Beyond Gray Droids: Domestic Robot Design for the 21st Century

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ABSTRACT

Robots are entering domestic environments in startling numbers. However, many of these robots still look and behave like they belong in a factory. In order to appropriately design robots for domestic environments, a number of design challenges must be surmounted. We propose a workshop to help to begin to address some of these challenges by giving researchers a forum to present current work in the field and to engage in a design activity to foster new ideas and novel discussion.

Categories and Subject Descriptors

I.2.9 [**Artificial Intelligence: Robotics**]; H.1.2 [**Information Systems: User Machine Systems**]

General Terms

Design, Human Factors

Keywords

Design, Human-Robot Interaction, Inclusive Design, Interactive Robots

1. INTRODUCTION

Each year, robots are entering domestic environments in increasing number. In fact, in 2007, 3.4 million personal service robots were in use worldwide in domestic settings, and this number is expected to increase to 4.6 million robots by 2012 [4]. These robots are intended to help with household chores, act as home health aids, and serve as companions and entertainers for people. However, because the field of domestic robotics is birthed from industrial robotics, many of these robots in the home still look and behave like they belong in a factory. Their interactive styles are often not well-suited toward the wide variety of home users that exist.

Domestic robots present unique design challenges that are very different from those of industrial robots. The first chal-

Figure 1: Robots intended to operate in domestic environments present unique design challenges. *Photo by Eirik Newth*

lenge is a lack of predictability - neither users' behavior nor the physical environment can be known before a robot is placed in a home. Thus, for mobile robots, safety can be a major concern, particularly for elderly or disabled users. For example, a robot vacuum cleaner that does not audibly announce its presence could cause an elderly user with vision loss to trip and fall.

Another challenge is with regard to presenting appropriate, dynamic interaction modalities that are inclusive of all users. For example, physically disabled children may not enjoy a robotic pet that moves too quickly, whereas able-bodied children may be bored by one that does not. The design of interaction modalities should also consider a robot's ability to perceive and interpret a user's behavior (e.g., affective and affect-related expressions, intentions, etc.) [1]. In this respect, personalization is a key aspect, because individual differences in emotional expression are quite varied [6].

A third design challenge is with regard to robot appearance. Vast cultural differences exist in how people think robots ought to look and behave, and certain types of appearance may be outside the realm of their comfort. For example, humanoid robots with large heads and no noses may be perfectly acceptable in Japan but may be very off-putting to Westerners. Also, individual personality differences can greatly affect how people perceive robot appearance. Introverts and emotionally unstable people prefer mechanical-

looking robots over humanoid ones [7], whereas people empathize significantly more with humanoid robots more than mechanical ones in a way that transcends individual differences in empathetic ability [5].

Finally, many researchers in the field of human-computer interaction (HCI) has in the last decade started to focus on issues beyond usability. As computers have moved out of the office and into everyday life, it has become increasingly important to integrate values such as experience and emotion. However, moving beyond the workplace and into homes and everyday situtations has required the development of new approaches and new measurements for evaluating and understanding systems in context. This so-called "Third Wave of HCI" could have much to offer to human-robot interaction (HRI), especially in domestic settings [2].

In order to start address these design challenges, it may be helpful to engage in several steps:

- Appropriately identifying likely domestic user groups
- Understanding design constraints of these groups
- Brainstorming dynamic interaction modalities for domestic robots
- Articulating ways to incorporate cultural and personality differences into robot appearance and behavior
- Creating new ways to evaluate HRI in domestic contexts

2. GOAL
The goal of this workshop is to provide a forum for researchers interested in improving the design of domestic robots. By gathering in a friendly environment, the hope is that researchers can openly share their ideas and vision for the future of the field.

3. ORGANIZATION
Prior to the workshop, we will invite people interested in attending to submit either position papers, works-in-progress, or completed research on any of the aforementioned topics. We will advertise the call-for-papers on numerous HRI, HCI, Affective Computing, and Design email lists in order to attract a broad set of participants.

The workshop organization is described below.

3.1 Icebreaker
We'll begin the day with a short ice breaker event in order to have participants get to know one another.

3.2 Presentations
Following the icebreaker, we will have a subset of participants present short spotlight presentations of their work. We will select participants whose work we think will be the most interesting and relevant to the group. Each talk will be about 15 minutes each, and talks will go until lunch time.

3.3 Design Activity
Following lunch, workshop participants will participate in a design activity. For this activity we will use a brainstorming method called Bootlegging [3]. This method is based on the idea of random connections between a familiar component, as used for instance in artistic collage and literary cut-ups. This kind of technique has been shown to stimulate creativity and break down preconceptions in brainstorming situations in a variety of different domains.

The Bootlegging session is run as follows. First, all participants will brainstorm keywords in a number of different categories. For this workshop the categories might include proposed user, robot technology, user task, and usage setting. Then, by randomly combining one keyword from each category the participants create a number of potential "applications". The participants are split up in groups to brainstorm a story and possible implementation for each of the applications. Finally, the groups re-convene to present one or two of their best results.

3.4 Poster Creation
These results will be amalgamated into a poster that will be shared at the main BCS HCI 2009 conference.

4. DESIRED OUTCOMES
It is our hope that this workshop will provide participants with novel ways to think about the challenges faced when designing domestic robots. Also, we will hopefully make progress toward generating practical guidelines to help designers.

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