Social Implications of Ubiquitous Computing

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Abstract

Disease and death: the bane of mankind's new age existence. Ubiquitous computing comes to the aid, however. While our young are nurtured by machines and our elderly fight pestilence and decay through technology it will be a bright age where our species can flourish and fuse with this new technology.

1 Introduction

Since work started in 1988 on the subject of ubiquitous computing, the IT world has developed enormously and the idea of ubiquity in computing is rapidly becoming a reality. With the widespread adoption of ubiquitous computing devices and even greater changes just around the corner, it is becoming apparent that there are significant social implications with these new technologies.

This paper will discuss these implications, both the present and those in the foreseeable future of the data that is made available by ubiquitous computing; the costs and benefits that it produces.

The social consequences can be broken down into... personal/domestic, organisation/work, health and safety, communication and leisure.

2 Personal/Domestic

The expansion of ubiquitous computing will significantly impact users of the technology in their personal lives. In the foreseeable future, systems running in the background may be seamlessly integrated into our daily lives.

Examples such as automatic stock control for the home could be easily implemented by extending the *smart shopping basket* concept [1] which could perform

functions such as automatically ordering items which the occupants are running low on. Examples of this technology are already in the pipeline from companies such as Electrolux [2].

Another example is the advent of home environment management with a central system controlling everything from your central heating and lighting, to your morning coffee pot [3].

Ubiquitous computing can fulfill some important needs of children like social experiences, control of their environment and ways of being creative [4]. Another important capability of Ubiquitous computing is the ability to assist the elderly or disabled in performing many daily tasks, such as taking medication, preparing food and operating household appliances. Intelligent environments can detect such activities and help users compensate for typical age-induced impairments, such as problems with memory, heating and vision [5]. This type of technology can help those without a voice to be heard, and those without sight to see the world in a new way.

3 Organisation/Work

For businesses, ubiquitous computing enables a new relationship towards customers. Businesses are becoming more aware of their customers needs, and through sensing and local resources, businesses become more responsive to fulfill them [6]. For example, when the user is running out of milk the refrigerator will notice and automatically request new milk from the supermarket.

The main problem with Ubiquitous Computing and organisations is the fact that it removes the desirable boundaries between work and personal life. Due to being online anytime and anywhere, the physical boundaries between work and home disappear.

Additional problems come from monitoring either employees or customers. By storing lots of information it becomes possible to create some long-term trends about an individual. Furthermore how can the organisation/business guarantee the security of all of the information stored about its customers/employees. [7] This is already covered, in some instances, by the Data Protection Act [8] in the UK but companies also need to implement the requirements.

The biggest danger is the monitoring of mobile workers. They will be monitored on their digital traces and activities. In the sense of: *'How long was he connected?'*, *'How many messages did he send?'*, and so on. In addition, the actual meaning of supervision changes and mobile workers might not receive guidance and development as they will simply disappear like the computers in ubiquitous computing [9]. The reduced personal communication could also result in reduced organisational development or managers making wrong decisions due

to lack of local knowledge, as they will base their decision on the digital output generated from the computer system. [10]

The potential benefits for corporations spread over many different localities is phenomenal; ranging from the simple niceties like being able to see if the coffee machine has coffee in it to huge economic savings like global meetings where the participants are spread around the world.

To elaborate, team members would be able to collaborate from remote locations (for example, their homes or different sides of the globe) thus allowing greater productivity without the need to either travel long distances to meet face-to-face or use a convoluted tele-conference device. Further to this, a white-board in a conference room could be used during the meeting by people in the room where it is located, but it could also be hooked up to the white-boards in the other conference rooms which are part of the meeting so that anything drawn on one board will appear on the others.

On a different tack from autonomous computer systems which purport to manage themselves, ubicomp offers companies new and ingenious ways to track the movement of their employees through means of location tracking. One example, however ludicrous, is the restroom policy for some fictional company [11] Thankfully, this is a prank but, if left unchecked, 'big brother' could start watching your every move and impose quotas on what is currently unregulated to any real extent.

4 Health & Safety

Our interest in our own health and well-being has already spawned a number of advances in ubiquitous computing and devices geared specifically toward harnessing the characteristics of ubiquity in technology to trace, monitor and assist the needy in our society.

For example, small children are highly inquisitive and tend to wander away from their parents in public places, which can be a very serious problem in crowded areas. Using a simple radio transmitter somewhere on the child's person, and a receiver clipped to the adult's belt, the Parent Pager [12] can sound an audible alarm from the adult unit when the child's unit moves out of signal range. Conversely, the same technology could be abused by certain members of society with less legitimate intentions. [13]

Similar devices have been developed for the elderly; a device on their person they activate to call for help. Such a device could be used to observe the heartbeat and other vital signs of a patient in a hospital, allowing them to be monitored even when mobile.

While the elderly don't have the problem of responsibility, they are often too infirm to look after themselves adequately. Arthritis, in serious cases, can prevent a fallen elderly adult from getting up again. A context aware device that senses the person's orientation and could call neighbours or medical staff for help when the device is horizontal, or when a sudden shock movement is sensed could be of immense benefit to the well being of the elderly suffering from conditions inhibiting their movement or balance.

Despite there having been positive developments in ubiquitous technology in the area of health and safety, these same developments could also pose problematic consequences. With technologies becoming available that will assist or even replace such natural functions as parenting it is more than possible that these technologies will become too heavily relied upon. It would be all too easy to assume that either device has everything under control, and lapse into a false sense of security.

> *"the computer becomes a taken-for-granted, ever-present device"* [14]

As with all new technologies there is the potential for failure and in this area, where it is a matter of life or death, over-reliance could have potentially fatal consequences.

Ubiquitous devices, whether connecting a Personal Area Network, communicating with the local LAN hotspot or indeed any other wireless link, all use part of the electromagnetic spectrum. Since they are still in their infancy, the health repercussions are unknown and may well remain so for many years. The radiation risks of mobile phones [15] have been emerging for several years and it could be a matter of time before similar effects could start being encountered for regular users of other, newer ubiquitous technologies. Until this issue is further researched, integrating the wireless devices that come with ubiquitous computing into our lives could be potentially dangerous.

5 Communications

Humans have lived in groups for millions of years and social behaviours have been essential to survival. Ubiquitous Computing removes the time and space constraints from communications. As people are connected and traceable 24/7 it becomes possible to reach a person regardless of location, maintaining contextual awareness allowing a conversation to be moved between devices. For example, you can continue your mobile conversation on a land line when you return home from work.

Context aware communication is defined as being a *class of applications that apply knowledge of a person's context to reduce communication barriers* [19]. Ubiq-

uitous communication allows contextual information to be shared that would not otherwise be available.

Participants in distributed meetings lack important contextual information that is present in face-to-face meetings. [16]

A negative aspect of ubiquitous communications is the problem of filtering information; the human mind automatically filters information that is personally relevant. In the same way, any devices that we use will also need to perform this task so as not to overload the individual with information he or she doesn't to wish see.

6 Leisure

Leisure is the world's fastest growing industry with a huge chance for ubiquitous computing to make a firm foothold. The implications for improving the ease of travel and enhancing people's use of their leisure time are far reaching, with the potential for huge social benefits in the form of leisure enhancement.

The data produced by and for ubiquitous computing has enormous potential for applications. Existing GPS systems have long been available and providing a useful service to travelers around the world, especially in automobiles where this is becoming most widespread. The possible future of this is considerable [17].

Geotags[18] is a location based search engine and is an example of the way tourists can access location specific information. Easily accessing the information on the local shops or services and seeing the equivalent of geographical 'post-it notes' left by other travelers will aid and encourage the use and sharing of information in this uniquely context sensitive fashion. Use of this service is simple; tourists get a GPS enabled PDA and wander around a covered area. As they move, their device will query the database for any relevant information. This will enable a tourist to see available attractions in his or her area, possibly make reservations or book tickets, and ultimately, plan a route from their present location to the site of the attraction.

The concept is to present the user with as much relevant and useable data pertaining to their situation. The device would, as the tourist moved about, undergo 'automatic contextual reconfiguration' [19] as proposed by Bill Schilit. An example of this would be walking into or near a restaurant. Your device would automatically interface with a static device in the restaurant, and display the menu. However, there can be issues if this happens frequently, say moving down a busy high street, where lots of varying contextual information can be presented. Schilit writes:

> *"Systems that reconfigure based on context are subject to the same problems faced by reconfigurable systems in general. In addition, if the context is changing rapidly it may be distracting to the user or impractical (due to performance) to adapt to every change. Also, certain adaptations may confuse users, particularly if the context is incorrectly reported, if the user is unaware of what context an application considers relevant, or if the context changes during use."*

This is something that will have to be considered if devices like this are to be developed as commercially viable products for use in the tourist industry.

7 Final Remarks

Like it or not, Ubiquitous Computing is a technology, or collection of technologys that will become steadily integrated into our daily lives. We must make sure we, as a society, are aware of all the possible impacts of this technology, and how we can gain the most from it. It is easy to develop an *"oooh shiny"* mentallity towards Ubiquitous Computing, but it must be recognised that there are also many downsides to the technology, such as protection of our personal privacy. If we keep that in mind whilst developing this technology, then it can be healthy integrated into our social environment with maximal benefit to us.

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