RoboCupJunior CoSpace Rescue Rules 2013

RoboCupJunior CoSpace Technical Committee 2013:
Jiayao Shen (Singapore), jyshen@sp.edu.sg
Martin Bader (Germany), martin_bader@gmx.de
Josie Hughes (UK), jaeh2@cam.ac.uk
Baogang Wang (China), ziyunxinxi@126.com

RoboCupJunior CoSpace Technical Consultant:
Tianwu Yang (Singapore), yangtw@sp.edu.sg

This document contains the official rules for RoboCupJunior CoSpace Rescue 2013, and is released by the RoboCupJunior CoSpace Technical Committee. The rules contained in this document have priority over any translations. Differences between the RoboCupJunior CoSpace Rescue (Demo) 2012 rules and the RoboCupJunior CoSpace Rescue 2013 rules are highlighted in red.

PREFACE

In CoSpace Rescue, a team has to develop appropriate strategies for both real and virtual autonomous robots to navigate through the real and virtual worlds to collect objects while also competing with other team's robots that are searching and collecting objects in the same real and virtual worlds.

GENERAL RULES

1 GAME DESCRIPTION

1.1 Primary Category

1.1.1 Game process

(a) The CoSpace Rescue Challenge for the PRIMARY CATEGORY consists of 2 virtual games in 2 stages. The whole duration is 8 minutes.

(b) In stage 1, a virtual robot (Robot_1) navigates in the virtual world 1 for at least 1 minute and a maximum of 3 minutes to collect virtual objects. In stage 2, the team's second virtual robot (Robot_2) navigates in the virtual world 2 for the remaining period and collects virtual objects. Teams have to program both virtual robots and establish communication between them to complete the mission and score as many points by collecting objects. Figure 1 shows the details.

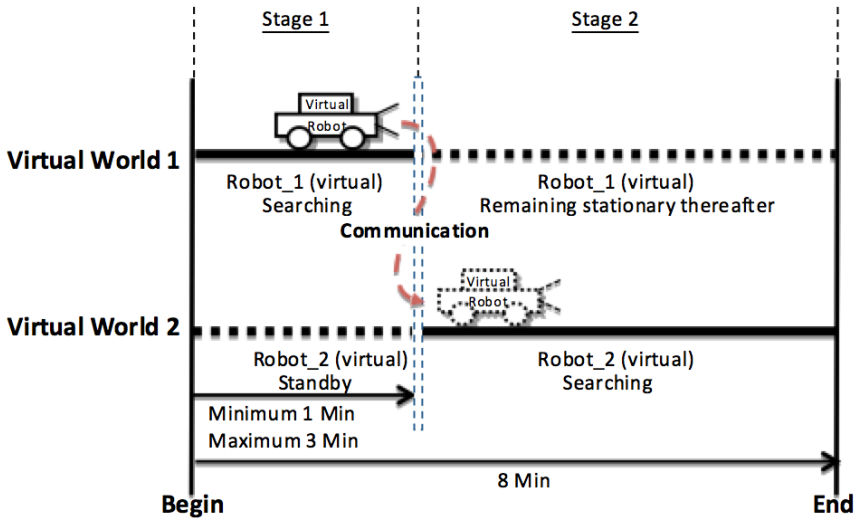


Figure 1: Primary Category Game Process

1.1.2 Stage 1: Virtual Game in virtual world 1

(a) The challenge begins with virtual Robot_1 navigating in virtual world 1 while the virtual Robot_2 is 'standing by' in the virtual world 2.

(b) In virtual world 1, Robot_1 searches for 3 types of objects, RED, GREEN, and BLACK objects. Robot_1 cannot collect more than the maximum number of objects without placing them in the collection box. The maximum number will be designed and announced on-site by the OC (see section 4.7.10).

(c) Any one set of RED, GREEN and BLACK objects that are deposited with one single trip to the collection box will result in the formation of one SUPER object. The SUPER object carries higher scores (see section 4.7.6). ONLY the SUPER objects formed from a set of red, green and black objects will be transferred to the virtual world 2 automatically upon the activation of Robot_2 (see section 2.8.4 and 3.2.5).

1.1.3 Virtual Worlds Communication

(a) Robot_1 will need to send a communication signal to activate the team's Robot_2 at any time after 1 minute within the first 3 minutes whilst ending its own movement. The minimum duration for which Robot_1 can moves in virtual world 1 is 1 minute and the maximum duration is 3 minutes.

(b) The communication signal sent by the Robot_1 within the first 1 minute is invalid.

(c) If Robot_1 fails to communicate with the Robot_2 by the end of the 3 minutes, the CoSpace server system will stop Robot_1 and activate the Robot_2 (see section 3.2.3).

(d) Only one robot can move at any one time. When Robot_1 moves in virtual world 1, Robot_2 must be in standby mode. When the Robot_2 is activated, Robot_1 stops until the end of the game.

1.1.4 Stage 2: Virtual Game in virtual world 2

(a) The virtual Robot_2 will be activated when it receives a communication signal from the virtual Robot_1 or the CoSpace System Server (see section 3.2.4).

(b) In the virtual world 2, Robot_2 searches for 4 types of objects, RED, GREEN, BLACK and SUPER objects. The Robot_2 cannot collect more than the maximum number of objects without placing them in the collection box. The maximum number will be designed and announced on-site by the OC (see section 4.7.10).

(c) One set of virtual RED, GREEN and BLACK objects found in virtual world 2 will NOT form a SUPER object.

1.2 Secondary Category

1.2.1 Game process

(a) The CoSpace Rescue Challenge for SECONDARY CATEGORY consists of a real game, and a virtual game. The whole duration is 8 minutes.

(b) In stage 1, a real robot (Robot_1) navigates in the real world for at least 1 minute and a maximum of 3 minutes to collect real objects. In stage 2, the team's virtual robot (Robot_2) navigates in the virtual world for the remaining period and collects virtual objects. Team has to program both real and virtual robots and establish communication between them to complete the mission and score as many points by collecting objects. Figure 2 shows the details.

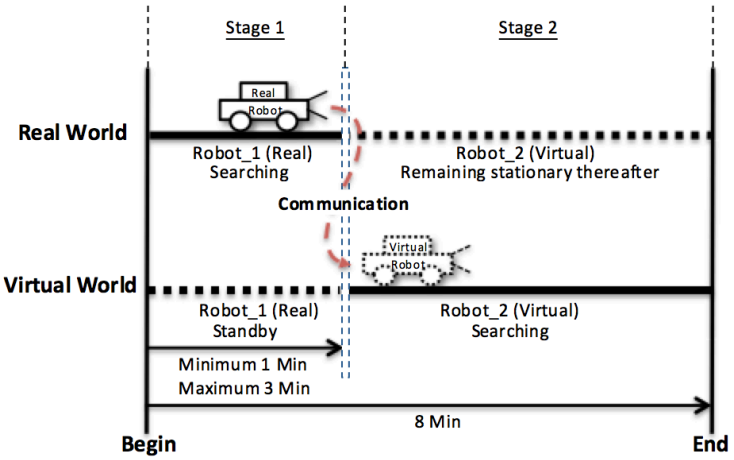


Figure 2: Secondary Category Game Process

1.2.2 Stage 1: Real Game

(a) The challenge begins with the real robot, Robot_1, navigating in the real world while the virtual robot, Robot_2, is 'standing by' in the virtual world.

(b) In the real world, Robot_1 searches for 3 types of objects, RED, GREEN, and BLACK objects. The Robot_1 is not allowed to collect the same object consecutively. The Robot_1 cannot collect more than the maximum number of objects without placing them in the collection box. The maximum number will be designed and announced on-site by the OC.

(c) Any one set of RED, GREEN and BLACK objects that is deposited with one single trip to the collection box will result in the formation of one SUPER object. The SUPER object carries higher scores (see section 4.7.6). ONLY the SUPER objects formed from a set of red, green and black objects will be transferred to the virtual world automatically upon the activation of Robot_2 (see section 2.8.4 and 3.2.5).

1.2.3 Real/Virtual Worlds Communication

(a) The Robot_1 (real robot) needs to send a communication signal to activate the team's Robot_2 (virtual robot) at any time after 1 minute within the first 3 minutes whilst ending its own movement. The maximum duration for which Robot_1 can move in the real world is 3 minutes.

(b) The communication signal sent by the Robot_1 within the first 1 minute is invalid.

(c) If the Robot_1 fails to communicate with the Robot_2 by the end of 3 minutes, the CoSpace server system will stop Robot_1 and activate the Robot_2 (see section 3.2.3).

(d) Only one robot can move at any one time. When Robot_1 moves in the real world, the Robot_2 must be in standby mode. When Robot_2 is activated, the Robot_1 stops until the end of the game.

1.2.4 Stage 2: Virtual Game

(a) The Robot_2 (virtual robot) will be activated when it receives communication signal from the Robot_1 (real robot), or CoSpace System Server (see section 3.2.4)

(b) In the virtual world, the Robot_2 searches for 4 types of objects, RED, GREEN, BLACK and SUPER object. The Robot_2 cannot collect more than the maximum number of objects without placing them in the collection box. The maximum number will be designed and announced on-site by the OC.

(c) One set of virtual RED, GREEN and BLACK objects found in virtual world will NOT form a SUPER object.

2 ARENA

2.1 Layout

2.1.1 The game takes place in two worlds, real world and virtual world. Appendix A shows the layout of virtual world 1 and virtual world 2 for the Primary category. Appendix B shows the layout of the real world and virtual world for Secondary category.

2.1.2 Both real and virtual worlds contain obstacles, traps, object collection boxes and objects. They may contain special zones. (See section 2.6)

2.2 Dimension

2.2.1 Primary category

The dimension of virtual world 1 is 180cm x 240cm. The dimension of virtual world 2 is 270cm x 360cm.

2.2.2 Secondary category

The dimension of real world is 180cm x 240cm (see Appendix C for building instruction). The dimension of virtual world is 270cm x 360cm.

2.3 Floor

2.3.1 The floor of the virtual/real world will generally be white. The floor may be either smooth or textured (same as Rescue A arena).

2.3.2 The outer edge of the real world setup is covered with 10cm wide yellow boundary (see Appendix B). The yellow boundary serves as the warning area and it is used to prevent the real robot from moving out of the real world.

2.3.3 The real world will be placed so that the floor is level.

2.4 Line

2.4.1 There will be lines of width 4 cm in the virtual/real world. The lines are used to guide virtual/real robot towards the object collection box and the special zone.

2.5 Obstacles

2.5.1 The obstacles, such as buildings or other similar blocks, will be in the shape of a cube or cylinder with a height greater than 10 cm in the virtual/real world.

2.6 Special Zones

2.6.1 Certain areas in the virtual/real world are designated as special zones. The special zone is blue in colour as shown in Figure 3. The special zone can be any size bigger than 30cm x 30cm.

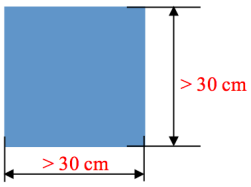


Figure 3: Special Zone

2.7 Traps

2.7.1 The size of trap is 10cm x 10cm. The trap is surrounded with a YELLOW warning area. Figure 4 shows an example of a trap.

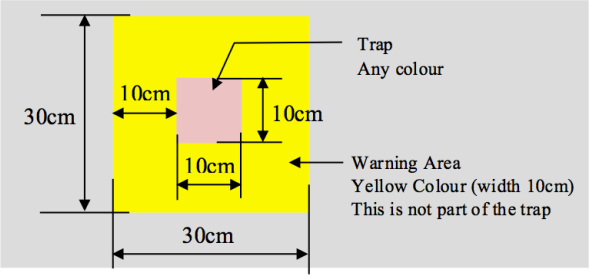


Figure 4: Trap

2.8 Objects

2.8.1 Objects will be located in random positions throughout the course. There will be FOUR types of objects, RED, GREEN, BLACK, and SUPER objects. The diameter and colour of each object are shown in Figure 5. The thickness of each object is less than 2mm.

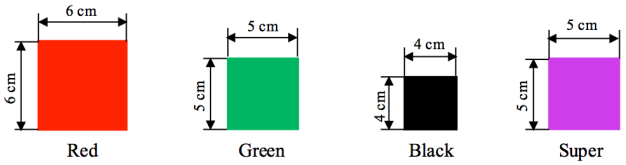


Figure 5: Various objects

2.8.2 Each type of objects has different point value (see section 4.7.6 and 4.7.7).

2.8.3 SUPER objects are created in two ways:

(a) A set of RED, GREEN and BLACK objects deposited in the collection box in Stage 1 will form one SUPER object. This process happens ONLY in Stage 1.

(b) SUPER objects can be created randomly by the CoSpace server in Stage 2.

2.8.4 The SUPER objects formed in Stage 1 will be transferred to Stage 2 and placed in front of the team's Robot_2 automatically. (See Figure 6).

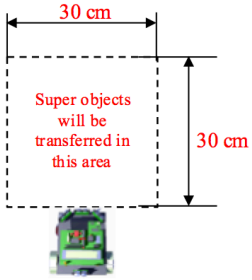


Figure 6: Location of Super Objects transferred from Stage 1

2.8.5 The randomly created SUPER objects in the virtual world by the CoSpace server in Stage 2 will be placed as follows:

(c) Primary Category:

The randomly created SUPER objects will be placed on the lines which are 15 cm away from the wall (see Appendix A). The line reference number (Line 1, 2, 3, or 4) will be sent to the virtual Robot_2 upon the SUPER objects creation.

(d) Secondary Category

The CoSpace server will send the X & Y coordinates of the randomly generated objects to the both teams' virtual robots (Robot_2) upon SUPER objects creation. (See Figure 7)

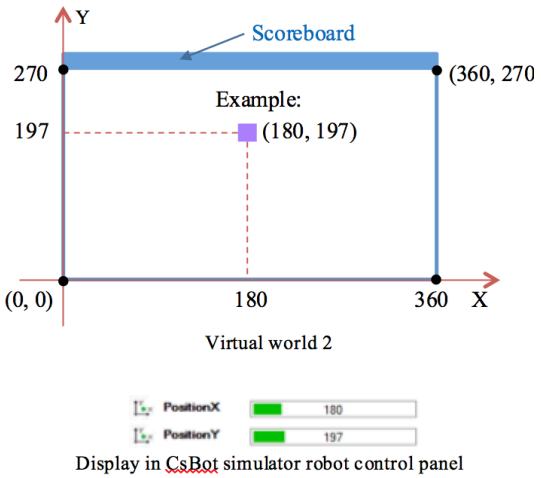


Figure 7: X & Y coordinate system for virtual world 2

2.9 Object Collection Boxes

2.9.1 Figure 8 shows the object collection box. The collection box is ORANGE in colour. The dimensions are 30m x 30cm.

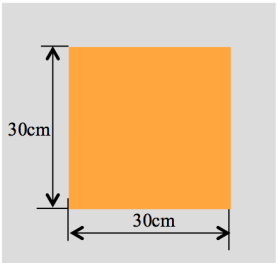


Figure 8: Object collection boxes

2.10 Lighting

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

2.10.2 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 organisers to strictly control factors outside of the real world. Teams are strongly encouraged to program their real robots so that sudden changes (eg. camera flash) do not cause major problems.

2.10.3 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.

3 ROBOTS

In RCJ2013, the organizer will provide the real robots (standard platform) for secondary teams during the competition. Own built robots are not allowed.

3.1 Control

3.1.1 Virtual/real robots must be controlled autonomously.

3.1.2 Virtual/real robots must be started manually by humans.

3.1.3 The use of a remote control to manually control virtual/real robots is not allowed.

3.1.4 BlueTooth Class 2 or ZigBee communication between real and virtual robot is permitted. No other form of radio communication is allowed. Robots that have radio communications on board, whether they are used during the duration of the competition or not, will be immediately disqualified.

3.1.5 In each round, the robots deployed must perform their tasks autonomously.

3.2 Communication

3.2.1 The minimum duration of the Robot_1 movement is 1 minute and maximum duration is 3 minutes. Robot_1 can send an activation signal to Robot_2 at any time within this period. Robot_2 will be activated when it receives a communication signal from Robot_1.

3.2.2 The communication signal sent by the Robot_1 within the first 1 minute is invalid (see section 1.1.3 and 1.2.3).

3.2.3 Scores will be awarded for a successful communication (see section 4.7.12).

3.2.4 If the Robot_1 fails to communicate with the team's Robot_2 at the end of 3 minutes, the CoSpace server system will stop Robot_1 and activate the Robot_2.

3.2.5 The Team's SUPER objects will be transferred to the virtual world 2 for primary category, or virtual world for secondary category, when the team's Robot_2 is activated. The SUPER objects will be placed near to the Robot_2 (see section 2.8.3).

4 GAME PLAY

4.1 Pre-setup

4.1.1 The layout of both the real and virtual worlds will be released prior to the tournament.

4.2 Pre-round Practice

4.2.1 Wherever possible, 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 the real robot's program to accommodate such sensor readings. Calibration can be done in as many locations as desired.

4.3 Humans

4.3.1 As the space around the competition fields is limited (and crowds can result in accidents to robots) teams should designate one member who will act as "captain" and be allowed to move the real robot, based on the stated rules and as directed by the referee.

4.3.2 The "captain" can move the real robot only when directed to by the referee.

4.3.3 Other team members (and any spectators) within the vicinity of the real world are to stand at least 150 cm (approximately 60 inches) away from the real world while their real robot is active, unless otherwise directed by the referee.

4.4 Game Procedure and Length of a Game

4.4.1 A game coordinator is an official who receives and uploads teams' programs as well as runs the games.

4.4.2 The game duration is 8 minutes (see section 1.1.1 and 1.2.1).

4.4.3 Teams should report to the registration counter at least 5 minutes before their game starts. Teams can be penalized by 20 scores per minute at the Referee's discretion if they are late for the game start (teams will be given 100 scores at the beginning of the game). Teams that are 5 minutes late for the time of their game will forfeit the round, therefore, the opponent will gain 500 scores and be declared the winner.

4.5 Pre-match Meeting

4.5.1 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 of the toss determines the colour.

4.6 Start of Play

4.6.1 Real competition

Teams should program the real robot and download it onto the real robot before the competition. The team "captain" is responsible for placing the real robot in the real world and starting the robot manually.

4.6.2 Virtual competition

Teams should give their program to the game coordinator 10 minutes before the game. The game coordinator will upload the programs to the competition server, place the team's robot in the starting point in the virtual world and start the competition.

4.7 Scoring

4.7.1 A team can gain game scores by collecting and placing the objects into the collection boxes.

Collecting an objects means that a robot stops and flashes the lamp for 3 seconds when it detects the objects.

Placing the objects into the collection box means a robot stops and turns on the lamp for 3 seconds (steady light) when both colour sensors detect the collection box.

4.7.2 Team will be given 100 scores at the beginning of each game.

4.7.3 A real/virtual robot must indicate that it has found an object by stopping and flashing a lamp for 3 seconds.

4.7.4 The object in the real world will NOT disappear after it is found. It is team's responsibility to move their real robot away from the real object and search for others.

4.7.5 The object in the virtual world will disappear after it is found.

4.7.6 When a robot discovers a RED object it is worth 10 scores, each GREEN object is worth 15 scores, each BLACK object is worth 20 scores and each SUPER object is worth 120 scores.

4.7.7 When a robot discovers objects in the special zone (see section 2.6), a RED object is worth 20 scores, each GREEN object is worth 30 scores, each BLACK object is worth 40 scores and each SUPER object is worth 240 scores.

4.7.8 If the virtual/real robot falls into the trap (see section 2.7), all objects collected that have not yet placed in the object collection box (see section 2.9) will disappear. Therefore, the scores awarded for those objects collected will be deducted.

A virtual/real robot is considered to be in the trap if any one of the colour sensors has detected the trap.

4.7.9 The robot needs to send the objects to the object collection box (see section 2.9). The score will be doubled upon successful placement of the objects in the collection box.

A robot is considered successfully placed the objects in the collection box when two colour sensors detected the collection box and the lamp was on for 3 seconds (steady light).

4.7.10 A real/virtual robot cannot collect more than the maximum number of objects without placing them in the collection box. The maximum number will be defined and announced on-site by the OC.

4.7.11 If a robot gets stuck after placing the collected object in the collection box, the robot will not be able to obtain the double points for placing their objects in the collection box.

4.7.12 The team will be awarded 100 scores for successful communication between Robot_1 and Robot_2.

4.7.13 After each game, following game points will be given accordingly.

Game	Points
Win	3
Draw	1
Loss	0

4.7.14 If the game points are the same for two competing teams, the winner will be decided based on the total game score. If the total game score are still the same, the team with the higher score at stage 2 will be the winner.

4.8 Human Interference

4.8.1 Except for a lack of progress, human interference (e.g. re-locate the real/virtual robot to any reset scores) during the game is not allowed unless permitted by the referee. A violating team can be disqualified from the game.

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

4.9 Lack of Progress

4.9.1 Lack of progress occurs when there is no progress in the game play for 10 seconds and the situation is not likely to change. A typical lack of progress situation is when a real/virtual robot is stuck. The referee will call "lack of progress" and will move the robot to a different location but close from where it was located.

4.9.2 A team may decide to stop a round early if the lack of progress cannot be resolved. 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 scores achieved.

4.10 Penalty

4.10.1 It is compulsory for teams to specify the team name in virtual game. Teams will be given a yellow card if they failed to do so for the first time. A red card will be given if the team fails to add the team name in virtual game.

4.10.2 If a virtual/real robot is hit/attacked by another virtual/real 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 score deduction.

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

4.10.4 For the Secondary Category, if the real robot moves out of the yellow boundary, a referee will move it inside the boundary. The real robot will be frozen for 10 seconds. There will be no score deduction.

4.11 Interruption of Game

4.11.1 In principle, a game will not be stopped during a game play.

4.11.2 The referee can end the game if all objects have been picked up by the teams.

4.11.3 The referee can stop the game if there is a situation on or around the field when the game coordinator/referee wants to discuss with the OC/TC. Game will be called "Time-out" in this case.

4.11.4 Teams are not allowed to quit a game passed 5 minutes after a game starts.

5 CONFLICT RESOLUTION

5.1 Referee

5.1.1 During a game play, the referee's decision is final.

5.2 Rule Clarification

5.2.1 Rule clarification may be made by members of the RoboCupJunior CoSpace Technical Committee.

5.3 Special Circumstances

5.3.1 Specific modifications to the rules to accommodate special circumstances, such as unforeseen problems and/or capabilities of a team's robot, may be agreed upon at the time of the tournament when a majority of the contestants agree with the proposed modifications.

6 DOCUMENTATIONPresentation

6.1.1 Each team must bring an electronic presentation (e.g. in PowerPoint or Flash format) and/or an A3 poster. The presentation should provide information about the team and how they prepared for RoboCupJunior. Areas that could be covered include:

- Team name;
- Team members' names and (perhaps) a picture of the team members;
- Team's country and location within country;
- Team's school and district;
- Development of the searching and placement strategies.
- Pictures of the robot under development (if any) and sample code,
- Any interesting or unusual features of the robot;
- What the team hopes to achieve in robotics.

6.1.2 Presentations and/or posters are to be shown to the judges during the scheduled interview session.

6.1.3 Teams are requested to provide a digital version of their presentation and poster.

6.1.4 Prizes may be awarded to teams with outstanding presentations.

6.2 Sharing

6.2.1 Teams are encouraged to view one another's posters and presentations.

7 CODE OF CONDUCT

7.1 Fair Play

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

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

7.2 Behaviour

7.2.1 If one team copies a program from another team then both teams will be disqualified.

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

7.2.3 Participants should be mindful of other people and their robots when moving around the tournament venue.

7.2.4 Participants are not to enter setup areas of other leagues or other teams, unless expressly invited to do so by team members.

7.2.5 Participants who misbehave may be asked to leave the building and risk being disqualified from the tournament.

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

7.3 Mentors

7.3.1 Mentors (teachers, parents, chaperones, translators, and other adult team members) are not allowed in the student work area.

7.3.2 Mentors are not allowed to be involved in programming of students' robots.

7.3.3 Mentor interference with robots or referee decisions will result in a warning in the first instance. If this recurs, the team will risk being disqualified.

7.4 **Sharing**

7.4.1 The understanding that any technological and curricular developments should be shared among the RoboCup and RoboCupJunior participants after the tournament has been a part of world RoboCup competitions

7.4.2 Any developments may be published on the RoboCupJunior website after the event.

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

7.5 **Spirit**

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

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

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

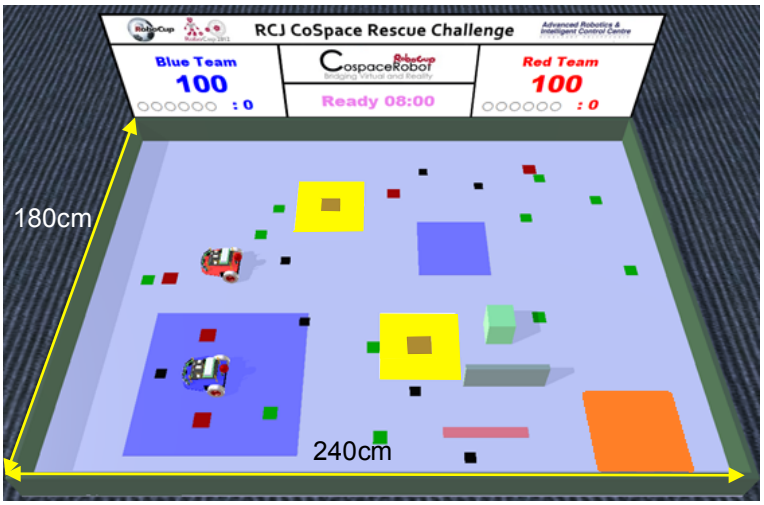
7.5.4 Queries regarding these rules or their interpretation may be sent to the CoSpace Technical Committee, Shen Jiayao (Singapore), at jyshen@sp.edu.sg .

Further Information about CoSpace Robotics

CoSpace Robot Home Page: www.CoSpaceRobot.org

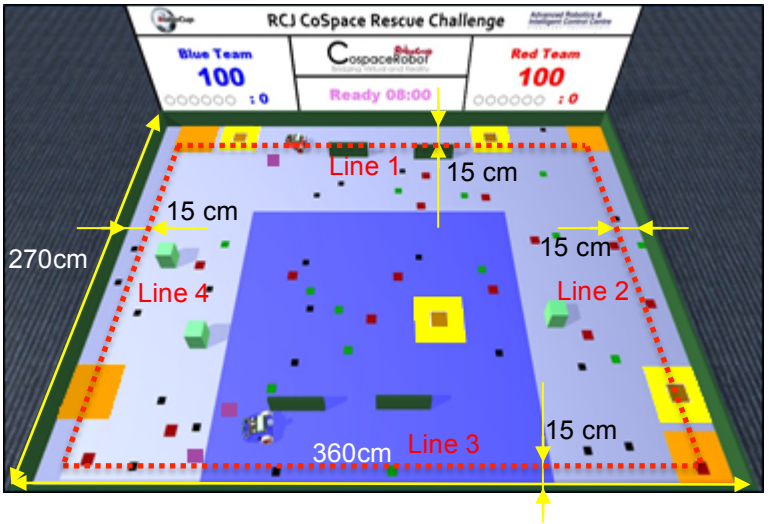
Appendix A: Primary Category Competition Setup

Virtual World 1:



The location (X& Y coordinates) of any objects including virtual robot, all objects to be collected, special zones, traps, guide lines, collection boxes, and obstacles will not be disclosed to teams before or during a game.

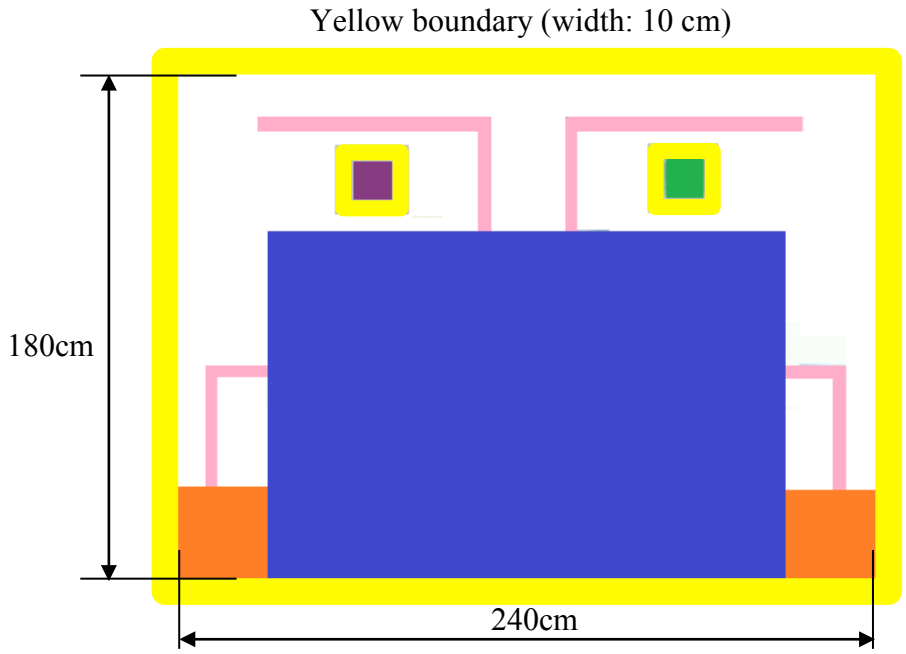
Virtual World 2:



- The location (X & Y coordinates) of any objects including virtual robot, all objects to be collected, special zones, traps, guide lines, collection boxes, and obstacles will not be disclosed to teams before or during a game.
- The transferred Super objects will be placed in front of Robot_2 but no information of the X & Y coordinates will be disclosed to teams.
- The coordinates of the SUPER objects randomly created by the CoSpace server will be placed 15cm away from the wall (indicated by the dash-lines in the diagram; however, the dash-line will not be shown in the virtual world 2).

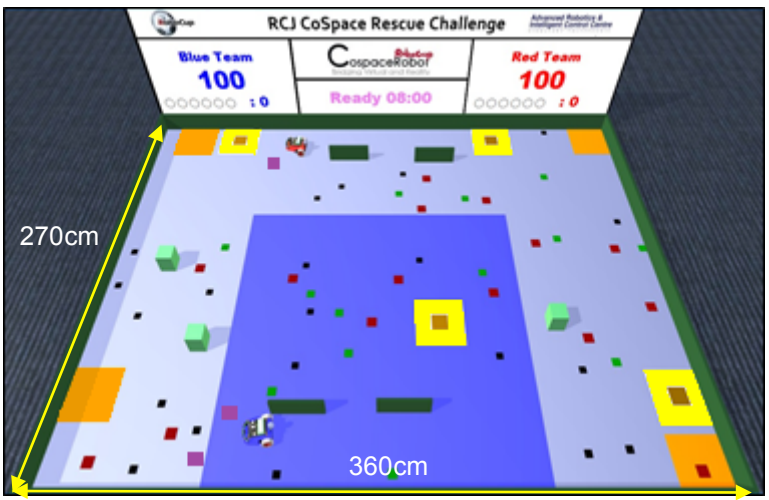
Appendix B: Secondary Category Competition Setup

Real World:



- The location (X& Y coordinates) of any objects including real robot, real objects to be collected, special zones, traps, guide lines, collection boxes, and obstacles will not be disclosed to teams before or during a game.

Virtual World:



- The location (X & Y coordinates) of any objects including all objects to be collected, special zones, traps, guide lines, collection boxes, and obstacles will not be disclosed to teams before or during a game.
- The X & Y coordinates of virtual robots will be provided to teams.
- The transferred Super objects will be placed in front of Robot_2 but no information of the X & Y coordinates will be disclosed to teams.
- The X & Y coordinates of the SUPER objects randomly created by the CoSpace server will be provided to teams.

Appendix C: Secondary Category Competition - Real World Suggested Building Instruction

The following is the suggested instruction for building the real world for CoSpace Rescue Secondary category.

1 Cut a piece of 240cm x 300cm plywood or fibreboard (about 1.5cm thickness is adequate). The surface of the board may be either smooth or textured. You may also join a few small ones together. Please make sure the joint is smooth. It should not affect the real robot movement.

2 Lay the board on the floor. The floor should be level.

3 Paint the surface to white colour.

4 Paste the yellow warning boundary on the board.