Universal Robots as 'Solutions' to Wicked Problems: Debunking a Robotic Myth

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ABSTRACT
This work in progress discusses a persistent myth about robots, namely that 'future robots will be universal solutions', or in other words that robots should tackle many complex tasks and situations. In our approach we consider whether this is a case of posing robots as solutions to wicked problems or if robots can be considered wicked design problems in themselves. At the same time we make an argument for adopting a research through design approach. Our stance suggests that by viewing robots as composed of design materials we can sensitively address and in the long run perhaps even avoid wicked problems related to robotics.

Categories and Subject Descriptors
H.5.M [**Info. interfaces and presentation**]: Misc.

General Terms
Design, Human Factors

1. INTRODUCTION
Within the field of HCI the approach of research through design has been practiced for some time now [1][2]. One of the factors that contributed to this shift in framing was the recognition of the issue of designing for so called wicked problems [3][4]. Such problems are often characterized by being very complex, are dependent on a variety of changing parameters, e.g. societal changes, and different stakeholders with potentially conflicting values and needs. Examples include such as urban crime or disease epidemics. Zimmerman et.al [4] argue that one of the main points in Rittel & Webbers classical analysis is that an engineering approach is far from enough when trying to address problems; no clear, one solution will solve these problems, and many 'solutions' that will have positive effects from the perspective of a subset of stakeholders are likely to have (unexpected or negative) side-effects for other stakeholders. The opposite of a wicked problem is defined as a tame problem, and could still be just as complex, but in contrast relatively easy to define and find a solution to. Within the field of HRI we sometimes come across statements regarding robotic 'solutions' for problems associated with for example low birth rates, healthcare for aging populations or time limitations of hard working families. Looking at how robotic research often is portrayed (and mystified) in research agendas as well as popular media we realize that many of the questions posed to be solved are indeed – wicked problems.

Within the research through design paradigm we have found participatory design and experience centered approaches valuable in identifying issues that contribute to and uphold wicked problems in the robotic artifact domain. From another perspective, a research through design approach would also validate robotic artifacts as a knowledge currency that can be assessed and reflected upon as a representative population of ideas and design cases. We thus have an unique position in that we as interdisciplinary researchers can actively take a stance and clearly motivate that our research is about exploring a most complex technological and social space available, and so without resorting to ideals and references from science fiction [6]. In our own research we have explored this theme through a number of workshops, the first one in 2005 entitled "Designing Robot Applications for Everyday Environments" and the last one in 2010 "Designing Robotic Artifacts With User- and Experience-Centered Perspectives" (see e.g. [7] and [8]).

The goal with this poster is on one hand to clarify the relationship between robots as complex design problems and robots as (mythical) solutions to wicked problems. Furthermore, we suggest that by viewing robotic artifacts as compositions of so called robotic materials, we will be able to distance ourselves from framing robots as solutions to wicked problems. Such materials would reside in both the physical and digital realm [9], and at the same time articulate aspects attuned to robotic artifacts.

2. UNIVERSAL ROBOTS
Looking at some given definitions of a wicked problem [3] we learn that different stakeholders have different definitions of such problems, that there are many parameters or interdependencies, that there may be unforeseen consequences when attempting to address wicked problems, often there is a lack of clear solutions, the problem can be of a constantly changing nature, it is socially complex, usually involves that people need to change behavior and finally - are prone to chronic policy failures. Still, such problems are often posed as the motivation for robot projects. Now let us compare it with how the term universal has been introduced and used in the context of robots.

The notion of robot was introduced in western popular culture with the play Rossum's Universal Robots by Čapek in 1921. We note that universal in this case stands in close relation to the slave connotation that has put a sort of cultural flavor to how we in the western culture have learned to adopt the word robot (Robota being the Czech word for compulsory labor). A more modern version of the concept of a universal robot can be described

HRI'11, March 6–9, 2011, Lausanne, Switzerland.
ACM 978-1-4503-0561-7/11/03.

similarly to how as for example Moravec frames the concept in his 1991 book [5]:

"To be useful in many tasks, the first generation of universal robots should navigate efficiently over flat ground and reliably and safely over rough terrain and stairs, be able to manipulate most objects, and to find them in the nearby world."

Perhaps more interesting is the defining vision in the far end of Moravec's prediction where we would finally arrive at what would be the ultimate universal robot:

"The fourth robot generation and its successors, with human perceptual and motor abilities and superior reasoning powers, could replace human beings in every essential task. In principle, our society could continue to operate increasingly well without us, with machines running the companies and doing the research as well as performing the productive work."

Visions of robots as 'having to be' universal and able to serve a multitude of tasks, and able to address a multitude of wicked problems, appear to still live on and are nurtured both within research as well as popular media. The pinpoint appears to be the following: an escalation of attributing human qualities to robots that even goes beyond human capabilities and thus would result in the belief that universality will solve our own unsolvable wicked problems. As a bit of a paradox, we are at the same time observing developments that show a very opposite trend - that robots with a rather particular purpose are the innovations that are actually breaking ground. Illustrative examples in this case would be the new breed of remote controlled robotic teleconferencing systems (e.g. The Giraffe) and commonly referenced robotic vacuum cleaners (e.g. Roomba).

3. ROBOT DESIGN & WICKED PROBLEMS

Let us then briefly consider aspects of robotic design and how these are commonly approached within the field. Here we find several concepts regarding e.g. level of autonomy, the uncanny valley and the media equation. The common theme of these concepts is the central role that we humans as a measure of success are used in their evaluation. Now, reflecting on humans as sufferers and producers (and an integral part) of wicked problems we can get to the core of this issue. A robot as a wicked design problem is thus really the following: how can we design robots that actually solve human problems and address needs – without resorting to trying to design for 'anything and everyone'? It would be safe to say that this is really still a core question for the HRI community and one that is up for a wider debate.

Here we would like to open the prospect of adopting a research through design agenda. An important aspect for us is that it helps us frame wicked problems by doing what Frayling refers to as 'doing the right thing'; making artifacts or in this case robotic artifacts intended to transfer the world from the current state to a preferred state [see 4]. From an ideological perspective, a designer can also be regarded 'responsible' for the resulting robotic artifacts. Researchers embracing such a value-sensitive agenda can feel truly proficient about creating artifacts that transform the world into 'a preferred' state, and thus will be able to answer up to and more clearly motivate their research. However, we have to realize the values we ourselves bring to the table and that what is preferred and 'solutions' are not universal. Nor should we try to solve all with one type of design. Our standpoint is that robots should not be posed as solutions to wicked problems, but rather sensitively designed as compilations of robotic materials that are articulated to particular situations rather than as universal agents.

In our vision we suggest that a robotic material is a material that combines the kind of physical-digital material proposed by Fernaeus, with an aesthetical take of being in motion as suggested by phenomenological approaches [1]. Robotic material is not always fundamentally different from other physical-digital materials, nor should building 'a robot' be the be-all and end-all of our endeavors. We believe that robotic designs are more likely to be successful if grounded in real use and real experiences addressing real needs. Our long-term goal is that this approach would in due time reduce the urge to pose "robots as solutions to wicked problems" by constantly asking ourselves the obvious question: could there be another technology or social change that addresses (part of) this particular problem in a better (perhaps less complex) way? All in all, the stance that we take -perhaps unsurprisingly- suggests that we continue doing research through an iterative loop consisting of field studies, design and implementation, and evaluation of (un)intended effects. As a byproduct we can rest in comfort knowing that we at least have a sound and universal argument for creating the kinds of robotic artifacts that we do. Or can we?

4. ACKNOWLEDGMENTS

This work is part of LIREC, funded by the EU Community's 7th Framework Program (FP7/2007-2013, grant n° 215554). We thank our colleagues for their valuable input on this work in progress and our "Robot Myth" group for intriguing discussions.

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