Ambient Technology — Now You See It, Now You Don’t

R Payne and B MacDonald

13.1 Introduction

There were 152 million PCs shipped in 2003 with 170 million expected by the end of 2004. The total number of PCs delivered worldwide over the last 10 years or so is now over one billion — but the processors in these PCs account for just 1–2% of all processors sold annually, the vast majority of the other 98% being embedded in equipment such as mobile phones, TVs, washing machines, game consoles, and cars. On the basis of these figures, an installed embedded processor base of something like 50+ billion is not an unreasonable estimate, and the average person in the UK can expect to come into contact with 100+ embedded processors a day without realising or thinking about it. This is especially true if you are driving a modern car, such as the latest Mercedes C-Class, which has 153 processors controlling things like fuel supply, braking efficiency, and navigational and safety features.

Pervasive computing (which we will use as being synonymous with ubiquitous and ambient computing) has its roots back in Xerox PARC’s computing research department, where Mark Weiser’s first thoughts on ubiquitous computing in 1988 were both futuristic and profound — especially since the necessary hardware at the time he wrote his paper was either very expensive or physically large. Weiser’s own words from his seminal paper on ubiquitous computing put his vision into context:

The most profound technologies are those that disappear. They weave themselves into the fabric of our everyday lives until they are indistinguishable from it.

and:

Such a disappearance is a fundamental consequence not of technology but of human psychology. Whenever people learn something sufficiently well, they cease to be aware of it ... in this way are we freed to use technology without thinking.

and:

I believe that what we call ubiquitous computing will gradually emerge as the dominant mode of computer access over the next twenty years. Like the personal computer, ubiquitous computing will enable nothing fundamentally
new, but by making everything faster and easier to do, with less strain and mental gymnastics, it will transform what is apparently possible. [1]

The development of the disappearing hardware technology itself is just an enabler for intelligent spaces and pervasive computing, which then opens up interesting questions about the new uses and business opportunities it enables. We are not discussing the business opportunities arising from the creation of the ‘intelligent spaces’ themselves, but they will certainly include the home, care, entertainment, car, workspace, classroom, and airport environments, some of which are discussed in depth elsewhere in this book. Pervasive ICT needs to follow other ‘disappearing’ technologies from the past — the electric motor, electricity, and the telephone, where, when they are functioning, nobody gives them a second thought. This means that we need to attach intelligence to lower- and lower-denominator pervasive devices. To achieve this, technology developments need to be progressed in the following key areas:

- low-power processing;
- memory storage;
- ubiquitous displays (fixed, mobile, large, and small);
- wireless connectivity;
- user/device interface;
- proximity and location-sensing technologies;
- powering techniques.

The pervasive computing environment is very dynamic and sometimes hostile, with devices, people, and objects consistently moving around in a sea of different input/output interfaces. Together they create ‘intelligent spaces’ that can assist users in carrying out the tasks required. These intelligent spaces (iSpaces) will allow individuals to create, manipulate, and access information while carrying little, or no, technology. Coupling with such things as public displays and other embedded technologies will allow tasks to be carried out simply and easily. The supporting software for these dynamic spaces will need to be distributed across the ubiquitous hidden hardware, coming together as connections are constantly made and broken. The scaling issues involved are complex and are the subject of ongoing research not discussed here.

Interacting with shared/public resources and displays, for example, introduces major difficulties that need to be addressed before they can become a practical reality. How would a user know which interfaces and devices to trust and what are the privacy issues? By what authority can you use them? If they are not free, how do you pay for the service?

The interfaces will need to become more intuitive and user-friendly, especially if distributed or shared use is envisaged. A multi-modal approach, i.e. not relying on a single magical interface that will solve all problems — remember the predictions for speech recognition not so many years ago — will aid in solving this dilemma. The interface should reflect the environment and be contextually aware, e.g. a speech-driven interface may be perfectly valid in a quiet secluded space but a pen may be more realistic on a crowded train. MIT’s ‘Project Oxygen’ [2] is looking at speech and gesture as a combined interaction rather than the clumsy keyboard and mouse.