Where Third Wave HCI Meets HRI: report from a workshop on user-centred design of robots

Ylva Fernaeus, Sara Ljungblad, Mattias Jacobsson
Swedish Institute of Computer Science
Box 1263, SE-164 29 Kista, Sweden
{ylva, saral, majac}@sics.se

Alex Taylor
Microsoft Research
J J Thomson Avenue, Cambridge, CB3 0FB, UK
ast@microsoft.com

ABSTRACT
In this report we discuss some of the challenges when applying a user-centred design approach in the field of human-robot interaction (HRI). The discussion is based on a one-day workshop at the NordiCHI'08 conference, investigating how methods, techniques and perspectives from the field of Human Computer Interaction (HCI) could contribute to and learn from recent developments in the area of HRI. Emphasis was put on topics that are infrequent in mainstream HCI such as machine movement, autonomy, anthropomorphism, physical interaction, environmental issues and issues concerned more generally with cultural notions of robots.

Categories and Subject Descriptors
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Design, Human Factors

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1. INTRODUCTION
The interactions with robotic technology raise a number of parallels with some of the themes that have become increasingly discussed in HCI in recent years, including aspects of aesthetics, affective interaction, embodied action, mobility, and situated aspects of human activity. In HCI, this collection of themes is sometimes referred to as "third wave HCI" [2, 5] and is also related to practices such as participatory design [3], the increased acknowledgement of systems development as a design-oriented field of study [4, 7], and the view of interactive systems as part in a larger activity framework [1, 6].

Not only do HCI and HRI appear to share some of these themes. A number of the tensions raised in third wave HCI appear particularly apt when reflecting on current HRI research. For instance, both areas appear to struggle with the following:

- Systems that aim to mimic human-human communication, with a primary focus on humanoid and zoomorphic technology, versus systems designed as tools for human activity;
- User studies concerned with psychological factors, language processing, reasoning and affect, versus the increased acknowledgement of theories of embodiment;
- Technology explorations focused on de-contextualised subsystems (e.g., bi-manual interaction, trained motor action, navigation in space, etc.), versus fully working systems studied in "the wild";
- Research primarily targeting application domains where efficiency and productivity are paramount rather than examining a broader range of reasons for participation.

Given this backdrop, we arranged a workshop to discuss how to relate current theories and practices in HCI with recent developments in robotics and human-robot interaction. Twelve researchers participated in the workshop, all with different backgrounds related to the areas of HCI, HRI, and industrial design.

2. SUMMARY OF TOPICS DISCUSSED
The workshop touched upon a broad range of themes, including the roles of embodiment, sustainable interaction, and contextual and cultural factors. Here we summarise some of the topics discussed, and how they were introduced in the position papers from the participating researchers. All the position papers are available for download at *http://www.sics.se/~majac/workshop/position/*.

2.1 The Future in Design Explorations
One challenge that was discussed was how to relate as a researcher to notions of robots in popular fiction, and the sometimes unrealistic ideas users often have of what robots can do. As an example, Anders Green explained how Wizard of Oz techniques, common in HCI, make it possible to try out different scripted scenarios for interaction with users without having technically functioning robots. Technical functionality is then simulated, for example by a person mimicking the robots voice or by remotely controlling its movement. However, a challenge is to know what would be realistic to achieve in a final implementation, in order to not investigate interaction scenarios that are only conducted because they appear interesting from a research perspective.

As a contrast to this, Anab Jain and Mie Nørgaard pointed out how robot research may adopt strategies to speculate on futuristic designs without having to build the actual technology. For example we might speculate on provocative scenarios that we may not want in reality. Separating such futuristic perspectives from robotic products actually intended for a near future is a critical distinction in this case.

The workshop also discussed how these issues could be addressed with the user centred approaches central to HCI. Discussions revolved around state of the art robotics and how such work might be understood in terms of people's established social practices. *In situ* field studies were seen as relevant here, but importance was again given to the possibilities of design speculation and provocation to reflect on imagined future robot technology.

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2.2 Form in Robot Design

Robots of varying shapes, sizes and forms are slowly gaining popularity in different arenas. Examples of recent consumer products range from autonomous vacuum cleaners to sophisticated zoomorphic interactive toys. Robots often of quite a different scale are found in industry and health care. Research, too, is contributing to growth in these areas, giving focus to industrial robots, service robots and interactive sculptural artworks, to list but a few broad areas.

In the workshop, several examples of robots were presented that were, perhaps unsurprisingly, quite different to the robots regularly seen in futuristic sci-fi visions. That is to say, they were not the fictional humanoid machines usually touted but rather relatively simple and primitive appliances, tools and toys. Moreover, they were shown to afford interactions that were radically different to ones familiar in interactive systems.

For instance, Jin Moen's *BodyBug* concept is designed as a personal object to play with in a kind of performance dance-game. An orb shaped BodyBug moves along a rope held by a user, responding to the user's bodily movements. Another example was the TRIK robot scenario, presented by Staffan Larsson, in which drawing robots develop a dialogue with children with communication disabilities. Rather than an agent with linguistic capabilities, the robot would be an enabler allowing children to experiment with new forms of communication. Also, with a focus on the situated nature of interaction, Alex Taylor and Laurel Swan reflected more broadly on how "intelligence" is enacted through the use of technology, and how new forms of machines, and thus interaction, might give rise to very different ideas of machine intelligence.

A challenge that was discussed with respect to this was how to reach any kind of consensus in developing general design guidelines for robotic products—given that they can differ so much in physical form, purpose and modalities of interaction. In moving away from the caricatured image, the idea of a robot appears in some ways to have become too disparate to be treated as one category. To partially address this, the workshop saw value in promoting continued experimentation with form, but at the same time attempting to find some patterns to the situated use of robots.

2.3 Beyond Use-centred Design

Bringing usability issues and the experiences of specific user-groups to the fore of the design process was an issue brought up in the workshop papers. For instance, the design of a robot swarm to assist fire-fighters and the use of robots to support oil rig workers were discussed along with their respective practices.

Such use-centred approaches in which one studies potential users *in situ* to inform design, have become commonplace in HCI. A thought-provoking question that was brought up in the workshop, however, was whether bottom-up user-centred design is really possible in the field of HRI. The problems of applying user-centred approaches appear to hinge on two issues. First, robots are particularly difficult to prototype and deploy *in situ* because of the complexity of resources needed to build them and the cost/sophistication of materials. Thus it is very difficult to get any informed sense of what human-robot interaction might be like in practice. Second, it seems users, when asked, struggle to imagine what robots might do. They quickly resort to stereotypical sci-fi imagery.

On a related note, it was asked whether robots were always the best solutions in the investigated settings. In some cases, it appears less sophisticated solutions may in fact be better in meeting the needs of users. Researchers seem inclined to search for solutions within their fields of expertise and can be coloured by their own technical skills and research interests (also sometimes biased by funding sources). There is then a risk that research results in unwanted products or even unrealistic use scenarios.

Strategies for re-thinking and questioning common ideas in robotics were considered in response to these problems. For example, Clint Heyer discussed how the usually sterile and dangerously powerful robots used in industry could afford interactions that were engaging and emotionally evocative. In short, use-centred but provocative exercises were seen as a means to stretch the imagination but still retain a connection to real-world practices.

3. CONCLUSIONS AND FUTURE WORK

In sum, the discussions at the workshop suggest that methods developed within HCI may not always be readily applicable in the design and evaluation of interactive robots. The varying physical forms, as well as the cultural notions of what a robot is, makes this an area that is essentially different from the design of software running on more conventional hardware platforms. There do though appear to be some useful strategies that might be adopted from 3rd wave HCI. For example, the speculative and sometimes provocative design strategies used in HCI to examine future scenarios, could enable serious questions to be asked about the new unconventional robotic systems that are growing in popularity. Alongside *in situ* field research, these strategies might also enable us to consider possibilities outside of our own immediate research interests. How to more concretely address these and related research challenges opens up for many interesting future explorations in the HRI field.

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