HKUST Robotics Team 2016/17

The 8th Robot Design Contest

Rule Book

Table of Contents

1. Introduction

Every year, the HKUST Robotics Team participates in multiple robotics competition, including ABU Robocon, MATE Remotely Operated Vehicles (ROV) and the NXP Intelligent Car Racing Competition.

This robot design contest is held for the newcomers of the Robotics Team. It aims to let participants get familiar with designing and constructing robots and experience the robotic competition environment. The contest is designed with elements from the three competitions mentioned above.

In this contest, participants are required to design two robots, Carrier Robot and Shooter Robot. Carrier Robot needs to carry provided balls to designated area by following a track while Shooter Robot needs to grab and lift a basket, and throw balls into it.

The game consists of four parts. Two robots will carry out tasks simultaneously until the last two parts of the game.

- **Part 1A – Carrier Robot getting to the Station Zone**

  Carrier Robot carries three balls within a container to the Station Zone automatically. The robot must move along the track.

- **Part 1B – Shooter Robot taking and placing the basket**

  Shooter Robot takes the basket out of the Basket Zone then places the basket on the 20cm high platform automatically. The basket must not fall in the process.

- **Part 2 – Shooter Robot grabs the container from the Carrier Robot**

  After Carrier Robot arrives Station Zone, Shooter Robot can grab the container from Carrier Robot.

- **Part 3 – Shooter Robot projects the grabbed balls into the basket**

  Shooter Robot projects grabbed balls into their previously placed basket. The team immediately win the game if one of the balls landed inside the basket.

2. Game field and objects

2.1 The game field is an area having the dimension of 8000mm * 4000 mm. It is equally divided into two sides in a mirror way. The competing teams are Blue Team and Red Team.

2.2 Each side of the game field consists of Start Zone, Basket Zone and Station Zone. Both teams share the same Target Zone.

2.3 All tapes used in the game field will be 30mm thick. The grid lines will use white tapes while No Touching Lines, Starting Line, Checkpoint A and Checkpoint B will use black tapes.

2.4 Start Zone

This is a 400mm * 400mm area. Shooter Robot should be placed here before the game starts.

2.5 Basket Zone

This is a 500mm * 500mm area. The basket will be placed within this zone by the team's game field members.

2.6 Station Zone

This is a 1500mm * 500mm area. Carrier Robot should stop here and Shooter Robot should project balls from here.

2.7 Target Zone

This is the top surface of a 200mm high platform (see appendix). The basket should be placed on it.

2.8 Basket

Made of transparent plastic with square holes. 243mm * 343mm * 142mm (height).

2.9 Ball

Standard table tennis ball.

3. Robot Set up

3.1 Before the game starts, the team has a preparation time of one minute to set up the robot and the basket.

3.2 Only three registered members from each team are permitted to enter the game field and set up the robots and the basket.

3.3 The basket can be placed inside the basket zone by game field members. The basket is considered inside basket zone if and only if the basket is not touching area outside basket zone.

3.4 Game field members are not allowed to touch the robot in the last five seconds of the preparation time.

3.5 Any team which fails to set up within the preparation time may continue the set up after the game starts.

4. Game flow and tasks

4.1 The game consists of four parts. Two robots will carry out tasks simultaneously until the last two parts of the game.

4.2 Part 1A – Carrier Robot getting to the Station Zone

4.2.1 All parts of the Carrier Robot must be placed behind the Starting Line (including air space) before the start of the automated process.

4.2.2 Carrier Robot carries three given balls inside a container and goes from the Starting Line to the Station Zone automatically.

4.2.3 Carrier Robot cannot leave the track.

4.3 Part 1B – Shooter Robot taking and placing the basket

4.3.1 Shooter Robot must be placed entirely within Start Zone before the start of the automated process. None of the robot parts can be outside of this area, including air space.

4.3.2 Shooter Robot takes the basket completely out of the Basket Zone, including air space.

4.3.3 Shooter Robot places the basket on the Target Zone such that the basket is in contact only with the Target Zone.

4.3.4 The basket must not fall after being taken out of the Basket Zone.

4.3.5 Shooter Robot cannot enter Carrier Robot's track.

4.3.6 After the completion of Part 1A or after two minutes, Shooter Robot can be switched to manual operation. Before that, the Shooter Robot must be automated.

4.3.7 The team can only switch between manual operation and automation during a Shooter Robot retry.

4.3.8 During and only during manual operation, Shooter Robot cannot touch any No Touching Lines in the game field.

4.3.9 The definition of falling off is that the basket is no longer in contact with the Shooter Robot and is in contact with the ground.

4.4 Part 2 – Shooter Robot grabs the container from the Carrier Robot

4.4.1 After Carrier Robot has arrived at Station Zone and the basket has been placed on the Target Zone, Shooter Robot might grab the container from Carrier Robot.

4.4.2 After successfully grabbing the container, Shooter Robot can proceed to Part 3.

4.4.3 For the container to be count as grabbed, it must be in contact and only in contact with the Shooter Robot.

4.5 Part 3 – Shooter Robot projects grabbed balls into the team's basket

4.5.1 Game field members can ask for referee's permission to get into the game field to take the grabbed balls and place them elsewhere on the Shooter Robot and to place the container back onto the Carrier Robot.

4.5.2 All game field members must leave the game field before Shooter Robot projects.

4.5.3 Shooter Robot must project with all parts staying inside the Station Zone, air space excluded.

4.5.4 If any projected ball lands inside the team's basket (The basket must remain standing on the Target Zone after the ball rest), the game ends and the team wins immediately.

4.5.5 After Part 1A, any ball, as soon as it is fell on the ground, will be contaminated and cannot be used. To decontaminate them, game field members could ask for referee's permission to collect balls fallen within their game field and place them back to Carrier Robot, and to restart Part 1A. This does not reset any scores gain in part 1A. During decontamination, the action of Carrier Robot will not lead to any increment in scores. **Game field members cannot collect any ball that falls on opponent's game field. Entering opponent's game field would be counted as disqualification.**

4.5.6 Targeting opponent's basket to make it fall does not violate the game rule and can be used strategically.

5. Game duration

5.1 Each game will have a duration of three minutes.

5.2 The three-minute game will start right after the one-minute preparation time.

5.3 There will be beeping sound(s) in the following cases:

5.3.1 Last five seconds of the preparation time, as a countdown.

5.3.2 The last 60th second of the game, as a reminder. Shooter Robot can switch to manual control at this point.

5.3.3 Last five seconds of the game, as a countdown.

6. Scoring

6.1 Carrier Robot passes Checkpoint A

+5 points *(+5 bonus if this happens for the first time in the game)*

6.2 Carrier Robot passes Checkpoint B

+5 points *(+5 bonus if this happens for the first time in the game)*

6.3 Carrier Robot stops at Station Zone

+10 points *(+5 bonus if this happens for the first time in the game)*

6.4 Taking the basket out of the space above Basket Zone

+10 points

6.5 Placing the basket on the Target Zone such that the basket is in contact with the Target Zone only

+10 points

6.6 Successfully grabbed the container from Carrier Robot

+10 point

6.7 Both teams will get the bonus score if both team passed the same checkpoint in its own field at the same time.

6.8 No scores will be double-counted.

6.9 The definition of passing a checkpoint is that all wheels have completely passed the line.

6.10 The definition of stopping at Station Zone is that any parts of the robot, excluding air space, touches the Station Zone and remains stationary for at least 3 seconds.

7. Winner of the game

7.1 The team immediately wins the game if their robot project a ball and such ball landed into that team's basket.

7.2 If no ball is landed into any basket when the time is up, or if the ball is landed into both team's baskets at the exact same time, the winner will be decided by the below conditions in the following order:

7.2.1 The team with higher score.

7.2.2 The team that has admitted fewer violations.

7.2.3 The team with less total robot weight.

7.2.4 To be decided by the judge panels.

7.3 When the game ends, the temporary score of both teams will be announced.

7.4 There will be 30 seconds countdown after a game ends. Teams may appeal if there is any doubt or unfairness for the game.

7.5 When the 30-second countdown ends, teams can no longer appeal for the game anymore. The finalized score and the winner of the game will be announced.

8. Robot

8.1 Each team must takes exactly one Carrier Robot and one Shooter Robot respectively for the game.

8.2 Both robots cannot be separated.

8.3 Operation of the robot:

8.3.1 The operator must be one of the game field members.

8.3.2 The operator must operates the robot outside the game field.

8.3.3 Only one operator is allowed and only operator is allowed to operate the robot.

8.3.4 For manual operation, the robot can be operated with a wireless / wired connection.

8.3.5 During automation process, the controller must be placed on the floor and the operator cannot touch the controller to indicate that the robot is automated.

8.3.6 If the operator wants to switch to manual mode (i.e. touch the controller) during automation, the team must ask for a Shooter Robot retry.

8.4 The container on the Carrier Robot is not considered as a part of the robot.

8.5 The use of wireless / radio wave device which affects other teams is strongly prohibited.

8.6 The cable and the controller are not included in neither the dimensional nor the weight limit.

8.7 The maximum extension of the cable is 5000mm.

8.8 The maximum dimension of Shooter Robot at the start of the game is 400mm * 400mm * 400mm

(width * length * height).

8.9 The maximum dimension of Shooter Robot when fully extended is 600mm * 600mm * 600mm (width * length * height).

8.10 The maximum dimension of Carrier Robot at any time is 400mm * 400mm * 400mm (width * length * height).

8.11 The maximum weight of two Robots in total is 15kg. The weight limit includes battery and pumped compressed air, if any, which is the exact situation at the beginning of the game.

8.12 The voltage source used in the robot shall not exceed 12.6V.

8.13 The maximum voltage in the circuit(s) shall not exceed 42V.

8.14 Compressed air should be filled into PET bottles and the maximum air pressure should be 6 bars (600 kPa).

8.15 It is strictly prohibited to use dangerous energy sources such as high-pressure gas and explosives.

8.16 Robots cannot be used to damage, hurt or injure human beings.

8.17 If referee judges that the robot will damage, hurt or injure human beings or the game field, the referee can end the game immediately.

9. Retry

9.1 A valid retry is granted by the referee.

9.2 A retry does not pause the ongoing game.

9.3 No scores will be counted during a retry.

9.4 Retries for Carrier Robot and Shooter Robot are separated. Retrying one of the robots does not affect the other.

9.5 Game field members can enter the game field and touch the robot that needs to retry during a valid retry.

9.6 Robots cannot be brought out of the game field during a retry.

9.7 The following actions will lead to an immediate and mandatory retry.

9.7.1 Carrier Robot has three or more wheels leaving the track.

9.7.2 The container or any ball drops during Part 1A.

9.7.3 Shooter Robot touches any No Touching Lines during manual operation.

9.7.4 Shooter Robot touches any part of the Carrier Robot’s track.

9.8 For Carrier Robot, after retry, the team can restart at any of the following location:

9.8.1 Behind Starting Line.

9.8.2 Behind any passed checkpoints.

9.8.3 At Station Zone, if Carrier Robot has stopped at Station Zone.

9.9 Scores will be adjusted according to the restart location. For example, if the team has gained (5+5) points for passing checkpoint 2, and decided to restart behind checkpoint 2, these (5+5) points will be cancelled. If their Carrier Robot passes through checkpoint 2 again, they can get back 5 points (without bonus).

9.10 For Shooter Robot, after retry, the team can restart at location specified as follow:

9.10.1 At Start Zone.

9.10.2 At Station Zone, if Shooter Robot has started Part 3 and has touched the container placed on Carrier Robot.

9.11 If the basket falls, game field members must place it back to the Basket Zone during a Shooter Robot retry.

9.12 If the basket does not fall, game field members need not place the basket back to the Basket Zone during a Shooter Robot retry.

9.13 If the container on the Carrier Robot falls during Part 1A, game field members can pick up the container and any ball that drops and place them back onto the Carrier Robot during a Carrier Robot retry.

9.14 A valid retry will be ended automatically if all game field members leave the game field.

10. Violations

10.1 The following actions will be regarded as violations and 5 points will be deducted for each violation:

10.1.1 The basket falls down after being taken out of the Basket Zone.

10.1.2 Any game field member touches any robot without getting permission from the referee.

10.1.3 Any game field member enters the game field without getting permission from the referee.

10.1.4 Any robot touches the opponent game field.

10.1.5 Any robot touches any part outside the game field.

10.1.6 Any game field member tries to control the Shooter Robot manually (i.e. touches the controller) during automation.

10.1.7 Other actions that infringe on the rules without mentioning in the disqualifications.

10.2 A retry for the specific robot is compulsory if that robot has admitted violation.

11. Disqualifications

11.1 The following actions will lead to disqualification and the opponent's team immediately wins the game:

11.1.1 Any robot entirely enters the opponent game field.

11.1.2 Any robot entirely leaves the game field.

11.1.3 Any robot separates during the game.

11.1.4 Damaging the game field or any game field objects.

11.1.5 Entering the opponent's game field.

11.1.6 Any act against fair play spirit.

12. Team Formation

12.1 All team members are the 2016/17 candidates of the HKUST Robotics Team and are undergraduate of HKUST.

12.2 Team members can be of any school, year or department.

12.3 Each team has a mentor(s) in order to handle team affairs.

12.4 The HKUST Robotics team will provide basic materials and tools for each team.

12.5 The unexpected usage of materials and tools are required to be approved and supplied by new members themselves.

13. Others

13.1 The dimensions, weights, etc. of the field, facilities, and equipment described in this rule book have a margin of error of ±5% unless otherwise stated.

13.2 HKUST Robotics Team does not guarantee a stable environment (e.g., stable wind, lighting, noise, etc.) for the contest venue. The participants should take sufficient measures to prevent robots being affected by any varying elements of the contest venue.

13.3 All robots must pass dimension, weight and safety check in order to take part in the contest.

13.4 Teams may be required to demonstrate all functions of the robots for checking before the contest.

13.5 All questions should be addressed to the official website of the HKUST robotics team, http://robotics.ust.hk/.

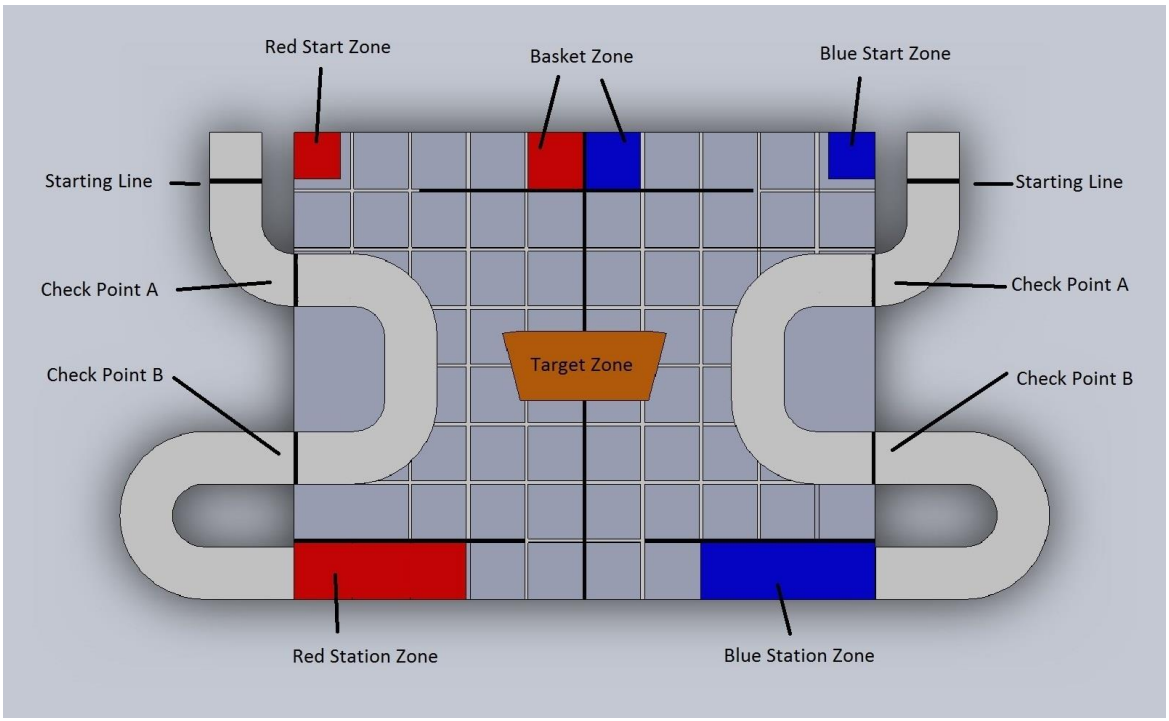
13.6 Notification of any additions and/or corrections to this rule book will be made on the official website. Participants are responsible for receiving all updated information.

13.7 The referees may demand additional explanations on safety issues when the safety of a robot is deemed to be in question.

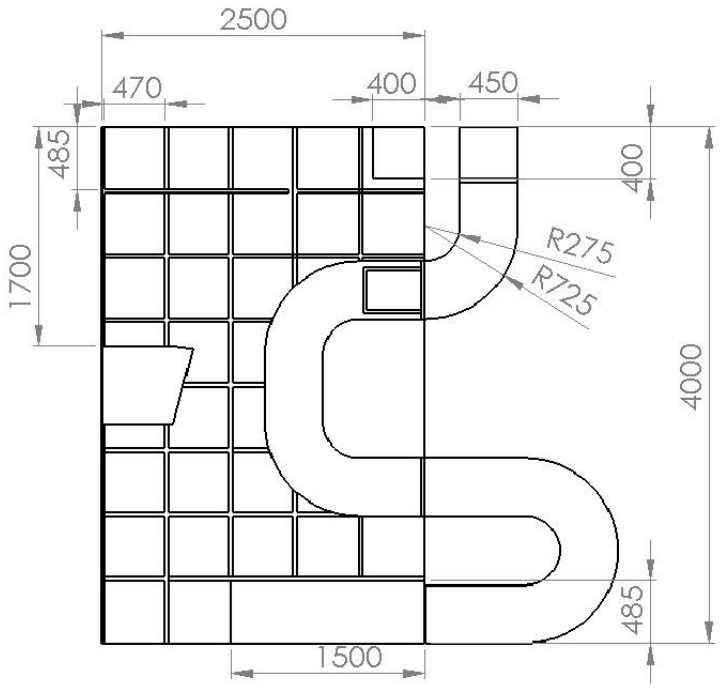
13.8 Each team is required to design a poster about their robots and display it to the public before the contest.

14. Appendix

- Game field illustration



- Dimension detail of the game field (half)



- Drawing of the 20cm high platform (Target Zone)