Human Computer Interaction with a PIM Application: Merging Activity, Location and Social Setting into Context

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Abstract. Personal Information Managers exploit the ubiquitous paradigm in mobile computing technology to integrate services and programs for business and leisure. Recognizing that every situation is constituted by information and events, this context will vary depending on the situation users are in, and the tasks they are about to commit. The value of context as a source of information is highly recognized and for individual dimensions context has been both conceptually described and prototypes implemented. The novelty in this paper is a new implementation of context by integrating three dimensions of context: social information, activity information and geographical position. Based on an application developed for Microsoft Window Mobile these three dimensions of context are explored and implemented in an application for mobile telephone users. Experiment conducted show the viability of tailoring contextual information in three dimensions to provide user with timely and relevant information.

Keywords: PIM, context, context-aware, Microsoft pocket outlook, ubiquitous computing, HCI.

1 Introduction

Personal Information Managers (PIM'S) exploit the ubiquitous paradigm in mobile computing technology to integrate services and programs for business and leisure. Activities performed with PIMs range from plotting appointments and tasks in a calendar to the automatic information exchange between mobile devices, different device synchronizations and base station communication. In every situation in our daily life, an independent context of information and events is defined. This context will vary depending on the situation users are in, and the tasks they are about to commit. Nonetheless, despite the fact that the challenge of defining context has already been addressed [1-3] and that its value as a source of information is

recognised, the link between context and PIMs is still an immature and unexplored area of research. This paper addresses the use of context in an everyday mobile phone based PIM application which makes use of context based information to enhance the user experience. The unique use of context in this PIM application combines activities, social information and geographical information.

2 Background

Developers and researchers agree that context is an important factor when designing new applications. With PIM devices becoming increasingly widespread and in daily use by a large population, this opens interesting possibilities for development. Such applications would potentially be used daily by people in their homes or at their workplace, especially bearing in mind that people carry mobile devices and thereby the application with them almost 24 hours a day. Recent arguments state the possibility for business travelers and other mobile workers to leave the laptop at home and shift entirely to mobile devices because of their increased capacity and convenient size.

Context in mobile applications has been looked at by more than a few researchers [1,10]. For example, Ludford et al. [8] looked at the use of context to provide useful information to the user on their mobile phone. In their work, context is based on the location and/or time of the day. This partly makes use of daily available context information, which, however, is not instantly fed back into the system as parameters for information retrieval. Efforts have also been made to make use of context as a tool for supporting business travelers in [8]. The definition of context here as the user's planned activity in combination with the location is quite interesting. This, because it generates quite a lot of information about the user, but information is of reduced interest if we have no way of making use of it. Zhou et al. [11] have also demonstrated the use of context sensitive information for the real estate business. These are just two examples out of many and one could only imagine many other possible scenarios. On an overall basis, though, the use of context in applications is often missing or single dimensional. This focus should be changed, since automated PIM applications which take into account the total context of the user would possibly be able to not only support the everyday tasks of the user, but also improve efficiency and ease the work of the user by automatically tailoring information to the user's needs and/or adapting the application to the user's current setting. The CityFlocks application [1] is one step in this direction, however it falls short of offering a full solution to the problem. The widespread use of small mobile devices (PIMs) has, as shown, forced researchers and developers to consider context as an important criteria for highly mobile systems. The notion of context-aware computing is generally the ability for the devices to adapt their behavior to the surrounding environment, hence enhancing usability [7].

Towards this goal, Dey and Abowd [2] state that if we understand context fully in a given environment and setting, we would then be able to better choose what context-

aware behaviours to sustain in applications. This could lead to more realistic applications and thereby applications more meaningful to users. This is also exemplified by Edwards [4] when he uses context information to build an application. In his application different layers represent different sources of information and they can be reused in later settings. Edwards argues that context is a major part of our daily life and that computing with support for sharing and using contextual information (context-aware computing) would improve user interaction. Indeed when viewing people rather than systems as consumers of information, a new infrastructure is needed.

3 Design

Our application interacts with the user by presenting information relevant to the users' context. To be able to do this, system design and functionality are split into three main modules, each of which generate context-aware information and responds to different user interactions. This enables a precise definition of elements and thereby tailoring of information to be displayed according to the users' actual needs. One of these main modules handles activity, one handles social context and the third handles the geographical location. The input from all three sources together provides the foundation for the user context computation. By this operationalization of context and context-aware concepts we are able to create a user context. This user context is then the foundation upon which the application takes action to present information. We now proceed to provide further details of each of the three modules involved in our PIM application.

3.1 Social context

This module computes the foundation upon which the social context is determined. Social context will naturally differ tremendously based upon each situation and for each individual. Still, it is possible to use one social context in common by several people by choosing concepts that are interpreted the same by most people. This is achieved through building a taxonomy of concept terms illustrated in Table 1 below.

Table 1. Taxonomy of social context

Categories:	**Leisure**	**Work**	**Travel**
Sub categories:	Shopping	Meeting	Train
	Cinema	Preparation	Car
	Spare time	Own time	Tube
	Food	Travelling	Foot
	Culture	Phone meeting	Transport

In our approach, building on the description of activities from Prekop and Burnett [9] information of the social context in the application are stored and meta-tagged as

Pocket Outlook activities / appointments. These tags are based on the above taxonomy and are implemented for the user through extending the standard Pocket Outlook category interface (Figure 1).

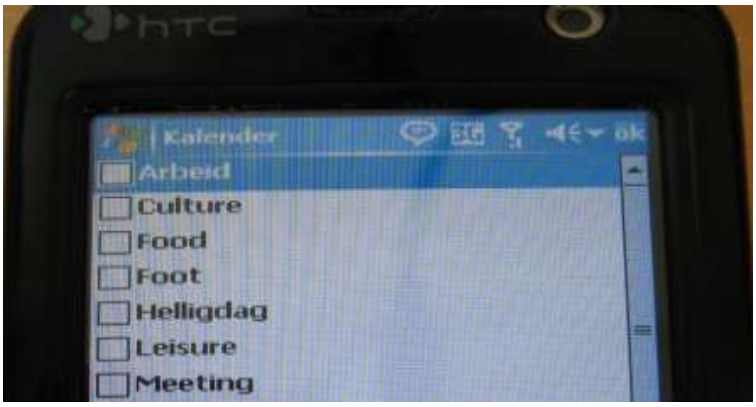

Figure 1: Taxonomy interface

Thereby the user can enrich (tag) the activity with category tags through a familiar interface and thereby greatly increase the familiarity of the system.

3.2 Geographical Location Module

This module calculates location based on input from the internal Global Positioning System (GPS) in the device. When a valid connection through the GPS device to a GPS satellite occurs, it returns location information to the application. The input from the GPS is then parsed and the actual location retrieved by inspecting the longitude and latitude coordinates. These coordinates are then mapped to a one of 16 specific zones (in our case, Oslo, Norway). As the user is moving, information about the current zone is updated and stored in the application. This is done by letting the device interact with the running applications data sources and although the user not actually is feeding any information into the device, the physical moving around is sufficient for context-aware exploitation of user information.

3.3 Activity Module

This module communicates with the Microsoft Pocket Outlook storage on the mobile device and retrieves appointments and activities. The module accesses the Pocket Outlook storage directly and also listens to system events generated in this storage. The user interacts with the activity module through the familiar Pocket Outlook interface, and attaches one or more of the category terms as described previously. In doing this, almost unknowingly, the user improves the quality of activity information and thus eases the use of the PIM application.

4 Implementation

The application prototype is designed for and implemented on a Pocket PC device [6] (HTC 3600 phone) using the Microsoft Windows Mobile 6.0 operating system. The application is programmed in Microsoft .NET Compact Framework with C# as implementation language. Geographical position is acquired through the use of GPS and activities and appointments are acquired through Microsoft Pocket Outlook. All data on the device are kept continuously up to date by computer synchronization with Microsoft Outlook 2007. This device is also chosen since it contains powerful enough hardware and has a decent enough storage area to be suitable for software development.

5 User Evaluation

The PIM application was evaluated with a test group of 15 users who undertook a set of social and work-related activities whilst navigating a route through central Oslo (Figure 2).

Figure 1: Suggested route through city

Users had to complete an evaluation questionnaire after the testing shown in Table 2 below. For all questions, users were asked to state whether they agreed or not to each statement. Measurement scale: *Strongly Disagree (SD)*, *Disagree (D)*, *Mildly Disagree (MD)*, *Mildly Agree (MA)*, *Agree (A)* and *Strongly Agree (SA)*. Each

possible answer from *SD* to *SA* was mapped to a number from 1 to 6, respectively, and the responses thus received were analyzed using a T-test (Table 3). We will in the following sections elaborate on the implications of our evaluation exercise.

Table 2. Questionnaire

1	The information provided by the reminder system correctly matched my current location
2	The information provided when I was "Sightseeing in old town" was incorrect.
3	The summary of blocked events I received after appointment "DNB Nor Solli plass" was useful
4	The system provides duplicated information
5	I liked the fact that the application is integrated with Outlook
6	The reminder system is useful
7	I would use this application in my daily life

User responses to the evaluation questionnaire are summarized in Table 3 below.

Table 3. T-Test results

Question	Mean Response	T-Value	P
1	4.80	8.088	0.000
2	2.47	-1.054	0.310
3	3.73	1.585	0.135
4	2.73	-0.654	0.524
5	5.47	12.854	0.000
6	5.20	12.602	0.000
7	3.93	3.287	0.005

From Table 3 we can see that all answers display a positive bias (Questions 2 and 4 are in fact negative statements about the application, therefore the negative bias here, reflects positive user statements). In question 1, 14 out of 15 answered that information displayed did match their current location and the responses are statistically significant. This would indicate a correct computed context and correct displayed information on an overall basis. For question number two, 11 out of 15 respondents were negative to that the information being displayed in one appointment was incorrect. This indicates that 11 got, at least partly, displayed correct information

and four had incorrect or no information displayed. There is thus a strong bias towards negative answers, a few (4) positive answers and no middle values (MA / MD). This polarization of results however leads to the data for this question not to be statistically significant.

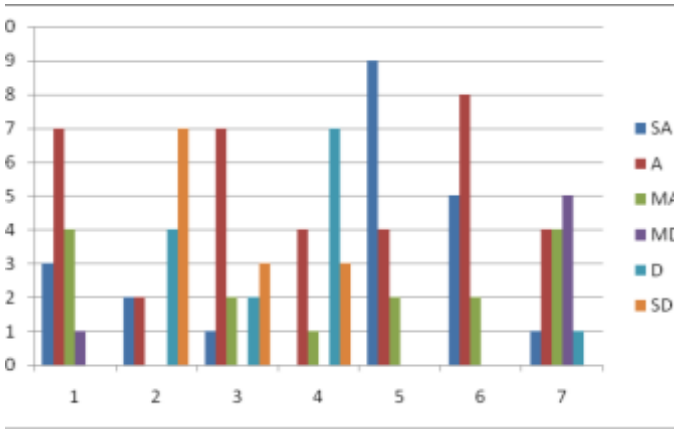

Figure 3: Questionnaire results

As described, the application prototype is adaptable to different scenarios and user settings, but a context dependent application needs to be tailored to the users' need when being deployed for a real life setting, e.g. the initial categories and their weight need to be configured in accordance with the findings of Prokop and Burnett [9]. When these issues are taken care of, the user experience might improve and increase even more the positive trend in answers to question six and seven. Moreover, as shown by Zhou et al. [11], information tailoring is an important task to help users interpret data. Our application focuses on tailoring by having minimal information displayed at the same time, when new messages are shown, thereby easing the users' interpretation.

Currently calendars and applications based on these do not take multi contextual information into account [7] as they often only reproduce the information already available there. Thereby, this can at worst lead to incorrect display of data and at the best a reproduction of data in a new interface. Our developed PIM application greatly differentiates from this by only displaying information based on the computed user context, given by the three factors social context, location and activity / appointment. Earlier approaches that have made use of calendar data from Pocket Outlook, often end in using Pocket Outlook data together with a simple timeline (i.e. [5]). In our approach, the use of Pocket Outlook data is extended to not only retrieve and display the data, but also to add extra meta-information to the appointments. Results from question five show that all respondents stated they liked the integration of the developed PIM application with the Outlook calendar. This is important because it shows they had no problems entering an appointment in one application, and having information displayed in another application (the prototype). In the evaluation

exercise, generation of information was tightly connected with the actual task at hand and participants were asked to judge whether or not they found the application useful (question six). Our results show that all 15 users involved in the evaluation thought the application gave useful value. This would indicate that the reminder system is an application with practical use for the users. One other side of usefulness is the behaviour of the device and the application. Therefore each was asked to evaluate these parameters as well in question six.

As a final question, after the test, the users were asked to state whether or not they would like to use this application in their daily life. As the t-test shows, the results for this question are statistically significant and one should note this indicates that the users found value in using the application in a daily life.

6 Concluding Remarks

Context and context-awareness have long been acknowledged as important and have generated considerable research effort. However, integration into PIMs has so far been limited and the perspective has often been single-dimensional. In this article, the main aspects of the design, implementation and evaluation of an application prototype which integrates context / context-awareness into a PIM from a novel three-dimensional perspective combining social-, geographical- and activity information have been presented. User evaluation of the proof of concept displayed a strong positive bias, highlighting its potential usefulness and applicability.

Based on the developed prototype, we have shown the viability and usefulness of our approach and we do believe that tailoring information in the manner described in this paper takes the PIM concept one step further towards the ideal of providing tailored and timely information to mobile information users everywhere.

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