Mobile information systems for all

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Abstract

In this paper we review empirical findings in three application scenarios and discuss challenges in mobile guides for all. The discussion about accessibility for all is extended to the variability of user needs in general. The concept of nomadic systems with a mix of automatic and user-driven adaptation is introduced and discussed. We conclude with an argument in favor of simplicity.

1. Introduction

Technology available today allows realizing a wealth of services for mobile people. Such services may support mobility as such, e.g. supply information about transportation or other practical facilities needed by traveling or commuting people. Or the services supply any sort of information and service that may be needed while moving, e.g. shopping, tourism, or cultural content.

The discussion about accessibility and usability for all is usually focused on the special needs of disabled people. We would like to argue for broadening the perspective to the variability of user needs in general, including disabled users as well as all people who have special needs without being disabled. Individual differences concerning information needs and modes of interaction with the devices itself may originate from individual skills and preferences, but equally from the situational context of use. To meet this heterogeneity of needs and preferences is a great challenge for research and development.

The variety on the user side faces the multiplicity of phases in a process, the assortment of devices and the diversity of reception requirements bound to different roles and styles of reception (e.g. strolling and goal driven). It is vital to assist users in their individual needs throughout different activity phases and different roles. A continuum of users ranging from high-end professionals to pupils, with strict compliance to tasks up to leisure walk need to be supported. On the one hand effectiveness and efficiency are especially important for users in task-driven situations. On the other hand, ambling users, triggered by clever arrangements of eye-catchers or thematic islands (physically and electronically) should be encouraged and assisted as well in more offer/supply-driven situations. Certainly the task to meet a trade-off between adaptability and adaptivity is crucial. Oppermann and Simm (1994) emphasize that a system should be able to automatically change its characteristics according to the user needs (adaptivity) and provide tools to enable the user to change the system characteristics (adaptable system) as well.

The overall goal in designing usable systems is, to support specified users in their specified context to reach their particular goals in an effective, efficient and satisfactory way. Human characteristics like knowledge, skills, experience, education, training, physical condition, and motorical/sensory capabilities must be taken into account in the development of new systems.

In the following, we introduce three application scenarios as concrete examples, summarize evaluation outcome, and discuss challenges in mobile guides for all.

2. Hippie - a museum guide

In this first scenario, a guide for a museum is introduced. The guide is a nomadic information system in the sense that the user is supported at all stages of a visit to this museum, including the preparation, the actual visit, and the evaluation after a visit. The mobile support is just one stage of the nomadic support. The system provides individual visualization and adapts the interaction to the current context.

The prototype "Hippie" (Oppermann & Specht, 1999) has been implemented for an art exhibition in the castle of Birlinghoven. Two evaluation experiments were conducted. In 2000, 60 visitors participated in the first trial using three comparative guides: Hippie on a sub-Notebook (Toshiba Librettos under Windows 98) compared to a booklet and an audio guide (Peters, 2000). The evaluation subjects were recruited from typical visitors of art museums. In 2002, 7 students participated in a second study using an advanced version of the prototype Hippie on a PDA, again compared to a booklet and an audio guide (Kraemer, Toepfer & Hedrich, 2002). The subjects were younger and had no experience with PDAs. Subjects in the studies were interested in art.

The main differences between the two versions of the system were the hardware devices: the first evaluation group used a sub-Notebook, which was bigger and heavier than the PDA in the second trial[1]. Another difference was a simpler user interface designed specificly for a PDA. The evaluation results reflect this difference showing a higher degree of usability: in the first study Hippie was rated 4.0 on a 6-point scale (with 1 for very good and 6 for very bad) compared to the audio guide with 2.5 and the brochure with 1.7 (alpha < 0.01). In the second study on the PDA the usability was rated 2.4 that was slightly better than the audio guide and the brochure with ratings of 2.8 and 2.6 respectively.

The results of the evaluation revealed that both prototypes were effective to support the visitors in their knowledge acquisition about the art exhibits. With both versions the users could receive and memorize relevant information. The first version of hippie was less efficient compared to classical media, i.e., the overall time needed for the visit was significantly longer (alpha < 0.00). The attention time paid to the system (65%) was significantly longer than for the environment (35%) (alpha < 0.01). For the second version, this relation is almost inverted: 36% of the time was dedicated to the system and 64% for the environment. The results of the second trial showed Hippie to be the best engagement and interest evocation stimulus compared to the classical media.

A main interest of the studies was the adaptivity of the system to different user needs. Based on the user's movements in physical space and information requests about the exhibits, the prototype proposed exhibit tours tailored to the estimated interests of the individual user. Based on a model of the physical space, the system proposed exhibits close to the user and based on the artwork and content selection of the visitor the system inferred an interest profile with types of artworks and types of information content. The most interesting exhibits and information presented about an exhibit was adapted to the user's interest. The adaptive features of the museum guide were considered helpful by the visitors. The assessment of adaptivity for re-approaching an exhibit based on the already presented information during the visitor's first approach was rated highly

[1] When the project started in 1997, no PDA with WLAN-connectivity was available so that the first version of the system had to use a fall-back solution with a sub-Notebook

helpful (M=3.1 on a 4 point scale, with 4 being the positive anchor) and evaluated as not-disturbing (M=3.3). The assessment of the adaptive tour function showed that the adaptive proposal of an exhibit tour matching the personal interests of the visitor is appreciated by the subjects: it is in particular interesting (M=3.3), helpful (M=2.7) and not disturbing (M=2.9).

3. CRUMPET – a mobile tourist guide

CRUMPET is a mobile tourism service, realized for PDAs, which offers location-aware, personalized recommendations of tourism-related content (e.g. local attractions, restaurants) and interactive maps that highlight sites and tours. CRUMPET has been implemented as a multi-agent system with a concept of service mediation and interaction facilitation. The prototype has been validated in terms of user-perceived qualities at four European trial sites. 88 users (age 20 to 70, 36% female) have taken part in the trials, most of them highly computer-literate and traveling several times a year. Such users would be typical early adopters of a mobile tourism service. The CRUMPET system has been acknowledged by users for its simplicity of use and for its focus on location-based services. A high percentage of the test users (> 88%) saw the added benefit of the system compared to other available information sources. The CRUMPET approach to mobile tourism support has been corroborated (Schmidt-Belz, B. et al.; 2003).

During the trials we could identify several issues related to the heterogeneous needs of users. When the system supports user navigation in space, for instance, most users were quite happy to get well-focused maps. A few users, however, could not read maps; they asked for textual directions instead. Textual directions would allow audio-output, which would be more adequate for visually impaired people, and for all users under circumstances when the visual attention is needed elsewhere but on a screen. We got many requirements what users want to see on maps, such as bus stops, shops, restaurants, special recommendations for disabled etc. It is up to the system designers to carefully consider the trade-off between details for specific circumstances or individuals, and, on the other hand, not to clutter the small screen with too many details. So, for maps as a very limited functionality of a system, the heterogeneity of needs and preferences is already worrying and all but easy to satisfy. Another example concerns the granularity of information presented to the user: 100% of users said brief information is important or very important; but only 62% said that detailed information is important or very important. Interviews then revealed that users, once they have found something interesting, they want detailed information on demand. They would be frustrated if the system had only brief information. So, granularity is another decision that depends on interest and situation.

4. SAiMotion - a trade-fair information system

In SAiMotion[2] we develop a nomadic information system to support the preparation, the visit and the evaluation of trade-fairs. SAiMotion gained to a large extend from the experiences that have been made in Hippie and CRUMPET. The baseline for the acceptance of information and communication systems is a simplified information presentation adapted to situation, location, task and user. On the one hand simplified means a reduction of information by adapting the information presentation to the context (a task, location, situation and user adapted choice of information) but on the other hand it means driving at an intuitive interaction with the SAiMotion system itself. Approaches that take context into account usually focus one or only few aspects like

[2] Situation Awareness in Motion - SAiMotion, funded by the German ministry BMB+F, is a collaboration of the Fraunhofer institutes FIT (coordinator), IGD, IPSI, IAO, IIS and IZM.

the users current position in physical space to adapt the information selection and presentation. Beyond to these approaches SAiMotion aims to provide an exhaustive situation model identifying and using *all* relevant situative parameters for proactive information supply and user interaction.

A trade fair may offer the SAiMotion System as a special service to its exhibitors and visitors. The visitor is supported in the preparation phase – at home or in the office – with annotated maps of the exhibition site for a quick overview to points of personal interest (Hermann & Heidmann, 2002). Information of the exhibitors are matched and presented according to the interest profile of the visitor. The system supports the scheduling of appointments, suggests personalized tours of the exhibition, and gives directions to points of interest. In situations without time pressure, the system will be able to suggest exhibitors and exhibits in the vicinity of the user he might be interested in. The system will be able to call the user's attention to changes in the schedule and to dynamically create new plans. The evaluation after the fair visit is supported through annotated tour data and personal notes.

To supply the user with personalized information the system learns a user's interest. The short interaction phases that are typical for a trade fair may not be sufficient to automatically learn an adequate user model. Therefore, SAiMotion uses stereotypes to initialize a user model (e.g. business visitor with tight time schedule, journalist or leisure visitor) which is being refined by the interaction of the user with the system.

A mock-up-based evaluation of the tour support in SAiMotion revealed a divergent understanding of the concept of a tour. Some people tend to identify a tour with a series of locations to be visited, with time constraints by fixed appointments, while others perceive a tour as a series of appointments which happen to be scattered in space. Both views must be supported by the system. Also, the relation and interconnection of navigation in the physical space as well as in the informational space is important. The click on an object in a map brings information about that object. The spatial distribution of personal notes or of points of interest seems to be of vital interest to build up a personal memory of the exhibition visit.

5. Conclusion

The presented application scenarios suggest that the goal of a mobile information system for all matching information services with user requirements lies in the combination of location-awareness, personalization and contextualization. The empirical studies in HIPS, CRUMPET, and SAiMotion, recommend a reasonable trade-off between adaptivity and adaptability especially for nomadic and mobile information systems. The system should combine adaptivity, i.e. "best guess" based on context information, with easy to use adaptation options for the user. The goal is to provide demand-oriented information to the point preserving the diversity of information and information needs. Of course allowing preferences to be set and making systems adaptable is in itself a usability challenge, as tuning long lists of preferences tends to overcharge most users.

The use of stereotypes in mobile information systems like in SAiMotion allows a quicker adaptation to the user requirements. However, the implementation of a broad variety of stereotypes is not enough. It is necessary to refine the stereotypes on the basis of empirical findings, such as individual contextual interaction.

Simplified information presentation and interaction adapted to situation, location, task and user resulted in being appreciated in all three application scenarios. On the other hand, psychological research found that simplification plays an important role in the way people cope with real-world

problems. There are many real-world situations involving multiple criteria of reasoning and rationality (accuracy, speed, simplicity, consistency, accountability), in which optimization is a fiction in the first place. As Gigerenzer and Goldstein (1996) point out in their book about bounded rationality, people often use simple step-by-step rules that work well under the constraints of limited search, knowledge, and time - whether or not an optimal procedure is available.

On the system side we favor a similar concept. We think that it is vital for a system to adapt information presentation and interaction and to determine individual information and interaction needs on the basis of location, environment, situation, user, task and activation features. But in real-world situations "optimal" adaptivity will be a fiction. It is good to adapt the system to a user's needs and context of use but only to certain extend. On the one hand, there is the need to reduce unnecessary cognitive load, but on the other hand, it is vital not to be too undemanding for the user. (Intellectual) co-operation of the user is an asset.

Several usability issues still need further investigation, which is subject to ongoing research work in HCI, see for instance (Schmidt-Belz, B., & Cheverst, K.; 2002). Among them, the adequate use of personalization, the individual preferences in visualization of tours and directions given, and more advanced interaction modes ask for empirically justified solutions.

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