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Design of a Handheld Interactive Support

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The growing availability of small devices whose computational and interactive resources are continuously increasing in terms of power and capacity has raised an interesting discussion on how to exploit them to support users in various context of use. We propose a solution that can be easily adopted for museum visitors. The basic elements are the use of a multimedia PDA (without the use of location-aware technology) whose main purpose is to support a user who can move freely about within a museum. The user interface is structured in such a way as to allow users to easily orient themselves and then provides the information that can be interesting for them.

Keywords: Handheld support, context-dependent design, PDA application

Introduction

The growing availability of small devices whose computational and interactive resources are continuously increasing in terms of power and capacity has raised an interesting discussion on how to exploit them to support users in various context of use. In this work we consider users who freely move about a building (in particular, in a museum). In these environments the most effective support is currently provided through either interactive multimedia kiosks or interactive audio recorders. In the former case the main limitation is that the kiosk does not allow the user to move while receiving information, whereas the latter allow the user only to hear predefined texts associated with each work.

In the meantime, at a research level an increasing interest in location-aware systems has arisen with the goal of better assisting users. However, systems based on automatic generation of location-aware information suffer from the limitations of adaptive systems, in which often users interact with an interface that changes in the attempt to better support them, but which in doing so actually causes disorientation. For example, one typical problem with location-aware, in-door systems is that they can automatically generate information regarding the closest work of art while the user is actually looking at one that is located farther away. In addition, location-aware systems often require technology that is either expensive or difficult to install in a widespread manner or do not work perfectly in all circumstances. For example, infrareds need to be installed for each work of art and require that the emitters and the receivers are lined-up in order to communicate.

In our work we have designed an application that aims to overcome such limitations. We propose a solution that can be easily adopted by many museums without requiring difficult to install technology. The basic elements are the use of a multimedia PDA (without the support of location-aware technology) whose main purpose is to support a user who can move freely about within a museum. The user interface is structured in such a way as to allow users to easily orient themselves and then provides the information that can be interesting for them.

Related Works

Museum visitors can be assisted in various manners. One possibility is the use of Audio Tours: visitors can use a sort of large telephone receiver; see for example [1]. They can select the work of interest by entering its code through a numeric keypad. Audio Tours are precursors of electronic guides. They are useful but have a very limited visual channel.

A more interactive support has been adopted in the *Whitney Museum of American Art* [8] in New York. The application is implemented on a tablet PC and integrates the description of the works of art with videos and interviews. The basic idea [5] is that visitors can download information from the museum web site [7] during the visit through a wireless network. The problem is that usually the time of finding and downloading interesting information is particularly long and the tablet is difficult to manage by a mobile visitor, as it requires the use of both hands.

In location-aware systems the information regarding works or sections is selected depending on user position and length of stay in that position. This information is used to understand what the user's interests are. This approach has been used for the Hippie system [3] developed at GMD within the HIPS [4] project. The authors have also considered how to effectively present information to the user while taking into account the user model (interests and preferences of users). This project also addresses the problem of how to adapt the user interface to the user model. The model can be modified either directly by the user at the beginning of the session or by the system's taking into account the history of user interactions and the choices performed by the user [6]; in both cases the system highlights proposals for further information to the user through a blinking light-bulb. The suggested information can be accessed through links to the descriptions of the works that best correspond to the current user model. When accepted the suggestions are used to updated the user model.

The limitation of this approach is that often the user's position alone is not enough to indicate interest in the closest work of art; external reasons, such as the a crowd preventing movements, can be the reason for a user's stopping. Thus, the risk is

that the system wrongly identifies the user interests and determines the corresponding user model.

One solution to the limitations of location-aware systems has been proposed [2] for visiting "Filoli", a Georgian Revival house. In this case the application provides the users with an image of the current room with the works of interest highlighted by red borders. Then, the user can select the object of interest with a pen which activates an audio comment or a video. It is possible to change the viewpoint of the room's representation by selecting one of the device's buttons. In this case, one possible limitation is the use of pictures to represent the room content duplicating the information that the user is already seeing, with the further risk of requiring too many interactions to identify the selectable elements of interest. In addition, this solution is valid only for those museums where the elements of interest are ordered along each wall, while it becomes difficult to follow in cases where they are spread throughout the room.

In the next section we will discuss our solution that agrees with the approach proposed in the aforementioned work on the limitations of location-aware systems, but proposes a different way to represent and select information of interest.

Our Design

In our approach the design is driven by three main elements: the tasks users wish to perform, the objects they need to manipulate in their performance (both interface and domain objects) and the context of use that includes both the device used for the interaction and the environment where such interaction occurs.

In the design of the user interface we have considered three types of tasks that users can perform in the context considered:

- *orientation within the museum*, for this purpose three levels of spatial information are provided: a museum map, a section map, and, for each physical environment composing the section, a map with icons indicating the main pieces of work available in the room and their location. By selecting such icons the picture of the related element is displayed along with some basic information and the corresponding audio description is activated. The purpose of the picture is not to show the details of the work of art (that is supposed to be in front of the user) but to allow the users to check that the work that they are looking at is really the one that they are interested in.
- *control of the user interface*, for example, to allow changing the volume of the audio comments, to stop and start them, and to move through the various levels of detail of the museum description;

- *access to museum information*, also this is provided at different abstraction levels (museum, section, physical environment, single work).

At any time the application is able to highlight where the users are in the museum area, assuming they are in the same room as the works last selected (see for example Figure 1).

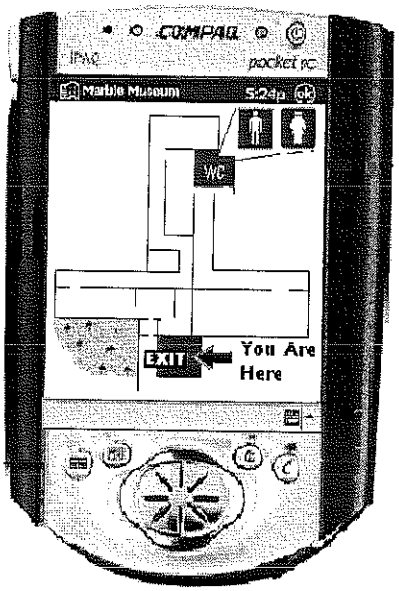


Figure 1: Presentation of orientation information

The information regarding the museum and the works that it contains is provided using both the audio and the visual channel. The visual information is mainly used to allow users to orient themselves and receive some supplementary information. It provides information at different logical levels:

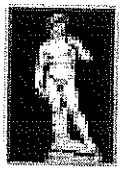
- The museum, it displays a map that shows the logical organization and the physical structure of the museum.
- Sections, the map of each thematic section of the museum is provided, when it covers multiple physical environments it is possible to select each of them to get more detailed related information,
- Environments, they are either rooms or separate environments partitioned with various techniques; the system provides a map with icons indicating where the main objects of interest are located;
- Works of art, in this case a picture and basic information are provided.

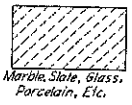
Since the museum considered is an interdisciplinary museum that contains various types of works, different icons are used to represent each type:

 for showcases containing historical artifacts, models or reproductions;

 for pictures or photos hung on the museum walls.

 for capitals.

 for representing sculptures.



for the marble exposition.

 for the reading-desks.

An alternative solution would have been to use pictures of the works considered in the room map instead of icons. However, the resolution of the PDA (240x320) would have made it difficult to interpret such images. The picture below shows an example of room map annotated with icons highlighting the main works of interest. The doors represented in the map are interactive and allow the user to change the room representation in the PDA (while physically moving in the new room).

Figure 2 Room map annotated with icons.

The audio part has been implemented reflecting the logical structure of the information to provide. There are comments introducing the museum, its sections,

each environment and each work located in them. They are provided in two languages: English, using text-to-speech synthesis. The resulting audio message is a bit metallic, but clearly understandable even by non-native English speakers. The other language is Italian, for which a prerecorded female voice was used for the comments because the synthesised speech was considered unpleasant.

The Context of Use

For the context of use, we consider both the interaction resources used and the environment where the user performs the tasks.

The application has been developed on a Compaq Ipaq 3650, with windows CE and 64 Mbytes Flash Memory Card. We have used Embedded Visual C++ 3.0 as programming language and the MFC toolkit for the user interface development. We decided to use text-to-speech synthesis for supporting audio comments. Unfortunately, the possibility of dynamic generation of text-to-speech is not supported in these environments because the Microsoft Speech API library is not yet available for Windows CE. In addition, the Italian version was considered unpleasant and was replaced with audio recorded comments.

Currently, the application contains description of 121 works, each of them with an associated Jpeg picture (dimensions are about 140x140 pixels). The audio files are in MP3 format. For the English version we have used text-to-speech provided by Text Aloud MP3. Overall the application requires about 30 Mega of memory.

The application has been developed for the Marble Museum. The managers of the museum decided to provide their visitors with information additional to that contained in traditional labels. They often had the problem to find guides able to provide such information and in some cases the guides were not able to communicate with foreign people. The structure of the museum forces to some extent the order of visit among the rooms. Such rooms contain many types of objects from the ancient Romans to pieces of quarrying technology of the past century. Thus, visitors need support able to interactively select those more interesting for them and receiving related information.

Conclusions and Future Work

The first complete version of our application has been implemented and just released to the museum where it will be used over the summer that is also the period when there are more visitors. Some of them will be required to fill in a questionnaire with a number of detailed questions that will provide useful feedback on the usability of the application.

Future work will be dedicated to identify adaptive features of the application that can increase the user interest without disorienting them.

Acknowledgements

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