

The users' perspective of context-dependent systems

Abstract. Context dependent systems are granted thanks to the convergence of several technologies as wireless communications, Internet, geographic information systems, etc. The aim of this paper is not to analyse the optimal technical solution to this problem, but to understand the importance and perceived value for users of having this kind of services or applications in their mobile devices.

In most of the cases, users in mobility need information while they are carrying out a task. The search of information across a handset wouldn't distract users from their primary task or activity. Usability problems are being slowly resolved, and mobile communications are getting closer to a ubiquitous scenario (connectivity anytime, anyplace, anyhow). However, this is not enough to provide the mobile user with a relevant positive experience when interacting with their mobile devices. Context-dependent services and applications seem to be the key for the value of wireless services.

1 Introduction

While the Internet has introduced and expanded the concept of navigation in the Cyberspace, the advent of wireless communication, and in particular, Mobile Internet technologies, are introducing the concept of location-aware interaction, or better, context-dependent systems (Cereijo Roibas A. *et al*, 2002). In other words, customized information can be delivered across mobile devices, based on the specific context (location, time, environment, etc.) of the user (Kindeberg T. *et al*, 2002). The interaction becomes now 'space and time sensitive', and physical positions and real things may recall, across mobile devices, automatically virtual positions (URLs, alert messages, etc) in the cyberspace (Kindeberg T. *et al*, 2002). This new link between the electronic and the physical space can be interpreted as a sort of materialization of cyberspace. Users till now have been used to differentiate interactions with the real or the virtual word. With the mobile Internet, however, this separation starts vanishing more and more.

It can be said that mobile Internet has represented an evolution of the concept of *utopical* (no real space) interaction to which the Internet was related, as virtual space where it is possible to interact with information. In fact it imported the concept of *topical* interaction, in which even interaction with a virtual information space happens in real places and can be affected by 'real things' that people meet in their way. For example, if the user is navigating through water-sports Wap sites with his/her mobile phone while he/she is walking in the proximity of the Brighton Pier, he/she can be automatically informed about a related event that is taking place there at that exact time (Raby F., 2000). This simultaneous presence of *utopical* and *topical* interaction is granted by making a direct relationship (mapping) between both ambits (so what happens in the real space may have an effect in the virtual one, and vice-versa). With mobile devices, people will still move around in the cyberspace interacting with virtual assets and information, but there will be a connection with their actual context. For example, you are walking around London, and you can use your handset to navigate through music related environments (e.g. he can be interested in getting information about new UK singers). The system, however, will privilege the presentation of information that is more related to the present context (place, time, identity, etc.) of the user. You can receive an instant message about Robbie Williams' concert at the Royal Albert the same day, or the site of the closest shop that is specialised in that kind of music, or about the club where Annie Ross used to sing. The consequence of this is that it will be able to provide the just-in-

time actionable information from which businesses - and not only - can make effective decisions and take immediate action (Niedzwiadek H., 2001).

2 The natural 'mapping'

According to the theories of cognitive psychology, humans store information in the brain by prioritizing, labelling, and making space relationships and associations. This process of organization of the information is called 'mapping'. We find the information we need because we have given it a place in the space. It can be seen as an analogy to which happens when we store a physical object in the real world or an electronic one in the virtual world.

Mapping aids the process of learning and memorisation. In fact, relating information with places of the physical space (e.g. the heaven is beyond the sky, the hell is underneath the ground), help us to construct mental maps of the world, which facilitates understanding and memory retention (Norman, D. A. 1993). But, above all, it becomes useful whenever some information must be retrieved (*pull*) and when an information is accidentally retrieved (*push*). Push systems are important for example in particular alert situations (danger, etc.). It is a common experience to remember information (*push*) by bumping into some signs of the context in which it has been acquired (where I was, when, with whom, was there a particular perfume, light, etc.) and vice versa. Both ways of dealing with information (push and pull) can also easily be translated conceptually into interaction across mobile devices. Users can use their handset to search for needed information. In this case, it is obvious how a quick and automated information retrieval system according to the user's context will save time (and money) to the user. Examples of useful pull information are routing, places finder, people finder, etc. (Schilit B. N., 1994). Now, let's try to imagine a sort of 'mechanism' that could retrieve automatically for us the information concerned to our present context in the same way that the human brain works. This concept has not only business applications as mobile advertisements, but also, quite helpful information as traffic alerts, friend finders etc. An interesting example of application of this concept can be found in (Raby F. 2000).

3 Location and time-based services

The location-based services can be defined as delivering of customized information across mobile devices, based on the specific location of the user (Nokia, 2001). This fact obviously means that the devices have to previously locate (or help to locate) in some way the position of the user. This customized information doesn't only mean information about the present location.

If we consider instead another feature of information that is time, we are talking about time-sensitive or time-based services. Most of the types of information with which we interact have at least one of these characteristics: time and space (physical or electronic). Events, objects, services and people are characterised by position and time.

The routing is the navigational information that helps the user to go from one position (real or virtual) to the other according to a certain time (Schilit B. N., 1994). Maps can be defined as the visualization of locations by representing the context and relationship between events, objects, services and people in a given location.

Mobile devices that deliver information about events, objects, services and people according to the specific time and the location of the user, and that can provide maps and a routing system permit thus location and time-sensible interaction.

In order to be able to provide location and time-based services to the users, providers need to organise the information into location information frameworks that must be supported by location services. This will enable to incorporate location-awareness and location-sensitivity into services and applications (Klemke R., 2000). Fig.1 shows the unifying information model proposed by Sun Microsystems (fig. 1).



Fig. 1

4 Context-dependent application services

This concept refers to the retrieval of information according to the user's needs in terms of context across mobile devices. Context is mainly characterised by four dimensions (Klemke, r. 2000): location, identity, time, and environment. Location can be physical or electronic and refers to the exact position where the user is. Identity regards user's interests, preferences and knowledge. Time is not only referred to the calendar time but also can be related to the sensorial time (day-night), occupational time (work, leisure), etc. The environment is related to the task or activity the user is carrying out, the presence of other users, things etc.

In this sense, the members of the European TEA project state that the dynamic profiling of user-place-activity, is not feasible by computationally intensive image analysis, nor is the use of high-precision positioning technology. Instead, they relay on multiple primitive cues, extracted from an open collection of low-cost sub-semantic sensors. Relevant sensors that we will explore give visual, auditory, environmental, temporal, motion, and location cues. The idea is much similar to a person saying 'it's getting late', a statement about time, while it is actually based on, for example, it getting dark outside (a feature of the environment) and herself getting tired (a feature of the person's metabolism). Combinations of low-level clues are indicative of semantic context characterisations.

This concept goes further than the ideal of having just-in-time information at the right time, at the right location, on any device (Niedzwiadek H., 2001). Context-dependent

services put the accent in personalization. As it can be seen, identity and environment factors are strongly related to the user. This extreme personalization might also bring some problems for the user. One of the main ones regards privacy. Users should be able to control their own privacy.

Conclusions

Context-dependent systems can be translated in a several advantages in terms of efficiency and effectiveness for the users: quickens and easiness retrieval of relevant information, increased safety. The strong impact of such concept can be found in the capacity of personalising the information. A good example of the possibilities of these systems can be found in the CRUMPET project of the Fraunhofer-Institut für Angewandte Informationstechnik. The aim of the project is to implement, validate, and trial tourism-related value-added services for nomadic users, who have access to the CRUMPET services across mobile and fixed networks. This shall be achieved by personalisation of services to the user's current location, to a user's personal interests, and to the history of this user's interaction with the system, adaptation of content presentation to changing technical environments, etc. It is mainly destined to More and more people combine several purposes with travelling, purposes such as business, leisure, entertainment, and education. The result is what can be called "*edutainment*" and "*busitainment*". An interesting application of context-dependent services can be found in 2 recent researches of mobile interactive applications for sport at the Faculty of Design of the Politecnico di Milano.

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