Chapter 33
Ubiquitous Computing for Independent Living

Neil W. Bergmann
University of Queensland, Australia

ABSTRACT

Ubiquitous computing technology (ICT) shows great potential in supporting the infirm elderly, and others managing complex health issues, to live independently in their own home. While these technologies have great promise, their adoption level is low in Australia. It is suggested that two concurrent strategies are needed to improve the penetration of ICT-based assistive technology in the community. Firstly, significant trials are needed to verify that such systems can provide improved health outcomes and reduce health system costs for suitably targeted patients. Secondly, research in security and privacy, open standards, human-computer interfaces and new models of care driving software specifications is needed, so that these health system benefits can be achieved at a reasonable cost, and with adequate consideration of the needs of clients and carers.

INTRODUCTION

A defining characteristic of humans is that they are inventive and habitual tool users. We all use tools to enhance our physical, cognitive and communicative capabilities. Assistive technologies are one class of tools which aim to improve the quality of life of those faced with particular medical, physical, or cognitive challenges. An important class of assistive technologies is enabled by Information and Communication Technologies (ICT). This chapter looks at a subset of ICT called ubiquitous computing. It investigates how such devices and systems can be best used to develop assistive technologies that can help the ageing and infirm to live more independently in their own homes, rather than in institutional settings.

The chapter will first look in some detail at the characteristics of modern ubiquitous computing systems and then the requirements for independent

DOI: 10.4018/978-1-4666-4422-9.ch033

living, before bringing the two topics together to investigate ways in which ubiquitous computing systems can be better designed to enhance living independently.

BACKGROUND

Ubiquitous Computing

Ubiquitous Computing has emerged in the past two decades as a term meaning computers everywhere. Much of the early thinking around this topic was due to the late Mark Weiser of Xerox PARC, and his idea of the disappearing computer (Weiser, 1991). There are many different views on what ubiquitous computing means, but it can be summarised as computers everywhere, communications everywhere and information everywhere. It is useful to explore trends of the near past and the envisioned future, to give more meaning to this domain of research.

Firstly, we have already seen computers becoming a key component of both simple and complex devices and systems. Of course, it depends what we mean by a computer. For the purposes of this discussion, we can consider a device whose function is programmable by software as a computer. In particular, the small microcontrollers which one finds in televisions, cameras, digital watches, and the like are certainly considered here as computers. One of the first signs of "computers everywhere" has been the rapid adoption of microcontrollers as key components in almost every electrical and electronic device.

Such devices exhibit a key characteristic of ubiquitous computing, that of the disappearing computer. The embedded computer in an appliance is often not obvious in either the function or user interface to a device. For example, it may be more economical to put a small microprocessor in a toaster to calculate the average toasting time given the "darkness setting" than it is to design a mechanical device for achieving the same function. Once the microcontroller is there, it is then easy to add additional features, such as a "defrost" button, or an asymmetric "crumpet" toasting setting. The computers in such devices are usually called embedded computers, since they are not directly programmable by the user, but rather are embedded as part of the core function of the device. Analysts suggest at least 99% of all computers sold annually are embedded computers, and in many cases their presence is not immediately obvious to the purchaser (Zurawski, 2006).

Computers Everywhere

When I was an undergraduate student, our first year electrical engineering professor asked us to go home and count how many electric motors we could find in our home, to motivate us in how important electric engineering was in our daily lives. Most people managed totals of around 20 or 30 motors. Nowadays, a similar exercise of asking how many computers are in our house would yield a total closer to 100.

A modern automobile is a good example of a complex device whose function now depends critically on embedded computers. Modern luxury cars may contain up to 70 micro-controllers, and electronics contribute almost 50% of the car's cost, up from around 20% a decade ago (Sangiovanni-Vincentelli, 2007). Almost every "power" device such as power windows, mirrors, or seats has its own controller, as well as controllers for audio entertainment, navigation systems, braking and stability programs (ABS, traction control), and multiple controllers for engine components such as ignition and fuel injection.

A modern car also provides a valuable lesson in what can go wrong with such a ubiquitous computing approach. For today's car, it is not enough for each microcontroller to be a separate subsystem – rather the microcontrollers are now integrated onto high-speed data buses. This allows programmed coordination of multiple microcontrollers, for example resetting mirror and seat posi-

Related Content

Teaching Executive Functions, Self-Management, and Ethical Decision-Making through Popular Videogame Play

Randy Kulman, Gary Stoner, Louis Ruffolo, Stephanie Marshall, Jennifer Slater, Amanda Dyland Alice Cheng (2014). *Assistive Technologies: Concepts, Methodologies, Tools, and Applications (pp. 771-785).*

www.irma-international.org/chapter/teaching-executive-functions-self-management-and-ethical-decision-making-through-popular-videogame-play/80643

Training, Teaching, and Learning

(2014). *Enhancing the Human Experience through Assistive Technologies and E-Accessibility (pp. 133-166).*

www.irma-international.org/chapter/training-teaching-and-learning/109952

Technology and Literacy for Students with Disabilities

Anya S. Evmenovaand Margaret E. King-Sears (2014). *Assistive Technologies: Concepts, Methodologies, Tools, and Applications (pp. 1269-1291).*

www.irma-international.org/chapter/technology-and-literacy-for-students-with-disabilities/80673

Assistive Technology for Children With Learning Disabilities as an Artificial Intelligence Application

Valerianus Hashiyana, Veiko Veiko, Nalina Suresh, Martin Mabeifam Ujakpaand William Sverdlik (2022). *Assistive Technologies for Differently Abled Students (pp. 113-125).*

www.irma-international.org/chapter/assistive-technology-for-children-with-learning-disabilities-as-an-artificial-intelligence-application/305467

Assistive Technology to Promote Physical Activity in Students With Disabilities

Laura A. Bassetteand Melissa N. Savage (2022). *Technology-Supported Interventions for Students With Special Needs in the 21st Century (pp. 1-25).*

www.irma-international.org/chapter/assistive-technology-to-promote-physical-activity-in-students-with-disabilities/300020