RTC CUP Rulebook

1. General aspects

1.1. At the "RTC Cup" competitions the participants are presented with a test area. The test area consist of sites of varying complexity from rough terrain to the consequences of disasters (earthquake, tsunami, collapses, mud gatherings and the like).
The purpose of the competition is to inspire children and students to create robots that can work in extreme situations and completely replace a person or act as a helper.

1.2. In the RTC Cup competition the robot can pass as many test area cells as possible for the given time and perform different tasks.

2. Test area

2.1. The test area is a reconfigurable maze consisting of cells. An example of a test area configuration is shown in Figure 1.

2.2. Test area cell is a section, bounded around the perimeter with a black profile.

2.3. A detailed description of the test area (types of obstacles and tasks which it contains and their technical characteristics) can be found in Appendix No.1 "RTC Cup Test Area".

2.4. The configuration of the Test area changes every competition and is not inform to the participants in previously.

2.5. The list of obstacles and points awarded for them are known at least one week before the start of the competition. Possibly add any sections immediately before the competition.

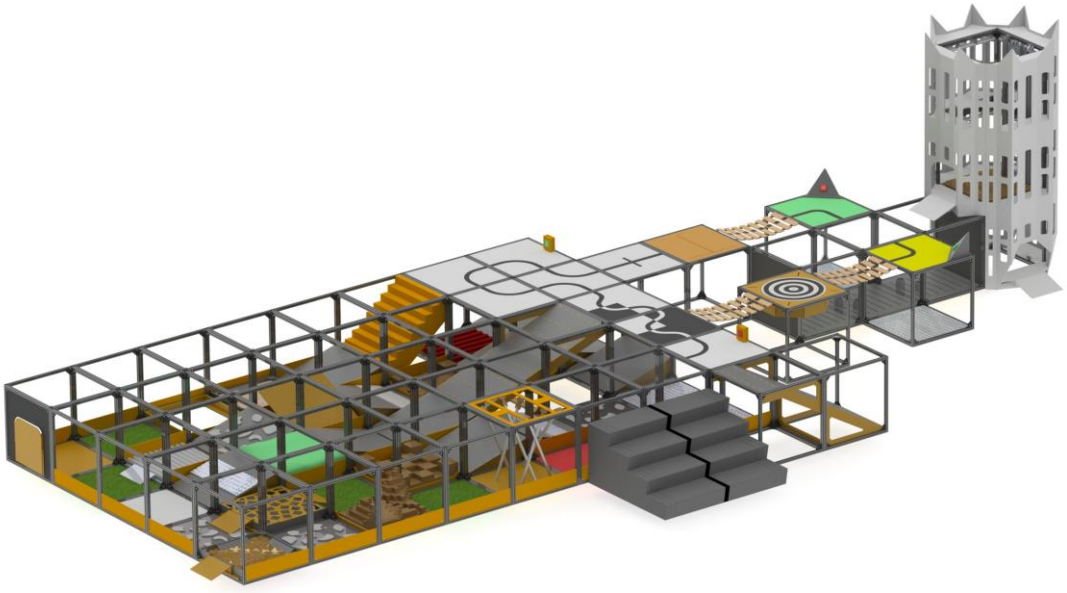

Figure 1 «Example of a test area configuration»

3. Categories

3.1. Competition are divided into two categories:

3.1.1. **"Scout" -** in this category operator can watch his robot going through test area, by his own eyes. Operator control the robot remotely and partially autonomically. Operator can use the data he receive from robot's sensors and camera.

Age limit: from 11 to 14 years inclusive. Performance of at least one manipulation or autonomous task is required.

3.1.2. "**Extreme**" - in this category the robot is out of sight of the operator (participant). Operator control the robot remotely by teleoperation and partially autonomically. Operator can use the data he receive from robot's sensors and camera.

Age limit:

- from 11 to 16 years inclusive. Performance of at least one manipulation or autonomous task is required.
- from 17 years and older. Performance of at least one autonomous task is required.

4. Requirements for Teams

4.1. There is allowed to be no more than two people in the team (not counting the mentor) - this rule only applies to Robofinist, RoboFest and Final competition. In all other situations there is no limit to the number of team members.

4.2. The robot can be operated by only one person.

4.3. It is allowed to change the operator between attempts.

4.4. The team can participate with only one robot in only one category.

4.5. It is forbidden to break and contaminate the Test area.

5. Requirements for Robot

5.1. There is no restrictions and limitations concerning of which elements robot can be build.

5.2. The recommended overall dimensions of the robot: no more than 350mm in height, no more than 400mm in length and no more than 400mm in width. After the start of the attempt, the robot can change dimensions.

5.3. The mass of the robot should not exceed 10 kg.

5.4. The robot should have an on-board wireless power source.

5.5. Communication with the robot should be conducted wirelessly. The minimum distance between operator and robot is approximately 10m.

Therefore, robots controlled from IR-remote control devices are not allowed for using during the competition.

Figure 2 «Examples of IR-remote control devices»

5.6. Participants are allowed to use Wi-Fi networks to communicate with the robot during the attempt.

5.7. Before the beginning of competitive attempts, training sessions of robots are held, during which participants can explore the testing ground and check what tests their robot is able to overcome.

5.8. For the qualifying round (if there is to be any) it is allowed to use cables and wires to communicate with the robot (only in the category "Extreme"). This rule is made to reduce the possibility of communication problems which happens for reasons that do not depend on the participants.

5.9. **Constructive bans**

5.9.1. It is forbidden to use liquid, powder and gas substances, including as a weapon against a rival robot.

5.9.2. Do not use flammable substances.

5.9.3. Interference with electronic equipment is prohibited. Frequency of exposure is more than 100 kHz and radiated power is more than 10 mW, with the exception of standard radio and video communications.

5.9.4. Robots that violate the above prohibitions are removed from the competition.

6. Competitions process

6.1. The competitions consist of two rounds: the first day - the qualifying round, the second day - the final round.

6.2. The robot should cross the test area under operator control, passing the tests and performing the tasks. There are beacons of different colors on the test area sites. The robot can collect beacons and place them in the corresponding color zones. Also, the test area contains a block of tasks for checking the characteristics of the robotic arm. There are a number of white fields with black line which can be passed only autonomously.

6.3. The robot does not have to go through each cell of the Test area. The operator can decide how to build his own route.

6.4. A group training session will be conducted before the start of attempts in each of the two rounds.

6.5. **«Pass/fail» conditions for attempts**

6.5.1. Mandatory availability and use:

- In categories **"Extreme"** and **"Scout"** the robot must use sensors (autonomy, semi-autonomy) or robotic arm to pass the attempt.
- In category **"Extreme Pro"** the robot must use sensors (autonomy, semi-autonomy) to pass the attempt.

6.5.2. **Conditions for «pass/fail» in rounds:**

- In the qualifying round the robot must meet conditions laid above during one or more attempts. In this case, all attempts will be counted as the «pass».
- In the final round each attempt will be evaluated separately. The robot must meet these conditions during at least one attempt.

6.6. **First day: qualifying round**

6.6.1. The test area is divided into 4 sections. Each team chooses 2 any sections. Thus, each team has 2 main attempts in the qualifying round.

6.6.2. One section contains 6 to 9 cells of the test area.

6.6.3. Also there is an additional 5th section containing a task (line following) presuming only autonomy operations. The white beacons are placed at intersections (black cross on the white field). Any team can choose to perform one additional attempt on this section.

6.6.4. Time for one attempt is 5 minutes. The break between attempts last 5 minutes.

6.6.5. During the qualifying round, it is not allowed to remove the functional parts (sensors, camera, robotic arm, levers, wheels, tracks, motors, flipper arms) from the robot. It is allowed to make small changes (add and remove clamps, tape, bands, screws and the like) and change details and modules to the same as was used. Changes must be announced to the judge before the attempt.

6.6.6. The schedule of qualifying round attempts would be set up in the morning during the training. Teams would be assembled to draw lots to choose the sections at the beginning of the day.

6.6.7. **Forming a list of teams for the final round**

6.6.8. The best 15-18 teams from all categories qualify for the finals.

6.7. **The second day: the final round**

6.7.1. Competitions consist of 2 attempts for each categories. The Test area is presented as a whole, undivided maze.

6.7.2. The attempt lasts 10 minutes.

6.7.3. The best of the 2 attempts passes into results table.

6.7.4. In the category **"Scout"** two robots start at the test area, in parallel.

6.7.5. In the categories **"Extreme"** and **"Extreme Pro"** one robot starts at the test area.

6.8. 30 minutes before the start of their attempt, team goes to the training area. 10 minutes before the start of the attempt, operator with robot must be in the competition area, be ready for the start, and notify the referees at the registration table that they are ready.

6.9. Rescheduling the attempt in case a team is not ready, is possible not later than one attempt before the rescheduling attempt presuming to start. Otherwise, a team would be disqualified.

6.10. Rescheduling the attempt entails a penalty to the future result of the attempt (see Appendix No. 2 “Scoring system” of the current document).

6.11. You can reschedule the attempt only once.

6.12. Start is located in front of the entrance to the Labyrinth. In the case when there are two entrances, team randomly assigned to one of them (green or red) before start. In the second attempt, assignment is reversed.
The robot must start its movement from the “start” field indicated by the judge, and move through the maze before it finds any other exit. It is not allowed to go back through the “start” gates to enter from another side of the maze. If the robot left the maze through any other exit, then in the future it has the right to enter and exit through any cells its choosing.

6.13. Robot does not score points for re-passing the cell.

6.14. For “Scout” attempt only the robot operator is allowed to be in the Test area, the rest of the team members and mentor are bound to be behind the barrier.

6.15. For “Extreme” attempt only operator is allowed to be in the booth; the rest of the team members and mentor are bound to be behind the barrier. For talking to the operator without permission of the judge the team could be disqualified.

6.16. Intervention for repairing or relocating the robot can be carried out both by the operator or any member of the team. After the intervention, all participants (except operator) must leave the Test area.

7. Score system

7.1. Results are shown in the number of points scored during attempt. The best attempt is taken into account.

7.2. A cell is considered as passed if the robot entered in it entirely and left through the other end (except for dead-end cells).

7.3. If two teams have the same number of points in the end, the team that ended the attempt in shorter time wins. If the time is equal too, the team with the highest total score in two attempts wins.

8. Beacons (cans) collection

8.1. **General rules for collecting beacons (cans)**

8.1.1. To get points for capturing a can — capturing and lifting must be made to a height of at least 20 mm for at least 1 second long. However, this is not a mandatory rule for getting delivery points, the beacon can be pushed or dragged into the according color field.

8.1.2. A beacon can be successfully captured and delivered only once.

8.1.3. A beacon is considered as delivered if it touches according field, even if it rolls out after.

8.2. **Special beacons**

8.3. Mini-tower is a stand for a can. The task is to capture a beacon by the robot arm and lift it. It is allowed to drop the beacon from the stand and capture it after, but then points will be awarded as for a standard beacon.

8.4. The location and number of beacons is determined by the judges before the start of the competition.

9. Autonomy and manipulation

9.1. Before starting, you must notify the judges about what actions the robot will perform automatically. Also during the attempt, the participant should loudly announce the beginning and end of the autonomous mode of the robot.

9.2. Automatically mode is counted only after confirmation from the judges.

9.3. Under the autonomous action means the passage of the site without the operator controlling action, necessarily using any sensors.

9.4. Movement on encoders or timer (just “motors forward”) is not considered an autonomous mode.

9.5. The on / off autonomy must be carried out remotely, the participant should not touch the robot. In this case, the number of automatic mode starts is unlimited.

9.6. In the course of an attempt, one test can be performed both autonomously and in manual mode, but points are counted in this case only for autonomous passing.

9.7. **The elements of autonomy include:**

- Line following with a light sensor or vision systems on flat tiles, slopes and bridges.
- Movement inside the maze - only in areas consisting of 3 cubes, and forming a turn around the corner. Autonomy is counted if the movement along the walls of the corner cube is made without interruption. Ways of performance: movement along a wall on a range finder, or by means of a compass, gyroscope or accelerometer, as well as technical systems view.
- Autonomous capture of objects and beacons carried out using a distance sensor or vision systems. At the same time, the robot must be turned away from the object, so it have to find it first, and at a distance of at least 10 cm from it.
- Movement along a complex trajectory: ascent/descent along the stairs by line, passing the “wood pile”, “rails”, “hypno disk”, “align ramps-2”, “logs”, “fog”, “hoof” sections using compass, gyro or accelerometer, vision system, combined methods, including the use of other sensors (for example, distance sensors).
- QR-code reading performed by robot (decryption of the code appearing on the operator screen). Possible only for Extreme category.

9.8. The tasks performed with the aid of the **manipulator** include: capturing and moving objects and pressing buttons with robot arm.

9.9. All other actions with sensors and a manipulator should be discussed with judges before the attempt.

10. Penalties and time limits

10.1. Final round

10.1.1. **Rescheduling the attempt until later time** will cause 50 points penalty. Can be done only once.

10.1.2. **Repair time-out**

10.1.2.1. If the operator uses the right to intervene in the work of the robot, then the team will be charged a 70 points penalty. Time for intervention is limited to 5 minutes. You can only intervene once during the attempt.

10.1.2.2. If the robot is stuck in a cell, operator can ask the judge to pick it up and transfer to the point of its arrival in this cell or to the previous cell. This action will be equivalent to intervention.

10.1.2.3. The time will not be stopped during the intervention.

10.1.2.4. The robot cannot stay in one cell for more than **2 minutes**. In this case the attempt would be finished.

10.1.2.5. The robot cannot stay outside the test area for more than 5 minutes. In this case the attempt would be finished.

10.1.3. **Lost robot parts**

10.1.3.1. The team will be charged 30 points penalty for each lost part (it does not matter if it was a small piece or a whole module).

10.1.3.2. If a part is not connected to the robot and is not moving, it considered lost.

10.1.4. **Touching robot to switch on/off the autonomic mode**

10.1.4.1. The autonomic mode should be switched on/off remotely (without touching the robot itself). In this case, the team will not be charged penalty points.

10.1.4.2. To switch from autonomic mode to remote control and back on by using the button placed on the robot, the team should receive 10 points penalty. You can only use two on/off cycles during the attempt.

10.1.5. **For unsportsmanlike behavior** (non-compliance with moral and ethical standards, rude behavior towards other participants, organizers and judges of the competition) is punished by disqualification by decision of the panel of judges.

10.2. **Qualifying round**

10.2.1. In the qualifying round, there is no penalty for loss of parts, switching on/off the autonomic mode by touching the robot and rescheduling attempt.

11. Flip over

11.1. Tipped to the side or turned upside down robot returns to its basic position (stands on “wheels”).

11.2. After flipping over robot remains able to move on without repair.

11.3. Flip over from a vertical standing position, when robot rests on its front or rear end, does not count.

11.4. Robot scores points for a flip over only once for a round.

11.5. **Operated flip over**

11.5.1. Robot performs a flip over being operated from distance according one of two variations:

- Robot flipping over with a help of its robot arm or some mechanical adjustment witch able to assist as manipulation device, scores points and get a pass in manipulation category.
- Robot flipping over with a help of basic chassis only (for example, by riding onto a wall), scores points but does not get a pass in

manipulation category. The same condition concerns situation when robot has a rounded back-frame (for example) and flips over on its own (uncommanded).

11.5.2. For performing a flip over robot scores 120 points.

11.6. **Autonomous flip over**

11.6.1. Flip over considered as an autonomic action if sensors have been used to explore the surroundings and robots position in space (without operators command).

11.6.2. It is acceptable if robot determines its position by sensors and give a signal to operator about its reversed position. Operator receives a signal (sound, text on a screen and etc.) and decides what to do next: take it as a false alert and keep moving, or enable autonomous flip over action by pressing a button.

11.6.3. For completion this task, robot scores 240 points and get a pass in autonomous category.

11.6.4. Team has to give a warning to judge about autonomous flip over before attempt starts.

11.7. **Possible options for performing flip over**

11.7.1. Option #1: robot can start an attempt by performing flip over right where it stands, before a starting gate. In that case, robot starts from tipped to the side or turned upside down position, performing flip over right after start of countdown.

11.7.2. For fully autonomous flip over, it is allowed to turn your robot immediately after the start of countdown. For this purpose operator can use help from his team.

11.7.3. Option #2: robot performs task during attempt, while passing test area. In this case, robot can be turned upside down only remotely.

11.7.4. For both options, if turned upside down robot cannot flip itself back over, general rules are in action: operator can take penalty to interfere and flip robot manually (see to “Penalties” chapter).

11.8. Robots position before and after flip over must to be checked and authorized by judge.

11.9. The web-link bellow shows an example of flip over task performance. According to the rules described earlier, it is operated flip over with manipulation – team scores 120 points and get a pass in manipulation category.

https://www.youtube.com/watch?v=CBN5L8dGg8o&list=PLgasM8avUUwH7EjA92314qNTmbmZXkMqp&index=2&t=0s

12. Judging

12.1. The operator signs the protocol at the end of the attempt, if he agrees with the results of attempt.

12.2. Discussion of the competitive process, schedule and results of attempts with the judges and the organizers is carried out only with team members and their mentors.

12.3. The protocol is an internal competition document and is used exclusively by the judges and organizers. The protocol is not intended to be used by the participants. It is forbidden to photograph or copy the protocol.

12.4. All questions arising during the competition are resolved by the judging committee. All participants should accept its final decisions.