Situating Ubiquitous Computing in Everyday Life: Some Useful Strategies

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Abstract. We can learn from the kinds of computing applications that have already become ubiquitous. The briefest examination of these successful applications shows that they tend to result from computer support for pre-existing valued interactions. Data in these interactions is not necessarily always held and managed by the applications, human beings and other non-digital objects may act as crucial intermediaries.

1 Introduction

Ubiquitous computing, computing which has disappeared into the fabric of everyday life, is already with us. Curiously it features rarely in the pages of journals, nor on the podia of conferences which claim to deal with academic field of ubiquitous computing. One might argue that the proper purpose of academic study to focus on the problems which have yet to be solved, and therefore it is, in some sense always concerned with failure rather than success. However, it is the contention of this paper that the academic field of ubiquitous computing has paid far too little attention to the run-away successes in what it claims to be its field. This is chiefly because in two very important ways the successful applications in this field do not conform to the received academic model of what constitutes a novel application:

1. *Successful ubiquitous applications augment existing valued interactions rather than seeking to replace them.*
2. *Successful applications use real world objects and humans at crucial points in the distribution and transmission of data, they do not insist on end-to-end digital data transfer and control.*

In this paper we briefly discuss some examples of genuine ubiquitous computing success and then outline some strategies in designing future ubiquitous computing applications which can be deduced from a proper understanding of these successes.

2 Learning from Genuinely Ubiquitous Computing

There are already many examples of computing disappearing into the environment. One example is supermarket shopping, where an enormous amount of technology is arrayed in order to support the consumer's desire to select her own vegetables from an attractively displayed shelf. There is evidence that this interaction is in fact very primal – the desire to pick fruit from a tree (or shelf) is optimised in the visual system of primates [1]. However, this primitive desire has lead to one of the largest digital databases in the world [2].

Another example is the interaction involved in driving a car. Here technology is employed not only in the car to ensure smooth running of the engine and safe braking but also in the traffic lights which control the movement of the car down the road and in the command and control systems which ensure that there is fuel in the pumps at the petrol station. This example highlights another very important feature of many successful disappearing computing applications. The computers that work in them do not form a 'joined-up' system. Data does not flow through them end-to-end but is mediated by mothers on the school run, delivery trucks, shop assistants etc. In both cases, although they may have changed in many small ways, driving and shopping are still recognizable as the same activities that they were 50 years ago when no computing technology was involved.

Further examples of compelling and valued interactions, which we will not discuss fully here due to lack of space, around which huge amounts of computing power have become "invisibly" oriented are the telephone and the printed word.

These examples demonstrate ways in which we need to broaden the concept of 'application' when we are designing in the sphere of ubiquitous computing. The desktop-centric view which has served us well for decades is too restrictive. For this view, the task is clear. There are a limited number of means for achieving it at the disposal of a user who is isolated from the world in an office with a closed door. The user interacts directly with the application through a designed interface. Information flows from the user to the application, which processes it and then returns information, which then helps the user towards the goal of her task. This 'boxed' view of what constitutes an application has been revised and informed through research in the field of computer-supported cooperative work (CSCW), which emphasizes the importance of understanding the way in which software applications become integrated into social practices, the way that the use of many different technologies are interleaved with other methods of communication in the business of getting work done and the importance of real work locations in affecting how technologies are used.

2.1 Some Strategies

Identify Compelling and Valued Interactions, Augment Them

We can see from the above examples that one characteristic of some genuinely invisible computing applications is that the computing involved tends to orient itself

around pre-existing, valued interactions. In other words, it augments and enhances what people already do. Some of these interactions might be regarded as fundamental – such as the fruit-reaching/shopping example. Others interactions are in some sense arbitrary, such as driving. It is a common mistake however, frequently made by novel ubiquitous computing applications, to assume that because an interaction is some sense arbitrary it is easily replaceable. The death of the book and the qwerty keyboard have often been predicted.

As detailed by Sellen and Harper [3], there may well be very good, concrete reasons why a particular form of "arbitrary" interaction is not replaced by another with apparent technological advantages. But there doesn't have to be. The fact that the word "love" is an entirely arbitrary noise amongst other entirely arbitrary noises within the English language does not mean that it could easily be replaced with the word "blet". Not even if one were to use the functional argument that this is a much better word than "love" because it rhymes with far more words and would make the endeavour of writing romantic songs and poetry that much easier. It is in the nature of humans to develop powerful attachments to arbitrary sounds, symbols and behaviours, especially if, like driving and using the qwerty keyboard proficiency requires a prolonged period of training and practice.

From the point of view of fieldwork and ethnography, it should therefore follow that ethnographers involved research into novel applications of ubiquitous computing should try to design their field studies, data gathering and data analysis in such a way as to try to discover or highlight valued interactions in any given setting.

From the point of view of technology, technologist should try to explore how these valued interactions can be improved, extended and augmented rather than entirely supplanted. A successful example of how this has happened already is the mobile phone which takes the function of the mobile phone and literally extends its reach.

Understand when to Let the Users Join the Dots

Successful disappearing computing applications do not have to constitute an end-to-end flow of data. Rather crucial parts of the data exchange may be mediated by humans or non-digital, physical media.

One of the crucial "affordances" of paper is that it can be used for delivery in person. The delivery of a paper document can be used as an opportunity to give "spin" to the contents of the document e.g. "this is just a rough idea" or "this is ready for submission"[3]. A physical document that requires urgent attention can be placed on someone's chair to ensure that commands the immediate attention of the recipient on return.

Fieldwork and ethnography of potential settings for ubiquitous computing applications must be able to highlight which aspects of dataflow might need to remain in the domain of physical objects or human communication and which aspects of information flow might possibly be digitised. Which aspects of a system should remain part a physical or human information system must be part of the design discussion.

From a technical point of view, there are enormous challenges in designing devices and applications which do not have a full picture.

Don't Start at the Very Beginning

Design of successful ubiquitous computing applications must begin neither from the "requirements" of the user stated in the absence of technology nor from new technology in the absence of the user and the user's environment in its broadest sense. Design of new ubiquitous technologies must permanently exist *in media res* - providing an ongoing dialogue between the needs of users in their real environmental setting and the possibilities offered by new technologies.

Get Out of the Lab

Accounts of applications designed and deployed only in laboratories and tested only by their inventors are of little value with regard to our definition of already "successful" ubiquitous computing applications as discussed above. Likewise, design and deployment of applications only in purpose-built spaces fail to capture or engage with the real-world messiness which is the absolute essence of genuine ubiquitous computing success.

3 Conclusion

We can learn a great deal from current successes of ubiquitous computing, but only if we decide to take on the challenges for design and evaluation that these successes present. If we can acknowledge that ubiquitous computing applications do not necessarily have to be complete curators of the flow of data nor do they have to replace an existing preferred method of interaction many more interesting and valuable applications of ambient and ubiquitous computing may be discoverable.

We feel that situated research in collaboration with users is essential to understanding how ubiquitous computing might become integrated into everyday life.

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