Context-aware Mobile Assistants for Optimal Interaction: a Prototype for Supporting the Business Traveler

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ABSTRACT

Travel has many situations where context-aware computing can bring important benefits: pointing out notorious delays or bad weather during the planning phase, allowing the user to replan for handling unexpected situations, or suggesting flight alternatives to avoid strikes.

This paper briefly describes an approach for integrating context-aware computing to a mobile travel assistant. We show how context-aware techniques can ease user interaction within mobile device applications. The presented ideas are illustrated with a scenario using a first version of a working prototype called *Pocket reality*.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User Interfaces—*interaction styles, screen design, user-centered design*

General Terms

Design, Human Factors.

Keywords

Context-aware computing, mobile applications, travel replanning.

1. INTRODUCTION

The market segment targeted by i:FAO[1] is the business traveler. A mixed-initiative system, called *reality* [3], has been developed to provide advanced booking functionalities considering personal preferences and company policies as well. The goal of our mobile travel assistant, called *Pocket reality*, is to offer an added value to travelers who booked their trip with *reality* in order to increase its adoption rate.

When studying the profile of the target users, *i.e.*, business travelers, it has been found that they often need to replan parts of their trips. Imagine a business man attending a meeting with a potential customer. He is nervously eying his watch since his next flight is leaving in two hours and the negotiations are still not finished. Is there any available seat on a later flight? If needed, is there a room available in a suitable hotel? The primary goal of *Pocket reality* is to support the user to overcome such unexpected situations during his trip.

2. REQUIREMENTS ANALYSIS

The most appropriate way to interact with the user during his trip is by means of a mobile device. The development of *Pocket reality* is focused on PDA[2] devices for the following reasons: (i) it offers a great tradeoff between size and performance, (ii) it is well spread among business travelers, (iii) it emulates quite well the capabilities of next generations of mobile phones, and (iv) it offers multiple Internet connectivity features, *e.g.*, WiFi[3] (currently available in many public places), or GPRS[4]/GSM[5] via a Bluetooth phone

Developing PDA applications raises both technical and usability challenges with respect to desktop PC applications. Firstly, processor performance and memory size cannot be compared. Secondly, the screen is much smaller and the interaction model is slightly different.

Besides those obvious issues, another usability factor has to be taken into account: the social context. It is not conceivable to suppose that the user is in the same environment as if he was in front of his desktop PC. Let's imagine a business man willing to rebook his next flight because his current meeting is lasting longer than expected. Probably, he will take care of the situation during a short break or even during the meeting. Therefore his attention is less focused and he may easily be disturbed by external events. Thus, a key point is to minimize the interaction between the user and the application: this way, users save considerable time and efforts while reducing the risk of mistakes.

In order to achieve such requirements, context-aware computing paradigm is a suitable research area. Automatically taking context information into account dispenses the user of giving it explicitly, and enables the system to provide

[1] `http://www.ifao.net`

[2] Stands for Personal Digital Assistant
[3] Stands for Wireless Fidelity (IEEE 802.11)
[4] Stands for General Packet Radio Service
[5] Stands for Global System for Mobile Communications

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right services at the right time without requiring any user interaction.

3. CONTEXT-AWARE COMPUTING

Context-aware computing generally refers to applications that can discover and take advantage of contextual information [1]. Active context-aware applications can adapt their behavior according to context and take action in an autonomous manner. Passive context-aware applications only present context to users and leave them the option to decide what to do with the context. In the early days of this research area, most context-aware systems dealt with only location context [4]. In [2] and [1], Schmidt and Chen respectively extended the location context notion to include the following aspects: computing context, user context, physical context and time context.

The novelty presented in this paper is to use a representation of the user travel plan, called User Task Model, to deduce contextual information. Just by detecting the current time, the system is able to deduce not only the current location but also the current user activity and is also able to anticipate some of the user's intentions.

4. USER TASK MODEL

The User Task Model (UTM) is a graph with an annotated workflow. The graph represents the travel plan tree as a hierarchy of tasks the user has planned, *i.e.*, flights, hotels, meetings, etc., and the workflow indicates the linear execution of the plan and contains annotations required to activate proactive services, channel relevant information, or enable replanning user tasks. The construction of the UTM is done collecting data from various information sources without requiring any user interaction. The UTM is built every time a user plans a trip using *reality* by integrating: (i) booking information, *i.e.*, flights, hotels, rental cars, personal preferences and corporate policies; and (ii) meeting information coming from agenda software such as Microsoft Outlook. With the resulting UTM and current time, the system is aware of the current location and activity of the user. Furthermore, the annotations associated to the UTM are used by the workflow execution engine at the right time to invoke the corresponding actions, *e.g.*, proactive services, relevant information channeling and replanning tasks.

5. A SCENARIO

Mary is an important manager of a software company based in Geneva, Switzerland. She has to negotiate and hopefully sign an important sales contract with a corporation located in Palo Alto, USA. This meeting is scheduled on January 13th from 10:00 to 15:00. Afterwards she will attend a conference taking place in Las Vegas, USA, from January 14th at noon to January 16th at 16:00.

5.1 Before the trip

Some days before leaving for her trip, Mary books her flights with *reality* [3]. As she is member of the frequent flyer program of `American Airlines` and `Swiss International Air Lines`, she states those preferences to the system in order to find a suitable flight combination. Mary also enters the meetings in her agenda, *i.e.*, Microsoft Outlook, and then synchronizes it with her PDA. Afterwards, when she launches *Pocket reality* on her PDA, it retrieves the needed information (*i.e.*, bookings with personal preferences and corporate policies, and meetings), builds the corresponding UTM and displays it as shown in Figure 1.

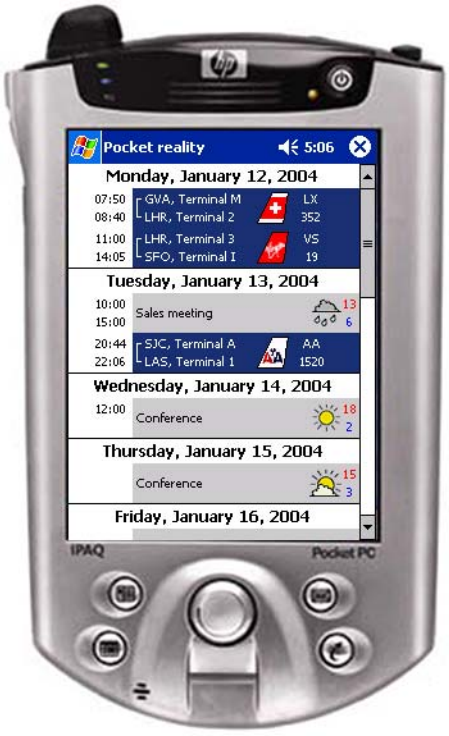

Figure 1: The different activities of the User Task Model are displayed chronologically from top to bottom. The current one is highlighted and past ones are grayed out.

5.2 During the trip

At 14:07 on January 13th, the negotiations Mary is conducting are progressing slower than expected. However, she estimates that a deal can still be concluded before 19:00. She enters that information in *Pocket reality* by *tap-and-holding* on the corresponding item. It informs her that ending her meeting at 19:00 will be too late for her next flight (Figure 2). The system proposes her some alternatives taking into account the preferences she set during the initial booking process. By *tap-and-holding* on any of the attributes of the proposed flights, she can criticize them to refine the propositions. The first alternative satisfies Mary and she decides to change her next flight accordingly (Figure 3). On the morning of her flight back home, *Pocket reality* informs Mary that heavy snow has been forecasted in Chicago (ORD) and that it may imply delays or even cancellations. She prefers to change her flight in order to avoid connecting through Chicago (Figure 4).

5.3 After the trip

After the trip, the User Task Model, that has actually recorded every step of the trip, can be used to automatically generate a template for the travel expenses report. Such a prefilled report can be easily completed and minimizes the risk of mistakes and omissions.

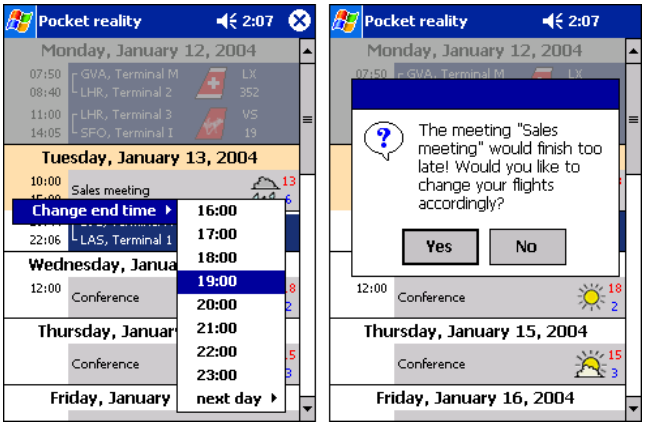

Figure 2: By *tap-and-holding* on the different items, the user is able to state the changes on his plan. If it implies important modifications (*e.g.*, change of flights), *Pocket reality* informs him.

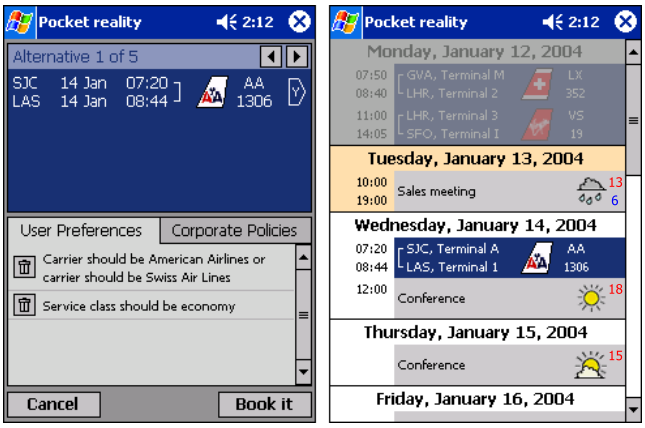

Figure 3: A set of alternatives is proposed to the user. Note that it takes into consideration the preferences set during the initial booking process. The user is able to refine the propositions by adding or removing preferences (mixed-initiative system).

6. EVALUATION

At this stage of the development, no formal user studies have been conducted yet. However, with the development of the presented working prototype we have shown how context-aware computing can bring important benefits to mobile applications, specifically with respect to the user interaction. Our approach enables development of smarter mobile assistants by minimizing the user interaction and thus providing better services and functionalities. More concretely, *Pocket reality* shows how our User Task Model can significantly reduce user's input and therefore facilitate user's interaction within mobile assistants.

7. FUTURE WORK

In order to enlarge the support *Pocket reality* offers to business travelers during their trips, more services and functionalities will be considered, for instance: proactively informing about traffic jams, strikes, flight cancellations, available parking lots, or automatically alerting meeting participants about changes.

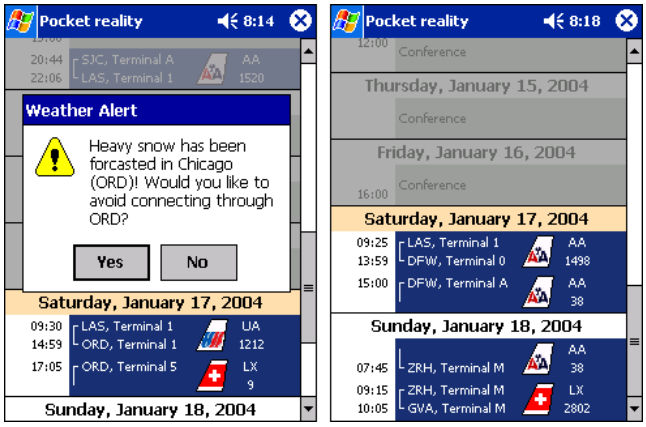

Figure 4: Alerts can be proactively sent if unexpected situations are detected. The user can decide to change his plan accordingly or not.

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