The *Micro-Rato* Contest: A popular approach to improve self-study in electronics and computer science

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Introduction

- Mobile robotic competitions have been around for the past 20 years and address several problem solving objectives.

- These competitions can be valuable pedagogical tools to integrate a wide sort of concepts.

- Many of these competitions tend to increase, over time, the degree of complexity.

- However, an approach based on a medium complexity problem allows the participation of a wider range of either undergraduate or even high school students.

- *Micro-Rato* is a competition among small autonomous and mobile robots.

Motivation and strategy (i)

- ◆ Main goal of the *Micro-Rato* contest
  - ■ to complement the technical skills of the DETUA students, in an informal and extra-curricular way through:
    - ● integration of multidisciplinary concepts which are typically taught in electronics engineering and computer science courses
    - ● learning through a *hands on* approach of problem solving
    - ● promotion of voluntary team work

Motivation and strategy (ii)

◆ Strategy:

- to promote competition as a way to improve the motivation and interest of the participating teams in building their own robots

- to ensure the availability of enough technical resources

- to promote group sessions for technical discussions

- to promote an informal relationship between the teams and organising comitee

- to reduce the minimum requirements for participating to a level as low as possible

Motivation and strategy (iii)

- ◆ Strategy (cont.)
  - participation prize
  - competition prizes (1º - 7º)
  - merit prizes:
    - Innovation, Engineering, DETUA
  - media coverage
  - integration in a simple mobile robotics festival

Brief history

◆ Summer 1995, the DETUA masters degree offered a course on Autonomous and Mobile Robotics taught by Prof. Keith Doty (Univ. of Florida).

◆ This course acted as the triggering event that led to the organisation of the 1st robotic contest in the country.

◆ This contest has been regularly organised since then.

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Brief history (ii)

◆ 1st edition – December, 1995

■ 6 registered teams

UA - 5

UM - 1

Brief history (iii)

- ◆ 2nd edition – March, 1997
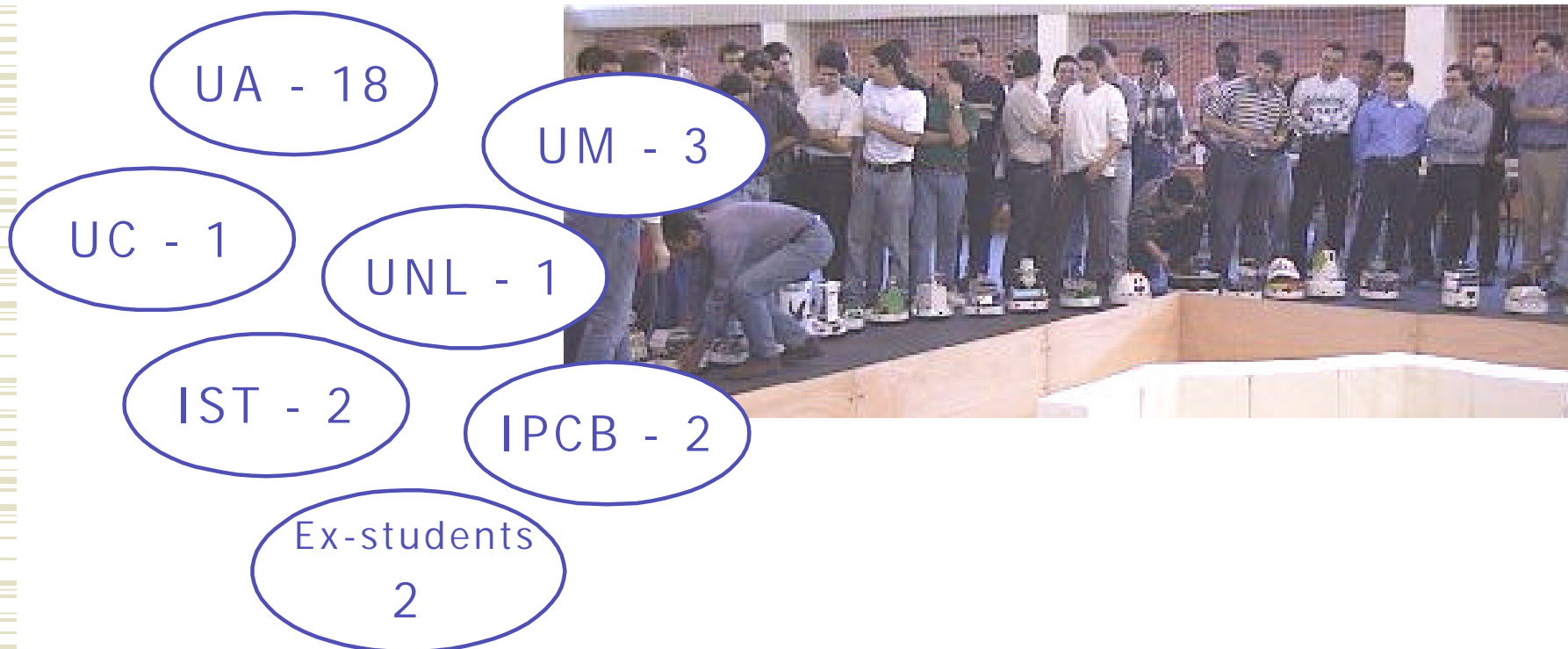 - ■ 14 Registered teams

UA - 10

UM - 2

Ex-students 2

Brief history (iv)

- ◆ 3rd edition – May, 1998
  - ■ 28 Registered teams

UA - 18

UM - 3

UC - 1

UNL - 1

IST - 2

IPCB - 2

Ex-students 2

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Brief history (v)

- 4th edition - May, 1999

    41 Registered teams

IPCB - 2

UA - 28

UM - 3

UC - 1

UNL - 2

High sch.
2

Ex-students
2

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Brief history (vi)

- ◆ 5th edition - May, 2000
  - ■ 48 registered teams

UA - 25

UM - 2

UEM - 1

N.L. - 2

IPCB - 3

UC - 4

UNL - 3

IPL - 1

FEUP - 2

ISEP - 1

High. Sch. 1

IPT - 1

IST - 1

ESTGA - 1

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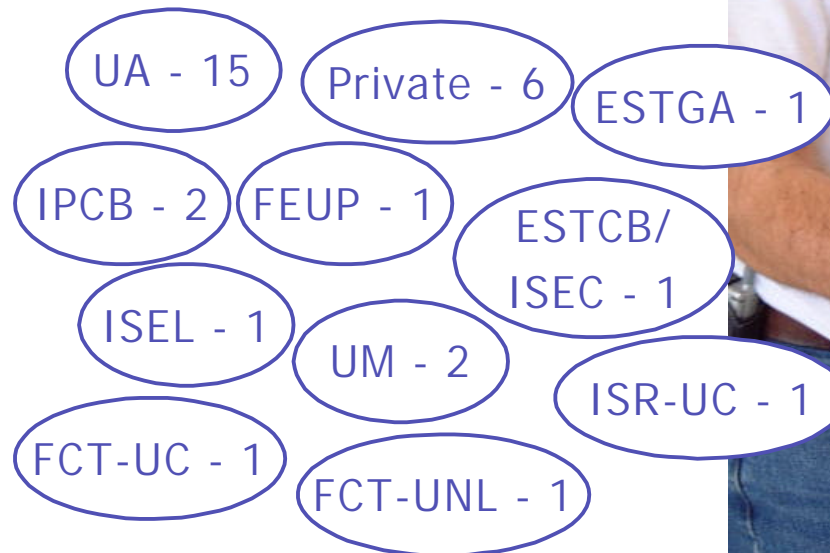
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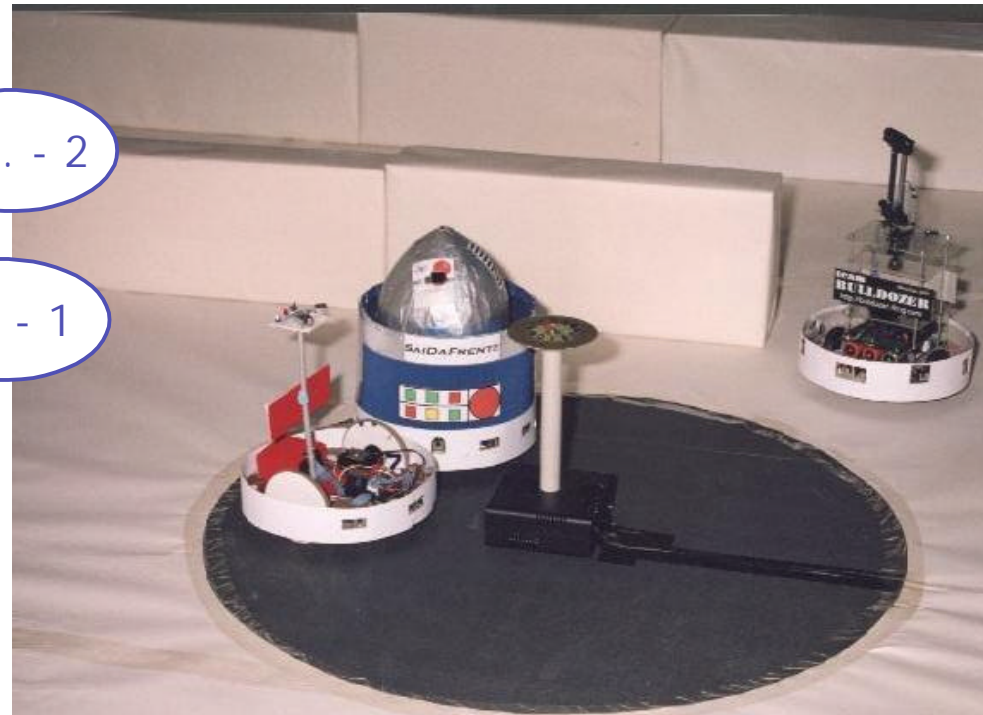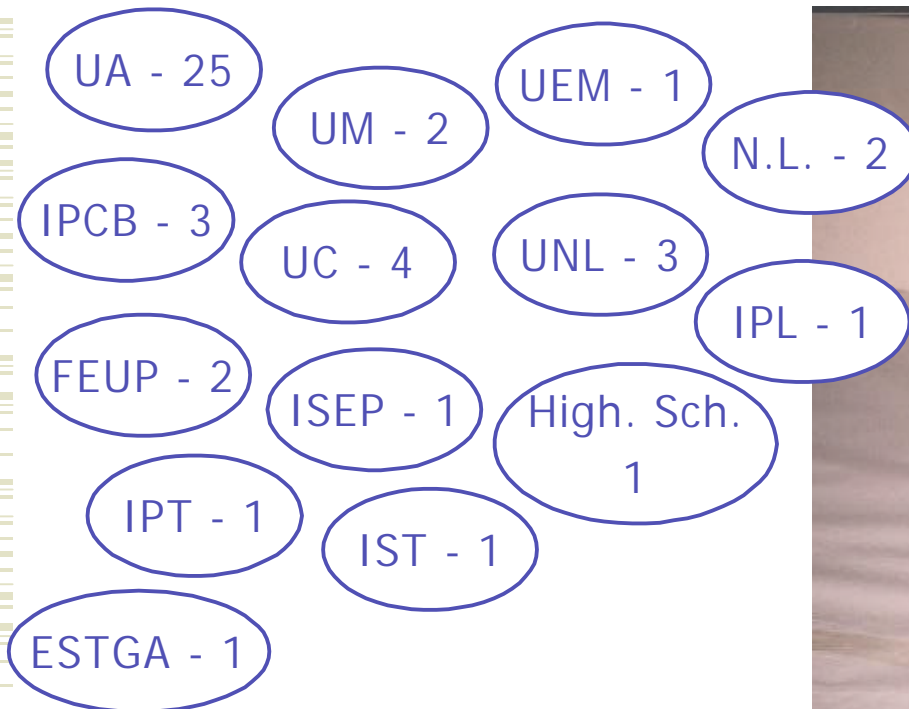
Brief history (vii)

- ◆ 6th edition - May, 2001
  - ■ Rules have changed (bigger maze, new goal)
  - ■ New competition (simulation): Ciber-Rato
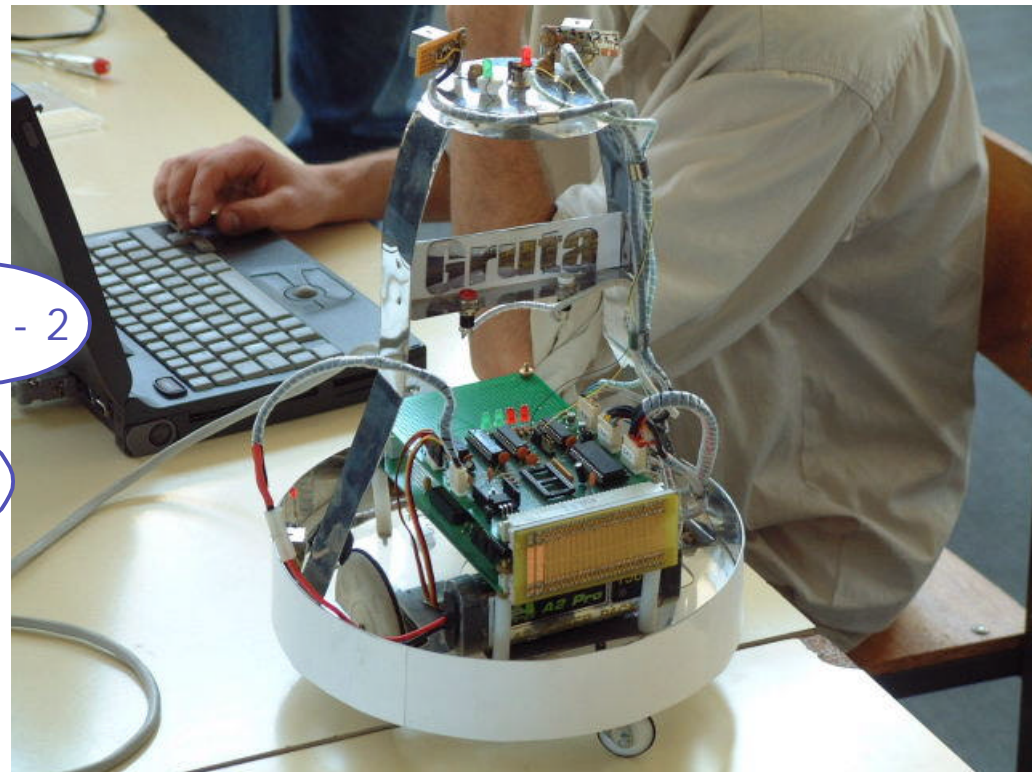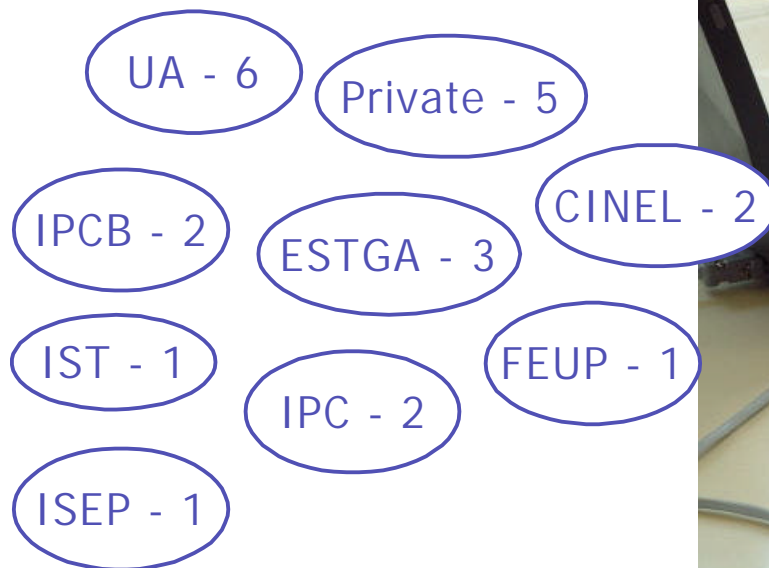 - ■ 32 registered teams (26 Micro-Rato + 6 Ciber-Rato)

UA - 12

Private - 3

ISEL - 1

IPCB - 2

ESTGA - 2

UM - 2

FEUP - 1

ISEP - 1

IST - 1

IPB - 1
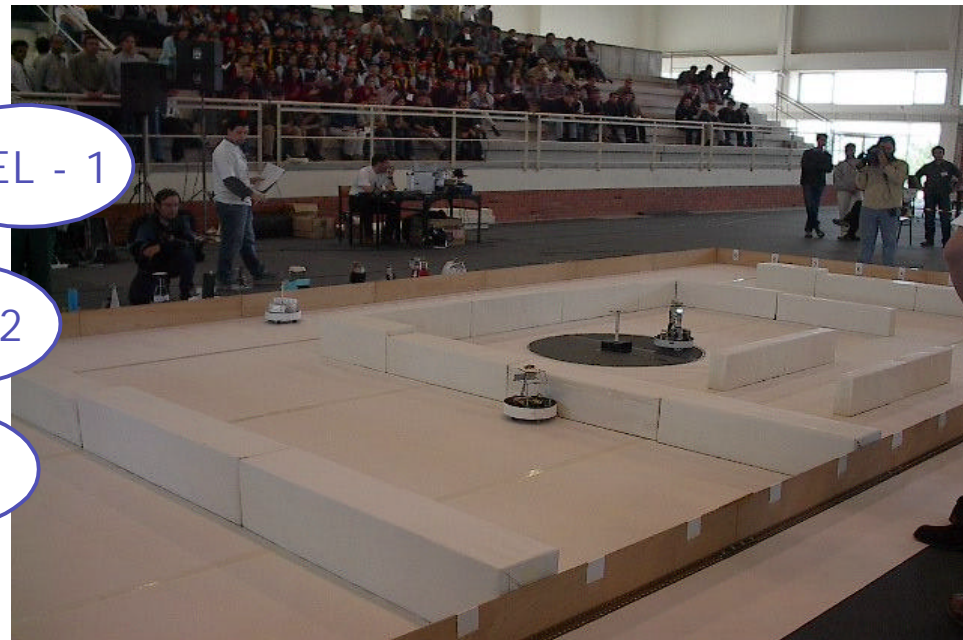
Brief history (viii)

- ◆ 7th edition - May, 2002
  - ■ 46 registered teams (32 Micro-Rato + 14 Ciber-Rato)

UA - 15

Private - 6

ESTGA - 1

IPCB - 2

FEUP - 1

ESTCB/ ISEC - 1

ISEL - 1

UM - 2

ISR-UC - 1

FCT-UC - 1

FCT-UNL - 1

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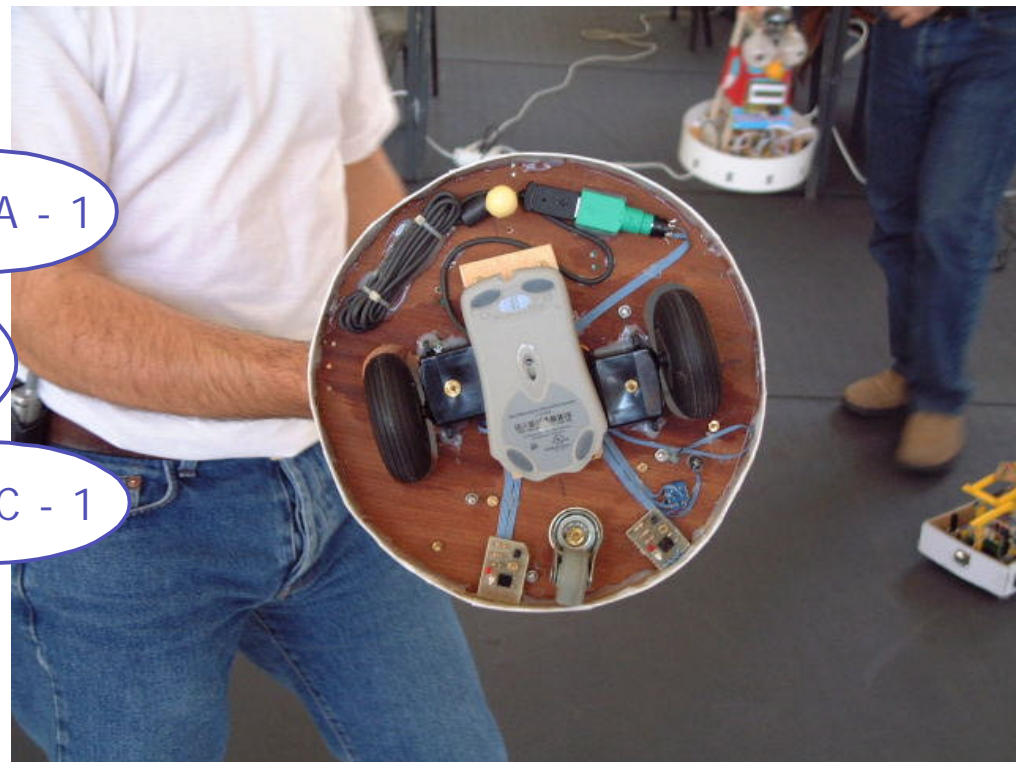
Brief history (ix)

- ◆ 8th edition - May, 2003

  - ■ 37 registered teams (23 Micro-Rato + 14 Ciber-Rato)

UA - 6

Private - 5

IPCB - 2

ESTGA - 3

CINEL - 2

IST - 1

IPC - 2

FEUP - 1

ISEP - 1

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Brief history (x)

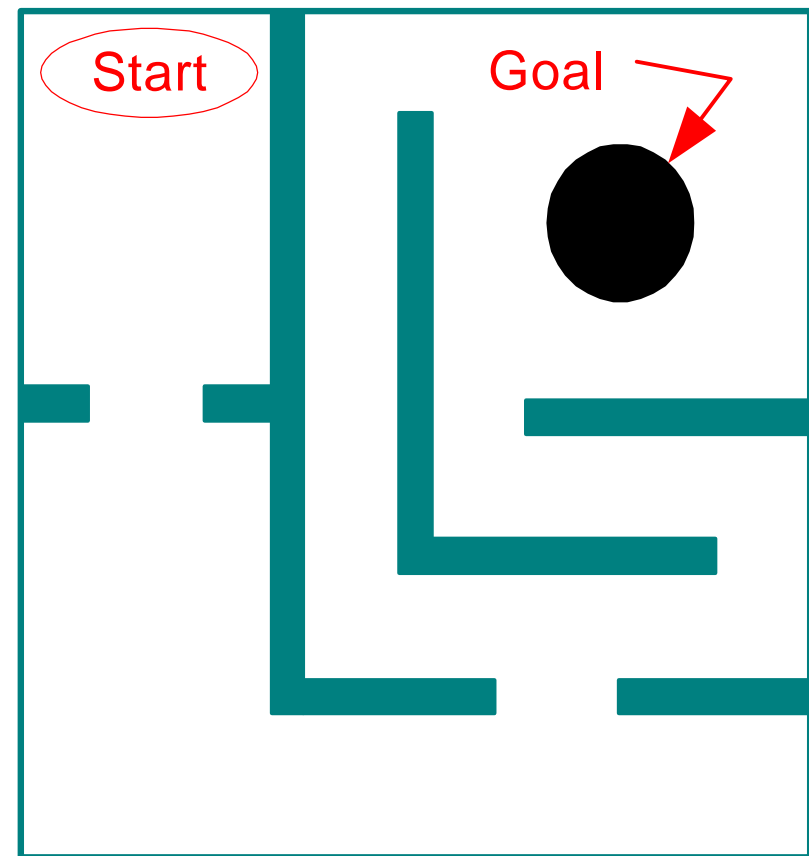- ◆ Evolution of the number of registered and participating teams
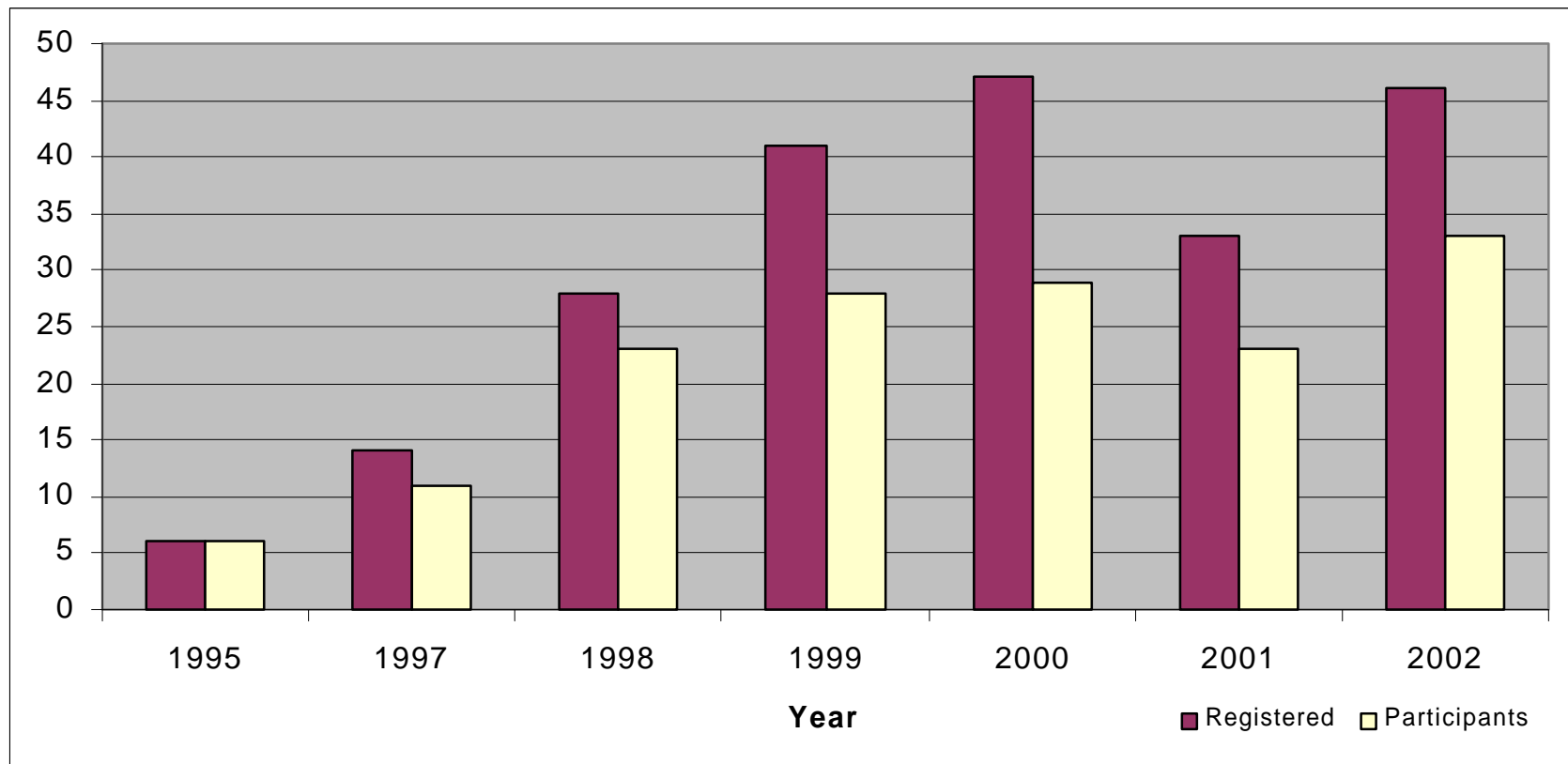
The contest rules

- Robots must compete in a closed area called the maze.

- There are two objectives:
    - To go from the starting point to the goal;
    - Return to the starting point.

- Other robots and obstacles should be avoided (penalties).

- Time to reach objectives is relevant.

- Robots compete in rounds of three.

Start

Goal

The contest rules (maze)

- ◆ The maze is 5x10m wide.

- ◆ The floor, walls and obstacles are covered with IR reflective material.

- ◆ The goal is a 1m wide circular area painted in black.

- ◆ In the centre of the goal stands a 30 cm high omnidirectional IR beacon.
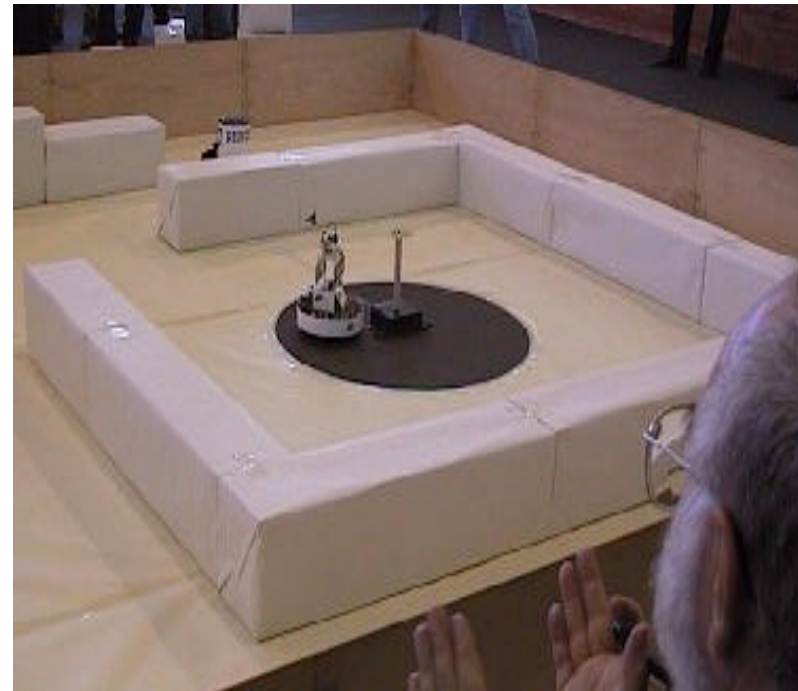
The contest rules (robots)

- ◆ Maxim. allowed size:
  - ■ 30x30x40 cm
  - ■ above 25cm high: max diameter of 15cm
- ◆ Buttons:
  - ■ Start
  - ■ Stop
- ◆ "Beacon area reached" and "Finish" lights.
- ◆ 5 cm height IR reflective band.
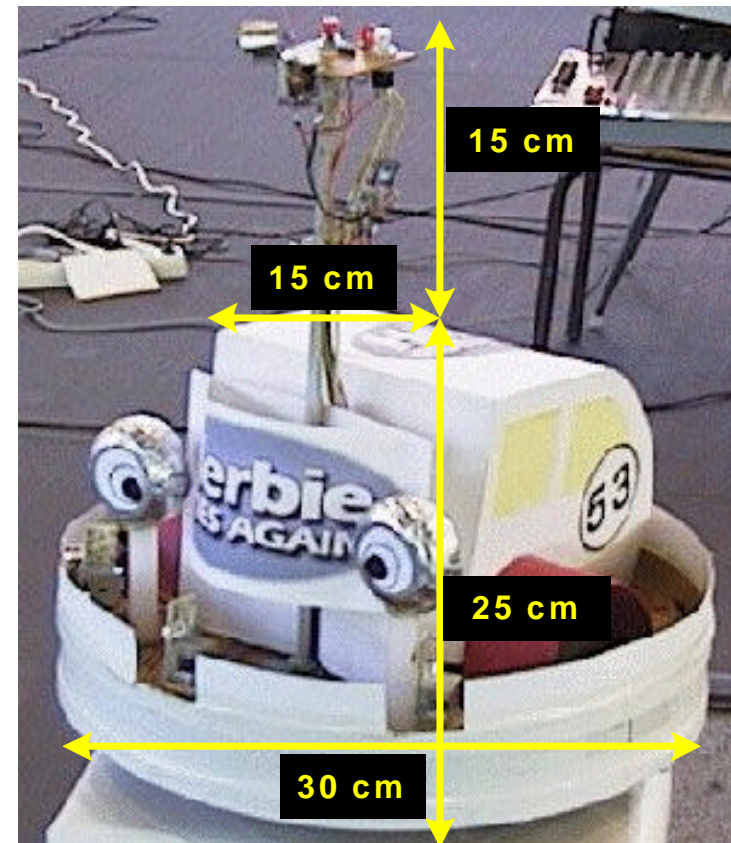
Typical solutions

- ◆ Hardware:
    - ■ 3 to 5 IR sensors to detect obstacles and follow walls
    - ■ 2 fixed or 1 rotating sensor to detect the beacon
    - ■ Controllers based on 80188, 8051, 68HC11, PIC, etc.
    - ■ Electronic compass + odometer

- ◆ Software:
    - ■ reactive behavior-based autonomous agents: beacon detection, collision avoidance, wall following, arrival detection and parking
    - ■ utilization of absolute spatial information based on the combination of an electronic compass and beacon readings
    - ■ utilization of relative spatial information based on odometers coupled to the wheels

Conclusions

- Significant support at the components and technical level encourage the participation of people with very different educational backgrounds.

- Very simple to rather complex solutions can be found at the contest.

- Students show greater ability to deal with embedded systems and control of physical devices after these experience.

- The country wide impact of the contest is turning it into a gathering space for mobile robotics devoted people.