Abstract Affective Design

An Alternative Future for Socially Interactive Technology

In recent years industry, care, and to a growing extent also domestic life increasingly relies on the development of robotic technology. Such technology replaces human workers and tasks, because it can be employed in circumstances that are not fit for humans, exceed human performance, or are more cost-effective. A relatively novel development specifically aims to develop robotic technology that can function in social environments. Endowing robots with social and affective capabilities enables such application, and allows people to interface with technology in an intuitive and natural way, but is also used to instil empathy in the human user or even achieve therapeutic goals. Furthermore, acceptance of technology in social environments greatly benefits from such capabilities. Social and affective technology is already starting to emerge in diverse application areas ranging from aids for education and healthcare, to security/safety, professional services and domestic/consumer technology. Utilization prospects include virtually any circumstance in which technology requires interaction with, or needs to function among people. Pragmatic and theoretic advances were recently made in all these application domains.

> *Robots with social and affective capabilities are emerging strongly in various application domains where they function among humans, principally in health care and elderly care.*

The Problem

The central problem within the design of socially and affective technology is how to integrate the requirements of people for natural social interaction with the diverse requirements for product or machine design. Currently, such technology is designed by mimicking the human or animal form either realistically or iconically. However, these approaches prove problematic from a man-machine interaction perspective, as well as a product design perspective. The major issue for industry is that the human and animal form limits product design, an ergonomic or functional design may require a very different type of body than a human or animal form. An in-hospital patient medication delivery robot, for instance, may better have a functional design than a human-mimetic form, from a safety, functional and cost-effectivity viewpoint, yet it would greatly benefit from empathic capabilities towards patients.

> *The current mimetic approach to social and affective technology design conflicts with important functional, technological, and cost-effectivity design issues.*

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We develop a novel design framework that solves this issue at a fundamental level. We develop this framework from a uniquely unified perspective on affective science and early abstract art. The proposed design framework exploits the human cognitive structures engaged in the recognition of non-verbal emotion expressions and social cues that do not rely on the configuration of the human body and face, as well as the process of abstraction in human cognition and perception. The research involves uncovering those structures, develop ways to reflect these into a robotic design and assess the implications for users. A scientific and pragmatic parallel to the artistic process of abstraction.

> *We propose a novel design framework that combines functional and social/affective technology design at a*

fundamental level, resulting in a practical design framework for social/affective (robot) technology. We call this framework: abstract affective design.

The novelty of abstract affective design is that it enables the integration of believable and intuitive social interaction in a design, at the highest level of abstraction (i.e. in its most minimal form), without being restricted to the (perceived) affordances of the human or animal form. We argue that abstract affective design effectively circumvents the issues of man-machine interaction inherent to the de facto mimetic approach, which benefits the believability and acceptance of such technology in social environments. Abstract affective design enables the designer to bridge the field of social robotics with a variety of design paradigms that are specific to their application domain. Abstract affective design is the first design framework that enables the design of socially interactive technology after its intended purpose.

The major innovation is that abstract affective design enables designers to integrate the requirements of people for intuitive social interaction with the diverse requirements of industry for product or machine design.

The possibility to design socially interactive technology after its intended purpose is beneficial from both a user experience and functional perspective, and opens up numerous novel niches for the integration of social communication with technology, extending beyond the possibilities for utilization than is currently possible. General examples include the design of robotic technology using functional, ergonomic or consumer based approaches, including technology that previously could not be easily endowed with socially interactive skills, but now can using abstract affective design. The prospects for utilization are vast.

We expect that abstract affective design will set the standard for socially interactive technology that is widely applicable in industry and consumer life. As such, it can transcend the currently de facto mimetic approach of socially interactive technology.

Some application examples of the proposed design framework:

Domestic
A domestic or institutional cleaning robot can, using the developed know-how from automated cleaning technology, exceed human performance from a functional and cost-efficiency perspective. Endowing such technology with social skills can provide a natural and intuitive interface to the technology and benefit its acceptance within a household or institutional/public environment. Abstract affective design allows for the integration of social behavior in with the functional design, which is difficult using the de facto mimetic approach.

Safety
An evacuation robot, for instance, can benefit from the efficiency and cross-cultural understanding of social and affective communication to safely guide people to an exit, but also needs to cope with rough terrain and uncertain circumstances, a demanding technological challenge. Abstract affective design allows the designer to integrate social and affective communication with its specific functional requirements. This allows for optimal design from both perspectives.

Healthcare
An in-home bathing robot can enable elderly people to remain longer independent from personal care. The design must be robust from a functional, safety and ergonomic perspective, matching the physical needs of the elderly. When it expresses states such as empathy or

clear goal-directedness, it offers a natural and intuitive interface for the elderly with technology, interfaces that are often hard to learn. Abstract affective design allows the designer to balance functional, safety and ergonomic issues, while integrating social and affective capabilities in the design without the need for an additional interface.

Therapy

The emerging niche of empathic companion robots benefits people's well-being in various healthcare niches, in particular dementia and autism patients. When a mimetic design deviates from the expectations people have of the actual creature, this causes confusion, negative responses and ultimately rejection by the user. For example, in the case of Paro (a mimetic companion robot modelled after a baby seal) the battery runs out, the resulting behavior may be associated with its death, leading to upsetting reactions. Abstract affective design can be used to design companion devices that do not resemble humans or animals. Because we initially do not expect much from simple looking devices, our expectations are construed through observation and interaction with the device. This will allow for a more robust and consistent empathic companion.

There is general consensus on the importance of endowing future technology with social and affective capabilities. Such technology holds great utilization prospects for industry, care and domestic life. The proposed abstract affective design allows, for the first time, the design of social robotic technology after its purpose. This opens up new possibilities, of which we have attempted to show a glimpse, and provides an opportunity to shape the future of technology. Therefore, abstract affective design is a unique opportunity.

Authors
Alwin de Rooij, Msc
Dr. Maarten H. Lamers
Dr. Ir. Fons J. Verbeek

Affiliation
Media Technology Program
Leiden Institute of Advanced Compute Science
Leiden university

Contact & further information
Alwin de Rooij
info@alwinderooij.nl
+31 6 15236238

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