



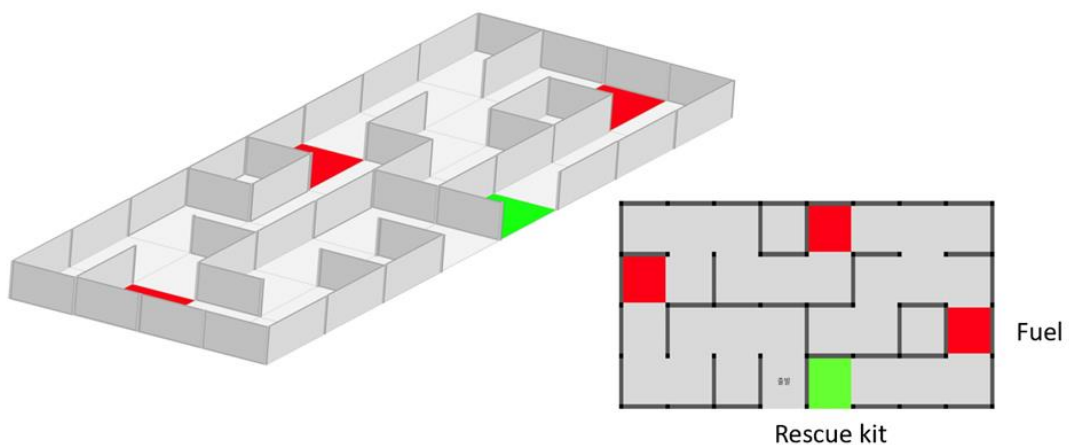
RoboCup Asia-Pacific 2023 Junior Rescue Maze Entry Rules - Final

2023-09-14

RCAP RCJ Rescue Committee

Scenario

The land is too dangerous for humans to reach the victims. Your team has been given a difficult task. The robot must be able to carry out a rescue mission in a fully autonomous mode with no human assistance. The robot must be durable and intelligent enough to navigate treacherous terrain, uneven land, and rubble without getting stuck. The robot must search for victims, dispense rescue kits, and signal the position of the victims so the humans can take over. Time and technical skills are essential! Come prepared to be the most successful rescue team.



Summary

The robot must navigate a maze to find the victim. The robot should explore as many mazes as possible, not find the fastest path through the maze. Each time the robot finds a rescue kit, it scores 10 points. An additional 10 points are awarded when the robot moves the rescue kit to the location of the room of victim. When the robot brings the rescue kit to the starting location, it receives a total of 30 points along with the points in the victim area.

Robots can earn points for:

- 10 points for each rescue kit
- 10 points for each rescue kit at the location of the victim
- 20 points for each rescue kit moved to the starting position: If the robot comes to the starting position and stops, the rescue kit at the location of the victim is considered to have been brought to the starting position and cannot be duplicated with storage points
→ Total 30 points per rescue kit

1 Field

1.1 Description

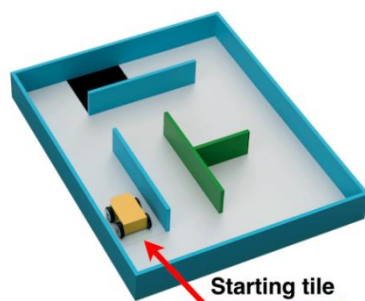
- 1.1.1 The field layout will consist of a collection of tiles with a horizontal floor, a perimeter wall, and walls within the field.
- 1.1.2 All walls used to create the maze are at least 15 cm high from any floor, 30 cm in length, and are mounted on the edges of the tiles.

1.2 Floor

- 1.2.1 Floors may be either smooth or textured (like linoleum or carpet) and may have deviations of up to 3 mm in height between the tiles. There may be holes in the floor (approximately 5 mm in diameter) for fastening walls.
- 1.2.2 There will be tiles of different colors on the floor of the maze. The meaning of each color is explained below.
 - i. Green tile for rescue kit.
 - ii. Blue tile for victim zone.
 - iii. Red tile for fuel.
- 1.2.3 Colored tiles will be placed randomly at the start of each game.
- 1.2.4 The organizers will fix colored tiles to the floor, but teams should be prepared for slight movements of up to 3 cm of these tiles.

1.3 Path

- 1.3.1 Walls may or may not lead to the starting tile consistently following the leftmost or rightmost wall. Walls that lead to the starting tile are called 'linear walls'. The walls that do NOT lead to the starting tile are called 'floating walls'.



 **Linear walls**

 **Floating walls**

※The colour and walls configuration are for illustration only.

- 1.3.2 Teams must prepare for the pathways to be slightly smaller in dimension ($\pm 10\%$ variation on the tile size) than a tile due to the nature of placing walls.



- 1.3.3 Pathways for the robot are intended to be of the width of the tile and may open into foyers more expansive than the pathways.
- 1.3.4 One tile is the starting tile, where a robot should start and exit the run. It can be located anywhere in the field.
- 1.3.5 Walls may be removed, added, or changed just before a scoring run starts to prevent teams from pre- mapping the layout of the fields. Organizers will do their best not to change the maze's length or difficulty when introducing these changes.

1.4 Environment Conditions

- 1.4.1 The environmental conditions at a tournament may differ from those at home. Teams must come prepared to adjust their robots to the conditions at the venue.
- 1.4.2 Lighting and magnetic conditions may vary in the field.
- 1.4.3 The field may be affected by magnetic fields (e.g., under-floor wiring and metallic objects). Teams should prepare their robots to handle such interference.
- 1.4.4 The field may be affected by unexpected lighting interference (e.g., camera flash from spectators). Teams should prepare their robots to handle such interference.
- 1.4.5 The RCAP RCJ Rescue Committee will try its best to fasten the walls onto the field floor so that the impact from contact should not affect the robot.
- 1.4.6 All measurements in the rules have a tolerance of $\pm 10\%$.
- 1.4.7 Objects detected by the robot will be distinguishable from the environment by their color or shape.



2 Robots

2.1 Control

- 2.1.1 Robots must be controlled autonomously. Using a remote control, manual control, or passing information (by external sensors, cables, wirelessly, etc.) to the robot is not allowed.
- 2.1.2 Robots must be started manually by the team captain.
- 2.1.3 Robots may utilize various maze navigation algorithms. Any pre-mapped type of dead reckoning (movements preprogrammed based on known locations or placement of features in the field) is prohibited.
- 2.1.4 Robots must not damage any part of the field in any way.

2.2 Construction

- 2.2.1 The height of a robot must not exceed 30 cm.
- 2.2.2 Robots may not have sensors or devices that enable them to 'see' over the walls.
- 2.2.3 Any robot kit or building blocks, either available on the market or built from raw hardware, may be used as long as the design and construction of the robot are primarily and substantially the students' original work.
- 2.2.4 Teams are not permitted to use commercially produced robot kits or sensor components specifically designed or marketed to complete any single primary task of RoboCupJunior Rescue. Robots that do not comply will face immediate disqualification from the tournament. If there is any doubt, teams should consult the RCAP RCJ Rescue Committee before the competition.
- 2.2.5 Only lasers from classes 1 and 2 are allowed for the safety of participants and spectators. The organizers will check this during the inspection. Teams using lasers must have the datasheet of the laser and submit them before the competition and be able to show them during the competition.
- 2.2.6 Wireless communication must be used as described on the RoboCupJunior General Rules. Robots performing other types of wireless communication need to be deleted or disabled. If the robot has other wireless communication equipment, the team must prove they are disabled. Non-conforming robots may be immediately disqualified from the tournament.
- 2.2.7 Robots may incur damage by falling off the field, making contact with another robot, or contacting field elements. The RCAP RCJ Rescue Committee cannot anticipate all potential situations where damage to the robot may occur. Teams should ensure that all active elements on a robot are adequately protected with



resistant materials. For example, teams must protect electrical circuits from all human contact and direct contact with other robots and field elements.

- 2.2.8 When batteries are transported, moved, or charged, it is strongly recommended that safety bags be used. Reasonable efforts should be made to ensure that robots avoid short circuits and chemical or air leaks.
- 2.2.9 Robots must be equipped with a handle that is to be used to pick them up during the scoring run.
- 2.2.10 Robots must be equipped with a single binary switch or button, clearly visible to the referee, for restarting the robot when a lack of progress occurs.

2.3 Team

- 2.3.1 Each team must have only one robot in the field.
- 2.3.2 Each team must have 2 to 4 team members.
- 2.3.3 Each team member must explain their work and have a specific technical role.
- 2.3.4 Mentors/parents are not allowed to be with the students during the competition. The students will have to govern themselves (without a mentor's supervision or assistance) during the long stretch of hours at the competition.

2.4 Inspection

- 2.4.1 A panel of referees will scrutinize the robots before the start of the tournament and at other times during the competition to ensure that they meet the constraints described in these rules.
- 2.4.2 Using a robot similar to another team's robot from a previous year or the current year is illegal.
- 2.4.3 The team's responsibility is to have their robot re-inspected if modified at any time during the tournament.
- 2.4.4 Students will be asked to explain their robot's operation to verify that its construction and programming are their own work.
- 2.4.5 Students will be asked about their preparation efforts. The RCAP RCJ Rescue Committee may request them to answer surveys and participate in videotaped interviews for research purposes.
- 2.4.6 All teams must complete a web form before the competition to allow referees to prepare better for the interviews. The RCAP RCJ Technical Committee will provide instructions on submitting the form to the teams before the competition.
- 2.4.7 All teams must submit their source code before the competition. The organizers will not share the source code with other teams without the team's permission.



- 2.4.8 All teams must submit their engineering journal before the competition. The organizers will not share the journals with other teams without the team's permission. The organizers will request permission at the registration.

2.5 Violations

- 2.5.1 Any violations of the inspection rules will prevent the offending robot from competing until modifications are made, and the robot passes inspection.
- 2.5.2 Teams must make modifications within the schedule of the tournament, and teams cannot delay tournament play while making modifications.
- 2.5.3 Suppose a robot fails to meet all specifications (even with modifications). In that case, it will be disqualified from that game (but not from the tournament).
- 2.5.4 No mentor assistance is allowed during the competition.
- 2.5.5 Any rule violations may be penalized by disqualification from the tournament or the game or result in a loss of points at the discretion of the referees, officials, or RCAP RCJ Rescue Committee.



3 Play

3.1 Pre-game Practice

- 3.1.1 When possible, teams will have access to practice fields for calibration and testing throughout the competition.
- 3.1.2 Whenever there are dedicated independent fields for competition and practice, it is at the organizers' discretion if testing is allowed on the competition fields.

3.2 Humans

- 3.2.1 Teams should designate one of their members as 'captain' and another as 'co-captain'. Only these two team members will be allowed access to the competition fields unless directed by a referee. Only the captain can interact with the robot during a scoring run.
- 3.2.2 The captain can move the robot only when they are told to do so by a referee.
- 3.2.3 Other team members (and any spectators) within the vicinity of the competition field must stand at least 150 cm away from the field unless directed by a referee.
- 3.2.4 No one is allowed to touch the fields intentionally during a scoring run.
- 3.2.5 All pre-mapping activities will immediately disqualify the robot for the round. Pre-mapping is the act of humans providing the robot with information about the field (e.g., location of walls, location of blue/green/blue tiles, location type of victims, etc.) before the game.

3.3 Start of Game

- 3.3.1 Each team has a maximum of 6 minutes for a game. The game includes the time for calibration and the scoring run.
- 3.3.2 Calibration is defined as taking sensor readings and modifying a robot's program to accommodate such sensor readings. Calibration does not count as pre-mapping.
- 3.3.3 The scoring run is defined as the time when the robot is moving autonomously to navigate the field, and the referee will record the scores.
- 3.3.4 A game begins at the scheduled starting time, whether or not the team is present or ready. Start times will be posted around the venue.
- 3.3.5 Once the game has begun, the robot is not permitted to leave the competition area.
- 3.3.6 Teams may calibrate their robot in as many locations as desired on the field, but the clock will continue to run. Robots are not permitted to move on their own



while calibrating.

- 3.3.7 Before a scoring run begins, the referee will roll a standard 6-sided dice, or another method of randomization set by the organizers to determine the location of the Red, Blue, and Black. Organizers will not reveal the position of the Red, Blue, and Black tiles to the team until they are ready to start a scoring run (see 3.3.11). Referees will ensure that the placement of tiles in a field layout is 'solvable' before a robot begins a scoring run.
- 3.3.8 Before a scoring run begins, the referee can change any walls of the field.
- 3.3.9 Once a team is ready to start a scoring run, the team must notify the referee. To start a scoring run, the robot is placed on the start tile of the course, as indicated by the referee. Once a scoring run has begun, no more calibration is permitted, including changing code/code selection.
- 3.3.10 Teams may choose not to calibrate the robot and immediately start the scoring run instead.
- 3.3.11 Once the robot starts moving as the scoring run begins, a referee will place the green, blue, and red tiles.

3.4 Scoring Run

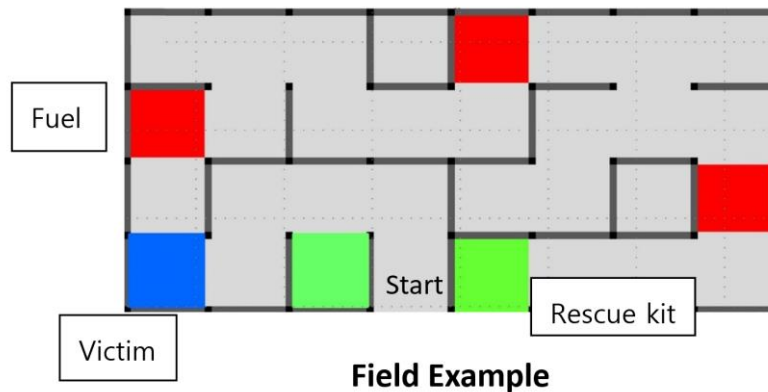
- 3.4.1 Modifying the robot during a scoring run is prohibited, which includes remounting parts that have fallen off.
- 3.4.2 Any parts the robot loses intentionally or unintentionally will be left on the field until the game ends. Team members and referees cannot move or remove elements from the field during a scoring run.
- 3.4.3 Teams cannot give their robot any information about the field. A robot is supposed to recognize the field elements by itself.
- 3.4.4 A 'visited tile' means that more than half of the robot is inside the tile when looking from above.

3.5 Scoring

- 3.5.1 The robot starts from the starting point, finds the rescue kit, stores it in the storage area, or transports it to the starting location.
- 3.5.2 When fuel or rescue kit is found, stop for more than 3 seconds, notify that it has been found by any method such as sound, screen display, flag waving, etc. in the stopped state.
- 3.5.3 After starting, the running time is 3 minutes, but each time fuel is acquired, the running time is extended by 1 minute. (E.g., Total game time 6 minutes when all 3 fuels are acquired)



- 3.5.4 To store rescue kits in victim area, stop for more than 5 seconds at the storage area and notify the storage box by the method in 3.5.2.
- 3.5.5 When the robot fully enters the starting position, the storage area is emptied and the rescue kits in the storage area are judged to have been transported to the starting position.
- 3.5.6 The robot can bring the rescue kit to the starting location and continue searching again. At this time, the rescue kit brought is valid and the team member can restart the robot immediately.
- 3.5.7 The re-start position (two zones) after stopping the search is as follows.
 - i. When restarting from the starting position, all rescue kits are returned to their original locations and the points obtained and stored are lost.
 - ii. However, you can restart from the storage area only if there are first-aid kits stored in the storage area.
 - iii. Rescue kits stored in the storage area are valid, and others are returned to their original locations.
- 3.5.8 The case of stopping search is as follows:
 - i. the captain can declare arbitrarily.
 - ii. In case the robot cannot run normally.
- 3.5.9 Rescue kit search 10 points per first aid kit.
- 3.5.10 Additional points per rescue kit stored in storage.
- 3.5.11 Additional points for each rescue kit brought to the starting position.
- 3.5.12 When the robot enters the starting position, the rescue kits in the storage area are considered to have been transported to the starting position. Cannot be duplicated with archived points. → Total 30 points
- 3.5.13 When restarting: Reset and power on/off possible, but robot repair and program change are not possible.
- 3.5.14 In the case of a tie in points, ranking is based on how long it takes the robot to complete the match.



3.6 Victim (U19 Only)

- 3.6.1 There are victims who distinguish by temperature. The organisers will keep a minimum of 10° Celsius difference between victim temperatures and the indoor temperature. The temperature of the victim simulates human body temperature between 28°C to 40°C.
- 3.6.2 Victims are located near the floor of the field (located about 7 cm above the floor).
- 3.6.3 Organizers will never locate victims on walls facing RED/GREEN/BLUE tiles, tiles with obstacles/speedbumps/stairs, and ramps.
- 3.6.4 There may be objects that resemble victims in appearance but are not victims. Such objects should not be identified as victims by robots.
- 3.6.5 When victim is found, stop for more than 3 seconds, notify that it has been found by any method such sound, screen display, flat waving, etc. in the stopped state.
- 3.6.6 50 points will be awarded per victim.

3.7 Lack of Progress

- 3.7.1 A lack of progress occurs when:
 - i. the team captain declares a lack of progress.
 - ii. a robot visited the black tile. See the definition of visited tile on 3.4.4.
 - iii. a robot does not stop for 5 seconds if the robot visits a blue tile.
 - iv. a robot damages the field.
 - v. a team member touches the field or their robot without permission from a referee.
- 3.7.2 In the event of a lack of progress, the robot must return to the last visited checkpoint (or the start tile if it never reached a checkpoint). The robot can be installed in any direction. For the definition of the visited tile (see 3.4.4).
- 3.7.3 After a lack of progress, the team must reset the robot by using a switch located in a visible location by the referee.



3.8 End of Game

- 3.8.1 A team may elect to stop the game early at any time. In this case, the team captain must indicate the team's desire to terminate the game to the referee. The team will be awarded all points earned up to the call for the end of the game. The referee will stop the time at the end of the game, which will be recorded as the game time.
- 3.8.2 The game ends when:
- i. the 3-6 minutes of allowed game time expires.
 - ii. The team captain calls the end of the game.



4 Open Technical Evaluation

4.1 Description

- 4.1.1 The organizers will evaluate your technical innovation during a dedicated time frame. All teams need to prepare for an open display during this time frame.
- 4.1.2 Judges will circulate and interact with the teams. The Open Technical Evaluation is intended to be a casual conversation with a question-and-answer atmosphere.
- 4.1.3 The Open Technical Evaluation's main objective is to emphasize innovation's ingenuity. Innovative may mean technical advances compared to existing knowledge or an out-of-the-ordinary, simple but clever solution to existing tasks.

4.2 Evaluation Aspects

- 4.2.1 A standardized rubric system will be used, focusing on:
 - Creativity
 - Cleverness
 - Simplicity
 - Functionality
- 4.2.2 Your 'work' can include (but is not limited to) one of the following aspects:
 - Creation of your own sensor instead of a pre-built sensor.
 - Creation of a 'sensor module' which is comprised of various electronics resulting in a self-contained module to provide specific functionality.
 - Creation of a mechanical invention that is functional but out of the ordinary.
 - Creation of a new software algorithm for a solution.
- 4.2.3 Teams must provide documents that explain their work. Each invention must be supported by concise but clear documentation. The documents must show precise steps towards the creation of the invention.
- 4.2.4 Documents must include one poster and one engineering journal. Teams should be prepared to explain their work.
- 4.2.5 Engineering Journals should demonstrate your best practices in the development process.
- 4.2.6 The poster should include but is not limited to: the name of the team, country, league, robot description, robot capabilities, controller, the programming language used, sensors included, method of construction, time used for development, cost of materials, and awards won by the team in its country, etc.



4.3 Sharing

- 4.3.1 Teams are encouraged to review others' posters and presentations.
- 4.3.2 Teams awarded certificates must post their documents and presentation online at the RCAP RCJ Rescue Committee's request.

5 Conflict Resolution

5.1 Referee and Referee Assistant

- 5.1.1 All decisions during gameplay are made by the referee or the referee assistant, who are in charge of the field, persons, and objects surrounding them.
- 5.1.2 During gameplay, the decisions made by the referee, or the referee assistant are final.
- 5.1.3 After game play, the referee will ask the captain to sign the score sheet. Captains will be given a maximum of 1 minute to review the score sheet and sign it. By signing the score sheet, the captain accepts the final score on behalf of the entire team. In case of further clarification, the team captain should write their comments on the score sheet and sign it.

5.2 Rule Clarification

- 5.2.1 If any rule clarification is needed, please contact the RCAP RCJ Rescue Committee.
- 5.2.2 If necessary, even during a tournament, a rule clarification may be made by members of the RCAP RCJ Rescue Committee.

5.3 Special Circumstance

- 5.3.1 If particular circumstances, such as unforeseen problems or capabilities of a robot occur, rules may be modified by the RCAP Rescue Committee Chair in conjunction with available committee members, even during a tournament.
- 5.3.2 Suppose team captains do not attend the team meetings to discuss problems, and the resulting rule modifications described in 5.3.1. In that case, the organizers will understand that they were aware of and have agreed to the changes.

The RCAP RCJ Rescue Organising Committee would like to acknowledge the RoboCup Korea Association (NPO) for drafting the Junior Rescue Maze Entry rules.