

RoboCup@Home

Rulebook
version 0.1

1 Introduction

RoboCup@Home is a new league inside the RoboCup competitions 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.

This document is a working document and the final version should be ready, after discussion on the email list, by 15th of April.

2 The Competition

2.1 Concepts behind the competition

A set of conceptual key criteria builds the basis for the RoboCup@Home Competitions.

2.1.1 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.

2.1.2 Autonomy

All robots participating in the RoboCup@Home competition have to be autonomous. The definition and grade of autonomy is still debatable.

2.1.3 Deal with uncertainty

The real world provides a high level of uncertainty, dynamic changes and variation. In RoboCup@Home, one has to deal with these attributes.

2.1.4 Aiming for applications

To foster advance in technology and to keep the competition interesting, the scenario and the tests will steadily increase in complexity over the years. While in the beginning necessary abilities are being tested, tests will focus more and more on real applications in the future. Also the number of tests will increase in the future.

2.1.5 Social relevance

The competition and the included tests should focus in showing socially relevant results.

2.1.6 Scientific value

Application orientation sometimes implies a more pragmatic approach. In RoboCup@Home the scientific value of an approach has to be taken in consideration. Creating a correctly functioning robot is science!

2.1.7 Time constraints

Setup time as well as time for the accomplishment of the tests is very limited, usually five minutes.

2.1.8 Simple setup

The scenarios 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

2.1.9 Attractiveness

The competition should have a high attractiveness towards the audience.

2.1.10 Community

Though having to compete against each other during the competition, the members Robocup@Home league are invited to cooperate and exchange knowledge to advance technology even faster. 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.

2.2 Participation

There are four phases in the process toward participation:

1. Intention for participation
2. Preregistration
3. Qualification announcements
4. Final registration for the qualified teams

Preregistration requires a team description paper, video and a website

2.3 Website and team description paper

The website should contain photos and videos of the robot(s), a description of the approaches and information on scientific achievements, team members and previous participation in RoboCup. The team description paper goes into details about the technical and scientific approach, but the website should be accessible for a broader audience.

2.4 Qualification

If there are many preregistered teams a selection will be made according to the data provided by the teams.

2.5 Scenario

The ultimate scenario is the real world itself. To build up the required technologies gradually a basic home environment is provided as a general scenario. In the first years it will consist of a living room and a kitchen but soon it should also involve other areas of daily life, such as a garden/park area, a shop, a street or other public places.

The scenario for 2006. The setting consists of a living room and kitchen and maybe a small garden. In the living room are a small diner table with two chairs, a couch, an open cupboard or small table with a television and remote control, some books in the cupboard and in the kitchen a refrigerator with some cans and plastic bottles inside. There is also a door with a handle (not a knob) which represents the entrance to the living room. 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. This is to simulate the real world more than in a fixed scenario. The competitions are being held all over the world and one can expect that the scenario will look typical for the country where the games are hosted.

An example is given in the figure 1. Please note that the actual scenario might look different. The walls in the scenario will be about 1m high. Standard fare construction material will be used to build them.

3 Rules

3.1 General Rules

In some instances the general rules can be overruled by a test description, but only for a specific test.

3.1.1 Minimum number of tests

A team has to participate in at least two tests for this league. This means that to participate in the Open Challenge the team has to participate in one (1) other test. Although the team does not have to be successful in that test it does help trying to get into the finals.

3.1.2 Proposals for test

The rules should be simple so that the test description can fit on one regular page, such as in section 4. Proposals for new tests can be submitted by the participants and can to be presented in the open challenge. If the technical

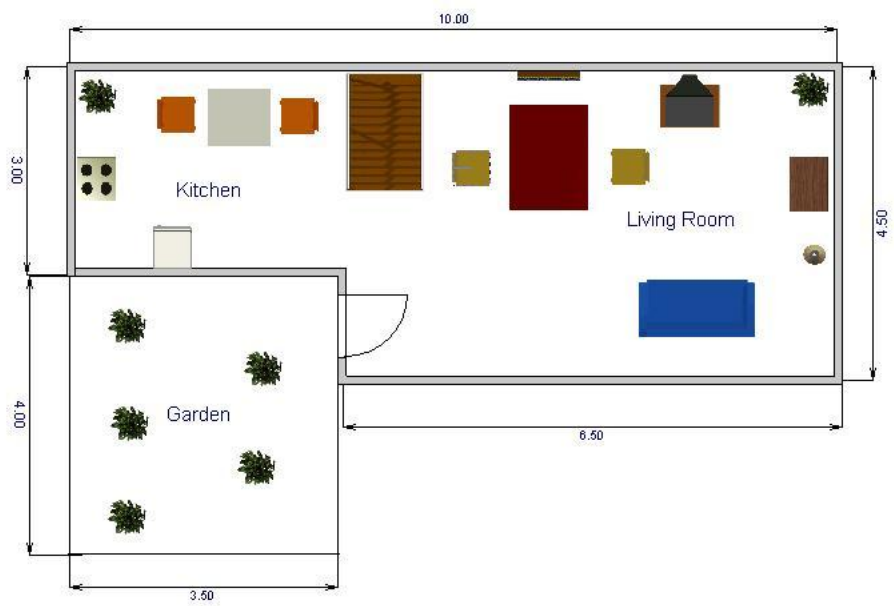


Figure 1: A possible configuration of the living room. The actual settings are most likely different from this picture and will probably change during the competitions.

committee of the league agrees and there is a minimum number of teams willing to join, the test gets included in the next competition.

3.1.3 Setup

One of the difficulties lies in the limited amount of time in which a team has to set up its robot. For all tests, this limit is set to 5 minutes due to organizational time constraints, to foster general applicability and to have simple set-up procedures in the presented approaches. If a team exceeds this period, it gets disqualified for the specific test. There are *no exceptions* to this rule. The 5 minute period forces teams to have easy procedures for setting up and improves the quality of the robot for home use.

3.1.4 Phases of a test

The first phase is called 'proof of concept' and is done with settings specified by the team to show that their approach works. Afterward the same test is done with generalized and therefore more difficult settings. This second phase is called 'general applicability' and the settings are specified by the RoboCup@Home technical committee. For each test the specific rules of these two phases are described in the test description.

3.1.5 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! Also repairs are not allowed, unless it is specified in advance that it is an essential part of the performance, but this has to be made very clear to the technical committee (and the referees), just as touching the robot.

3.1.6 Score system

The total amount of points scored determines who gets into the finals. Tests where many teams succeed get fewer points and tests where few teams succeed get more points. This is a natural way of stimulating teams to tackle the more difficult problems. The score system is normalized.

For both the phases of the tests points can be scored. So it might be that many succeed in the "proof of concept" phase, and thus get a few points for this test, but that only a few succeed in the second phase, thus scoring more points.

Every phase of a test has (approximately) 100 points to divide. If the test is boolean then the amount of points is: $1/(\text{amount of winners}) * 100$. If the test is ranking based, the first gets the most points, the second less, the third ... The ranking is summed (ex: 3 winners := $1 + 2 + 3 = 6$, 4 winners := $1 + 2 + 3 + 4 = 10$) and the first place gets $3/6$, 2nd $2/6$ and the 3rd $1/6$ of the total amount of points, or $4/10$, $3/10$, $2/10$ and $1/10$. The pseudo code is written below:

```

N = amount of winners
// calculate the points multiplier
Ntotal = sigma N (from 1 to N)
P = 1 / Ntotal * 100; //as in the boolean case
// calculate the points for the winners
i = N;
for ( int R=1; R<=N; R++ )
{
  Ranking R gets i * P points
  // the 1st place gets the most points and last place the least
  i --;
}

```

Table 1 shows the amount of points for up to 10 winners in a ranking based test.

Table 1: amount of points in ranking based system.

1	2	3	4	5	6	7	8	9	10
100									
67	33								
50	33	17							
40	30	20	10						
33	27	20	13	7					
29	24	19	14	10	5				
25	21	18	14	11	7	4			
22	19	17	14	11	8	6	3		
20	18	16	13	11	9	7	4	2	
18	16	15	13	11	9	7	5	4	2

3.1.7 Maximum number of robots

The maximum number of robots that can register for the competitions are two. Also the maximum number of robots that can participate in a test are two. This means that a team is allowed to use two robots to solve a problem, or to demonstrate something, unless stated otherwise in the test description.

3.1.8 Maximum number of people

The maximum number of people to register is virtually unlimited, but the organization only provides space for four (4) persons to work at tables. The maximum number of people who can participate in a test are two, unless stated otherwise.

3.1.9 Maximum number of external devices

This number is also set at two. So a team can bring two object into the scenario for use with the robots. Devices can be anything that is 'natural' in the scenario, such as a glass on the table, a plant in the corner, a vacuum cleaner, a video cassette etc. in the case of a living room. Logo's, banners etc. are not allowed as an object to bring into the games.

3.2 Types of robots allowed for participation

Any robot that can normally be in a house can participate. The robots can be no taller than 2 meters, no heavier than 150 kilograms and should not be dangerous for anyone. Also a robot has to fit through a regular doorway.

3.3 Test specific rules

The rules of a test supersede the general rules, unless it is inconsistent with the general idea of the league as stated in the introduction.

3.4 The tests

The tests are the keystones of the league. The robots have to solve as many tests as possible in order to get the most points. Sometimes it is less a test than a performance. Depending on the test there is either a ranking based score system or a boolean yes or no. Both influence the total amount of points.

The tests should be in compliance with the key criteria as stated in chapter 2.1.

3.5 Open Challenge

On the day before the finals the open challenge is being held. To participate in the open challenge the team/robot has to participate in at least one other test.

In the open challenge one can demonstrate freely chosen abilities. The demonstration should be according to the goal and criteria of the league. A jury will decide on the ranking. During the setting up of the robot the team has the opportunity to give a short presentation about their approach. Video-projector and microphone will be available. The presentation influences the ranking.

The idea is that during the tests the abilities of the robots are tested on a technical level. During the open challenge the performance is more audience directed, so non-roboticists should be able to understand the motivation behind the research. Still the decision of the performance is mostly based on the technical level, also to ensure that the five teams that are going to the finals can perform excellently. In the open challenge the amount of points is doubled compared to the normal tests.

3.6 The finals

The league ends with the finals on the last day. The rules are the same as in the open challenge, but now the focus is not mostly on the technical level. Again there is only five minutes of setup, where the team gives a presentation.

The winner of the league is the team that gets the highest ranking in the finals, which is independent from previous results. Every member of the jury gives an amount of point between 1 and 10. The total amount of points of all jury members for a given team gives the ranking.

The jury consists of people with various background, such as people from industry, from human-machine interaction, from industrial design, from the audience and the press. Every member of the jury judges the performance of the teams from his/her own professional perspective. The categories of people in the jury, and thus the categories of the decision process, are listed below.

- President of the RoboCup federation (or the vice-president or a trustee if the (vice-)president is participating with a team)
- Marketing
- Industrial design
- Psychology/human-machine interaction
- Audience
- Press
- Engineering
- ...

4 The specific tests:

4.1 Follow a Human

4.1.1 Task

The robot has to follow a human (leader) through a random obstacle track in the home scenario of 2006.

4.1.2 Setup

The setup time for the test is 5 minutes. The start and the end position as well as the obstacle position is not known in advance. The maximum time for going through the track is 3 minutes.

4.1.3 Phase 1: Prove of concept

The team is allowed to present the ability, if necessary with their own aiding technology (e.g color marks, transponders,) carried by or fixed on the leader who is a team member. The starting and finishing position are defined by the technical committee, just as the obstacle positions.

4.1.4 Phase 2: General applicability

The technical committee chooses a leader from outside of the team. No aiding markers or technology is carried by or attached to the leader. At the start of the test, the leader stands with his back towards the robot at a distance of 2m. After 1 minute, which can be used for calibration by the team members, the leader starts to walk towards the goal.

4.1.5 Possible extensions for future competitions

- Only the pushing of max. 1 button to calibrate the robot.
- No pushing a button allowed, only voice or gesture commands to start/calibrate the robot.
- Instead of obstacles, the robot has to follow the leader through a crowd of people standing still.
- Instead of the crowd of people standing still, the people are allowed to move around in the area not being allowed to move between the leader and the robot.
- The robot has to lead the human to a goal somewhere in the venue.

4.1.6 Score System

Boolean

4.2 Navigate

4.2.1 Task

The robot has to safely navigate towards objects in the living room environment without touching obstacles. The robot has to visit three distinct places, at least 3 meters away from each other, within 5 minutes. When the robot thinks it has reached the designated place a loud sound or bright light is activated for about 5 seconds.

4.2.2 Setup

The setup time for the test is 5 minutes and can be used for map-building. The start and the end position as well as the obstacle positions are not known in advance. All objects described in the scenario can be used.

4.2.3 Phase 1: Prove of concept

Given a command (preferably spoken), such as: 'go to TV' or 'go to door', the robot has to get at the designated position, safely without touching objects. The team members are allowed to pick the places to visit.

4.2.4 Phase 2: General applicability

The technical committee picks out places where the robot has to go to, and as commands only the naming of the technical committee may be used. So if the TC says: 'go to TV' and the robot only knows 'go to television' then the robot has to be able to interpret this. Also it should get back at the starting location.

4.2.5 Possible extensions for future competitions

- The robot is lead to a place in the venue and has to find its way back to the starting location.
- The robot is given a map at the main info desk (the same map as for humans) and has to find its way to the competition area.
- The robot is taken to a local shop and has to deliver some goods back at the venue.

4.2.6 Score System

Boolean

4.3 Manipulate

4.3.1 Task

The robot has to open a door with a handle and get through the doorway, or open a refrigerator door and get a soda can out of the refrigerator, or get a newspaper. The robot starts at a position at least three meters from the door, refrigerator or newspaper. This is done in the living room scenario of 2006.

4.3.2 Setup

The setup time for the test is 5 minutes.

4.3.3 Phase 1: Prove of concept

The test succeeds if the robot is through the door, has a can or the newspaper. The team can choose the starting position.

4.3.4 Phase 2: General applicability

The test succeeds if the robot is through the door or has a can and has also (gently) closed the door again. The technical committee chooses the starting position. It is unknown if the door of the living room opens to the inside or outside. The test can also succeed if the robot brings the newspaper back to its owner.

4.3.5 Possible extensions for future competitions

- Give an object to another robot.
- Voice commanded manipulation.
- Handling breakable objects.
- Moving around with a tray of drinks.
- Shaking hands and introducing oneself.

4.3.6 Score System

Boolean