

Personal Mobile Navigation Systems - Design Considerations and Experiences

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Keywords

personal navigation, eGuide, personal assistant, situation aware mobile assistant, SAMoA, fair guide, exhibition guide, PDA, data-station

Abstract

For the CeBIT 2000, the Fraunhofer IGD Rostock developed the official electronic exhibition guide (eGuide) for palmsized computers and is thereby founding a new generation of personal assistant for fairs and exhibitions. This report describes the concepts and experiences with the application which has already been used by more than 40.000 user.

Introduction

Every business- or salesman knows the problem of a fast orientation on an unknown area like a fairground or an exhibition. For instance the CeBIT 2000 represents the world-wide biggest computer fair with approx. 8200 exhibitors in an area of more than 400,000 square meters. The exhibitors are located in 26 different halls, whereby some buildings have up to 6 floors, in addition are pavilions and open-air areas. The size of the fair-ground is tremendous. In case a visitor would try to see all exhibitor at the CeBIT, he has to walk a distance of over 30km. Some 700,000 visitors made the trip to Hannover from all over the globe to view the products and services presented by more than 7,000 exhibitors from some 70 countries. There, an orientation and fast finding of the searched exhibitor can be quite hard. But not only on trade fairs is a need for a good orientation system. Even for huge congress centers, on big exhibitions like the EXPO2000, on airports and as well for the shopping mart next door we can find the application field of a

personal navigation system. The Fraunhofer Institute of Computer Graphic in Rostock developed a personal guide on the platform of PDA's, (personal digital assistant) to assist the user by personal mobile navigation. That personal information system was presented on the CeBIT as the official electronic exhibition guide (eGuide) for palmsized computers and is thereby founding a generation of personal assistant for fairs and exhibitions. Since it's presentation the eGuide has been used also for trade shows like the world biggest industrial fair (Hannover Industriemesse), world biggest exhibition for printmedia (drupa, Düsseldorf), the world exhibition EXPO2000, in the large congress centers like in Hamburg / Berlin / München and also on events in France and USA.

1 Motivation

The common goal of the exhibitors is the exchange of information, reach out for new personal contacts, knowledge exchange, advertising or simply doing an effective presentation. A fair only can lead to success if the right people will meet each other. At the exhibition the little time has to be used effectively which remains to a visitor. This task is been taken seriously by the Trade Fair Organization. Some different methods are tested, in order to give the visitor a guiding assistance. Traditionally, catalogs can be bought and everywhere are maps available, distributed free of charge. For a few years the EBI is on duty, the electronic information system. The EBI is a stationary information center, where the visitor can retrieve his queries by a printout of the desired information. Unfortunately this service can be affected by rush hours and can produce some waiting periods. Since the availability of

electronic Organizer and PDA's, electronic lists of the exhibitors are available. Before the CeBIT2000 the electronic lists contained only a text-view application to see the name of the exhibitor and the hall / location. The use of these exhibitor-lists by the portable computers was just a transforming of the print media to the electronic device and not a special use of the capabilities of the mobile technology. By regarding the possibilities and requests of the modern information technologies it becomes visible that a simple lot of space for large fairs on "a green meadow", without any service, is not sufficient any longer. The central task of a fair is the goal to bring visitors and exhibitors together. It would be very insufficient only to replace the use of conservative technologies with modern or to exchange the characteristics without considering further possibilities and aspects.

2 The SAMoA Framework

For the design of the eGuide two basic concepts had to be implemented. First is the use of the ultra mobile computer as a new tool and feature set which are now available in comparison to catalogs, paper or prints. Fair guides of a new generation can't be just the substitution of the print media. The digital exhibition guide represents the information in an innovative way and can use the advantages of an eternal database, the Internet. Information is not just displayed the data is combined, computed and linked and can be visualized by representing spatial relations.

The other concept is to use context information to process the data. The main goal of using a mobile computer for helping and support the user is to assist him. This can be done by taking care on the user's needs, aims and wishes. A non-intelligent catalog or book can never calculate, estimate or suggest something to the user. To support the user such a way, it is necessary to track interactions, get input by the surrounding and environment and adapt to the present situation. Only when the system knows where it is, it can display location related information like where the next exhibitor or restaurant might be.

To fulfill the task of setting up a new kind of exhibition guide, this can be only solved by the look to the past in dependency to the future. These considerations are affecting the architecture of the system. The architecture of the eGuide consists of the SAMoA (Situation Aware Mobile

Assistant) and PIN (personal interactive navigator) framework. This framework is built around the following concepts:

Tasks: A user might have several tasks to accomplish that are simultaneously active. Each active task consists of a task definition and a task state. The task definition describes the task's internal structure, the individual subgoals a user has to reach in order to fulfill the task. The task state describes which goals still have to be fulfilled.

A critical aspect here is the task definition language. This language must not only be simple and intuitive enough to allow task definition by the end user ("end-user-programming"), it also needs to support incremental and ad-hoc modification resp. creation of (sub-) tasks by the user in order to account for the unpredictability of real life. Currently, we concentrate on the second requirement – incremental modifiability. Here, a specific derivative of rule-based systems, namely production systems, seem to provide interesting conflict resolution concepts (specificity, recency, refractoriness, rule-ordering) that support the ad-hoc modification of rule sets even during execution.

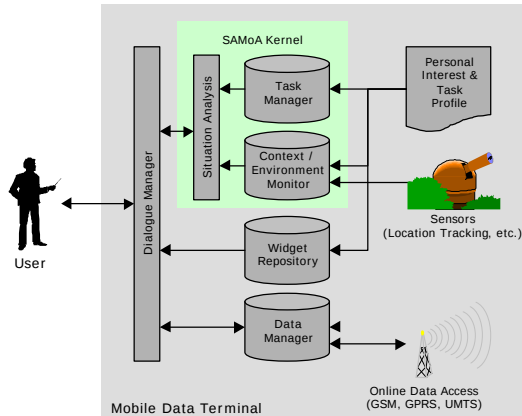
Other task description models, such as the GOMS-model or MAD (Méthode Analytique de Description de Tâches) are further potential approaches to a task definition language. Common to all task modeling mechanisms is the concept of dividing a complex task recursively into subtasks until basic activities are reached. Within SAMoA, this notion has a definite and obvious meaning: a basic activity is a subtask that does not span multiple situations.

Situations: The "situation" is the second important concept in SAMoA. It contains the following aspects:

The user's physical environment (objects in proximity, etc.), including his own position. The user's currently active tasks with their respective states. User preferences (subjective task priorities, individual preferences for processing orders, etc.)

Contexts: There usually is a lot of information, – documents, sketches, contacts, notes, etc. – connected to a task, which is not part of the task definition itself, but nevertheless important to the user for fulfilling the task. This collection of information items is called the task's context. Although one information item could be contained in more than one context, there is only one context per task.

When a situation changes, it is useful to switch the context accordingly (i.e., to the task active in the new situation), providing the user with all the information required in the new situation.



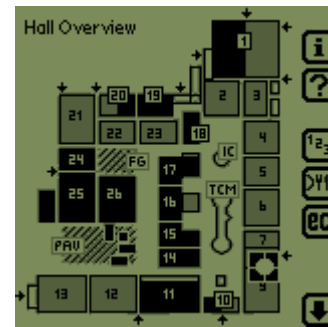
Pic 1. Situation Aware Mobile Assistance - the SAMoA Framework

In the special application field of personal guides for fairs and exhibitions no experiences, rules or even expectations were known before. That was the reason of using a new method of the verification of the software-prototype. Every event where the eGuide has been used, the results of the feedback could give new clues and ideas which could be implemented in the next software release. By this short-term implementation of the feedback we could archive a fast progress in the software development.

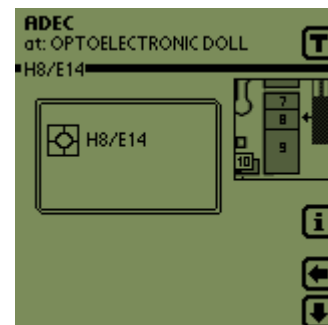
3 Design Considerations

The user of modern technology is flooded by impressions and information, on every fair the exhibitors are trying to receive the highest regards by innovative superstructures, posters or multimedia presentations. The visitor is interested not in receiving the most information but the correct and condensed. In order to give a visitor on exhibitions a guiding assistance, it is necessary to provide him the correct information at the right time at the correct place.

With the help of the Internet, at home the user can do a research on the exhibitors, plan a tour and download the personalized database on his organizer comfortably.



Pic. 5, Screenshot of a palmsized computer, the overview of the fairground, CeBIT 2000



Pic. 6, Relative position of an exhibitor in the specified hall

A system like the personal assistant has to support the user during the execution of his present tasks. During the design of a exhibition guide, the inference regulation is feasible without separate consideration of contradiction analyses. A dynamic production of task models is not necessary because the goal and intention of a visitor can be assumed as known during the phase of implementation of the system. By the design of the system it is useful to consider the interaction components and the hardware of the computer. The pen controlled display with 160*160 pixel (2 bits depth of shade) needs to be integrated in a useful software, also reflecting the availability of max. 2MB of memory.

For approx. 8250 exhibitors a search function is to be implemented, which allows a fast access to the exhibitor list. Useful is an alphabetical search function. Also exhibitors can be subdivided into different topics, regarding that some of the exhibitors can only be found as a co-exhibitor of another company. The information, for example A1/4g8, helps the user only a little. Due to a general map the user can identify the hall A1, but 4g8 is probably only possible to find by searching

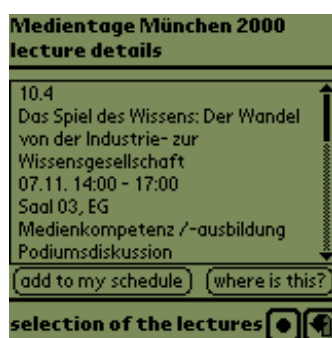
further signs. The electronic fair leader for the CeBIT determines however the relative position of the exhibitor within the hall. The search function displays the hall/location and displays a drawn hall with the position of the exhibitor.

Due to the different shapes of the halls, an efficient way of saving storage space was to vector the detail layout. The additional information, like position of the EC machines or restaurants could visualized easily by that.



Pic. 8, Organizer of distributed physical objects in location and time

The design basis for information systems are already known for a long time. Not only presentation, visualization, accessing of data is the main task, it's also the permanent availability, the ubiquitous computing. The exhibition guide is no application for a note book or a PC, the application has to be mobile, on palmsized computer or even a smaller device. Still it has to be possible to write down a short note which can be stored later on the PC.



Pic. 9, Lectures details of a congress event

For receiving new input and results, the CeBIT will be used to give new ideas and innovations. Today the exhibition guide is available in a couple of implementation forms. A download via

Internet or on the fair itself by infrared data beaming stations and a wireless connectivity.

4 Results / Experiences

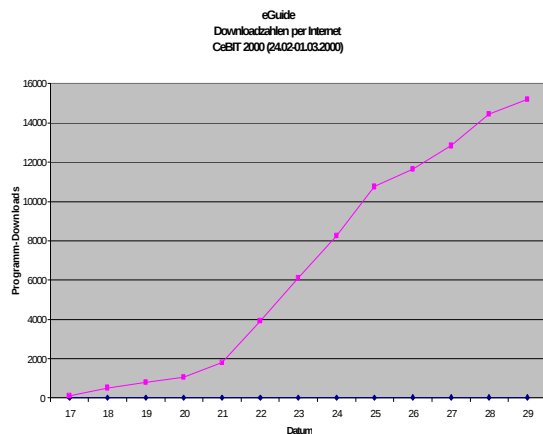
The main features which are on the focus of the optimization are described by the following difference between the electronic media and the traditional printmedia. Obviously a listed order of topics can never be complete but the arrangement gives a good clue about the basic concept of the eGuide. Each point could be verified by a redesigned application and shows the steps of the evolution.

Considerations and experiences:

Actuality - At the EXPO2000 hundreds of nations offered and presented an unbelievable amount of shows and events. Unfortunately the most of the events were known just one or two days before they started and so it was not possible to print the program in booklets, magazines or flyers. These events were only published via the Internet, daily news and by the Fraunhofer's eGuide. This shows one of the main advantages against the printmedia. Electronic media like ebooks, radio, TV, eGuides etc. can visualize data immediately and just on the fly. The database of the EXPO2000 guide was automatic generated by a server process to allow an access to a daily updated information base.

capability of unlimited copies - On a fair like the International Car Show like the IAA'99 in Frankfurt the organizations can't guess the number of the prospects which they really will need during the exhibition. The great effort to organize and distribute the right amount of printed media can be minimized by the use of electronic media. For instance on fairs like the 'IBM Partnercamp 2000' the organizers had the wish to provide the eGuide to every visitor who wants to have it the software eGuide. The electronic media has the advantage of an unlimited reproduction if there is the need.

In total, the eGuide has been published now in over 40.000 copies. Only for the CeBIT there were over 20.000 Internet downloads, ca. 8.000 downloads at the data stations



Pic 2. Internet download statistic of the eGuide for the CeBIT 2000

Voluminous - The catalogs for fairs like the CeBIT have the volumina of a thick book. But even that size is small against the capacity of the electronic media. But beside the storage-capacity, the eGuide can hold links to further sources of information - Internet links. This linked information gives the access to the unlimited database - the world wide web.

personalization / personal assistance - On a trade show where thousands of exhibitors are present, only a few of them are on the focus of interest by the single visitor. For instance on the CeBIT with more than 8000 present exhibitors, only a little can be visited during the open hours of the fair. For the application field of fairs and exhibitions, the eGuide set up the first personalized database for mobile computers. For the CeBIT it was possible to create a personalized database in the Internet by interactive search and choices. This online generated personal database could be downloaded to the PDA. The smaller database implements a smaller code size and more capacity for other applications on the PDA.

Distribution - For the distribution of the program eGuide there were a couple of possibility used. Beside the download possibility of the Internet a new kind of distribution was used.

The Fraunhofer IGD Rostock organized the probably biggest beam action of the world by the use of data-filling stations at the main entrances of the fairground. At these stations the software could be downloaded from device to device by the standard infrared port.

On the worlds biggest fair for printmedia, the drupa 2000, online terminals were installed with

the opportunity to download a personalized software directly on the fairground.

For smaller events the software is developed in such a way that it can be transferred from device to device. Using that feature it is possible to distribute the software on a fair or congress like by the snowball system. To create an exhibition guide which includes all the specified data, links, categories has to be automatic generated. The eGuide uses a very use- and powerful data exchange format, the XML. By the use of a converter, a resource independent conversion of the source code to the destination hardware can be possible. On the fair Systems'2000, german's second biggest computer-fair, the service is also provided by wireless communication systems, the WAP.



Pic 3. A data-station at one of the main entrances of the CeBIT 2000



Pic 4. Infrared beaming from device to device

Security / deletion - Even electronic data can be copied, reengineered, changed or deleted it has an elementary advantage, the security. To let data vanish from any printmedia you have to destroy the media. By the use of personal computers a good deletion-routine wipes away the data without any waste. A personal assistant must be

very discreet and this can be done by electronic systems very easily, if necessary it can hide information till the very end of the program or device.

situation aware - A modern system of mobile assistance has to interact with the environment. A personal assistant which is blind or deaf can't be a good assistant. The eGuide's architecture includes a core with the functionality of situation aware. A situation is more than just location management or user preferences. A situation includes the history of the entire system and incorporate that into a context. The eGuide uses different mechanism of obtaining the information of the special interest. The eGuide doesn't combine just a location (a room, booth or hall) with related information - the spatial information implies to be in a special situation (why is who with what when and where). The present task and situation gives a curtailment to the available information and is a need to retrieve the right information.

Usability - A user isn't satisfied by the pure access of data. It is highly necessary to work with the data, to transform it, copy, transfer, save, export and simply use the data. The big disadvantage of the printmedia is the lack of possibilities to work with the data. Visiting an exhibitor also means to make notes about the visit, exporting notes, addresses and import interesting data to other applications. Another concern of the usability of the program is the efficiency for the user. The duration time of installation, and to get familiar with the software must be short also the time to receive the necessary data. The output of the system must be high so that it is worth to work with all the circumstances.

The usability of the system can also be exist by a total different scope. For exhibitors it can be quite useful to know, which topic of the booth was the point of interest or how many persons came by actually. These and more statistic function and also advertising or a news broadcast which can be implemented into the software can be a special meaning of the usability.

For the improvement of the eGuide it becomes necessary to receive a useful feedback by everyone who is involved with the system, mainly the user and provider. The direct way to come to the feedback is the data-station, where people can

download the software and can get in discussion. Another way is the use of a questionnaire which was available in the Internet, a direct feedback by the wireless versions WAP and of cause the Email feedback. To compare the useraction and the feedback, it is necessary to know how high the interaction and preparation time with the system has been, the skill level of the user and other circumstances.

The return of the questionnaire could evaluate the concepts and architecture. Only 40 % of the returned questionnaire were anonymous. This is one good criteria of the reliable source. The main message was a high acceptance of a personal assistant. Still there is a need of a higher range of the provided information, e.g. a shuttle plan on the fair ground, a better routing, an overall travel information, an extended search of the exhibitors by products, categories, office address etc. Another point of the acceptance of the personal guide is beside the price the effort to receive the system. A download time by the Internet of 3 minutes with an installation time of more than 10 min is well accepted because the user is at home or in the office and can use the download time for something else. On the fairground, the time counts different, 2,5 min is a borderline.

5 Conclusions

The increasing number of mobile applications represents the request of personal support for the user. The time is right for a personal mobile assistant basing on PDAs. The high usability of the exhibition guide shows the efficient use of the combination of modern and mobile technology and the presentation of information. The eGuide was the first exhibition guide with a graphic visualization of exhibitor location. Personal navigation systems for fairs and exhibitions will be a market and the service is established now. The flood of information needs a reduction and conversion to the substantial. The efforts of an adapted knowledge representation via mobile technology will thereby take a strong position in the future.

The usage of context information can improve the human computer interaction. Especially in the mobile environment where the environment and user needs can change rapidly the use of context information is very important and will be a standard feature of mobile applications in future.

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