Location-Aware Adaptive Interfaces for Information Access with Handheld Computers

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Abstract. Adpating to user context versus adapting to individual user features or behaviour patterns has been a topic of recent discussion. We believe both types of adaptation are valuable and the decision of which to apply, or how to combine the two, is domain or application specific. As an illustration, this paper presents two approaches to adapting the interface according to the type of user and the extent to which the user's task and location is predetermined.

1 Introduction

A challenge in ubiquitous computing is to design personalised interfaces and software enabling easy access to information while being sufficiently flexible to handle changes in a user's context and available resources [1]. Adapting to context, especially location and time, could help improve usability of small-screen interfaces [2]. Various issues are relevant in supporting adaptive mobile access to information: location, connectivity, task, schedule, user type and others. Which of these issues are most relevant depend on the domain and context of use of the application and device. While sharing the function of adapting interfaces for information access, different user modelling and adaptation techniques may be suitable in different contexts.

In this paper we focus on features for consideration in the development of adaptive interfaces for information access with handheld computers, in particular where the adaptivity is related to location and the activity to be performed. We use two examples to demonstrate different approaches according to whether activities are tied to location and class of user, or whether the coincidence of activity and location is based on user preference. Both are implemented for iPAQ Pocket PCs.

2 Mobi-Timar and My Chameleon

Mobi-Timar ('mobile caregiver' in Farsi) [3] supports access by homecare workers, to non-critical information such as scheduling and patient data, and supports communication between homecare workers. Each patient has a team of homecare workers, comprising nurses, physiotherapists, home health aides, social workers and dieticians. Tasks and duties are divided based on skills and availability. Providing homecare workers with small mobile devices and access to a wireless network allows them to retrieve information, receive and send notification of schedule changes, update the data/information system and communicate with others. However, there are two difficulties in implementing the handheld computer solution: (1) the non reliable connection due to uneven coverage of the area; (2) the benefits of a highly portable device bring problems of limited screen size, making it difficult to design a user interface providing the range of functionality needed to support users in their tasks. Mobi-Timar combines techniques from agent technologies, distributed database transaction management, user and task modeling [3]. One goal is to ensure seamless access to information despite frequent interruptions in connection caused by mobility of workers and unequal coverage of the area. The interface has to be designed for small wireless devices allowing workers to conveniently perform typical operations.

Health care and homecare workers have typical tasks, which have standard information needs. Therefore it is possible to: (1) predict the kind of information needed by the homecare worker using their schedule; (2) pre-fetch and/or adapt information appropriate for the task; (3) present it according to the user's preferences and limitations of the device. Fig. 1 illustrates the interface for different users.

Nurse interface (a) | Physiotherapist interface (a) | Interface in a connected area (b) | Interface in a disconnected area (b)

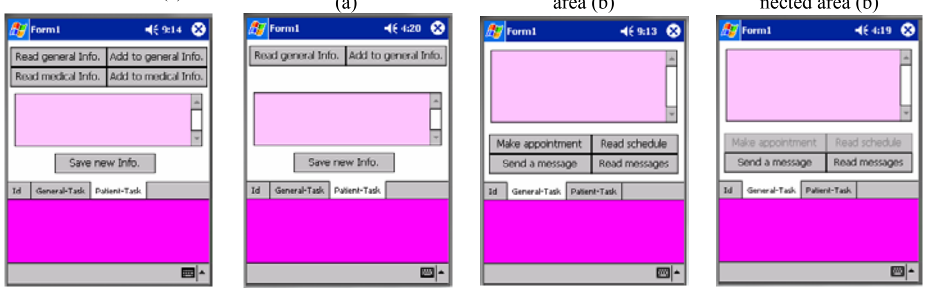

Fig. 1. Task (a) and location (b) - adapted interface for user types nurse and physiotherapist.

Agents are used to give the impression of seamless connection. They hide the changes in network bandwidth from users by pre-fetching information before the time it is required, by means of task, user and context modelling, and adaptation techniques related to these. When the context (time, location) and the current task of the user is known, the interface can provide those specific functionalities needed.

Chameleons are known for the fact that their appearance matches features of their local environment. 'My Chameleon' belongs to the mobile user - wherever the user is, his or her chameleon adapts its interface to suit the user's requirements at that place. It provides easy 'one click' access to applications, tasks, files, documents needed by the user, according to their current location. It is being used by university students. University students often work quite flexibly in a range of locations. They typically have individual usage patterns related to their locations of use [4] and could therefore benefit from an adaptive interface for their small-screen device.

Ensuring seamless connection is not so important, as many of the activities pursued by students on their handheld computer (as revealed in a logbook study [4]) do not require connectivity. The goal is to provide easy access to those tasks, files and applications that a student habitually uses on their handheld device, in their various locations of use. The responsibility remains with the student of ensuring that they have the particular documents that they will require. Although students tend to use different files in different locations, from the logbook data it was often more difficult to predict where they might be at any one time except for during their scheduled lecture and lab sessions. Consequently, the problem of pre-fetching anticipated useful information or documents before students leave a connected area is not considered. The interface of My Chameleon is illustrated in Fig. 2.

Fig. 2. Screens for a user at two locations

Within My Chameleon users only access files, tasks, applications and schedule. The techniques are therefore straightforward. As stated above, a typical user has specific, individual usage patterns. My Chameleon maintains a model of these patterns. Each time a user accesses a document or application in a particular location (e.g. home) or category (e.g. 'on the move'), the weighting for that item being required again in that location or category, increases.

Table 1 summarises issues relevant to location-aware adaptive interfaces for mobile devices, highlighting the important features in the two applications presented.

Table 1. Issues relevant to location-aware adaptive interfaces for mobile information access

	abstract category	loca-tion	schedule	specified task	connecti-vity	control of UM	user type	UM technique	dyna-mic
M-T		+	+	+	+		+	stereotype	
M C	+	+	+			+		individual	+

User Model: Homecare workers are classified by profession. Therefore, Mobi-Timar user models use stereotypes which do not change over time, as a homecare worker's duties remain the same. Individual user models extend stereotypes with personal information, preferences, rank and experience, and may occasionally change. For My Chameleon, the logbook study revealed no possibility for using stereotypes. Although users had identifiable usage patterns, these were *individual* patterns. Thus individual data forms the content of My Chameleon user models, which may remain similar, or may change if activities change over time.

Task Model: Each Mobi-Timar user has to perform standard tasks. Each task needs specific types of information, and the information needs of tasks typically do not vary over time. There are no pre-defined tasks in My Chameleon. Any user may perform any task, and these are defined by the user. The nature of a user's activities may remain similar over time, or may differ according to course requirements.

Schedule: The Mobi-Timar schedule predicts task and context (time, location), so information can be pre-fetched. In My Chameleon the calendar predicts where a user is likely to be, to allow easy confirmation of the current location. Unlike Mobi-Timar, where users will definitely be at the predicted location, students are less reliable and may need to select their location from a menu. A second difference is that rather than specifying a location, students may use a descriptor corresponding to an abstract category (e.g. 'user modelling course' or 'on the move'), which is useful for atypical activities in a location.

Connectivity Model: Mobi-Timar's connectivity model contains a map of network connectivity for each location. An important issue is how to deal with disconnection and weak connections using proxy agents, when to pre-fetch what information and how to ensure data consistency when a disconnected user enters data using mobile transaction management [3]. My Chameleon does not require a connectivity model as users have on their devices the files that they may need.

User Control of the User Model: Mobi-Timar users should not be able to change the stereotype model as it is pre-defined according to the required tasks for the user class. However, they can change some individual preferences, e.g. interface layout. In contrast, the My Chameleon user must be able to change their user model, as they may need to work with some documents for a restricted time. They must be able to 'expire' links if required.

3 Summary

This paper explored some relevant issues for user- and location-aware adaptive interfaces for mobile information access, contrasted in two systems: one with predetermined tasks and locations, using a predominately stereotype approach; and one that employs individual user models built from user preferences for location and activities.

References

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