minimum number of teams participating in the friendship tournament is 4.

10.2.2 Teams will draw lots to determine the team to play with. At the end of a match, the winning team must continue on to the next match. The losing team can modify the program and play again, or withdraw its participation. The challenge will be carried out during the specific duration announced by the RCAP CoSpace Rescue Organizing Committee onsite. The last survivor will be the winner.

10.5 Winner

10.5.1 Round Robin

- If two teams gained the same result, the winner will be decided based on the technical challenge result. If the technical challenge results are still the same, the winner will be decided based on the total round robin points. If the total round robin points are still the same, the team with the higher points in VIRTUAL_WORLD will be the winner.

10.5.2 Quarter-Finals, Semi-finals and Final



- The winner of the quarter-finals, semi-finals and final will be decided solely based on the quarter- /semi- /final game result.
- If match tie, the team with the higher points in VIRTUAL_WORLD will be the winner.
- If the points in VIRTUAL_WORLD tie, the teams will move to go re-match.

10.5. Friendship Tournament

- The winner will be the last survivor of the Friendship Tournament.

10.6 Awards

Depending on the number of teams entering the competition, there will be awards for trophies and certificates. The Organizing Committee can adjust the award type (trophy or certificate) if needed. Trophies and certificates will be awarded for FirstSteps, U12 and U19 group. These awards list will be released closer to the event.

11 Code of Conduct

11.1 Fair Play

11.1.1 Humans that cause a deliberate interference with real robots or damage to the real field setup will be disqualified.

11.1.2 It is expected that the aim of all teams is to participate fairly.

11.2 Behaviour

11.2.1 If one team copies a program from another team, both teams will be disqualified.

11.2.2 Teams will be disqualified for deliberately trying to lose the game or tie with the opponent team.

11.2.3 Team members should be mindful of other people and their robots when moving around the tournament venue.

11.2.4 Team members are not to enter setup areas of other leagues or other teams, unless expressly invited to do so by referee.

11.2.5 Team members who misbehave may be asked to leave the building and risk being disqualified from the tournament.

11.2.6 These rules will be enforced at the discretion of the referees, officials, tournament organizers and local law enforcement authorities.

11.2.7 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 programming of students' robots. Mentor interference with robots or referee decisions will result in a warning in the first instance. If it reoccurs, the team will risk being disqualified.

11.3 Sharing

11.3.1 Teams are encouraged to share their programming and strategies to the members from other teams.

11.3.2 Any developments may be published on the RCAP website after the event.



11.3.3 This furthers the mission of RoboCupJunior as an educational initiative.

11.4 Spirit

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

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

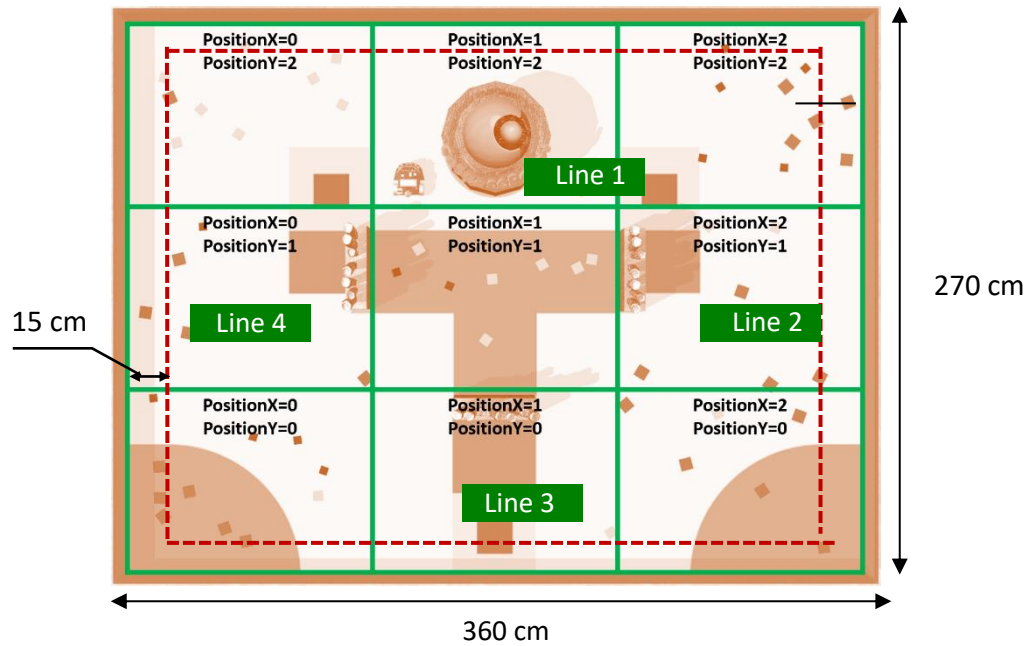
11.4.3 It is not whether you win or lose, but how much you learn that counts!

Rule clarification: RCAP_Challenge@CoSpaceRobot.org

Technical support: support@CoSpaceRobot.org

12 APPENDIX A: Competition Setup

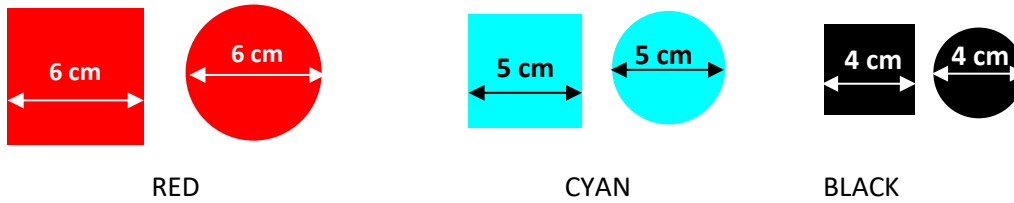
VIRTUAL_WORLD (FirstSteps Group):



- The VIRTUAL_WORLD is a 3D simulated environment. The floor is not restricted to white or light colour. However, the colour objects, collection box, special zones, etc., can still be distinguished.
- For RCAP CoSpace Rescue FirstSteps groups: VIRTUAL_WORLD will be enclosed by a wall of height 20 cm.

13 APPENDIX C: List of Objects

The colour, shape, and size of objects is fixed. They are square or round shape in general.



14 APPENDIX E: Interview Key Points

14.1 FirstSteps Group

1. What was the strategy to solve certain task in your program? Was there any other way to do it? What was the advantage of your method over the others?
2. How would you modify your program if.....? (e.g. collection box in a different location, swampland here, lots of black objects in the special zone)
3. Are you able to program a robot to complete a certain task?
4. What have you learnt through the CoSpace Rescue Challenge?
5. The explanation should be clear and logical.