

# IROS 2012 Competitions

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The 2012 IEEE/Robotics Society of Japan International Conference on Intelligent Robots and Systems (IROS 2012) was held in Vilamoura, Portugal, 7–12 October. For the first time in IROS history (IROS is now celebrating its 25th anniversary), the conference program included robot competitions. The selected challenge was the recently created RoboCup@Work, currently a demonstration league at RoboCup.

In RoboCup@Work, robot manipulators mounted on mobile platforms perform complex industrial tasks. The integration of autonomous manipulation and navigation, distributed sensing, and reasoning is a key goal in this competition. High-level performance on the manipulation

side, coordinated with navigation tasks, makes RoboCup@Work a challenging competition, requiring multidisciplinary teams.

From 7 to 11 October, three teams composed of 19 team members (professors and Ph.D. and M.Sc. students as well as postdoctoral researchers) applied their technical solutions to the current RoboCup@Work tasks. These

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IROS 2012 RoboCup@Work competition teams.



The b-it-bots team.



The Ephesus team.



IROS 2012 RoboCup@Work arena.

were carried out by mobile manipulator vehicles, whose dimensions were constrained by the rules, and took place in a  $2 \times 4$  m arena surrounded by walls encircling free space and service areas where the robots pick and place objects of industrial relevance (e.g., nuts, bolts, raw materials, finished parts). The tasks considered during IROS 2012 were

- *navigation*: ability to perform goal-oriented, autonomous, and robust

maneuvering, including the ability to self-localize, avoiding obstacles whose locations are unknown

- *manipulation*: ability to grasp, turn, and/or place an object in the service areas but whose precise location is unknown
- *transportation*: combining the other two tasks, namely picking up objects at one service area and taking them to another.

An additional open challenge was addressed by the teams, who showed other functionalities, such as the ability to pick and place an object on the ground while moving, object re-ordering using task-planning methods, and integrating sophisticated object and bin recognition methods with other tasks. The open challenge was evaluated by experts from academia, industry, and public bodies (Anne Bajart, project

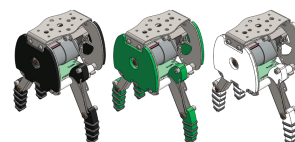


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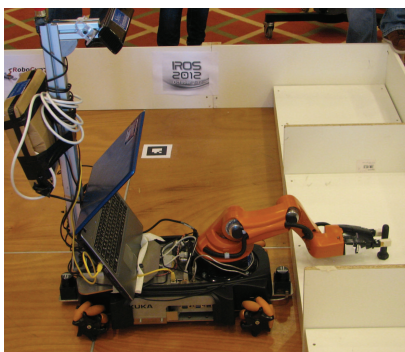
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IROS 2012 RoboCup@Work arena.



The Ephesus team in action.

officer of the European Commission DG Connect-Robotics; Thilo Grundmann, Robert Bosch GmbH; Stefano Stramigioli, University of Twente and IEEE Robotics and Automation Society Vice President of Member Activities; José Santos-Victor, Institute for Systems and Robotics of Instituto Superior

Técnico, TU Lisbon; and Rui Cortesão, Institute for Systems and Robotics of the University of Coimbra) using as set criteria the industrial relevance, difficulty, novelty and scientific contribution, and professionalism of robot system development.

The RoboCup@Work Technical Committee handles the rules, scoring, and competition execution (see rules at <http://www.robocupatwork.org/rules.html>). This year, it was composed of the following people:

- Walter Nowak, Locomotec, Germany
- Gerhard Kraetzschmar, Bonn-Rhein-Sieg University, Germany
- Nico Hochgeschwender, Bonn-Rhein-Sieg University, Germany
- Rainer Bischoff, KUKA Laboratories, Germany.

In this first edition, three teams competed:

- LUHbots, Leibniz University Hannover, Germany
- Ephesus, Sabanci University, Turkey
- b-it-bots, Bonn-Rhein-Sieg University of Applied Sciences, Germany.

These teams were selected by an International Program Committee composed of the following experts:

- Rainer Bischoff, KUKA Laboratories, Germany

- Gerhard Kraetzschmar, Bonn-Rhein-Sieg University, Germany
- Erwin Prassler, Bonn-Rhein-Sieg University, Germany
- Bill Smart, Oregon State University, United States.

All teams used KUKA youBots, although the competition is open to other mobile manipulation robots. Nevertheless, each team added its own novel contribution, such as the use of Microsoft Kinect to recognize and locate objects (b-it-bots and Ephesus), red-green-blue cameras attached to the manipulator end-effector for visual-servoing of the robot when picking up objects (b-it-bots, LUHbots), and a self-designed gripper (LUHbots). The winner of the 2012 competition was LUHbots.

Overall, the IROS 2012 competitions were a great success, attracting many visitors among conference participants and showing successful performances in multiple industrial scenarios. The involvement of the compliant motion control community (traditionally away from robot competitions) should be encouraged in upcoming editions to help on robust manipulation. Other research areas orthogonal to robotics (such as philosophy and psychology) can have a key role in the development of new learning paradigms, which are currently too focused on sensor-based data.

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The LUHbots team.