



RoboCup@Home

Rules & Regulations

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Chapter 1

Introduction

1.1 RoboCup

RoboCup is an international joint project to promote AI, robotics, and related fields. It is an attempt to foster AI and intelligent robotics research by providing standard problems where a wide range of technologies can be integrated and examined. More information can be found at <http://www.robocup.org/>.

1.2 RoboCup@Home

1.2.1 What is RoboCup@Home

RoboCup@Home is a new RoboCup league that focuses on real-world applications and human-machine interaction with autonomous robots. The aim is to foster the development of useful robotic applications that can assist humans in everyday life.

1.3 Organization

1.3.1 Executive Committee

The *Executive Committee* consists of members of the board of trustees, and representatives of each activity area. The terms are three years as shown.

Members representing the @Home league 2006-2009:

- Luca Iocchi (Università di Roma "La Sapienza", Italy),
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- Tijn van der Zant (Rijksuniversiteit Groningen, Netherlands),
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1.3.2 Technical Committee

The *Technical Committee* (TC) is responsible for the rules of each league. The TCs consist of the exec members from above and the members listed below.

Members of the RoboCup@Home league Technical Committee for 2009:

- Javier Ruiz-del-Solar
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- Stefan Schiffer
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- Komei Sugiura
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1.3.3 Organizing Committee

The *Organizing Committee* (OC) is responsible for the organization of the next competition of each league. The OC consist of members listed below.

Members for the @Home league 2009:

- Paul Ploeger
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- Jesus Savage
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1.4 Infrastructure

1.4.1 RoboCup@Home Mailinglist

The *official mailinglist* can be reached at

robocupathome[at]iais.fraunhofer.de

You can register to the email list at:

<https://lists.iais.fraunhofer.de/sympa/info/robocupathome>

1.4.2 RoboCup@Home Web Page

The *official website* that will also contain all of the rules and listing of registered teams can be found at

<http://www.robocupathome.org/>

1.4.3 RoboCup@Home Wiki

The *RoboCup@Home-Wiki* is meant to be a central place to collect information on all topics related to the RoboCup@Home league. It was set up to simplify and unify the exchange of relevant information. This includes but is certainly not limited to hardware, software, media, data, and alike. The *wiki* can be reached at



<http://robocup.rwth-aachen.de/athomewiki>.

To contribute, i.e. to add/edit/change things you need to create an account and log in.

1.5 Competition

The competition consists of 2 *Stages* and the *Finals*. Each stage consists of a series of *Tests* that are being held in a daily life environment. In *Stage I*, an *Open Challenge* is held. The ten best teams from Stage I advance to *Stage II* which consists of more difficult tests. The competition ends with the *Finals* where only the five highest ranked teams compete to become the winner. There will be a 1st, 2nd, and 3rd place award.

Chapter 2

Concepts behind the competition

A set of conceptual key criteria builds the basis for the RoboCup@Home Competitions. These criteria are to be understood as a common agreement on the *general concept of the competition*. The concrete rules are listed in Chapter 3.

Anything that is related to Robocup@Home can always be discussed on the email list (cf. Section 1.4.1), but after the finalization of the rulebook cannot be taken into account or incorporated in the games until the next year.

2.1 Lean set of rules

To allow for different, general and transmissible approaches in the RoboCup@Home competitions, the rule set should be as lean as possible. Still, to avoid rule discussions during the competition itself, it should be very concrete leaving no room for diverse interpretation.

If, during a competition, there are any discrepancies or multiple interpretations, a decision will be made by the referees on site.

2.2 Autonomy & Mobility

All robots participating in the RoboCup@Home competition have to be *autonomous* and *mobile*.

An aim of RoboCup@Home is to foster mobile autonomous service robotics and natural human-robot interaction. As a consequence humans are not allowed to directly (remote) control the robot. This also includes verbally remote controlling the robot. Furthermore, the specific tasks must not be solved using open loop control.

2.3 Aiming for applications

To foster advance in technology and to keep the competition interesting, the scenario and the tests will steadily increase in complexity. While in the beginning necessary abilities are being tested, tests will focus more and more on real applications with a rising level of

uncertainty. Useful, robust, general, cost effective, and applicable solutions are rewarded in RoboCup@Home.

2.4 Social relevance

The competition and the included tests should produce socially relevant results. The aim is to convince the public about the usefulness of autonomous robotic applications. This should be done by showing applications where robots directly help or assist humans in everyday life situations. Examples are: Personal robot assistant, guide robot for the blind, robot care for elderly people, etc. Such socially relevant results are rewarded in RoboCup@Home.

2.5 Scientific value

RoboCup@Home should not only show what can be put into practice today, but should also present new approaches, even if they are not yet fully applicable or demand a very special configuration or setup. Therefore high scientific value of an approach is rewarded.

2.6 Time constraints

Setup time as well as time for the accomplishment of the tests is very limited, to allow for many participating teams and tests and to foster simple setup procedures.

2.7 No standardized Scenario

The scenario for the competition should be simple but effective, available world-wide and low in costs. As uncertainty is part of the concept, no standard scenario will be provided in the RoboCup@Home League. One can expect that the scenario will look typical for the country where the games are hosted.

The scenario is something that people encounter in daily life. It can be a home environment, such as a living room and a kitchen, but also an office space, garden, supermarket, restaurant etc. The scenario should change from year to year, as long as the desired tests can still be executed.

2.8 Attractiveness

The competition should be attractive for the audience and the public. Therefore high attractiveness and originality of an approach should be rewarded.

2.9 Community

Though having to compete against each other during the competition, the members of the Robocup@Home league are expected to cooperate and exchange knowledge to advance technology together. The RoboCup@Home mailing list can be used to get in contact with other teams and to discuss league specific issues such as rule changes, proposals for new tests, etc. Since 2007 there is also the RoboCup@Home-Wiki (see 1.4.3) which serves as a central place to collect information relevant for the @Home league. Every team is expected to share relevant technical, scientific (and team related) information there and in its team description paper (see 3.3.2).

All teams are invited to submit papers on related research at the RoboCup Symposium which accompanies the annual RoboCup World Championship.

2.10 Desired Abilities

This is a list of the current desired technical abilities which the tests in RoboCup@Home will focus on.

- Navigation in dynamic environments
- Fast and easy calibration and setup
The ultimate goal is to have a robot up and running out of the box.
- Object Recognition
- Object Manipulation
Manipulation is essential for almost any future home applications.
- Recognition of Humans
- Human Robot Interaction
An aim of the competition is to foster natural interaction with the robot using speech and gesture commands.
- Speech recognition
For intuitive interaction it is essential to come up with solutions that do not require headsets in the future.
- Gesture recognition
- Robot applications
RoboCup@Home is aiming for applications of robots in daily life.
- Ambient intelligence
Communicate with surrounding devices, getting information from the the Internet, e.g. Asking the robot about the weather, reading/writing emails.

Chapter 3

Rules

These are the rules for the 2009 competition.

3.1 Scenario

The RoboCup@Home competitions take place in a realistic home setting. It consists of inter-connected rooms such as a living room, a kitchen a bath room or bed room. There will be a designated area (e.g. a second room) which can be used for preparation.

3.1.1 Walls & Doors & Floor

The indoor home setting will be surrounded by high and low walls. These walls will be built up using standard fair construction material (similar to what is used to build a fair booth) with neutral color, smooth surface and a minimum height of 60cm. A maximum height is not specified, but of course the audience still has to be able to watch the competition. Transparent glass elements could be used but it is unlikely at the moment. The walls will be fixed and will not be modified during the competition. There will be at least two entry/exit doors connecting the outside of the scenario which are used as starting points for the robots.

One can expect the floor of the arena and the doorways to the arena to be even. That is to say, there will be no significant steps or even stairways. However, minor unevenness such as carpets and transitions in floor covering between different areas must be expected. Floor and walls are mainly uni-colored but can contain texture, e.g. a carpet on the floor, or a poster or picture on the wall.

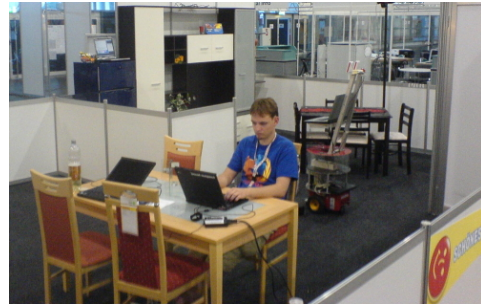
3.1.2 Furniture

Examples of previous @Home arenas are given in Figure 3.1. Please note that the actual arena will most likely look different.

The arena will be equipped with typical objects (furniture) that are not specified in quantity and kind. The minimum configuration consists of a small dinner table with two chairs, a couch, an open cupboard or small table with a television and remote control, some books



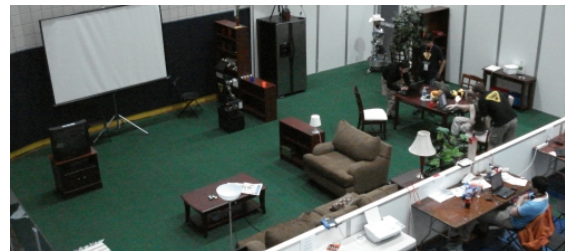
(a) RoboCup 2006 Bremen - living room



(b) RoboCup 2006 Bremen - kitchen area



(c) RoboCup German Open 2007 Hannover



(d) RoboCup 2007 Atlanta



(e) RoboCup German Open 2008 Hannover



(f) RoboCup 2008 Suzhou

Figure 3.1: Previous @Home arenas as example configurations

in the cupboard and in the kitchen a refrigerator with some cans and plastic bottles inside. There will be at least two entrances to the scenario. At least one of the entrances will be a door with a handle (not a knob).

Since the robots should be able to function in the real world the scenario is not fixed and might change every day without further notice. Changes will influence the position of objects inside the arena. One hour before a test slot begins no *major* modifications will be made.

3.1.3 Predefined Objects

Certain tests involve interaction with *predefined objects*. The TC will compile a set of roughly ten different objects. Whenever a test involves the use of a predefined object it is taken from this set. The TC makes the set of objects and their names available during the setup days.

3.1.4 Predefined Locations

Some tests involve *predefined locations*. This may include places as well as certain objects such as 'plant', 'television', or 'front door'. The TC provides a list of these predefined locations before the beginning of the competition. Note that the positions are *not* necessarily fixed.

3.2 Equipment

3.2.1 Maximum number of people

The maximum number of people to register per team is unlimited, but the organization only provides space for *four* (4) persons to work at tables in the team area. During a test, the maximum number of team-members allowed inside the arena is *two* (2), unless stated otherwise. During the setup of a test, in the Open Challenge, in the Demo Challenge and in the Finals there is no limitation on the amount of persons allowed in the arena. During a test, one team member *must* be available to host the event.

3.2.2 Robots

Robots that participate in the RoboCup@Home league need to be *autonomous* and *mobile*.

Number of Robots

The maximum *number of robots* per team that can be registered for the competitions is *two* (2). Unless stated otherwise, one robot is allowed per test, but in the Open Challenge and the Finals two robots can be used simultaneously. For different tests different robots can be used.

Size of Robots

Any robot that can operate in a regular indoor environment is allowed to participate, there are restrictions on the *size of robots* though. Height is limited to 2 meters, weight is limited to 150 kilograms. Also a robot has to fit through a regular doorway (180x70cm).

Safety

In human populated environments *safety* is an important issue. Every participating robot has to be operated safely, being not dangerous to people and the environment. Therefore all robots have to have a marked "*emergency off*" button with good accessibility (preferably placed on top).

Start button

Every participating robot has to provide a "*start button*" that must be used by the referee (or by team members) to start the test. Generally, when the team leader declares that the robot is ready to start, a referee will push the start button and the test begins. After pushing the start button, no intervention on the robot is allowed to the team members (unless the team leader calls for a restart).

The start button can be any "one-button procedure" that can be easily executed by a referee to start the robot. This includes:

- the release of the "emergency off" button
- an hardware button different from the "emergency off" one (e.g., a green button)
- a software button in a Graphical User Interface (either on the robot or on a remote PC connected with the robot)
- a key on the keyboard (either on the robot or on a remote PC connected with the robot)

The start procedure for a robot should be the same for all the tests and must be announced in the *robot registration* form and tested during the *robot inspection* procedure. In case, at the beginning of a test, the start procedure does not work, the team can call for a restart and fix it, within the time allowed for the test.

Appearance of the robot

Robots should have a nice look. In particular, most of the robots internal hardware (electronics and cables) should be covered in an appealing way.

Requirements

Every robot should have a *speaker output plug*. This will be used to connect the robot to the sound system so that the audience can hear and follow when the robot is talking.

3.2.3 External devices

Everything which is not part of the robot and is being brought into the arena by a team additionally is considered an *external device*. In general, external devices are not allowed during the competition unless presented and explained to the Technical Committee during the Robot Inspection before the competition. If a team wants to make sure that a certain external device is allowed, it is recommended to ask the Technical Committee far before the competition.

For the Open Challenge the Demo Challenge and the finals, external devices are allowed, still their use needs to be announced beforehand.

Artificial Landmarks

Artificial landmarks and *markers* are not allowed.

Computing devices

External devices may also include computers used for decentralized computation or external sensors. External computers are allowed, but have to be inside the arena, i.e. not on its periphery.

Microphones

External microphones (also headsets) are allowed. A long-term goal is to integrate the microphones on-board. Teams that already use an *on-board microphone* are rewarded with an extra score of *50 bonus points* per successful test. (see Bonus)

3.2.4 Wireless Communication

Network

For wireless communication, one WLAN Router will be provided using IEEE 802.11b standard (Max 11Mbit), another one using IEEE 802.11a. One channel will be provided for each 802.11a and 802.11b for RoboCup@Home. To avoid interference with other leagues if using WLAN in general, these routers and channels have to be used for communication only. It is not allowed to use the above or any other WLAN for personal use in the halls. During the competitions, only the active team is allowed to use the WLAN Router and the channel. However, organizers cannot guarantee reliability and performance of wireless communication. Therefore, teams are required to be ready to setup, start their robots and run the tests even if, for any reason, network is not working properly.

Preferably the organizers will try to provide one LAN cable on the desk of each participating team for Internet connection. However, this cannot be guaranteed. If multiple LAN connections are needed, each team has to bring its own LAN hub/switch and cables.

Wireless Devices

Every team has to provide a list of all wireless devices they plan to use on site. This includes any analog or digital wireless microphones, bluetooth, headsets, walkie-talkies, and anything else that uses an RF signal to operate.

The list has to be provided to the Organizing Committee before the competition. The use of any wireless device not listed is strictly prohibited.

3.2.5 Robot Registration and Inspection

Every participating robot must be registered before the beginning of the competition and TC will inspect them. Robots non-compliant with the rules will not be allowed to participate. Each team must fill a '*robot registration form*' that will be distributed before the competition (for example, through the mailing list) and return the form to the OC+TC in the first RoboCup day (or as soon as the team arrives at the competition site).

TC will inspect the participating robots, checking in particular:

- robots size and weight
- presence and easy accessibility of the "emergency stop" button
- presence of the "start button"
- robot speaker system (plug for RF Transmission)
- use of external devices (including wireless network)
- manipulation constraints
- most of the robots internal hardware should be covered in an appealing way

During the *robot inspection period*, teams have to demonstrate the correct functionality of the start/stop procedure (i.e., test their emergency off and start buttons). Robot inspection can be performed by TC at any time during the competition, thus teams are required to maintain the requirements described in this section, including a nice look of their robots, at any time.

3.3 Procedures before the competitions

3.3.1 Toward Participation

Each year there are four phases in the process toward participation:

1. *Intention of Participation* (optional)
2. *Preregistration*
3. *Qualification* announcements
4. *Final Registration* for qualified teams

Positions 1 and 2 will be announced by a call on the RoboCup@Home mailing list. Pre-registration requires a *Team Description Paper*, a video and a website.

3.3.2 Team Website and Team Description Paper

The *Team Website* has to contain photos and videos of the robot(s), a description of the approaches, and information on scientific achievements, relevant *publications*, team members, and previous participation in RoboCup.

The *Team Description Paper* (TDP) should at least contain the following sections:

- Name of the team
- contact information
- website
- team members
- description of the hardware
- description of the software

Preferably, it should also contain the following:

- innovative technology (if any)
- photo(s) of the robot
- focus of research/research interests
- re-usability of the system for other research groups
- applicability of the robot in the real world

The team description paper goes into detail about the technical and scientific approach, but the website should be designed for a broader audience. Both the website and the TDP have to be in English.

3.3.3 Qualification

During the *qualification process* a selection will be made according to the team data provided by the technical committee. To motivate the use of the new @Home WIKI, a special focus is put on the information the teams provide in the WIKI. So when entering relevant information in the WIKI (e.g. hardware and software related entries) make sure you put your team name next to it.

The evaluation criteria will include:

- Performance in previous competitions
- Team description paper
- Video
- Website
- Relevant Scientific contribution/publications
- Novelty of approach
- Contribution to RoboCup@Home League
 - Organization of events
 - Especially: Contribution to the RoboCup@Home-Wiki and exchange of knowledge

3.3.4 Poster and Welcome Session



A *Poster and Welcome Session* will be held on the first day of the competition. Therefore, every team has to prepare and bring a team poster to the competition. The poster needs to be displayed starting from the last evening before the beginning of competition. The poster will be evaluated by the team leaders of the other teams. Each team has a *maximum total time* of *five minutes* to present the poster to the other teams including questions. Please note that there will be another occasion for presentation during the Open Challenge. The evaluation is used to determine a part of the score in the Open Challenge. Evaluation criteria for the poster session are:

- Quality of appearance of the poster
- Quality of the poster content
- Scientific value
- Poster presentation and Questions

3.4 Procedures during the competition

3.4.1 Fair Play

Fair Play and cooperative behavior is expected from all teams during the entire competition, in particular:

- while evaluating other teams
- while refereeing
- when having to interact with other teams robots

This also includes:

- not trying to cheat (e.g. pretending autonomous behavior where there is none)
- not trying to exploit the rules (e.g. not trying to solve the task but trying to score)
- not trying to make other robots fail on purpose

Disregard of this rule can lead to disqualification for a test or even for the entire competition.

3.4.2 Stage System

The competition features a *stage system*. It is organized in two stages each consisting of a number of specific tests. It ends with the finals.

Stage I

The first days of the competition will be called *Stage I*. All qualified teams can participate in Stage I. The tests in this stage can be done quite quickly and are not very complex. (Similar to phase 1 of a test from the 2006 and 2007 competition). The *Open Challenge* will be done in Stage I so everybody can and should prepare for it.

Stage II

Only the best *ten teams* advance to *Stage II* which is being held within the last 2 days of the competition. Here more complex abilities or combinations of abilities are tested. The *Demo Challenge* will be held within Stage II.

Finals

The best *five teams* from Stage II advance to the finals.

3.4.3 Number of Tests


In Stage I, apart from the Open Challenge, the *maximum number of tests* that a team can participate in is *four out of five*. To participate in the Open Challenge the team has to participate in at least one other test in Stage I. Participation in the Open Challenge is not necessary to advance to Stage II.

In Stage II, apart from the Demo Challenge, the *maximum number of tests* that a team can participate in is *three out of four*. So, apart from the Demo Challenge, three test slots per team exist. Teams can either choose to do a different test in each test slot, or they can choose to repeat a test. In case of repetition, the highest score of the repeated test counts.


3.4.4 Time Limits

All the tests have certain *time limits*. The time limit for each test includes setup time. After the period is over, the team has to immediately leave the arena. Partial credits (cf. Section 3.4.12) are awarded for the robot's performance only within the given time period.

Stage I

The time limit for each test in Stage I is *5 minutes* unless stated otherwise in the test description. 

Stage II

The time limit for each test in Stage II is *10 minutes* unless stated otherwise in the test description. 

3.4.5 Restart

A team has the opportunity to request one restart during a test. Although the test is restarted the time continues and is not restarted.

With a restart, the amount of points is the average of the first and second run if and only if in the second run the score is lower than in the first run, otherwise the score of the second run counts.

3.4.6 Schedule

The tests will be held in test slots of approximately two hours. A schedule for all teams is provided by the TC organizing access to the arena between competition time which can be used for preparation/calibration. One hour before a test slot, only the teams participating in that slot are allowed in the arena.

3.4.7 Penalty for not attending

If a team has registered and is scheduled for a test but can not participate in that test for any reason, the team leader has to announce this at least 15 minutes before the test slot begins. Otherwise there will be a *penalty* of 500 points. If a team is not present at the start position when their scheduled test starts, the team is not allowed to participate in this test anymore.



3.4.8 Referees

Two team members from two different teams – not from the team which is currently performing – and a member of the TC or OC are the *referees* for each test. The referee from the TC/OC acts as a main referee. Not showing up for refereeing will result in a penalty of 500 points for the referees team and will be remembered for qualification decisions in future competitions.

3.4.9 Moderator

A general aim of @Home is to explain our motivation, research and activities to the public audience. Therefore, where applicable, every test in the competition is commented by a moderator. So, for each regular test (not for Introduction, Open Challenge, Demo Challenge and Finals), the teams have to provide a moderator for the tests they are participating in. For competitive test (test in which two teams directly compete against each other) the moderation has to be done by the two teams together.

The moderator has to:

- explain the rules of the test
- comment on the performance of the teams
- not interfere with the performance
- speak in English

3.4.10 Robot start position

Unless stated otherwise the robot has to autonomously enter the arena from the outside through the open entrance/doorway. Remote control of the robot is forbidden, but e.g. using a following behavior is allowed. Successfully entering by opening the closed door adds a one-time bonus of 500 points (cf. Section 3.4.12). Teams must be able use any of the entrances as start position for their robot.

3.4.11 Robot Autonomy

During a test, the participants are not allowed to make contact with the robot, unless it is in a "natural" way. This means that gestures and speech are allowed but remote control or touching buttons on the robot are not!

The idea of *autonomy* is that only general instructions can be given, such as "Go to the kitchen". Anything that resembles direct control, such as "lift gripper, stop, forward 1.2, ..." instead of "get the red can out of the refrigerator" is not in accordance with the idea of autonomy.

3.4.12 Score System

The total score of Stage I including the Open Challenge determines the *ten* teams that advance into Stage II. Then, the *five* teams with the highest total score (the sum of Stage I and Stage II) advance into the finals.

Partial Score

All tests except for the Open Challenge are rewarded on a partial scoring basis. That is to say a team receives points for successfully passing a certain part of that test. In Stage I (excluding the Open Challenge), the maximum total score per test is *1000 points*. In Stage II and the Open Challenge, the maximum total score per test is *2000 points*.

Bonus

To foster research and development on some specific capabilities there are bonuses a team can try to achieve by demonstrating those capabilities.

Opening the door An additional *one-time bonus* of 500 points is awarded for autonomously opening the closed door. To prevent open loop behavior, the referees reposition the robot slightly in front of the door. If the attempt to open the door is not successful, the team is allowed to proceed with the test without penalty within the rest of the time period. The door has a regular door handle, not a knob and will open to the inside.

On-board microphone If an *on-board microphone* is successfully used in a test and if use of the microphone is required and makes sense a bonus of *50 points* is awarded for each test. The minimum distance between the person speaking and the robot must be *50cm*.

Outstanding Performance For every regular test in Stage I and Stage II (excluding Open Challenge, Demo Challenge and the Finals), the @Home Technical Committee can decide to give an extra bonus for *outstanding performance* of 10% of the maximum test score. This is to reward teams that do more than what is needed to solely score points in a test but show innovative and general approaches to enhance the scope of @Home. If a team thinks that it deserves this bonus, it should announce (and briefly explain) this to the Technical Committee beforehand.

3.4.13 Open Challenge

Within Stage I the Open Challenge (OC) is being held. In the Open Challenge a team can demonstrate freely chosen abilities according to the goal and criteria of the league. The performance is evaluated by a jury that consists of the team leaders of all other teams. This evaluation will decide on the ranking.

The Open Challenge is described in Section 4.6 in detail.

3.4.14 Demo Challenge

Within Stage II the *Demo Challenge* (DC) is being held. The Demo Challenge is a challenge on a specific topic that is (re-)defined on a yearly basis. Teams can demonstrate their robots abilities according to the topic with some restrictions The Demo Challenge is described in detail in Section 5.5.

3.4.15 The Finals

The competition ends with the finals on the last day, where the five teams with the highest total score compete. The concept is the same as in the Open Challenge, but evaluation criteria of the jury are different. The jury will probably consist of people from various background, not only from robotics.

The demonstration in the finals does not have to be different from the one shown in the Open Challenge (if any). It does not have to be the same either.

3.5 Special Awards



3.5.1 Innovation Award

To honor outstanding technical and scientific achievements as well as applicable solutions in the @Home league, a special innovation award is being given to one of the participating teams. Special attention is being paid to making usable robot components and technology available to the @Home community.

After the Open Challenge, the executive committee members from the RoboCup@Home league nominate a set of candidates for the award. The winner is determined by election of the Technical Committee. A TC member whose team is among the nominees is not allowed to vote.

Chapter 4

Tests in Stage I

4.1 Introduce

The robot introduces itself and its team to the audience. The other team leaders evaluate the appearance and the presentation behavior of the robot.

4.1.1 Focus

The purpose of this test is for the teams to get to know each other. The test focuses is on speech synthesis, articulation, presentation and appearance.

4.1.2 Task

The robot enters the living room from one side. When it is at the designated spot in front of all the team leaders it introduces itself and the team to the other team leaders. A video projector can be used for presentation purpose. The operation of the presentation computer can be done by a team member. The presentation computer can be external. After the introduction, the robot leaves the living room through the other door. The total time for the introduction per team is *five minutes*.



4.1.3 Remarks

A team has to be ready to start immediately after the previous team finishes. After the previous team has finished, there is a maximum break of *one minute* for the previous team to leave the arena and for the final setup of the following team (radio transmitter, projector, presentation...). The moderator announces the start signal in agreement with the referees.



Make sure your presentation using a projector works by checking the setup beforehand. Natural interaction with the robot currently performing is allowed and wanted.

4.1.4 Referee Instructions



The referee has to make sure the time limit is not exceeded.

4.1.5 Score System

Points ranging from 0 to 10 are given for the following criteria by each team leader:

Appearance The professional and appealing appearance of the robot is evaluated.

Presentation How advanced are the presentation skills of the robot, for example speech synthesis, gestures, facial expression?

Movement How well does the robot move in the environment? Is it a smooth and robust movement?

The points given by each team leader are multiplied by 33 to receive a maximum of *1000 points* per team leader. The total score for each team is then calculated by

$$\frac{\sum \text{team-leader-score}}{\text{number-of-teams} - N}$$

In case of 20 or more teams, the two highest and the two lowest scores do not count and $N = 5$. In case of 10 to 20 teams, the highest and the lowest scores do not count and $N = 3$.

4.2 Follow Me

The robot has to safely follow an unknown person through a dynamical environment.

4.2.1 Focus

This test focuses on tracking of and multi-modal interaction with an unknown person and safe navigation.

4.2.2 Task

The teams cannot freely select a person for the robot to follow, but a 'professional' walker selected by the TC tests the robot. The robot has up to 1 minute to train/calibrate on the walker. The two teams start simultaneously at the opposite entries of the arena. They have to follow the same path but in opposite directions. This means that they will have to pass each other. When the robot arrives at the opposite entry of the arena (within 2m radius) it is stopped by a HRI command (speech, gesture recognition or any other 'natural' interaction), and using HRI the robot should either move backwards, move forward, turn left or turn right. The distance to the robot should be at least one meter when giving a command. Then the robot is commanded using HRI to follow the walker. The walker walks to a designated place at least 10 meters outside the scenario and then they walk back and enter through the door which they used to enter in the first place (so not the door through which they left the scenario). The total time for this is 5+1=6 minutes (1 minute calibration, if calibration finishes earlier that team can already start walking). The walker walks with his back towards the robot at a regular slow walking speed and waits for the robot if the robot is too slow but the walker never walks back.

Important note about hand gestures' definition and use:

- The teams define the hand gestures by themselves, with the restriction that the gestures should be at most the movement of a single limb and not the total body.
- The HRI actions (commands) a robot should be able to do are: turn left, turn right, move backwards, move forward.
- The referees decide during the competition which action the robot has to do. The gesture commands to be used need to be specified by the team to the referees before the test starts. The gesture should be natural, for instance waiving the arm towards the robot.
- A speech command can be used to set the robot into a "Receive-gesture-mode"

4.2.3 Referee Instructions

The referees need to

- select walkers and announce them the path and the checkpoints.
- take special care of not interfering with the robots.
- define check point where robot has to stop and start using HRI



- check whether a team receives the passing score.
- detect whether a robot touches something.
- check what the move backwards/turn gesture/command is

4.2.4 Score System

Points are given for the following:

Passing the opponent *100 points* are awarded for passing the opponent robot. To receive this the walker is not allowed to stop walking while passing the opponent leader and robot.

Reaching the checkpoint *100 points*

Completing the track *100 points* are awarded for having completed the track by leaving the room.

HRI *100 points* are awarded for stopping/moving back/turning the robot and *100 points* for starting using HRI. *2 Times 100 extra points* can be scored if the HRI is not speech but a gesture action specified to the referees before the test starts. One command is selected by the TC or referee out of at least 4 commands: e.g: turn left (command: point right arm to your right while facing the robot), turn right (opposite as left), move forward, and move backwards.

Outside scenario *100 points* are awarded for reaching the designated area outside the scenario and another *100* are awarded for returning into the scenario

No touching *100 points* are awarded for having completed the track and not having touched any object inside the scenario. Note that major collisions (both in- and outside the scenario) will result in disqualification for this test.

A team is allowed to skip the HRI part, of course not getting points for this, but being able to finish the task

4.3 Fetch & Carry

The robot has to retrieve a certain object.

4.3.1 Focus

This test focuses on human-robot interaction, navigation, object detection/recognition, and manipulation.

4.3.2 Task

One object is chosen by the team from a the set provided by the TC. The team specifies 5 locations out of the given list of locations which are not visible from the robot's starting position. They also have to provide information through which door they are entering the arena. A list containing this information has to be given to the TC at least one hour before the competition starts. The TC has to approve the object locations. After a one minute setup phase of a test the team is not allowed to touch the robot anymore and has to be ready to start. Then, one location is chosen by the referees and given to the team. The team places the object and the referee moves the object without mayor rotation. If the object is on the floor this movement can be 20cm in any direction max. If it is not on the floor, the movement is 10cm max in any direction with the robot still being physically able to manipulate the object.

Then the test starts. The robot and a team member enter the arena together and go to a starting position near the entrance. The team member tells the robot to search the object, and is allowed to give one hint (e.g. "The teddy is near the TV") on the position. The robot searches for the object, grasps it, and brings it back to within one meter of the robot's starting position.

The object has to be easily removed from the robot by the person.

4.3.3 Referee Instructions

The referees need to

- Have the set of objects prepared ahead of time
- Have the locations pre-selected for which each object could be placed. Note that the locations may be different for each robot based on its manipulation capabilities.
- Keep track of the 50 points for using an on-board microphone
- Define the starting positions

4.3.4 Score System

Understanding *150 points* are awarded for understanding the person and moving to the designated region.

Finding the object *150 points* are awarded if the robot finds the object. This needs to be indicated by turning towards the object within a maximum distance of 50 cm



and face the object for at least three seconds to let the referees know that the robot has found the object.



Manipulation *200 points* are awarded for successfully lifting the object, i.e. keeping it lifted for at least *five seconds*. If the object does not need to be on a single fixed height to be manipulated (i.e. variability of at least 10cm), another *200 points* are awarded.

Delivery *200 points* are awarded for bringing the object back to a place within one meter of the starting position and the person has to get the object from the robot.



Leaving *100 points* for autonomously leaving the arena within the *five minute* time-limit

4.4 Who Is Who?

A robot should be able to autonomously recognize persons. Without manual calibration, a robot will have to introduce itself to a group of people, ask for their names, memorize them and recognize the persons when meeting them again. Before the test a list with English names is published which the robot should be able to recognize, in case the team prefers that.

4.4.1 Focus

This test focuses on human detection/recognition, face detection/recognition, safe navigation and human-robot interaction with unknown persons.

4.4.2 Task

Three people, one known to the robot (e.g. a team member) and two (random) unknown persons selected by the referees, are positioned at least one meter away from the audience and within a five meter radius of the door according to the referees' instructions. All people are standing and do not move around. They also have to face the robot at all times.

1. The robot enters the arena through the doorway and starts looking for people.
2. When the robot finds a person it has to announce this and introduce itself to the person. Then it has to indicate whether this person is known or unknown to the robot. The announcement and introduction must be done by facing the person. The distance from the robot to the person must not exceed *one meter* when announcing that it has found the person.
3. If it is unknown the person and the robot introduce themselves to each other. The robot's introduction must be obvious to both the human as well as the referees. If the robot requires the human to perform some specific actions, this must be explained by the robot to the human during the robot's introduction. Whatever information the human gives to the robot can be used later to show that the robot can "recognize" the person. This introduction must not involve touching any part of the robot.
4. This process continues until all of the people have been found or the robot decides that it has found as many people as it can.
5. Finally, the robot *autonomously* returns to the entrance and the people leave the scenario one by one. The person has to stand in front of the robot and face the robot for *10 seconds*. The robot has to greet each of the persons as they exit and give the correct identification what was learned during step 3. Once again, this greeting must not involve the human touching the robot in any way, except for shaking hands.

If the robot incorrectly announces that it has found a person (such as introducing itself to a plant), then this counts against the score. If the robot chooses to give up prematurely (say after only finding 1 person correctly), then the robot suffers no additional penalties.

The time limit is *seven minutes*.



4.4.3 Referee Instructions

The referees need to

- select the people before the test starts.
- select the location for each person to stand before the test starts.
- select the order in which the people leave the environment after the introduction phase.
- keep track of the 50 points for using an on-board microphone
- always stay behind the robot

4.4.4 Score System

Finding humans (correctly found humans - incorrectly found humans) * *100 points*.

Known or unknown humans (correctly identified humans - incorrectly identified humans) * *100 points*

Identification when leaving (correctly identified humans - incorrectly identified humans) * *50 points* when not using information given by the person or *100 points* when using information given by the person

Leaving Another *100 points* are awarded if the robot leaves immediately after the last humans leaves, which means that the robot should start to move to the exit within ten (10) seconds.

For each partial credit, there can be no negative score.

4.5 Competitive Lost & Found

Two robots (from different teams) compete in finding objects.

4.5.1 Focus

This test focuses on navigation in a dynamic environment, object detection and recognition.

4.5.2 Task

Two teams are competing simultaneously. Three different objects from the set of objects are placed (by the referees) in the scenario. It's the same three objects for both teams. The objects can be on the floor but there is at least one object not on the floor. The robots have to find those three objects as fast as possible without touching anything. A robot has to clearly indicate that it has found (and possibly identified) an object by facing it within a radius and performing an action that can be identified by the referees.

There is a maximum of *five minutes* for this test.



4.5.3 Remarks

The TC selects the objects. The objects remain the same during this test for all teams, but the positions will vary. The three objects are announced *one hour* before the tests starts.

Robots should only 'talk' (especially via the arena sound system it is connected to) when it has found/identified something.

A restart is not allowed in this test, as the object positions can not be changed anymore due to two teams performing simultaneously.



4.5.4 Referee Instructions

The referees need to

- place the objects such that they are visible for both robots from some point in the environment.
- count the number of objects found and identified per team.
- determine which team finishes this test first.



4.5.5 Score System

Finding For every object found *100 points* are awarded.

Identifying For every object correctly identified (e.g. speech/display) *100 points* are awarded.

Speed The first team to find all 3 objects correctly is awarded another *300 points*.

Leaving the arena Autonomously leaving the arena within the time limit adds another *100 points*. Even if not all objects are found, the robot can still receive this partial credit.

4.6 Open Challenge

During the *Open Challenge* (OC) teams are encouraged to demonstrate the best of their robots' abilities.

4.6.1 Focus

This test focuses on the demonstration of new approaches/applications, human-robot interaction and scientific value.

4.6.2 Task

The Open Challenge consists of a presentation, a demonstration and a question part. All teams have to provide *one* person (preferably the team-leader) to follow and evaluate the entire Open Challenge. Not providing a person results in no score for this team in the OC. For the presentation *only three slides* are allowed. The focus should lie on the demonstration. When the team enters, it has *three minutes* for the setup. Then the team has maximum *seven minutes* for presentation and demonstration. When the demonstration is finished there is another *three minutes* where the team answers questions and the next team is setting up their demonstration. A wireless microphone and a video projector will be available to the teams. The presentation, demonstration and the questioning influence the score.



Changes to the Environment

For the Open Challenge teams are allowed to make modifications to the environment as they like under the condition that they are reversible and the team leaves the arena in the *very same* condition they entered it (i.e. revert all modifications made). The changes and their reversion have to be made within the total time given.

4.6.3 Score System

The score is determined by the other team leaders. He/she should never leave the scenario. Acting against that can be punished by disqualification of the team from the OC.

For each evaluation criterion (see below) a maximum of *10 points* is given per team leader.

Evaluation Criteria

The evaluation of the jury is based upon the desired abilities described in Section 2.10 and the following criteria:

- Relevance and Contribution
(this includes social relevance, usefulness for daily life and contributions to RoboCup@Home)
- Human-robot interaction in the demonstration

- Robot autonomy during the demonstration
- Difficulty and success of the demonstration
- Novelty + Scientific Value
(of the approach(es) shown in the OC)
- Jury Questions
(which may include presentation-aspects if there were no questions)
- Poster evaluation (cf. Section 3.3.4) along the following criteria
 - Quality & Scientific Value
 - Appearance
 - Questions

Normalization

The points given by each team leader are multiplied by a factor of $\frac{20}{7}$ to receive a maximum of *2000 points* per team leader. In case of 20 or more teams, the two highest and the two lowest scores do not count and $N = 5$. In case of 10 to 20 teams, the highest and the lowest scores do not count and $N = 3$. The total score for each team is then calculated by

$$\frac{\sum \text{team-leader-score}}{\text{number-of-teams} - N}$$

Chapter 5

Tests in Stage II

5.1 PartyBot (Who Is Who? Reloaded)

The robot has to identify humans and bring a drink to one of them.

5.1.1 Focus

The aim of this test is to evaluate a robots capability to detect humans and learn their identity for recognition at a later point in time.

It also contains the following aspects: human detection/recognition, face detection/recognition, human-robot interaction, fast calibration, navigation, manipulation

5.1.2 Task

Four persons chosen by the referees are dispersed through the scenario and position themselves in a natural manner such as sitting at the table, on the couch, *Two persons* will be sitting and *two persons* will be standing. The host, the referees and the team members need to stay outside the scenario if they are not one of the four persons.

1. After the robot enters the scenario it has to find as many people as possible, and should get to know them well enough to be able to identify them later on.
2. When the robot finds a person it has to announce this and introduces itself to the person. The announcement and the introducing have to be done facing the person. The distance from the robot to the person must not exceed *one meter*. If there is a physical obstruction (e.g. furniture) the distance may exceed one meter but still must not be more than *two meters*.
3. After the robot has found all persons or decides to stop searching for more it moves to the refrigerator. It waits there to receive orders from any of the identified persons.
4. One person that is known to the robot is chosen by the referees to order a drink. This person goes to the robot (at the fridge), orders a drink, and returns to her original position. The drink is either handed to the robot by a human or the robot

grasps the drink by itself. If the robot grasps the drink autonomously, the team can set up a place near the fridge for the robot to do so.

5. The robot delivers the drink to the correct person (who has returned to the same spot as during the introduction period). The robot then has to give the drink and act polite.



The duration of the test is *ten minutes*.



5.1.3 Referee Instructions

The referees need to

- select & collect the four persons involved before the tests starts.
- select one of the persons detected and introduced to to receive a drink.
- look out for false positives.



5.1.4 Score System

detecting humans For every person detected and introduced to *200 points* are rewarded if the person is standing and *300 points* are awarded if the person is sitting.

Falsely detecting a human where there is none gives a penalty of *100 points*.

navigating to the fridge For correctly navigating to the fridge *100 points* are awarded.

grasping the drink If the robot grasps the drink by itself *200 points* are awarded.

delivering the drink For delivering the drink to the correct person *400 points* are awarded.

handing the drink If the robot hands over the drink by itself, *100 points* are awarded.

leaving autonomously If the robot autonomously leaves the arena in time *200 points* are awarded.

A team cannot leave this test with a negative total score but instead receives *zero points*.

5.2 Supermarket (Lost & Found Reloaded)

The robot has to get a particular object from the shelf.

5.2.1 Focus

Human-robot interaction, manipulation

5.2.2 Task

A random person selected by the referees is using natural interaction (gestures, speech) without prior knowledge on how to use the robot, to get the robot to deliver a maximum number of *three* (3) objects from one or more shelves. The robot is allowed to give instructions on how it can be operated.

The *three* objects are taken from the set of standard objects (cf. Section 3.1.3). The team can choose *one* of the objects itself, the other *two* objects are chosen by the referees (respecting the physical constraints of the robot). The objects are then put on one or more shelves by the referees.

A team has to announce whether the robot is able to get objects from different levels before the test starts.

5.2.3 Referee Instructions

The referees need to

- select the person to interact with the robot.
- check whether the robot is able to get objects from different levels.
- choose two objects and ask the team for the other object.
- distribute objects among shelves and levels.

5.2.4 Score System

Correctly understanding which object to get For every correctly understood object *50 points*, i.e. by clearly indicating the object.

Note that if the robot goes through the entire list of objects and asks whether this object is correct is forbidden and no points will be awarded.

Recognition For every correctly found object: *150 points*.

Grabbing For every correct object retrieved from the shelf *100 points* are awarded. If the object was lifted for at least *five seconds* another *100 points* are awarded.

Delivery For every object delivered to the person: *100 points*. It is allowed to deliver multiple objects at once.

Different levels For getting objects from different levels *200 points* are awarded.

Multi modal input For using gestures in a meaningful way besides speech to communicate with the robot: *300 points*

5.3 Walk & Talk

Introduce the robot to a new home.

5.3.1 Focus

This test evaluates the ability of the robot to build a (topological) map of a previously unknown environment and to instantaneously use this map for localization and navigation to taught in positions (SLaM).

Furthermore, it contains the following aspects: speech recognition, human recognition, human tracking, following, navigation, localization, map building, object recognition, intuitive calibration, behavior integration

5.3.2 Task

A robot is guided through an unknown environment and has to memorize a set of objects/places (Guide phase). Then the robot has to navigate to these object/places in random order (Navigation phase) proving that it was able to memorize these places.

Before the test, the arena is being rearranged in such way that a pre-built map can not be used in a useful manner.

A list of standard objects/places (e.g. Plant, Couch, Television,...) is published during the setup days (cf. Section 3.1.4). The referees pick a set of *five* objects/places of this list.



Guide Phase

One team member has to guide the robot through the arena making the robot memorize the places and their names. Note, that only natural interaction with the robot is allowed. During the Guide Phase, the team member can decide how many of the *five* objects/places it wants to teach in (*two* places/objects minimum) depending on the time left. Also the order of visited objects/places can be chosen freely. The robot has to be within a *one meter* range of the object/place and the robot needs to announce clearly which object/place it has currently learned.

Then, the team member needs to announce that the Guide Phase is over and that they proceed with the Navigation Phase. After this announcement it is not allowed to switch back to the Guide Phase.

Navigation Phase

During the Navigation Phase, the referees pick memorized object/places from the Guide phase in random order, preferably with a long distance in-between them. The team member has to tell the robot to go to these objects/places. The robot needs to indicate that it has arrived at an object/place. The robot has to be within a *one meter* range of the object/place.

5.3.3 Referee Instructions



The referees need to

- pick a set of *five* objects/places.
- note which locations were learnt successfully.
- select the order of testing the learnt locations.

5.3.4 Score System



Following *100 points* per object/place reached in the Guide Phase

Mapping/Navigation *250 points* for each object/place reached correctly in the Navigation Phase

No touching *100 points* are awarded for having completed the guide and the navigation phase and not having touched *anything*. Note that major collisions will result in disqualification for this test.

Autonomous leaving *150 points* for autonomously leaving the arena in time

5.4 Cleaning up

The robot has to clean the scenario from unknown objects.

5.4.1 Focus

The test focuses on detection and recognition of unknown objects, navigation, and interaction with objects.

5.4.2 Task

Two weeks before the competition starts, a list of object descriptions i.e. not the list of objects mentioned in section 3.1.3 is published by the TC. This list contains specific objects (e.g. Coke can or Kellogs Cornflakes box) as well as unspecific objects (e.g. green apple, red toy car). Two specific objects, two unspecific objects and two completely unknown objects (i.e. not from the list of object descriptions) are distributed on the floor of the scenario.

The sum of the three dimensions of each object is at least 25 cm, where each dimension is at least 5 cm. They will be visually distinguishable from the floor and it is possible to move them around by pushing. That also means, that the objects will be placed in such a way that there is enough space around them for the robot to maneuver.

The robot's task is to detect the objects and to bring (e.g. push/pull/carry) them to a single designated area that the team or robot can choose on its own. The area needs to be same for all objects. It is not allowed to mark that area with a beacon. When the robot thinks it has encountered an object, it may test whether it has really found something by carefully trying to push it. The robot has to announce when it thinks it has actually found an object and start bringing the object to the designated area. All objects have to be within a circle with 1.5m diameter.



The total time for this test is *ten minutes*.



5.4.3 Referee Instructions

The referees need to

- distribute the objects before the test starts.
- count objects detected and collected.
- look out for false positives.

5.4.4 Score System

Detection *100 points* for each of the six objects being detected following the procedure mentioned in the task description. The same object is not counted multiple times.

Recognition - Naming the object correctly *100 points*

Collecting *100 points* for every object successfully pushed/pulled/carried/brought to the designated area.

No false positives *100 points* for not falsely detecting an object where there is none.

Leaving autonomously *100 points* for leaving the arena autonomously.

5.5 In the bar (Demo Challenge)

The robot has to function in a bar/restaurant setting as a waiter (serving drinks/snacks, focus on *Human-Robot Interaction* (HRI) by taking orders) or a bartender (pouring/mixing drinks, focus on HRI + manipulation). Other roles (host, preparing snacks etc.) are allowed but have to be asked for at least 3 weeks and approved by the TC at most 2 weeks before the competition starts. Be aware that fluids are used in the challenge! It is advisable to make the robot water resistant.

5.5.1 Focus

human-robot interaction, ambient intelligence, manipulation, situation awareness

5.5.2 Task

This year we are giving a little party for the trustees (and perhaps executives) of the RoboCup Federation. For the party both bartender robots and waiter robots are needed. The participating robots can do bar work, such as pouring a drink or opening a bottle, and/or serve drinks and/or food.

The simplest task that a robot can do is to drive around with a tray of solid foods. More complicated tasks could include asking a person what he/she would like to drink and then get the drink. Another possibility could be a robot that can (open a bottle and) pour the correct drink in a glass without making a mess.

Other tasks that are common in a bar are also allowed, but have to be checked with the technical committee at least two weeks before the competition starts. Examples of other tasks are 'working in the lobby' (getting the coats from people and returning the correct items to the persons), cleaning up (as in getting empty glasses from the tables) or be a host (making enjoyable smalltalk to the guests and react appropriately). All proposals have to include a storyline about what the robot is likely to do.

The robot should follow this story-line which has to be communicated before the challenge. The story should be self-explaining. An example: The robot is driving around looking for people who are waving their hand. The robot goes to the person and asks if the person would like to order something. The person orders a cocktail such as a Tequila Sunrise but the robot already knows that only cola and diet-cola is being served. It replies with the drinks and snacks that are served this evening and asks if the person would like to order anything from the menu. When the order is taken the robot tries to get the order at the bar. In other words: the robot should behave useful and according to common sense and should show a complete and practical behavior.

The robot is probably not the only robot in the scenario. Two robots are allowed at the same time (depending on the roles they have). The time for a task is 15 minutes.

5.5.3 Referee Instructions

The referees need to

- Set up the bar area with the necessary props so that the robot is able to see and grab what it needs based on its physical capabilities.
- Understand what it is that the teams will be demonstrating and ensure that the environment is set up properly so as to not obtain undue delays.
- Instruct the 'guests' and make certain that at any time there are no more than 10 people in the scenario in total (including TC, trustees etc).
- Make certain that there is a TC member for every robot that participates in the challenge who writes down the best achievements of the robot in order to compare them with each other for the scoring.

5.5.4 Score System

1500 points max. The TC can give partial scoring for factors such as complexity of the task, robot performing multiple tasks (correctly), appearance/usability/HRI of the robot, appearance, safety and excellent performance. It is more important to do one thing very good than many things not so good. Of course most points are awarded to teams that do multiple tasks very good. Although at least one TC member is monitoring the robot, the entire TC votes for the score.

Chapter 6

Finals

The competition ends with the *Finals* on the last day, where the five teams with the highest total score compete. The concept is the same as in the Open Challenge. Every team in the Finals can choose freely what to demonstrate. The performance is evaluated by a jury and the Executive Committee. The jury will consist of people from various background, not necessarily only from robotics.

The demonstration in the Finals does not have to be different from the one shown in the open challenge (if any). It does not have to be the same either.

A wireless microphone and a video projector are provided.

6.1 Changes to the Environment

For the Finals teams are allowed to make modifications to the environment as they like under the condition that they are reversible and the team leaves the arena in the *very same* condition they entered it (i.e. revert all modifications made). The changes and their reversion have to be made within the total time given.

6.2 Setup and Presentation

During the setting up of the robot (*max. ten minutes*) the team has to give a maximum *five minutes* presentation in English for the audience. It should be made clear to the audience and the jury what they are about to see. Please note that the focus should lie on the demonstration and not on the presentation.



6.3 Performance

The performance takes a minimum of *five minutes* and should be commented in English by a team member. In short: Focus on the demonstration!



6.4 Score System

The score in the finals is made up of three equal parts.

1. One third of the points is given by the *previous performance* of a team, i.e., the sum of points scored in Stage I and Stage II.
2. One third of the points stems from an *evaluation by the Executive Committee* which serve as “league insider”. This evaluation is done according to the following criteria:
 - Scientific contribution
 - Contribution to @Home
 - Relevance for @Home / Novelty of approaches
 - Presentation and performance in the finals.
3. One third of the points is awarded by an *external jury*.
The evaluation criteria of the jury are based upon the desired abilities described in Section 2.10 and the list of criteria below. A maximum of ten points is given for each of these criteria by each jury member.
 - Originality and Presentation
(story-telling is to be rewarded)
 - Usability / Human-robot interaction
 - Multi-modality / System integration
 - Difficulty and success of the performance
 - Relevance / Usefulness for daily life

6.4.1 Jury Questions



After the performance there is a *five minute* period where the jury can ask questions to the team representative. The questioning influences the ranking and will be held in English.

6.4.2 Winner

The winner of the competition is the team that gets the highest ranking in the finals. There will be an award for 1st, 2nd and 3rd place. All teams in the Finals receive a certificate stating that they made it into the Finals of the RoboCup@Home competition.

Abbreviations

DC	Demo Challenge	20
HRI	Human-Robot Interaction	40
OC	Open Challenge	31
OC	Organizing Committee	2
TC	Technical Committee	2
TDP	Team Description Paper	15

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