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Domestic Service Robots

By Anibal T. de Almeida (adealmeida@isr.uc.pt) and Joao Fong

Recent worldwide trends of the world show that it is very important to develop new systems for saving energy and creating alternative/new energy sources for many sectors of the technical systems, in particular, in the field of robotics and automation. Service robots that are being produced in bulk deserve special attention. The Technical Committee (TC) on Energy, Environment, and Safety Issues of the IEEE Robotics and Automation Society (RAS) should encourage green robotics and automation for the future technology. Today, this field attracts many industries, governments, and academia in the world so that RAS should take the leadership and give service to the members of the Society to have many opportunities.

The TC organized a workshop at the 2011 IEEE International Conference on Robotics and Automation (ICRA) that attracted 22 papers showing a strong interest in the field. Another workshop, organized by the Institute for Systems and Robotics (ISR), University of Coimbra, Portugal, is planned at the 2011 IEEE International Conference on Intelligent Robots and Systems (IROS). The TC is also considering the joint organization of activities related to intervention in situations such as the Fukushima power plant. Anibal T. de Almeida plans to attend IROS 2011, and this may be a good occasion for planning possible events.

According to the International Federation of Robotics (IFR), a service robot is a robot that operates semi- or fully autonomously to perform services

useful to the well being of humans and equipment, excluding manufacturing operations [1]. IFR further divides service robots into two subcategories: robots for professional use and robots for personal and domestic use.

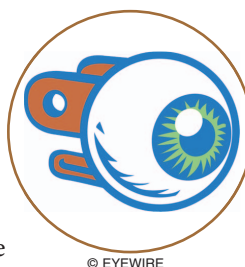
Domestic robots include vacuum cleaning and lawn-mowing robots, but a variety of other product ideas are being developed, including food and beverage waiters, robots for handicapped or elderly assistance, and even automated butlers.

The market for these products has been steadily rising and is expected to grow even further in the next few years, driven by the decreasing cost of components such as processors, motor drives, and sensors. Another important driver is the increasing energy density and lower cost of batteries, allowing a longer autonomy.

The stock of robots for domestic use is estimated at around 5.6 million units. In 2009, about 1 million vacuum cleaning robots and more than 26,000 lawn-mowing robots were sold [2]. It is projected that the sales of all types of domestic robots (vacuum cleaning, lawn-mowing, window cleaning, and other types) in the period 2010–2013 could reach 6.7 million units [3]. The environmental and energy impact of these products, therefore, becomes very relevant.

The European Commission's Ecodesign Directive—A Life Cycle Approach

In 2005, the European Commission issued the ecodesign directive with the aim of reducing the environmental impact of energy-using products



during their life cycle. Since then, a number of preparatory studies for the introduction of implementing measures have been undertaken, or are undergoing, covering a wide variety of products. All energy-using products that are sold in quantities above 200,000 units per year are eligible under this directive. The commission established, in 2005, a well-defined approach to the development of implementing measures—the Methodology for the Ecodesign of Energy Using Products (MEEuP) [4].

This sets out a common method to gather information to evaluate whether and to which extent a product fulfills certain criteria that make it eligible for implementing measures under the directive, namely its environmental impact and potential for improvement. The method involves the use of a simplified reporting tool that helps translate information gathered during the first stages of the process into environmental impacts (Figure 1).

One of the product groups covered by these preparatory studies was vacuum cleaners (Lot 17) [5], and regulatory measures (ecodesign and labeling) are expected to be implemented in the near future. Although robot vacuum cleaners were investigated, they are not yet regulated at this stage due to the lack of compatible measurement standards. The current performance standard in the European Union is EN 60312 [6], which is harmonized with the equivalent International Electrotechnical Commission (IEC) standards, but it is not applicable to robots. The International Organization for Standardization (ISO) has a

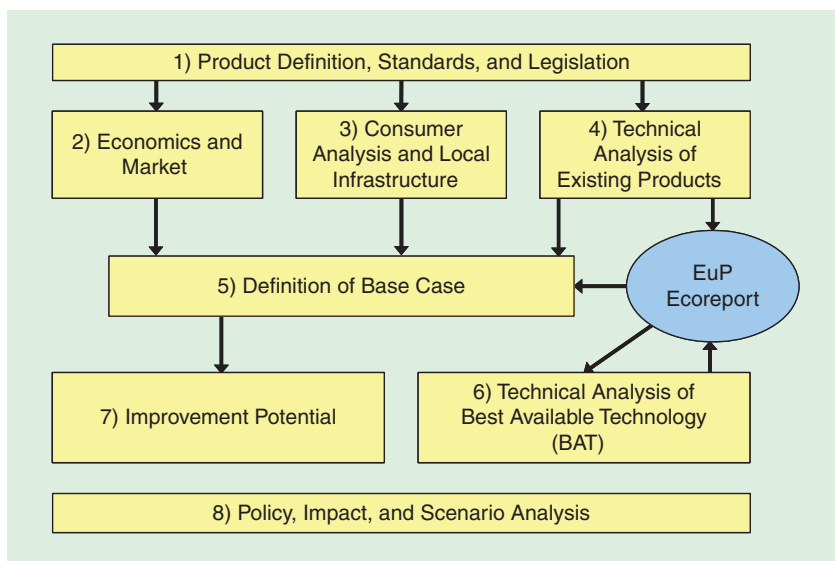


Figure 1. Outline of MEEuP.



Figure 2. (a) and (b) The iRobot Roomba (<http://www.irobot.com/>).

TC, ISO/TC 184/SC, that is developing standards for robots and, specifically, working group 8 (WG 8) is investigating on the standardization needs for service robots.

Environmental Impact of Service Robots

The environmental benefits or drawbacks of using robots instead of human power to perform everyday tasks are not clear. As mentioned above, the lack

of standards makes it difficult to compare both situations on a level ground. Furthermore, factors such as the possibility of freeing people's time so that they can focus on less mundane and more meaningful work are not easily accountable.

Currently, service robots in general draw power from batteries carried on the robot, which have a limited charge capacity and constrain the operational time of the robot. This problem

presents itself as a challenge for manufacturers to design products that are more energy efficient to extend battery time. For example, as conventional vacuum cleaner manufacturers increased the motor power to improve their cleaning ability, robot vacuum cleaner manufacturers could not do so as they would have to increase battery size by losing competitiveness.

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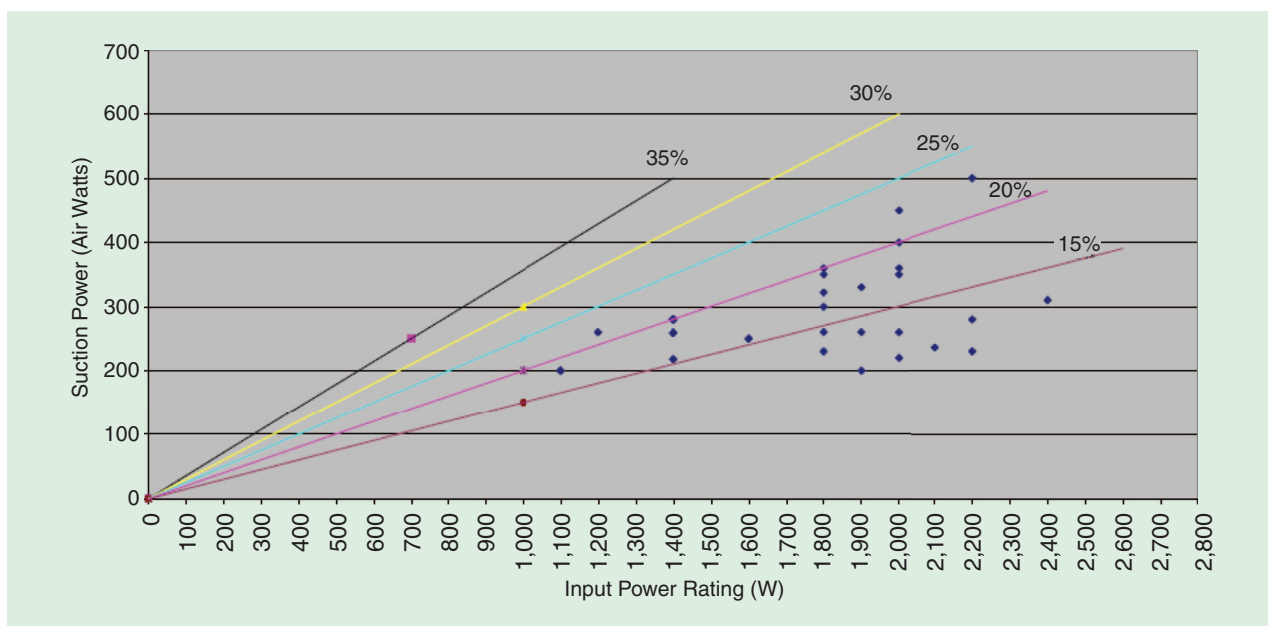


Figure 3. Suction power versus motor power showing wide differences in performance [5].

Future RAS Support for Summer Schools

By John Hollerbach, Andreas Birk, and Stefano Stramigioli

Summer schools are a great and important instrument for education and outreach. By having a number of experts from a selected area and a dedicated crowd of attendees, these schools have the ability to convey complex material in a very efficient and compact manner, while at the same time offer many opportunities for social interaction and networking. Robotics summer schools are being offered by a number of organizations annually, and the IEEE Robotics and Automation Society (RAS) has been cosponsoring an annual summer school with the International Foundation of Robotics

Research. In view of the importance that RAS wishes to place on summer schools, RAS will now quadruple the annual budget for summer schools, open up cosponsorship opportunities to other organizations, and sponsor or cosponsor three summer schools per year around the world.

The new summer school program, the RAS Technical Education Program, will be jointly run by the Member Activities Board (MAB) and the Technical Activities Board (TAB). One of the three summer schools will be fully sponsored by RAS to a level of US\$40,000 and will rotate annually through the three geographical regions of RAS in a round-robin fashion. The other two summer schools will be cosponsored with interested

organizations in the other two geographical regions up to a level of US\$20,000 each. The MAB and TAB are developing guidelines for the schools' format, structure, organization, and selection procedure.

We invite applications to run the fully sponsored RAS summer school, especially from the technical committees, as a way to promote their research areas. For the cosponsored summer schools, we invite potential partnering organizations to contact either the vice president for Member Activities or Technical Activities with a proposal. To allow sufficient time for planning, it is expected that a proposal for a summer school will be made at least a year ahead of time.



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Therefore, they based their design on other strategies, such as

- optimization of suction power-motor power ratio and super-efficient motors [7]
- better coverage of the area to be cleaned using improved navigation algorithms instead of random movement
- better handling of obstacles
- improved nozzle design
- use of dirt-collecting aids such as rotating brushes or similar devices.

All these features not only help improve the cleaning performance but also help reduce the amount of energy and time required to perform a given task (Figures 2 and 3). Further developments may include the ability to sense the amount of dirt present and alter their energy consumption accordingly and, the automatic adjustment of power consumption to the type of floor

surface being cleaned. With the development of smart homes, it will be possible to schedule a complete cleaning pattern over a longer period of time, so that the vacuum cleaner will remember the room layouts.

Other features include the ability to find their own way back to a base charger when their charge runs low and empty themselves, thus reducing harmful dust and allergen emissions.

Conclusions

Domestic service robots are a fast-growing market, particularly in applications traditionally carried out by conventional human-driven appliances such as vacuum cleaners and lawn mowers. The ecodesign approach leads to a reduction in energy consumption along with the environmental impact over their life cycle, as well as other benefits such as longer autonomy.

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