

# **Minirobot - An original international robotic competition for high school students of Etna Valley: considerations after seven editions**

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**Abstract.** MiniRobot is a robotic competition organized by the University of Catania and ARCES since 2006. The robotic competition is devoted to high school students and each year regards a different challenge. In this paper we will briefly summarize the last editions of miniRobot. Finally some considerations on the gained experience are exposed.

**Keywords:** Robotic competitions, Edutainment, Mobile robots.

## **1 Introduction**

It is well known that robotics represents a successful way to attract young students toward science and technology [1]. Robotic for edutainment has been identified as a key instrument to teach technologies to young people: it is nowadays fundamental to start making changes in the educational system, also by introducing new instruments for teaching and learning [2]. To this aim many new flexible and modular teaching courses have been developed to guarantee fast learning to the students. The main objective is not only to allow them to understand, but also to control and develop the new technological systems that they will encounter in their daily life.

Among the different initiatives developed, great success have reached the robotic competitions, especially in Japan and in the U.S.A [3].

Robotic competitions allow the students to develop robotic systems and at the same time to entertain themselves, without realizing that they are studying. The willingness to win a contest and to compete with their colleagues acts as a strong stimulus to work.

University of Catania is involved in robotic competitions for University students since 1998, when a team participated to the first edition of the EUROBOT competition [4]. Since then teams of our University attended each year to the Eurobot

competition, hosting it in 2006. Moreover we started attending and organizing other competition as the CLAWAR climbing robot competition [5],[6],[7].

In a cooperation between University of Catania and ARCES, a non-profit organization that prepares each year several activities for students, in 2003 we commenced preparing several introductory courses to robotics for high-school students. In 2006 we hosted in Catania the EUROBOT international event, attracting a lot of media and public attention. Driven by the success achieved by our courses and by similar experiences worldwide, we then decided to involve also high school students of the county of Catania, often named as Etna valley, in a new competition devoted to younger scholars.

Instead of joining to one of the many competitions already existing, we decided to create a new one, more suitable for our territory and to our purposes.

## **2 The Minirobot competitions**

In a Minirobot competition two robots have to play in two different fields, but at the same time to play totally autonomously a given challenge [7]. Each year the theme of the competition changes, thus allowing also to newcomers to be competitive. Consequently each year the teams, composed by high schools students, have to build new robots. A team can use only one robot and, in order to promote engagement and originality, different teams of the same school cannot use similar robots.

The robots must be totally autonomous as regard energy and control, no remote commands are allowed. The robots must adopt Lego NXT or RCX kits, but it is allowed to build mechanical components without using LEGO parts; those are the main limitations for the robot design. The rules, developed by a team composed by both researchers and organizers, give very precise instructions concerning how to build the playing arena and the various components needed, with their dimensions and tolerances. The scores are assigned on the basis of the team that is faster in reaching the goals, but also on the basis of the number of goals achieved or penalties incurred. Assistance and interaction between organizers and teams is managed through a forum on the web. Moreover the teams are assisted through high skilled tutors that supervise HW and SW development, and a central service, in order to help in the realization of the arenas and accessories, is provided.

The rules are usually published during the end of the year and the competition is held at the beginning of June, hosted by the University. During the competition several lectures on robotics, videos and demonstrations are also organized. Everything is done in a cheerful and festive atmosphere.

Common aspects in the rules of each year are that the robots must be able to:

- move and orient themselves within the demarcated areas;
- distinguish objects based on their characteristics;
- move through a path with obstacles;
- pick up objects and place them in a random position with precision.

Each contest lasts typically 210 seconds and is held in two separated but close fields to increase the competition atmosphere. The arena has the same dimension of a tennis-table field.

During the first part of competitions teams are arranged in groups of around five teams, after some short tournaments only the first two teams for each groups move on to a series of direct elimination matches which leads to the winner.

All the teams are required also to make a video posted on YouTube a week before the date of the competition. This video can tell the story of the creation of the robot, its technical characteristics, working methods adopted by the team, the different phases of the project, etc... A committee judges the best video for creativity, editing, etc... and this team receives the prize "Golden Tube".

In the following paragraphs a summary of the rules of the past editions, with some pictures and considerations is presented. As it was said before, each year a different theme is chosen. In this selection we try to give also a social message to the students and to the public, concerning the future capabilities for robots in everyday life.

## 2.1 2006: Plastic cup picking

As a first edition we choose a very simple task in order to attract many teams. In particular the aim of the competition for each robot was to collect plastic cups of the specified color from one side of the table and to bring them back to the starting point.



**Fig. 1.** Robots from the 2006 edition and a picture of a contest.

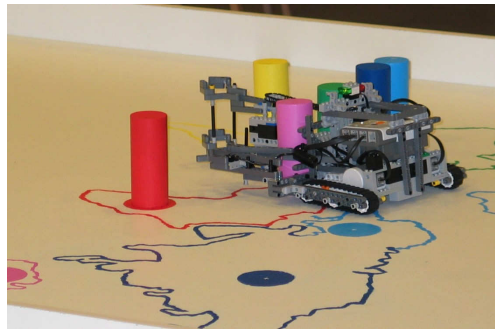
## 2.2 2007: Peace robot

The objective of this year was to build a robot capable to collect several colored flags on the fields and to put them on a specified position within 240 seconds.

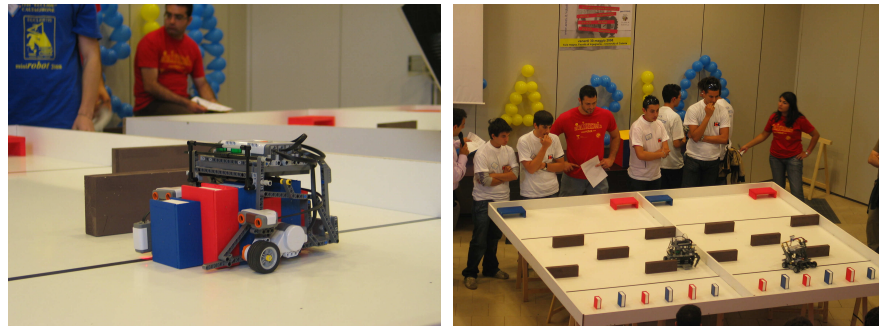
The different flags were inside the 6 continents drawn on the arena.



**Fig. 2.** The arena for the 2007 edition with the 6 continents and the flags represented by the colored cylinders.



**Fig. 3.** A robot capturing several flags.



**Fig. 4.** A robot of the 2008 edition collecting several books and a global view of a contest.

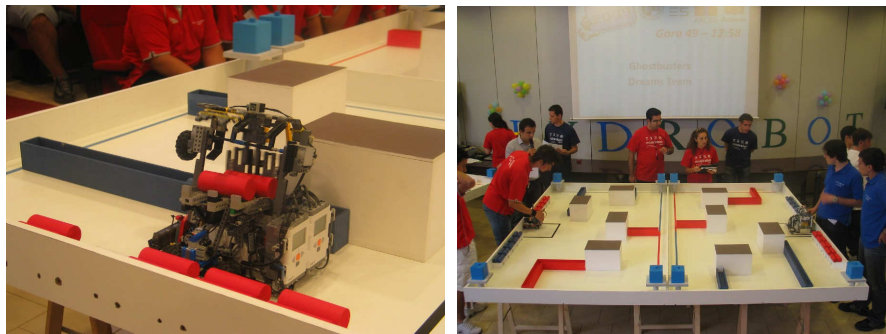
## 2.1 2008: The librarian

The aim was to build robots that are able to collect in the arena books of various sizes and colors and store them on some tables within a set timeframe.

### 2.1 2009: Hydrobot

The objective of the 2009 edition was that of realizing robots that are able to pick up pipes and place them in special areas, differentiated by color, so as to reconstitute the connections in a network of water reservoirs in a village.

In this edition we started involving primary and middle schools students too. Several basic courses on robotics were organized and during the competition an exhibition with the best systems prepared by the students was held. A great success was reached by a robot built to spread slices of bread with “Nutella”.



**Fig. 5.** A robot of the 2009 edition picking up pipes and a view of the field structure.



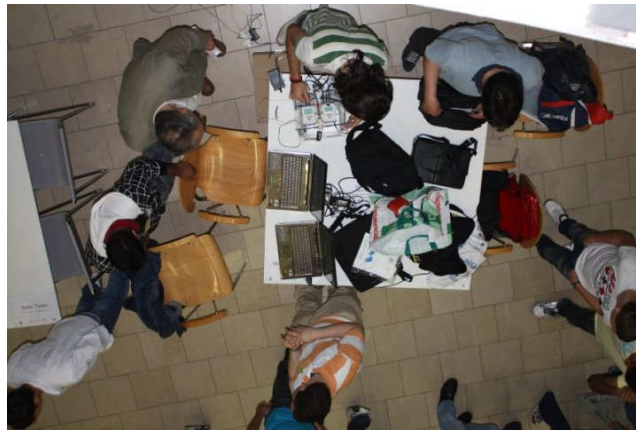
**Fig. 6.** Middle school demonstrating a robot built to spread slices of bread with “Nutella” chocolate cream (left). Another prototype of robot built by middle school students to clean automatically a village (right).

### 2.1 2010: The shepherd robot

The aim of this edition was that of realizing robots that are able to gather sheep and bring them inside a special enclosure, placing them inside the stall at different altitudes.



**Fig. 7.** Field of the 2010 edition and a robot capturing several sheeps. The small cylinders represent the sheeps.



**Fig. 8.** Students at work in the backstage.

## 2.1 2011:RoboChef

The objective of this year was to provide robots that are able to collect the culinary ingredients in a recipe and place them on the stove.

The robot was required to be able to move and orient itself within the playing field avoiding some fixed obstacles. The ability to distinguish objects based on their characteristics, such as color, was in this case really important; before the round to start, a recipe was randomly selected between five possible ones; thus the robots had to find the right ingredients, collect them from several different-heighted racks, and move them to the stove. The stove was just another grey-painted box inside the field. Of course right ingredients raise the final score while wrong ones lower it.



This year a simpler competition for middle school students was also organized. The aim of this competition was to ensure that robots reproduce - in their movement - a suitable route, bypassing the obstacles in the correct order and in the right direction without dropping them. All in the shortest possible time.



**Fig. 9.** The 2011 edition fields and a robot collecting ingredients for its recipe.



**Fig. 10.** Picture from the 2011 middle school competition. The robot had to follow the line avoiding the obstacles in the shortest time.

## 2.2 2012: The postman

The competition of this year will have as an objective to create robots that are able to deliver the mail, or postal parcels. The postman-robot will go to the post office, take and pass the letters to be sent from homes; return from these will be delivered in the mail a receipt back. They will also be able to deliver packages taken from the center shipments at the homes of the recipients.

### 3 Final considerations and conclusions

MiniRobot is a competition locally based, born with the spirit to disseminate robotics in the Catania county among the students. The competition, as it is shown in Figs. 11-13 evolved over the year attracting an increasing number of teams and students.

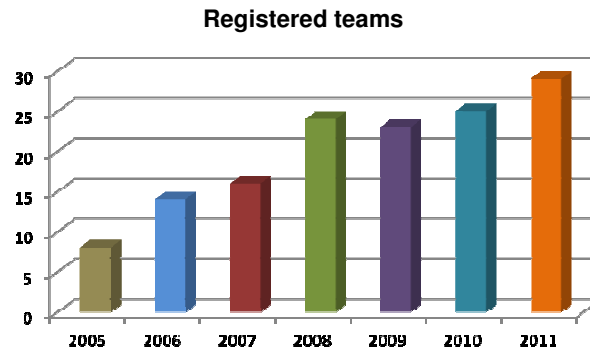


Fig. 11. Number of registered teams in all the past seven editions.

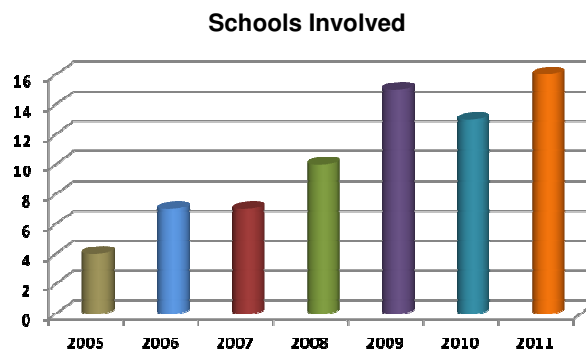


Fig. 12. Number of schools participating in all the past seven editions.

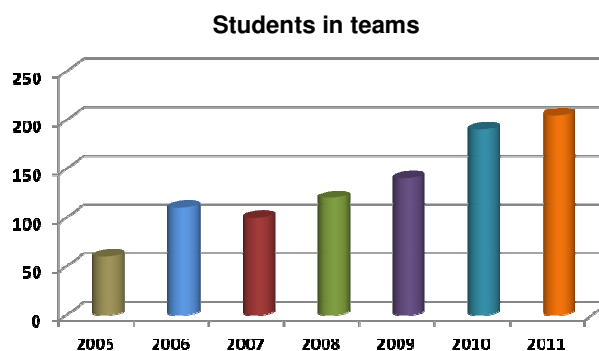


Fig. 13. Number of students in the teams in all the past seven editions.



There are many competitions worldwide, with different level of competences required. From our experience we believe that it is not important only to promote and enhance excellence by means of complex challenges, but it is also essential to stimulate the less motivated students to improve and to be attracted to science and technology.

Some international competitions require higher budgets for travelling and for organizing everything and cannot be attended by many schools or students for economic reasons.

Several times in other important competitions very sophisticated robots are presented. Many times the impression was that the contest was between teachers, while the students are just their assistants. From our point of view the competition must be for the students and the teachers had to be just their tutors.

Our competitions have been always organized with a very limited budget and are mainly based on the work of volunteers and on a small registration fee asked to the teams just to cover the expenses. Avoiding big public or private sponsors allowed maintaining everything clear and transparent, without making our contest a commercial or political show.

Some schools, that before participating to miniRobot had no experience in robotics, are now involved also in other national and international robotic competitions and organise specialised courses in robotics for their students.

Several students that participated in past robotic competitions have subsequently enrolled to University, began engineering studies and some of them are now working in robotic in research organization and companies.

## **Acknowledgements**

Each year MiniRobot can be organized thanks to the many volunteers that spend a lot of time helping to write the rules, building the field tables, organizing and referring contests, helping and recruiting new teams, etc. Their help is gratefully acknowledged.

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