



## Junior Category - Home Robot Challenge

### Rules and Regulations

#### About this Rulebook

This is the official rulebook of the Junior Category – Home Robot Challenge 2020 competition. It is written by the Junior Category- Home Robot Challenge Technical Committee members.

#### Acknowledgement

The Junior Category – School Robot Challenge has been developed upon the experience and the know-how learning and developed through RoboCup Junior as its foundation. The successful design of the Junior Category – School Robot Challenge including the development of the rules and regulations could not have been possible without the efforts and contributions of the School Robot Challenge committee members most of who are members of RoboCup/RoboCup Junior community.

#### Junior Category - Home Robot Challenge Executive Committee 2020:

Amy Eguchi – Chair (USA), [amy\\_eguchi@gmail.com](mailto:amy_eguchi@gmail.com)  
Damien Kee – (Australia), [damien@domabotics.com](mailto:damien@domabotics.com)  
Kate Sim (United Kingdom), [kate.sim61@gmail.com](mailto:kate.sim61@gmail.com)  
Koujiro Tabaru (Japan), [tabaru@tamagawa.ed.jp](mailto:tabaru@tamagawa.ed.jp)  
Luis Jose Lopez Lora (Mexico), [llopez@tecnovanguardia.com](mailto:llopez@tecnovanguardia.com)  
Raimondo Sgrò (Italy), [remosgro@virgilio.it](mailto:remosgro@virgilio.it)  
Kaiya Sakamoto (Japan), [keiyasakamoto0414@gmail.com](mailto:keiyasakamoto0414@gmail.com)  
Hiroki Nakamura (Japan), [hiroki-nak@kanagawa-u.ac.jp](mailto:hiroki-nak@kanagawa-u.ac.jp)  
Hiroyuki Okada (Japan), [h.okada@tamagawa.ac.jp](mailto:h.okada@tamagawa.ac.jp)  
Jeffrey Too Chuan Tan (China), [i@jeffreytan.org](http://i@jeffreytan.org)

## Contents

<b>Junior Category - Home Robot Challenge Executive Committee 2020:</b>	<b>1</b>
<b>Overview:</b>	<b>4</b>
Game Classes:	4
Skills Challenge (30% of the Total Score):	5
Open Demonstration (50% of the Total Score):	6
Technical Interview (20% of the Total Score):	6
Documentation:	7
<b>Robots</b>	<b>7</b>
Open Platform	7
Communication	7
Advices for designing and programming robot movements	7
<b>Skill Challenges (30% of total score)</b>	<b>7</b>
<b>Overview</b>	<b>7</b>
<b>Number of attempts</b>	<b>8</b>
<b>Scoring</b>	<b>8</b>
<b>The number of skill challenges complete will affect the final Skill Challenge Team score.</b>	<b>8</b>
<b>Note: 30% of the score obtained from the Skill Challenge will be added to the Total Score.</b>	<b>8</b>
<b>Open Demonstration (50% of total score)</b>	<b>8</b>
Overview	8
Open Demonstration judging	8
Open Demonstration Tasks	8
Open Demonstration	8
Demonstration area	9
Human-robot interaction	10



Penalties	10
Practice on the main Open Demonstration area	10
Message and image of the Open Demonstration	10
Security and safety	10
Authenticity and originality	10
<b>Technical interview (20% of total score)</b>	<b>11</b>
Interview procedure	11
Translator	11
Second technical interview	11
<b>Documentation required for the event</b>	<b>11</b>
Documentation	11
Team Website	11
Poster, Digital Presentation, Team Website	12
<b>Judging and Awards</b>	<b>12</b>
Judging criteria	12
Totalling	12
Prizes and awards	12
Feedback	12
<b>Additional information</b>	<b>13</b>
Information about the event	13
WRS Junior Category Forum	13
<b>Contact information</b>	<b>13</b>



### Overview:

“If you have a humanoid robot at home, what would you want it to do? What is the role of a humanoid at home? Helping you, your mom, your siblings, or grandparents? What can it do?” This is the question that World Robot Summit (WRS) Junior Home Robot Challenge would like to ask you.

WRS Junior Home Robot Challenge invites teams of 2-6 students to develop a creative and innovative idea for the use of humanoid robot at home, and realize the idea by programming a robot you construct. The main objective is to develop a robot that can complete the given tasks (Skills Challenge), and develop the robotic demonstration of 7 minutes to show your creative and innovative idea of using a robot at home. The demonstration should maximize the capability of your robot at home. Teams are encouraged to be as creative, innovative and/or entertaining as possible to show off your creation!

During the Competition, teams are judged in three areas; Skills Challenge, Open Demonstration, and Technical Interview.

### Game Classes:

WRS Junior Home Robot Challenge has two Game Classes: Mini Size class and Real Size class. Mini Size class is for table-top size robots, while robots in the Real Size class to be used in the real home environment. Table-top size robots for Mini Size class must be 300mm x 300mm x 300mm (starting size). They can extend after the demonstration has begun ( i.e. extendable arm).



### Skills Challenge (30% of the Total Score):

Skills Challenge is a set of tasks to test a team's ability to control a robot. There are three Skills Challenge tasks for each class.

#### Mini Size Class:

Skills Challenge for 2020 include:

1. Robot Guide Test
2. Follow Me Test
3. Pick and Place Test

#### 1. Robot Guide Tests

The Robot Guide Tests aim for a robot to simulate a guide dog leading a blind or visually impaired person around obstacles. Every time it encounters an obstacle, the robot has to indicate that an obstacle has been detected.

#### 2. Follow Me Tests

The Follow Me Test aims for the robot to complete the task to follow another robot to simulate following a person around the home.

#### 3. Pick and Place Tests

The Pick and Place Test aims for the robot to complete the task to pick up an object from one location and move it to another location.

#### Real Size Class:

Skills challenges for 2020 include:

1. Robot Guide Test
2. Hearing Robot Test
3. Assisted Service Robot Test

#### 1. Robot Guide Test

The Robot Guide Tests aim for a robot to simulate a guide dog leading a blind or visually impaired person around obstacles. Every time it encounters an obstacle, the robot has to indicate where the obstacle is for the blind/visually impaired person in effective and creative way so that the robot and the person can go around obstacles (without hitting).

#### 2. Hearing Robots Test

The Hearing Robots Test aims for robot to simulate a hearing dog in assisting deaf or hearing-impaired person by alerting to important sounds, such as doorbells, smoke detector



alarms, telephone ringer, and alarm clocks.

### 3. Assisted Service Robot Test

The Assisted Service Robots Test aims to simulate a service dog in helping people who have disabilities. The robot is required to be able to communicate with the owner to understand the owner's needs or instructions in order to provide appropriate assistance. A list of tasks that teams can use will be announced two months (in August 2020) before the competition.

#### Open Demonstration (50% of the Total Score):

A 7-minute demonstration to outline a problem as well as showcase the capabilities of a robot that addresses this problem. Teams propose and execute creative and innovative tasks that solve an identifiable challenge from within a home-based context. Teams should demonstrate and describe the tasks and their use of the capabilities of their robots. Teams need to present a summary of the technical description of how the capabilities have been developed, the algorithms controlling the behaviour/performance and problems they encountered and overcame during development.

The assessment is done on the following categories:

- appropriate communication of the challenge to be solved
- successful demonstration of the robot's capabilities described during the Technical Interview (details below)

Note: See the Open Technical Demonstration Score Sheet (will be published).

#### Technical Interview (20% of the Total Score):

A face-to-face interview (maximum 15-minute, subject to change depending on the competition schedule, but *ALL* teams have the same length of interview) with a panel of judges in which robot construction, performance, algorithms and programs are assessed against technical criteria. Creative and innovative ideas and use of technical aspects are rewarded with higher scores. Judges are interested in determining students' understanding of the development of their robot, the robotic technologies including sensors and functions, and programming they have created as well as the processes they went through to arrive at their preferred solution. Teams are expected to use this opportunity to show authenticity and originality of their work. Each team members must be prepared to answer questions about the technical aspects of their involvement in the development of their robot, ideas and programming. See the Technical Interview Score Sheet (will be published).

### Documentation:

All teams are to submit a “From Challenge to Solution” paper several days (will be defined before the competition) *before* the day of the competition. A template will be provided to participating teams which teams can choose to use if they desire. Additional documentation (website / posters / newspaper articles etc.) outlining how a team has chosen to share their finding and learning with the wider community is highly encouraged, not for the benefit of the team at the competition, but to demonstrate how science and knowledge can be spread amongst peers for the advancement of everyone interested in learning robotics.

All “From Challenge to Solution” papers will be released publicly after the competition. Future participants are encouraged to take this body of knowledge, learn from it, improve on sections and forge new directions of research.

## 1. Robots

### 1.1. Open Platform

- 1.1.1. Teams are required to build a robot that functions in a home environment.
- 1.1.2. Teams are free to choose robotics components and other materials to build their robot.
- 1.1.3. Teams are encouraged to use the robot’s technologies in creative and innovative ways to engage or interact with humans, and/or complete the tasks set by the team.
- 1.1.4. The robot is strongly encouraged to interact with human, but not have low-level control by humans. (i.e. A human is not permitted to ‘drive’ a robot around, but can issue commands via voice/interacting with sensors, etc.)

### 1.2. Communication

- 1.2.1. A robot has to run autonomously and cannot communicate with team’s computer during a performance/demonstration.

### 1.3. Advices for designing and programming robot movements

- 1.3.1. While floor joints will be taped to make them as smooth as possible, robots must be prepared for irregularities of up to *5 mm* in the floor surface. Whereas every effort will be made to make the demonstration floor flat, teams should be prepared to cope with this uncertainty.
- 1.3.2. The WRS organizers endeavor to make lighting as similar to ones in a home environment, and avoid direct lights to be shed on a robot. However, teams should come prepared to calibrate their robots based on the lighting conditions at the venue.
- 1.3.3. The WRS organizers endeavour to minimize the noise around the performance area during a team’s performance. However, teams should come prepared to calibrate their robots based on the noise level at the venue.

## 2. Skill Challenges (30% of total score)

### 2.3. Overview

Skills Challenge is a set of tasks to test a team’s ability to control a robot. There are

three tasks.

#### 2.4. Number of attempts

Teams will have the opportunity to attempt each task 3 times. Each task will be awarded either a Pass or Fail grade.

#### 2.5. Scoring

The number of skill challenges complete will affect the final Skill Challenge Team score.

Number of Skills Challenges completed	Score – Each task is 29 points. It is scaled by the multiplier
0	0
1	30.5 (29x1x1.05)
2	64 (29x2x1.10)
3	100 (29x3x1.15)

Note: 30% of the score obtained from the Skill Challenge will be added to the Total Score.

### 3. Open Demonstration (50% of total score)

#### 3.1. Overview

The Open Demonstration is an opportunity to demonstrate the team's solution, and how the tasks are executed. Teams are encouraged to seek out both creative and innovative solutions as well as unexpected and challenging problems to be solved.

#### 3.2. Open Demonstration judging

3.2.1. All teams will be given two opportunities to demonstrate before a panel of judges. The highest score will be used.

3.2.2. The Open Demonstration will be judged by a panel of at least three judges. At least one of these judges are WRS officials who have judged the Technical Interview as well.

#### 3.3. Open Demonstration Tasks

3.3.1. Teams are required to identify a problem/issues/situation in a home environment, that may benefit from the use of a robot.

3.3.2. Teams are required to develop creative and innovative solutions to the problem they have identified, for their robot to accomplish at home.

3.3.3. Teams are required to execute the tasks during the Open Demonstration.

3.3.4. Solutions should be original and support activities and tasks at home.

3.3.5. Solutions should improve the life at home.

#### 3.4. Open Demonstration

3.4.1. The duration of the demonstration routine must not exceed five minutes.

- 3.4.2. Each team will have a total of seven minutes for their demonstration including up to two minutes for setting up their robot and any props in the demonstration area. A judge starts a stopwatch when a team member steps in the demonstration area. This time includes robot and demonstration area set-up (two minutes), introduction and demonstration routine, pack up, including any restarts due to factors under the team's control. If the time is exceeded seven minutes due to circumstances outside the team's control, there will be no penalty. The judges have the final decision on any time penalties.
  - 3.4.3. Each team is encouraged to create a narrative describing their demonstration including a problem/challenge identified, and the solution developed. This could cover any aspect of the demonstration, and/or the construction and technical capabilities of the robot(s), such as interaction with humans or the use of a particular sensor/technology.
  - 3.4.4. Following each demonstration, a team must fully tidy up the demonstration area, pack up and remove any objects related to their demonstration. Also, a team should have returned the demonstration area to its original state.
  - 3.4.5. Teams are strongly encouraged to use the time while they are setting up on the stage to introduce to the audience their demonstration including the tasks and how they execute them.
  - 3.4.6. Restarts  
Teams are allowed to restart their routine if necessary, at the discretion of the judges. There is no limit on the number of restarts allowed within their five-minute demonstration time. Restart penalty marks will be deducted from the score. The team will be asked to leave the stage after the five-minute demonstration time.
- 3.5. **Demonstration area**
- 3.5.1. The size of the demonstration area will be marked in a rectangular area of 5 x 4 meters (m) with the 5m side facing the judges.
  - 3.5.2. Props  
*Mini Size class:* The organisers will provide a table (for 4 people, about half the size of ping-pong table). Teams are required to bring their own home environment setup, including furniture, objects, etc.. It should be visible to the audience as well as the judges sitting in front of the demonstration area.  
*Real Size class:* The organisers will provide a set of furniture including dining table (for 4 people, about half the size of ping-pong table) and 4 chairs, a counter (standard size), a love-chair. Teams may place these objects during the set-up. Furniture measurements will be provided to the participating teams before the competition.
  - 3.5.3. Teams are strongly encouraged to use the entire demonstration area (the table for the Mini Size class) during its demonstration with the robot.

### 3.6. Human-robot interaction

3.6.1. Human-robot interaction is strongly encouraged. However, humans are prohibited to physically control the robot. They can interact with the robot's sensors. Interaction which is used to alter the robot's behaviour directly (e.g. physically touching it to stop it from going outside of the demonstration area, or falling off of the table) may lead to some point deduction, while using more intelligent interaction (e.g. creative use of sensor technology) can gain some extra points.

### 3.7. Penalties

3.7.1. If a team exceeds the time limit explained in 3.4, the team will be penalized by the loss of points (see Open Technical Demonstration Score Sheet).

### 3.8. Practice on the main Open Demonstration area

3.8.1. The main Open Demonstration area will be made available for teams to practice on. In fairness to all teams who may wish to practice, a practice sign-up sheet will be used to reserve the area for a short practice time. Teams are expected to be respectful of the allocated time as well as other teams.

3.8.2. The last team to practice on the main Open Demonstration area before Open Demonstration time starts must fully clean up the area and clear the area at least 3 minutes before the Open Demonstration start time.

### 3.9. Message and image of the Open Demonstration

Participants are asked to carefully consider the wording and messages communicated in any aspect of their demonstration. What seems acceptable to one group may be offensive to friends from a different country or culture.

### 3.10. Security and safety

3.10.1. In order to protect participants and comply with occupational health and safety regulations of the host country, WRS officials and bystanders, routines may not include explosions, smoke or flame, use of large amount of water, or any other hazardous substances.

3.10.2. A team whose routine includes any situation that could be deemed hazardous, including the possibility of damaging the floor, furniture or/and materials provided, must submit a report outlining the content of their demonstration to the WRS Junior Competition Committee one month prior to their arrival at the competition. The WRS Junior Competition Committee may also request further explanation and also a demonstration of the activity before the demonstration. Teams not conforming to this rule may not be allowed to demonstrate in public.

### 3.11. Authenticity and originality

The performance is to be unique and have never been used in any other International competitions. Teams are responsible for carefully checking that their robot demonstration conforms to this rule.

#### 4. Technical interview (20% of total score)

##### 4.1. Interview procedure

- 4.1.1. All teams will have a 15-minute technical interview (subject to change depending on the competition schedule, but *ALL* teams have the same length of interview) during the competition.
- 4.1.2. Interviews will be judged by at least two WRS officials.
- 4.1.3. The Interview Score Sheet is used in the interview judging. It is strongly recommended for teams to review the Technical Interview Score Sheet prior to the competition to make good use of the interview.
- 4.1.4. Teams should ensure that they bring the copies of all their programs in a format that can be easily viewed.
- 4.1.5. Teams should bring their laptop to show their programming capabilities.
- 4.1.6. Each team member must be prepared to answer questions about the technical aspects of their involvement in the development of their robot demonstration.

##### 4.2. Translator

Interviews will take place in English. If teams require a translator, they should inform the WRS officials or the local organizing committee via e-mail prior to the event to allow translators to be organized. (The team mentor or parents of the team members **CANNOT** be the translator.)

##### 4.3. Second technical interview

If the judges consider it necessary, teams may be asked to participate in a second technical interview. If this occurs, the score from the second interview will be used to calculate the total score.

#### 5. Documentation required for the event

##### 5.1. Documentation

- 5.1.1. A “From Challenge to Solution” template will be available to teams prior to a competition. This allows teams to provide a summary of the problems and solutions that they developed to realize their goal using a robot.
- 5.1.2. The “From Challenge to Solution” must be submitted to the judges prior to judging.

##### 5.2. Team Website

- 5.2.1. Teams are highly encouraged to create a team website to provide team information including team introduction, members, your region/country, tasks to be accomplished, annotated pictures and explanation of the robot performances under development at various stages and an explanation of the innovative ways that robot technologies were used.
- 5.2.2. The tasks used and the information about how the tasks are realized should be open-source and shared on their website after the competition so that teams can learn from each other.

### 5.3. Poster, Digital Presentation, Team Website

- 5.3.1. Teams will be given public space to display a poster. The size of the poster should be no larger than A1 (60 x 84 cm). The interview the poster should be displayed in the designated location. Teams may bring the poster to the interview if they contain useful information, however the poster will not be judged during the interview. Electronic posters will not be accepted.
- 5.3.2. The purpose of the poster is to introduce the team, explain the technology used to develop the robot performances and document the preparation work. Posters should be made in an interesting and engaging format. They will be viewed not only by the judges, but also by other teams and visiting members of the public.
- 5.3.3. Items that are useful to include are: team name, members, your region/country, tasks to be accomplished, annotated pictures and explanation of the robot performances under development at various stages and an explanation of the innovative ways that robot technologies were used.
- 5.3.4. Teams can also use other medium including Digital Presentation and/or Team Website to present and share the same information described in 5.3.1 to 5.3.3.

## 6. Judging and Awards

### 6.1. Judging criteria

The judging criteria and allocation of marks are given in the respective score sheets published to the participating teams prior to the competition.

### 6.2. Totalling

- 6.2.1. The total score of each team is calculated by combining the scores from the team's final score of Skill Challenges, Technical Interview, and the higher score of the two open demonstrations. There will be no finals.

### 6.3. Prizes and awards

- 6.3.1. The following trophies will be awarded.
  - The WRS Home Robot Challenge Team of the Year (1<sup>st</sup> place), 2<sup>nd</sup> and 3<sup>rd</sup> places will be awarded to the teams with the top three highest combined overall scores.
  - Awards may also be given to individual teams in the following categories:
    - Best Open Demonstration
    - Best Skill Challenges
    - Best Fair Play
    - Best Collegiality

The awards will be awarded based on the Skill Challenges, Technical Interview and the Open Demonstration scores at the discretion of the judges.



#### 6.4. Feedback

WRS is an educational initiative. It is important that team members learn from their experiences with WRS Junior Home Robot Challenge, and have the opportunity to improve their performances in following years. The organizers will provide feedback on each team's performance after the competition.

### 7. Additional information

#### 7.1. Information about the event

7.1.1. Teams will be responsible for checking for updated information during the competition. Teams should check the notice boards at the venue and also the WRS website for updates.

7.1.2. Newsletters will be shared before and during the event to ensure teams and mentors have the most updated information via email and on the WRS website.

#### 7.2. WRS Junior Category Forum

Teams are encouraged to sign up for the WRS Junior Category Forum (<http://wrsjunior.org/>) to be connected, share ideas with, ask questions to the WRS Junior Category organizers and other teams.

### 8. Contact information

Inquiries regarding the rules, competition, and/or its interpretation may be sent to [info@worldrobotsummit.org](mailto:info@worldrobotsummit.org).