

Socially Embodied Technology

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Embodiment means more than having a physical substance or presence in an environment. It means that a system is able to affect its environment and be affected by that environment. The more embodied a system is, then the more integrated and complementary it is to its surroundings (Quick et al 1999).

In Artificial Intelligence we are realizing that embodied devices enable us to produce more natural behaviours that are more effective. They work better because they are plastic and able to mold their functionalities to match the needs of their environments. Contrast this with traditional design, which is based on a set of unchanging assumptions about requirements and environments that are inflexible and incomplete.

While **AI and robotics** may explicitly focus on notions of embodiment, other fields of computer science also depend on a good integration of technology with their surroundings. For example, **wireless networking, RFID technology and ubiquitous computing** all have ambitions towards the integration of technology in everyday products and for everyday tasks (Gershenfeld 2000). If these technologies were more embodied then they would be more seamlessly integrated into products; dynamic networks and data-centric protocols could adapt to our needs by bringing our data to us instead of forcing us to adapt to the constraints of a more fixed architecture. Another example is **social networking** and **crowd sourcing**, which are not only hugely popular sources of entertainment, they are active research areas that may improve our ability to reach people who were previously overlooked (Lim et al 2010). If more embodied then these software approaches could exploit normal interactions between thousands of users to empower and derive databases and computer services. Today millions of us carry **smart phones** in our pockets (Keijzers et al 2008). If portable computers become more embodied then they would use methods of interaction more natural to us and would learn our favourite methods, enabling us to communicate and access information faster (e.g. swipes, touches, shakes, voice, light, orientation, location, augmented reality, textures, temperature). Millions more play **computer games** on consoles that are increasingly sophisticated, sensing 3D location and movement of controllers. As they become more embodied they will sense our bodies and voices directly. These consoles already provide feedback in the form of highly realistic interactive virtual worlds, audio and even in the movement of seats and controllers (Sears and Jacko 2007). They already allow gamers to connect with each other over the Internet and join their friends in virtual communities. More embodied games may use augmented reality and social networking to overlay games onto existing spaces such as in museums or near archeological features. A new generation of devices also explores **emotional interactions** with us – “Mood Lamps” that play music and show lights depending on how we interact with them, or **socially aware robots** that behave like living pets to encourage us to care for them. More embodied versions will respond better to our own moods and will integrate into our lives by meeting our personal emotional needs in beneficial ways (Dautenhahn et al 2002).

Predictions suggest that the integration of different technologies into our lives will continue to become ever more widespread. The distinction between the digital worlds within our computers and the physical worlds we evolved to inhabit will become more blurred. For example, one idea suggests that there will be an Internet of Things – that physical objects will have a “digital mirror” that enables everything we interact with to be embodied in the digital world, and everything in the digital world to be embodied in the physical world. Predictions also suggest that we will be highly connected, with data available to all. Physical objects will become more active, with computers becoming embedded in our clothing, buildings and all artifacts that we make. More interfaces will be used, allowing us to interact with the devices in more varied ways (Yan et al 2008).

Unfortunately, there is a gulf between today’s research and the visions of tomorrow. Researchers stay in their respective fields, ignoring the trends towards more integrated products. There are few roboticists in social networking conferences, There are few experts in emotional communication who perform research on computer games. There are few RFID experts who work in crowd sourcing. All too often the major innovations are created by engineers with little interest in everyday user behaviour or favoured methods of interaction, and those specialists in social aspects of computing rarely become involved in technology design. Consequently, today the vast majority of our devices are not

embodied, nor are they adaptive to our needs. Modern computer technology is sufficiently complex that it requires specialist training to use the devices efficiently, and yet more training to program, deploy, and maintain them. In the future, are we going to surround ourselves with ever-more obscure gadgetry, which will require several years of training to use?

These visions of the future and problems of the past, point to this Grand Challenge: how do we make future technology more usable in our societies, by all types of people from the very young, to the elderly, to the disabled? Can we find ways of making technology that adapts to us, instead of making devices that force us to act unnaturally? Can we connect the different types of knowledge amongst the fields of research that specialize in all these aspects of social technology? Can we create **socially embodied technology**?

This Challenge fits squarely into the named *assisted living* Challenge, although effective solutions should also impact the Challenge on *health*. Today's best examples of such technology include:

- Robot devices with personalities that enable an easy to use interface with the Internet and RFID tagged objects (e.g. the Nabaztag:tag)
- Social networking to help form communities which can be used for crowd-sourcing and obtain normally inaccessible data (e.g. the StakeNet project)
- Robots that communicate through emotional cues (e.g. the Pleo dinosaur robot)
- Computer games consoles that enable greater social engagement through physical movement (e.g. the Nintendo Wii).

Tomorrow's examples might include:

- Social networking for the elderly through devices that communicate using emotional cues.
- Augmented reality computer games for education that follow you on ubiquitous devices.
- Social robot friends that communicate with each other wirelessly and encourage social integration of autistic people.
- Embodied AI with rich sensing that learns our needs in the physical world and assists our corresponding information retrieval in the digital world.
- Novel interfaces or novel devices that enable new ways of social engagement and interaction.

In the next few years our technology will integrate more and more forms of interaction, connectivity, adaptability and functionality. The challenge for researchers is to connect many disparate fields of work and discover the best way to produce sophisticated technology that is designed specifically to adapt to our emotional and social needs.

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