Design and Technology in Situated Computing

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ABSTRACT

Since all technology in use is "situated" in some sense, "situated computing" could for instance mean that we design for a specific situation, a specific activity or a specific user. Is situated computing to be understood as customised technology, e.g., optimised tools with a narrower range of use (cf. Norman on information appliances [7]), as adaptive and context-aware computing, or as some combination of these? In this paper, I will first present one of the approaches to the design problems posed by situated computing that we have developed at PLAY. Second, I will discuss a scenario involving mobile phones and use it to illustrate some of the distinctions that I believe to be of importance to the design of situated computing.

AMPLIFICATION

In order to learn more about the constraints posed by the "situated-ness" of artefacts, we have explored the functionality of existing artefacts that at least partly alreadyplays the role, or occupies the *ecological niche* [cf. 6], we want to design for. Using information technology, we have worked on how to augment, or *amplify* [1], the properties of ordinary physical objects.

Using Physical Tokens to Access Digital Information

In everyday life, we are surrounded by artefacts, such as Post-It notes, souvenirs and documents, that act as reminder and pointers to various sorts of information. The placement of artefacts also give people cues about the present context; a document lying on the desk is more likely to be a part of present work than one on the shelf or in a filing-cabinet.

In dealing with, for instance, the problem of web-bookmark management, we have explored the use of different physical tokens as representations for digital media [3]. The *WebStickers* system [5] made it possible for users to easily associate any physical token with any web-page by applying a barcode to the token and associating it with the desired web-page. After the association has been done, all the user has to do to get back to the web-page, is to scan the barcode on the token.

The freedom to choose physical tokens according to what page one wants to bookmark opens up for the possibility to use tokens with affordances that reflect the content of the page. Bookmarks that are supposed to have short life-span can be associated with for instance Post-It notes, bookmarks that are to be handled with care with fragile tokens, private bookmarks with tokens that are easy to hide, bookmarks that are frequently used with tokens that can take the wear and tear of use, etc. The most interesting aspect of this, from the point of situated computing, is that the physical tokens are objects that already exists and are employed to some extent by the user – WebStickers just adds one dimension of representation to them. The tokens are already a part of the users physical environment, making the organisation of bookmarks completely integrated with the overall organisation of the workplace.

Informative Art

Other sources of readily available information are the many posters, pictures and paintings that furnish the walls of our offices, homes and other places. Often, they give the visitors some cues about the local culture, such as aesthetical preferences and areas of interest. With *informative art* [8], we have explored how this property of being able to carry information can be amplified using computers to generate dynamic works of "art" that reflect changes in the near environment, such as the extent of digital communication taking place.

Our aim was not to create art *per se*, but to revisit some issues in information visualisation from a different point of view. In information visualisation one normally creates a structure or representation that optimises the efficiency in the presentation of some set of data. Due to the situation of informative art, i.e., that it is designed to take on the very same role in the environment as posters, pictures or paintings, the structures carrying the information are determined by other factors, such as aesthetics. We have used various kinds of mapping relations to represent information, such as mapping changes in some information to the size, colour and placement of objects in a composition, as well as generative techniques to be able to map information to the very generation of a composition. Thus, approaching information presentation from this point of situated computing posed several new challenges to the design of information displays.

SOME ASPECTS OF SITUATED COMPUTING

One illustration of the difference between designing for the typical one person – one tool situation and designing for an environment that can be seen quite frequently, is the frenetic and seemingly collective search for mobile phones whenever *one* such phone rings[1]. Although there are many more or less annoying melodies to chose from that would customise the phone making it easier to differentiate them, it often seems necessary for people to actually look at the display of the phone in order to be sure whether it is ringing or not. This problem is probably transient as designers develop better ring signals and other ways of notifying the user. However, the scenario illustrates to some interesting issues in situated computing.

1. Please note that this is only a scenario illustrating a few distinctions I want to point out, and not a scientific report on any empirical data. For such studies, see for instance [4]

The situation arises because of the way of notifying users is problematic since it makes it hard for them to differentiate between different phones.When most people only had stationary phones and were less mobile themselves, it was plausible to think "*the* phone's ringing" and thereafter either choose to answer it or not, according to factors such as whether it was the phone at *my* home, *my* office etc. Differentiation between phones was very much a differentiation between the location of phones.

From the perspective of interaction design this was a one person – one tool situation. It seemed sufficient to think that the information to broadcast to the environment was "it's ringing". In the early days of mobile phones the situation was very much the same. Broadcasting "it's ringing" did not only inform the user about an incoming call, it also notified her environment about the prestigious piece of technology she was using, which probably was conceived as a good thing. As the number of users increased and mobile phones became almost ubiquitous, the context of usage changed so much that even though the interaction itself was the same, it did not work very well anymore: the mobile phone was designed like it was the sole piece of such technology around, and people reacted to the ring signal "*the* phone's ringing" as they have always done, all in all resulting in that everyone searches for her phone whenever some phone rings.

Now, is the solution to the excess of notification cues due to mobile phones and other such tools, to make the interaction more private and less public, e.g., to use a vibrating device in the pocket? In many cases, such as in a bus when people are largely anonymous to each other, this might be a good idea. In other cases, however, cues such as ring signals are important to our understanding of other people's behaviour [cf. 2]. Consider for instance the difference between when a colleague suddenly stands up in the middle of a meeting, and when he stands up shortly after someone explicitly asked him to stand up. Giving the behaviour in the second case an explanation is so easy that we would not even think about it. In the first case, the action is less obvious. If someone suddenly leaves a meeting due to a calling phone it might be disturbing, but at least we would know why the person left. There seems to be a trade-off between sparing people the burden of even more information and giving them appropriate cues that help them understand our behaviour.

Distinctions

The example with the mobile phone illustrates that even though we have a refined interaction design, and users have a consistent mental model of it, we can not simply transfer technology from one situation to another. For instance, the scenario illustrates the distinction between the *private* and *public* properties of technology. Another important distinction is *specific – general*. These two are intimately related to each other; the transfer of the previously more private phone to a more general context, changed the usage significantly and made the private call a somewhat public affair.

Finding a good solution to these design problems is not necessarily about using adaptive technology, such as context-aware computing, sensors and AI, but about *how* we design and for *what*. Consider for instance a musical instrument such as the violin. A violin is a rather ancient technology – some of the best implementations were made several hundred years ago – and a highly specialised tool that takes years to learn how to use properly. However, it has proved to be very flexible; the music of today is quite different from the music of the time when it was designed. We might say that the violin is optimised for the "invariants" of the situations and activities it is supposed to be used in, but seemingly flexible in other respects.

If we turn back to situated computing, this might translate to that we should optimise for what is invariant in the situations we are interested in, but try not to restrict the design too much in other respects. Creating a design that can handle smooth transition between different situations could then bear on a logical and consistent relation between the invariants of the two situations.

Such invariants could for instance be positions on a scale between public and private; the notification of a phone call should be private enough not to disturb people involved in other activities, but public enough to be understandable to people within the same activity or situation. Such a notification would probably solve the problem above without the need for an adaptive or context-aware technology, since it would work throughout many different contexts.

Depending on what situations one aims to design, the relevant invariants might concern aspects of the activity, the environment, the user etc., or some combination of these. Further, the distinction between *static – adaptive* have not been discussed here as the focus has been on how to develop design rather than technology for situated computing. However, many situations will require adaptive technology as well, adding even more complexity to the task of designing situated computing.

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