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## Rules of the OPEN category

Version 1.2 – September 13rd, 2012

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### Beach Cleaner Robot

#### 1. Introduction

This year the IEEE Students Latin American Robotics Competition focuses again in significant problems that society needs to deal with and at the same time challenging problems to the young Latino American roboticists. The goal of the competition is three-fold: (1) Investigate and propose solutions to the problem of accumulation of garbage on the beaches of Latin America, (2) Raise public awareness about the significance of environment pollution, and (3) Invite people to participate actively in solutions to prevent pollution and protect the environment.

Beach pollution is caused by natural phenomena, such as red tide and hurricanes, and also by the effect of human activity, such as garbage accumulation, drainage discharges and oil spills. Beach pollution causes serious damages to marine ecosystems, poses health risks to swimmers, damages fishing industry, and affects tourism on the beach.

We call young Latino American people to image and build an autonomous robot able to collect solid garbage in a scenario simulating a beach in a tiny touristic island, illustrated in Figure 1.

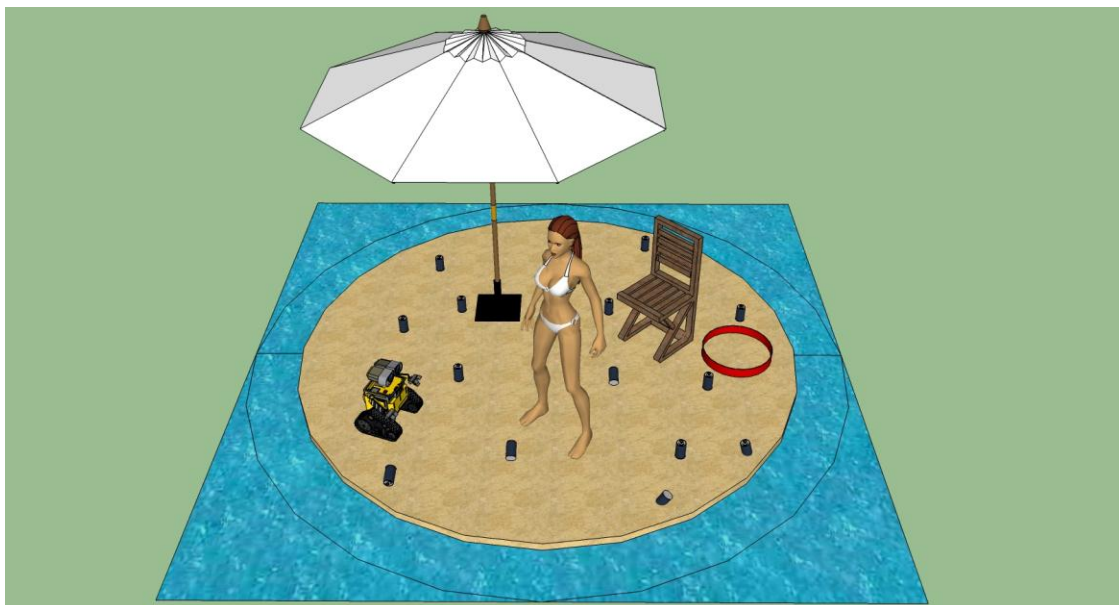


Figure 1. Scenario of the Open category – Beach Cleaner Robot

It is worth to remark that the Beach Cleaner Robot competition is about service robotics in natural environments. For that, it is unfeasible to foresee detailed features of the elements in the scenario, such as the beach furniture, and the mannequin. The robots that participate in this category are expected to deal with these elements in spite of the lack of details.

## 2. The goals

The ultimate goal is to have an autonomous robot looking for garbage around the environment, collect it, and dispose the garbage in a depot.

The robot can move, push or take just the garbage distributed around the environment. If the mannequin is touched by the robot, it will have a penalization in the score.

The challenge of the contest is to have a robot moving around, looking at, collecting and leaving solid waste in a depot. The robot must collect and leave as most garbage as it can, without touching the mannequin and other objects around, moving on an irregular surface.

## 3. The scenario

The scenario is a 5.5 m round sand arena without walls mounted on a blue canvas of 6.0 m x 6.0 m. The sand of the arena shall be dry construction sand. The measurements of the scenario are shown in Figure 2.

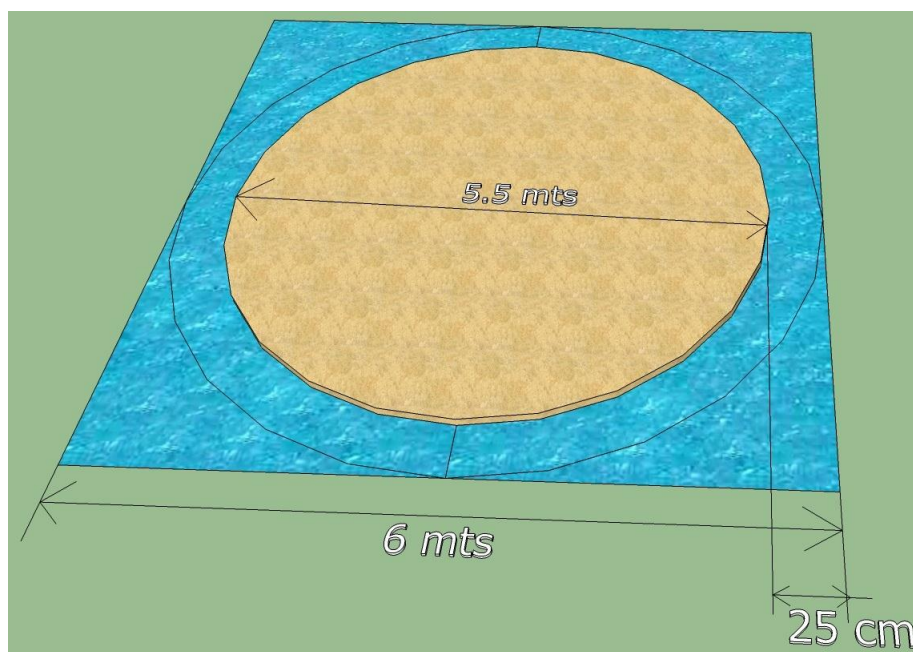


Figure 2. Measurement of the scenario.

The stand on the surface of the scenario can have hills of 5 to 10 cm of height, and variable diameter. Landmarks or signals of any kind can not be added to the environment.

Even though the local committee looks for construction sand that is dry and clean for the competition, construction sand may contain sand pebbles and may also stay moisturized. For that, the teams must prepare their robots to move over construction sand as it is. Once the competition has begun, the teams will play under the conditions of the scenario without arguing or making of any claims.

There will be several objects randomly distributed within the scenario:

- ✓ A beach chair, real size.
- ✓ A beach umbrella, real size.
- ✓ A real size mannequin, seating on the chair or standing up at the arena.
- ✓ A ring of a height of 10 cm and a diameter of 70 cm, the **garbage depot**.
- ✓ 20 soda empty cans 12 US flo oz / 355 ml, painted in flat black, they simulate the **garbage**. A soda can is a garbage unit.

Figures 3 and 4 show scenario details.

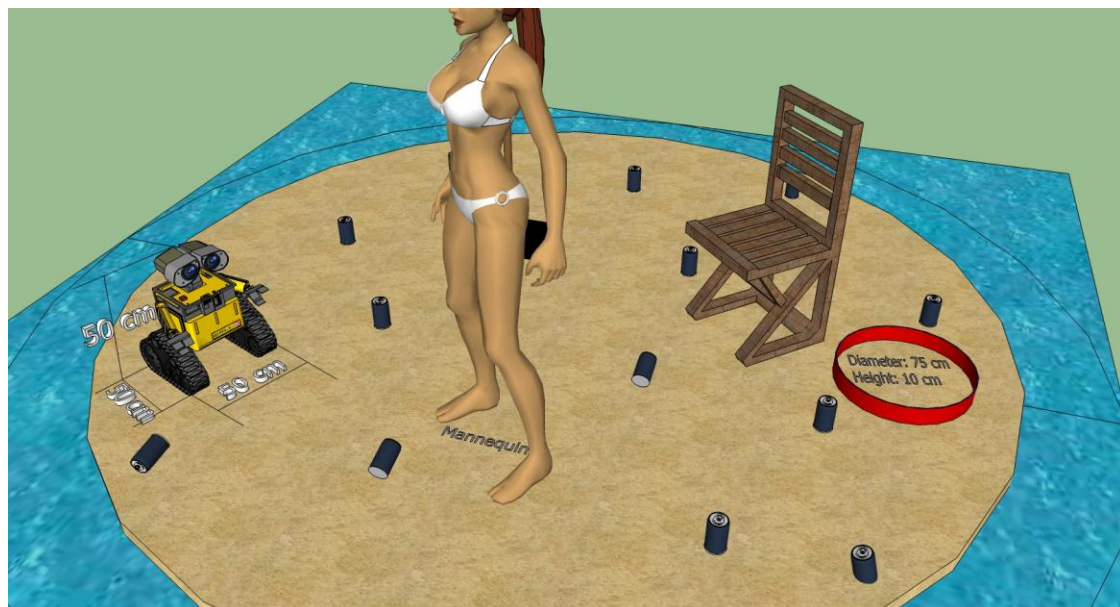


Figure 3. Scenario details (top view).

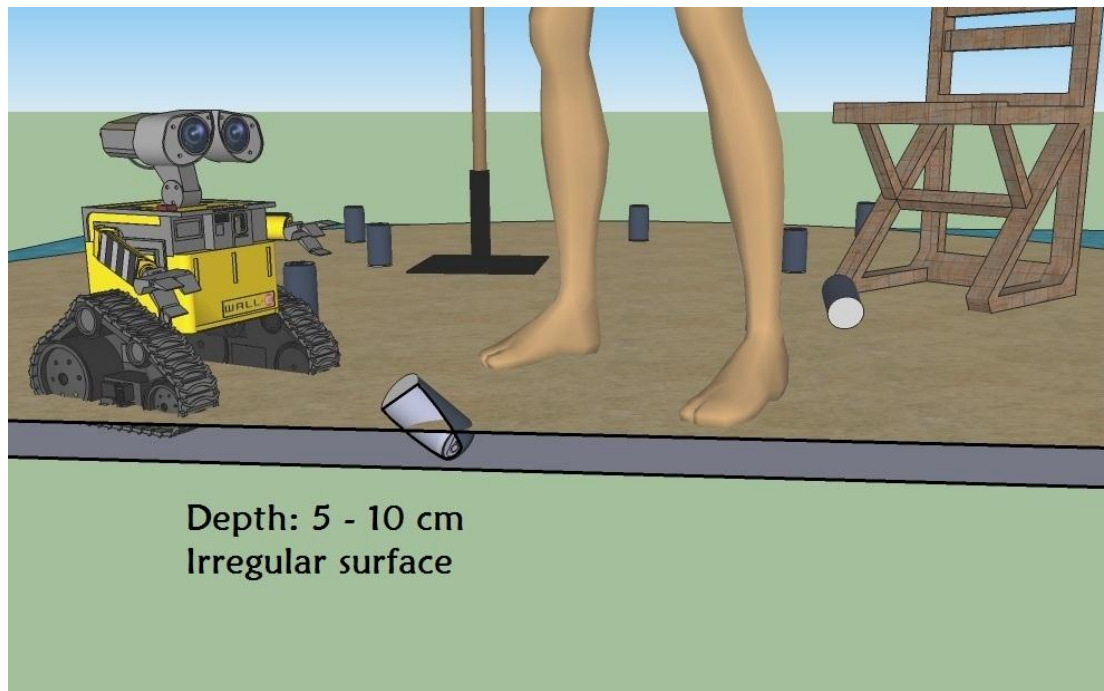


Figure 4. Scenario details (side view).

#### 4. Lighting conditions

The environment can be placed indoors in a gymnasium or in an outdoor patio of the LARC 2012 venue. Therefore, some parts of the scenario may be exposed to direct sunlight. For that reason, robots must be able to take any indoor/outdoor light conditions and then robots must be calibrated by team-members for the lighting conditions of place and time of the tests.

Once the competition has begun, the teams will play under the conditions of the scenario without arguing or making of any complain.

#### 5. The robot

The robot must be an autonomous mobile device, able to move across the scenario and achieve its goals without human intervention, without any communication to computer, mobile phones or any external device. The robot relies uniquely on sensors, processors and devices carried onboard.

Below is a list of compliant features about measurements and characteristics of the robots:

- ✓ The robot must fit in a cube of 50 cm by side.
- ✓ The robot must start by pushing one button once at any round of the contest.

- ✓ The communication with any external device located outboard the robot is forbidden.
- ✓ The scenario can not be changed by the robot. The robot is only allowed to move the garbage and leave its traces on the arena.

The teams will be disqualified of the competition if their robot violates any of the above constraints.

## 6. The contest rules

Once the competition has started, all the teams must let the robots at the “**waiting room lounge**”, a space designated by the committee out of the scenario but at any sight. The robots can be taken away from the waiting room lounge at the competition time and when the round has finished. In this way all the teams will have the same time to adjust their robots.

After, the team representatives will be in the lottery to get the order of the competition of their robots, to accord the scenario conditions and the starting pose of the robots.

While in the waiting room lounge, the robots cannot be modified in any way. The changes or reprogramming of the robots will only be allowed once all competitors have ended the round.

**About the restart:** The timing will stop, the initial settings of the scenario and the robot pose will be set, the score will be reset to zero, and the robot will receive a penalty. The settings of the scenario and the manipulation of the robot will be reset by the judge and their assistants. After that the proof will restart, and the timing will continue. A maximum of two restarts during one proof is allowed for any robot.

**About the faults:** The timing will not stop, the robot activities will continue, the scenario will not be modified or touched and the score will not be reset. The robot will receive a penalty for any fault. A maximum of five faults is allowed during one proof is allowed for any robot.

### Restart and Fault Cases:

Restarts:

- ✓ If the members of the team get in or touch with their robot or any element of the scenario without judge authorization (unauthorized intervention), a restart will be required.
- ✓ If the robot has an evident mechanical problem and the judges have previously allowed the team to restart the robot. Evident mechanical problems are: a detached motor, sensor, tire or limb; a discharged



battery; or any weird performance not associated with a bad design that can be quickly repaired.

- ✓ If the robot get stuck (stall) while its whole body or one part of its body touches the scenario, and the judges have previously allowed the team to restart the robot. Stalls are situations where at least one part of the robot does not have a linear displacement of more 15 cm (5.9 inches) during 1 minute.
- ✓ If the whole body of the robot stays on the blue canvas or beyond the sand arena for more than 10 seconds, the judges will allow the team to restart the robot.

Faults:

- ✓ Each time the whole body of the robot stays more than 5 seconds and less than 10 seconds on the blue canvas and the robot is able to return to the sand arena it will receive a penalty.
- ✓ Each time the robot touches the mannequin it will be receive a penalty.

**During the round:** The robot can collect or dispose garbage units one by one or by grouping them. Each garbage unit has the same value no matter its position in the scenario.

The score assigned for each garbage unit collected by the robot is valid once the robot has taken this unit. The score assigned for each garbage unit disposed by the robot is valid once the garbage unit is within the deposit and the robot does not touch the garbage unit. Otherwise no score will be given to the robot for a garbage unit.

**About the end of the proof:** The test will end when some of the conditions mentioned below are accomplished:

1. When the time of the test is over: 3 minutes for each activity of the proof concept demonstration or 10 minutes for the general performance proof.
2. When the robot has made 3 restarts or 5 faults in the same proof.

A team will be classified or win on the basis of the score of its robot. If two or more teams tie with an even score during the classifier round in a classified position all the teams in the same situation will pass to the final round. If two or more teams tie with an even score during the final round an extra round of general performance proofs will be held immediately following the final round.

Any extraordinary situation with regard to the rules or the scores will be analyzed by the judges and the organizers of the LARC 2012 OPEN category and they will emit a verdict with honesty and impartiality.

## 7. The assessment

The assessment of the robots will be based on both a proof of concept demonstration and a general performance proof.

**About the proof of concept demonstration:** In this proof the robot shows separately, each part of the solution proposed for beach cleaning. During the proof of concept demonstration the team members will explain to the judges the strategies designed for each activity performed by their robots. The considered activities are: obstacle/mannequin avoidance, garbage localization, garbage collection, and garbage disposal. The robot must be programmed to show explicitly to the judges the accomplishment of each activity, by using buzzers, sound signals, light signals through LEDS, displays, or messages printed on a monitor or a screen. The maximum time to perform each activity is 3 minutes. Table 1 shows the maximum scores for each one of the activities evaluated during the proof of concept demonstration.

**About the general performance proof:** In this test the robot cleans the beach using the activities shown in the proof of concept demonstration. The maximum time of this proof is 10 minutes. Table 2 shows the score for this proof.

Activity/Action	Score
Obstacle/mannequin avoidance	1.00
Garbage localization	1.00
Garbage collection	1.00
Garbage disposal	1.00
Restart	-0.25

**Table 1. Score of the proof of concept demonstration.**

Activity/Action	Score
Collected garbage unit	1.00
Disposed garbage unit	2.00
Fault (each contact to the mannequin, each exit of the sand arena for more than 5 seconds and less than 10 seconds)	-0.50
Restart (unauthorized intervention, evident mechanical problem, stalled robot, exit of the sand arena for more than 10 seconds)	-0.25

**Table 2. Score of the general performance proof.**

## 8. Tests and round executions

There will be an announcement one hour in advance for the test to start and the exact time when the robot must be in the waiting room lounge. This time can be used by the teams to make calibration and adjustments to the robot in the scenario used for the proofs.

There will be two kinds of rounds: classifier and final.

### Classifier Round:

- ✓ All teams registered in LARC 2012 OPEN category participate.
- ✓ It has two rounds per team: one proof of concept demonstration and one general performance proof. The scores and time for each proof are provided in Section 7.
- ✓ In the proof of concept demonstration the robots will have at most two restart options per activity. The judges will generate random conditions for the scenarios that will be used for all the teams.
- ✓ In the general performance proof the robots will have at most two restart options in the same proof.
- ✓ The four teams with the best scores, resulting of the sum of the scores obtained in the proof of concept demonstration plus the scored obtained in the general performance proof will pass to the final round.

### Final Round:

- ✓ All teams classified in LARC 2012 OPEN category participate.
- ✓ Each team will compete in two rounds of general performance proofs. The robots will have at most two restart options in the same proof. The



judges will generate random conditions for the scenarios that will be used for all the teams.

- ✓ The first, second and third places of the LARC 2012 OPEN category will be for the three teams with the best scores. It is worth to remark that teams that have scored negative or null scores cannot be classified in the winning teams.

The “Most Original Home-made Prototype” and the “Most Original Commercial Kit-based Prototype” will receive special honors mention from the Jury.

## **9. Inscription and registration**

The way to participate in the Competition Robotics LARC 2012 OPEN category is to form a group of up to 6 people of any educational institution of any country. The members of team must be students or prior students who have completed their studies not longer than two years ago. The teams must register in the website. Once the team receive and acknowledgment of its registrations it is officially registered. The team list will be announced in the web site of the LARC OPEN category.

The contest will be held in Fortaleza, Brazil on October 2012.

It is a requirement for participation the submission of a report prepared using the template of the IEEE conference describing the design, building and programming of the robots. After the end of the competitions, winners will briefly present their robot to other teams. The report must be submitted through the web site of LARC 2012. The lack of this document will impede the participation of the team in the contest, since it is important for the development, learning and knowledge transference among the participants.

All the teams that participate in the LARC 2012 OPEN category will receive a certificate of participation. Additionally, the teams classified in the first three places will receive certificate of winners.

## **10. The jury**

The jury will be compound by distinguished roboticists, one of the them could be an organizer of the contest and two more specials guests. The names of the jury will be announced before the competition.

## **11. About extraordinary situations during the contest**

Any extraordinary situation with regard to the rules or the score will be analyzed by the judges and the Organizers of the LARC 2012 OPEN category and they will emit a verdict with honesty and impartiality.