Ubiquitous Computing

A Topic Overview

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Ubiquitous Computing

Ubiquitous Computing (Ubi Comp), or pervasive computing is hyped as the 'third wave' in computing (Weiser, 1996) and is best described by its creator Mark Weiser, (1996, p1) as " invisible, everywhere computing that does not live on a personal device of any sort, but is in the woodwork everywhere". Ubiquitous computing therefore attempts to create technologies that mar the boundary between the users experience with computing and the world by becoming one with it. There are a number of ubiquitous computing research branches such as mobile computing, wearable computing and the intelligent environment.

Ubiquitous computing is reputed to evolve our business, learning, entertainment, collaborative and home environments by embedding smart technologies that interact with us quietly behind the scenes (Roussos et al, 2003). The vision is of smart embedded technology grounded in the realizable theory where microprocessors are becoming smaller, less expensive and able to incorporate into everyday objects and environments such as clothes, pencils, paper, toys, tools, home and office appliances, walls, floors and fixtures (Mattern & Strum, 2003). Wireless technologies will be the enabler for these devices and environments seamlessly communicating with other smart devices or services over the internet (Mattern & Strum, 2003). User interfaces will consist of speech or gesture recognition systems designed to blend into the world and require little knowledge for users to accomplish complex tasks (Mattern & Strum 2003; Emerson 1999).

There are several research studies regarding the development and application of ubiquitous computing in environments for example the 'Aware Home' (Kidd et al, 1999), the 'Intelligent Room' (Coen, 1998), the 'Smart Home' (Park et al, 2003) and the 'Smart Classroom' (Jiang et al, 2001). The "Smart Classroom' enables remote students to actively participate in lectures as well as recording the lecturer's verbal presentation (Jiang et al, 2001). The 'Smart Home' seeks to devise intelligent home appliances that provide 'the good life' (Park et al, 2003). 'Roomware' transforms the office environment with interactive walls able to utilise large displays of collaborative work, tables that record group discussions and chairs that adjust accordingly to correct posture and comfort (Streitz et al, 2002). Patterson et al (2002) propose smart technologies in health care to assist Alzheimer's patients by prompting them for activities of daily living and reorientating them to location with an activity compass that leads patients home. Proposed devices include 'Intelligent Paper' that works like real paper (Dymetman & Copperman, 1998), 'Peek-a-Drawer' a scanning communicating device for children (Siio, 2002) and 'Cyberguide' the guide book that knows where you are (Abowd, 1997). Park et al (2003) discuss the 'Smart Pen' that finds definitions and saves phrases as well as the 'Smart Pillow' that reads you to sleep and turns off the light amongst many others.

Complex issues and constraints arise for government, business and the individual concerning the implementation of ubiquitous computing devices and environments. Mattern and Strum (2003) identified the reality of information overload as well as the political, legal and social concerns regarding locatable and traceable communicating objects. Privacy has become the biggest concern where 'smart' processes within objects and environments will make decisions that will most likely effect our entire lives (Langheinrich 2003; Boyd et al 2002). Users will be interacting with embedded systems in their working, playing and sleeping lives (Langheinrich, 2003). Does your desk interface inform you of your highest priority task and then inform your boss if you decide to undertake one of less priority? What

information does your fridge manufacturer sell about your individual spending habits? Langheinrich (2003) discusses the issue of the invisibility of the technology that mars the border between interaction and surveillance. There are far reaching implications of living in a digitized world where every action can be stored and retrieved for scrutiny later (Langheinrich, 2003). Langheinrich (2003) proposes the following guiding principles: providing notice about data and its use, providing choice and obtaining consent from users, allowing anonymity or pseudonymity and only saving data when the user is witness.

Maintaining security in ubiquitous computing devices and environments is fundamentally difficult due to the wireless nature of the communication transport level and the heavy power consumption of devices (Langheinrich, 2003). Data and information sent over 'airwaves' is inherently at risk so robust security measures would only be implemented for highly sensitive data such as medical records, etc (Langheinrich, 2003).

Bohn et al (2003) identify how difficult it is to predict the implications on our lives of extensively embedded technologies in objects and environments and raises points on failed deliverables when proposed benefits of ubiquitous computing don't simplify our lives, save time, or reduce our task list. The perceived loss of control over our environments is an important factor in the user's proliferation of embedded technologies (Bohn et al, 2003). The is a risk of creating a new digital divide through providing different sections of the population the ability to 'connect' to the new information highway (Bohn et al, 2003).

With further development of ubiquitous computing technologies, new devices and services will evolve from the mobile devices we currently use (Mattern & Strum, 2003). Environments will transform with the ability to sense, learn and adapt to the changing stimulus from the user (Park et al, 2003). Smart objects that have benefited from increases in processing power, memory resources and network connectivity will be able to sense and adapt to the environment and provide new services as well as the services they are originally intended for (Mattern & Strum 2003; Mavrommati & Kameas 2003; Mynatt 2000). A medicine cabinet used for storage transforms into a tool that tells you not to take aspirin with ibuprofen or that you forgot to take your contraceptive pill. The fridge that adjusts its temperature according to the foods stored within it or indicates those foods well past there use by date. Alternatively, in the work environment the 'Snatcher Catcher' a refrigerator that records on video who took your sandwich (Lundberg et al, 2002).

The adoption and proliferation of ubiquitous computing technologies in E-business expects to expand as the strategic advantages of implementation become more tangible to business owners. (Roussos et al, 2003) 'Just in time' pricing, 'pay-per-use' and being part of the 'now or new economy' are attractive benefits encouraging business to invest in ubiquitous computing (Langheinrich et al, 2002).

Mattern & Strum (2003) identified a need for further research and development in mobile and portable devices, adequate communication systems and software infrastructures to enable a successful ubiquitous computing wave.

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