The Associative PDA 2.0

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Abstract
In this paper I describe the Associative PDA 2.0, a mobile system for Personal Information Management (PIM), based on an associative information network. In addition to associate items manually, context information is used for defining associations and thereby indexing data automatically. The design is limited to note-taking, allowing a representative example of a PIM application. I conducted initial interviews to receive background information about note-taking. The system will be evolved following a user centered design. It will be evaluated in a long-term study with authentic personal information to verify the design and usefulness.

Keywords
Personal Information Management, Associative Network, Context-Awareness, Ubiquitous Computing, Note-Taking

ACM Classification Keywords
H.5.m. Information Interfaces and Presentation (e.g., HCI): Miscellaneous, H.3.3. Information Systems: Information Search and Retrieval.

Introduction
Personal Information Management is the process of acquiring, organizing, maintaining, retrieving, and using information that is relevant to its owner and his

everyday life [1]. Since these activities often happen in transit, mobile support is indispensable. Despite the existence and availability of several mobile solutions to support PIM, there is no adequate solution yet. A major cause is the lack of an appropriate underlying information structure: hierarchical structures (e.g., folders containing files or more folders) are known to be inefficient in terms of information retrieval [2, 9]. Further problems are usability, flexibility, and the hardware.

The Associative PDA 2.0 (APDA 2.0) addresses this problem. It is based on an associative network of information. Retrieving information is either done by traversing the network or searching in the shared neighbourhoods of relevant items. Context information is used for defining automatic associations. Studies showed that the context of an event, such as writing a document, can be easier to remember than abstract properties, e.g., the file name of the document [7, 8]. This is additionally supported by the network structure, since in contrast to a hierarchical structure it provides semantic context, similar to information in the human brain [9].

The APDA 2.0 is a continuation and extension to the Associative PDA [4]. A major problem of the Associative PDA was its evaluation. It was a universal PIM system, and in user tests the subjects had to work with an artificial data set which was unfamiliar to the users, since it was not their own personal information. In this work I want to perform a long-term study and concentrate on the subjects' real personal information to get more authentic evaluation results.

To do so, I will limit my design to note-taking as a representative example of a PIM application and implement a high fidelity prototype. I chose note-taking as a representative example of a PIM application, because it is a mobile activity that can happen in transit and at any location.

With the APDA 2.0 three associations are defined automatically when taking a note: date and time, the location, and people present at the current location. We will assume that this information is always available and reliable. To adhere to exceptional situations, I will allow moderation of the automatic associations. Unapparent associations, like project or activity, can be added manually.

I conducted initial interviews about note-taking and derived implications for my design. I have created two paper prototypes which will be evaluated in a user study. Considering the feedback, I will then develop a complete note-taking tool. Multiple users will be asked to use the system for a period of four weeks and capture their experiences in a diary. I will analyze these diaries and log files from the system and perform additional interviews to understand the strengths and weaknesses of the system.

My goal is to show that a mobile personal information management system based on an associative network is beneficial for the user, especially when using meta-data for defining automatic associations.

Related Work

The Associative PDA [4] constitutes the foundation of this work. The fundamental concept is adopted and will

be extended by a detailed implementation and a long term evaluation.

There are two systems for PIM that are based on associations: SEMEX [2] and Personal Brain [11]. The APDA 2.0 differs from them in two important aspects: they do not consider the case of mobile devices, nor do they focus on the user interface, being concerned only with the underlying concept. However, SEMEX introduces several possible ways of realizing automatic associations.

In 1994 Lamming et al. introduced a PDA as a memory aid using context as retrieval key [8]. Stored information is indexed automatically with information such as location, encountered people, or workstation activities. Similar to the APDA 2.0 it is a mobile PIM system that uses physical context as a cue to recall information. However, it is not based on an associative network.

The APDA 2.0 will use WiFi tracking for location sensing and defining automatic association. Saha et al. [10] present ways of determining the location of a mobile device with the help of WiFi. I will adopt one of these methods.

The studies of Khan [6], Hayes et al. [5], and Dai et al. [3], give interesting information about the characteristics of notes and note-taking behavior. They indirectly show which requirements have to be met in a note-taking system.

Interviews

In order to receive more detailed information about notes and the note-taking process, to identify problems, and to extend and confirm related studies I conducted preliminary interviews. Seven people from a variety of occupations were asked about their note-taking behavior: three students, one university professor, one management assistant, and two lawyers. All but one were male and ages ranged from 25 to 40.

Among other interesting results the study showed that:

- notes are used as memory aid
- notes can be appointments, learning aids, shopping-lists, to-do items, conversation progresses, telephone numbers, addresses, events, bullet points from texts, project plans, etc.
- most subjects prefer paper for taking notes, because it is “faster”
- for time reasons most subjects do not structure or organize their notes, since note-taking mostly happens spontaneously
- the subjects often have problems retrieving notes, especially when there are many notes or after a long period of time
- almost half of the subjects keep their notes indefinitely
- one of the lawyers mentioned that date, time, location, and people present are exactly the information that he annotates on most notes

Roughly, the interview results correspond with the results of other note-taking studies [5, 6]. However, they differ in one important point. In related studies almost all people mention that they do organize their notes. In my interview only two subjects mentioned having a clear organization, mainly caused by the

organizational characteristics of their jobs (management assistant and university professor). But the other subjects do not organize their notes at all. This leads to a clear requirement of an automatic organization feature.

Altogether, the following implications can be derived for my design:

- device and system have to provide fast and steady availability
- the device has to provide fast text input
- large storage capacity has to be provided for collecting notes over a long period of time
- there is the necessity for automatic organization of notes
- the system has to provide efficient retrieval for fast note access

Design

I created two paper prototypes to visualize my design ideas. Figure 1 provides an example of how the note-taking screen could be realized. Figure 2 shows an example of the retrieval screen. Of course the design will evolve during user tests.

As soon as the device is switched on, the user can start writing. Three associations are created automatically and are displayed: time and date, the location, and people at this location. The user can change these associations add other associations manually.

Navigation is done through a history or by searching the network. The history stores data about opened

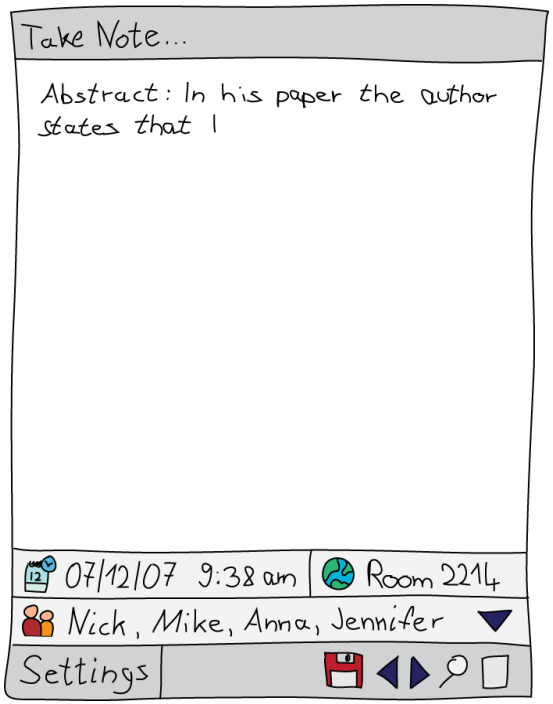

Figure 1: Paper prototype of the note-taking screen. Below the text input the automatic associations are displayed. The arrow next to them allows associating further items manually in a screen similar to figure 2. With the arrows in the menu bar the user can switch through the history. The floppy-disk icon stores the current note, the magnifier glass opens the search screen, and the empty sheet opens a new note.

notes and other displayed screens, so that the user can easily switch among these screens similar to a web browser history. To search for an item, the user selects related information. For example, if the user remembers that she took a note two days ago in the conference room, her boss was with her, and the

meeting was about PDAs, she selects these items and finds the note immediately.

Related items are found by type. For each type an appropriate search interface is shown. For people, e.g., a searchable list of names is displayed. For date and time, e.g., a selection menu with an optional calendar opens, where points in time or periods of time can be selected.

The result list is incrementally updated. The relevance of each hit is visualized, e.g., by icons representing the corresponding matching search item. An additional view could be implemented, showing a detailed view of the results in the associative network. This way the user not only has the advantage of an easily scan-able list view, where all results can be seen in one view, but also the possibility of looking at the coherencies.

Implementation

The final prototype will be realized on Windows Mobile for Pocket PC with an integrated full keyboard. This platform provides all necessary functions (like WiFi and Bluetooth) and is a good compromise of size and keyboard availability. The device also provides other useful functionality, like an organizer and a phone, to improve its overall usefulness and thus acceptance during the user study.

The location will be determined by mapping the signal strengths of available WiFi access points to physical locations. A more elaborate version might also use GPS, but for my design and purpose of research the WiFi alternative is sufficient.

People present are determined via Bluetooth. It is

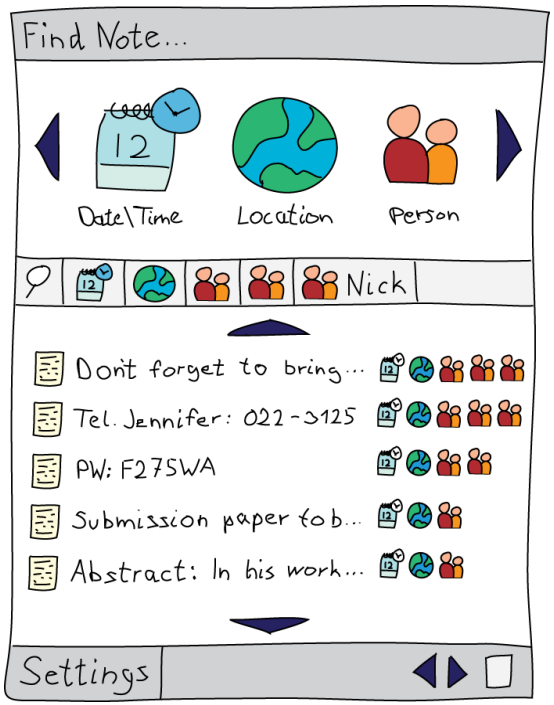

Figure 2: Paper prototype of the note retrieval screen. The association bar shows the available types. Dragging items to the search bar below automatically updates the search results. Space is conserved by minimizing previous items, which can be reopened. Removing an item is simply done by dragging off the bar. Below it the search results are shown. The icons next to each result indicate its rating: for each search hit the corresponding icon is displayed.

assumed that other people have a Bluetooth-enabled phone with them. Nevertheless, I am expecting some noise because of bystanders and misses because of the limited range of Bluetooth. To counter this, I will keep the automatic associations visible and changeable.

Location and people tracking is a hot topic in current research. Therefore I will not try to implement a perfect tracking system, but aim at giving motivation to improve current techniques, by showing that they are useful in the context of PIM.

Future Work

As a next step I want to evaluate my design ideas in multiple user studies. The paper prototypes will be presented to several participants. After receiving their feedback and improving the prototypes, I will develop a complete note-taking system. For a period of four weeks subjects will be given a Pocket PC with the system, which they will use in their everyday life. Not only their experiences will be captured in a diary study, but also log files will be created while using it. They will capture all kinds of events, e.g., how often the system was used for taking/searching notes or the number of search steps. For the diary study the subjects will be asked to write down in which context they used the system, encountered system errors and problems, perceived efficiency, etc. I will analyze both diaries and log files and perform concluding interviews to retrieve additional qualitative feedback. This way I will receive enough quantitative and qualitative evaluation results to prove or falsify my research question.

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