Minimal Interaction for Mobile Tourism Computers

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In this paper, we present two contextually-aware mobile systems: one suited to the indoor museum environment and one to outside environments. Our concern is with producing devices that involve minimal interaction. Both systems are designed to respond to changes in the user's location to modify the information displayed, i.e., the user interacts with the information simply by moving around the environment. The systems also respond to simple speech and gestures to allow the user to navigate the displayed information.

1 Introduction

A context-aware computer could employ the tourist's location, a model of the tourist and a definition of the media used to display information, "…in order to provide tailored functionality." [1]. As far as the domain of tourism is concerned there are three broad areas of previous research that are of interest: dynamic labeling; user adaptation; physical hyperspace.

1.1 Dynamic Labeling

Milosavljevic et al. [2] point out that the labels used in museums "...are written according to the assumed knowledge and needs of a single restricted audience model." So, the information used to describe an artifact will only be sufficient for a specific type of visitor (and often for a specific type of visitor query). Thus, the label might contain the name of the artist, the title of the painting and the probable date of completion of the work. Visitors wishing to know more about a painting will need to consult the guidebook or a tour-guide. Consequently, an electronic device that can present information to visitors could be made dynamic in the sense that its content will change for different visitors and can be used to answer a variety of visitor queries [2, 3]. This removes the need for paper labels that detract from the experience and aura of the works of art on display.

1.2 User Adaptation

In order for dynamic labels to accommodate a variety of visitors, it is necessary to have some means of adapting to different types of visitor. This requires some form of user model [4, 5]. For instance, Milosavljevic et al. [2] propose dividing visitors into 'naïve' and 'expert' (depending on their background knowledge), and to allow visitors to select one of several languages. This approach seeks to classify individuals in terms of a set of criteria. An alternative approach would follow from the work of Cooper [6], and define users in terms of the type of visit that they will make. Falk and Dierking [7] suggest that it is possible to typify visitors in terms of visit, and we follow this work to propose the following examples: first time visitor; return visitor; systematic route follower; cruiser / browser; artifact spotter; specific artifact searcher. Without going into detail about the defining characteristics of these visit types, it is clear that one might anticipate information requirements to vary across these groups. Current work is being undertaken to survey museum and art gallery visitors to develop this classification scheme.

1.3 Physical Hyperspace

Having a system that can determine the visitor's location, and then modify information to suit that location is the central aim of the HyperAudio project [4, 5, 8, 9]. Exhibits are provided with infra-red (IR) transmitters and visitors carry a device that incorporates an IR receiver. When the transmitter and receiver are within range, an audio commentary begins to play. In this work, electronic information is stored in a hypertext format an"…moving around the physical space…the visitor implicitly 'clicks' on meaningful points of the hypertext." [6]. This merging of computer and real worlds has been termed 'physical hyperspace'. The merging could either involve audio information and artifacts [9], or visual information and artifacts [10].

1.4 Focus of paper

In this paper, our concern is on the development of user interfaces and systems that support minimal interaction. The broad aim is to produce systems that can be used whilst a person is interacting with the environment and the objects it contains. This means that we wish to create a means of interacting with the computer that can be merged with the interactions with the world. Thus, devices that might require holding in one hand and selection (e.g., via pen or touchscreen) with the other will also involve visual attention to be directed at the display. For such systems, interaction with the computer will involve disruption to interaction with the environment. Consequently, we have been investigating various approaches to allowing the user to maintain focus on the environment whilst also interacting with the computer. In the following sections, the intention is to describe several working prototype systems to provide an idea of the work that has been undertaken. The systems have been evaluated through user trials that have been reported elsewhere and that will be briefly reviewed in the conclusions section.

2 The IMPS Project

The Interactive Media Presentation Study investigates different ways of presenting information in art galleries (Baber et al., [10], [11]). Although in this paper we are not directly examining ways in which information is presented, this study demonstrates indoor location-based contextual information presentation.

Visitors to an art gallery or museum are typically interested, at any given time, in the painting or artefact directly in front of them. Thus a system for identifying each painting to the presentations system is needed. A locating system was devised using a very simple Infrared (IR) link that sent a 4-bit painting Identity (ID) code from the painting to the presentation system.

As the user walks in front of the painting a badge on their person receives the ID code from the transmitter next to the painting. This ID code triggers a presentation relating to this painting. At present the system only uses a 4-bit code allowing only 16 paintings or artefacts, however it would be very simple to enhance the system to cope with more painting than even the largest galleries hold.

The IMPS system increases contextual information by giving the user an ID as well. This would allow the presentations to be tailored to the user, e.g. an art expert may wish for a more detailed presentation than a child.

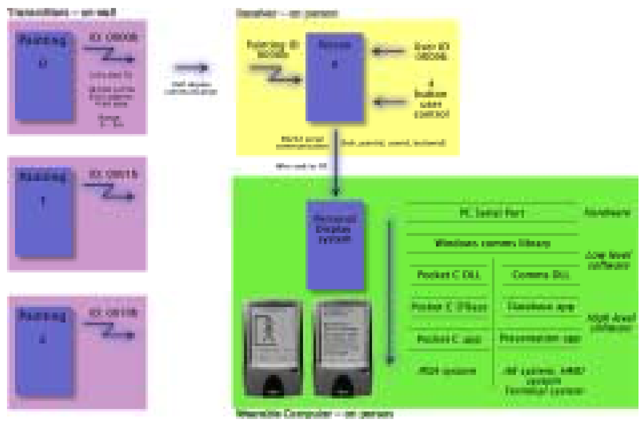

Figure 1 - System Overview

Thus, the system provides indoor location-based contextual information to the user. While an IR-based locating system works well indoors it is inadequate outdoors. It is not suitable for large distances and the size of task to add the infrastructure to the outside world (i.e. putting small IR transmitters of every building) means it is not well suited to the outdoors. A different tracking system is needed to give users location-based contextual information in the outside.

3 The χ^3 and WECA PC

The χ^3 is a wearable computer developed at the University of Birmingham (Cross et al. [12]). WECA PC runs as an application on the χ3 and it is designed to give the user location-based contextual web-based information while moving around the outside world.

3.1 Technical Set up

The χ^3 uses a PC104 embedded pc board. It has SVGA out, two comm. Ports, on-board LAN and USB sound. The main unit is a 166Mhz Pentium class chipset capable of running the necessary software. A Head-mounted display is used as the display system, with the addition of a SVGA to NTSC converter allowing the screen to be made larger for reading text. A Global Positioning System (GPS) is used for tracking the users location, the GPS is accurate to a small number of meters but some problems were found and are discussed later. A mobile phone is used for connecting the χ^3 to the Internet.

Figure 2 - The χ3

χ^3 measures 170 mm by 40mm by 100mm. Even with the addition of the head mounted display and battery the system is comfortable, light and easy to wear.

Figure 3 - The first author wearing the χ^3

3.2 Software

WECA PC was devised to give users mobile contextual information as they move around the University of Birmingham campus. As the user approaches key buildings around the campus a web page associated with that building is displayed.

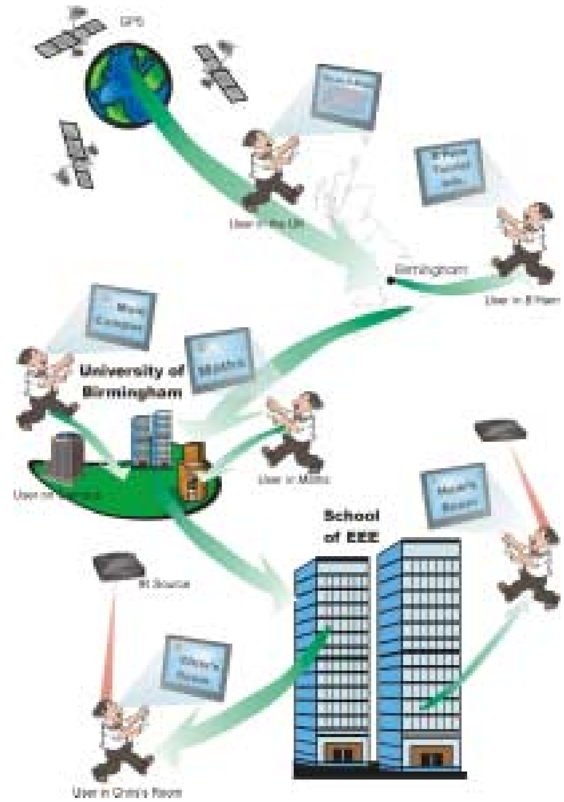

Figure 4 - WECA PC System Overview

WECA PC analyses data from the Comm. Port and sends a URL from a database to Internet Explorer. It is written in Visual Basic. This is the key feature that turns the χ^3 into a location-based contextual system. The main specification of WECA PC is to: -

- Extract GPS Coordinates from GPS receiver.
- Identify URL from database to fit GPS coordinates.
- Load Internet Explorer with URL from the GPS Database.
- Cope with errors in the input signal or no signal at all.
- Be a small attractive package that is error free.

This software will be explained by displaying how it reacts to all the possible scenarios it may be put in, e.g. No GPS signal.

The scenarios identified are:
Scenario One: No Signal from GPS.
Scenario Two: The Signal from GPS is corrupted.
Scenario Three: Error free GPS signal.

Scenario One: A test is applied to the input string from the comm. Port buffer to ascertain if any signal is present. If no signal present then a warning message is displayed (“No GPS signal”).

Scenario Two: If the correct header i.e. $GPRMC, cannot be found then it is assumed that the signal has been corrupted. Again a warning message is displayed (“Corrupted GPS Signal”).

Scenario Three: If the correct header is found the latitude and longitude is removed and queried against an Access database using SQL. If the user is near a building of interest i.e. a building in the database the URL is returned and sent to Internet Explorer. If no building of interest is located then a default URL is sent (in the case a the trail a picture map of the campus).

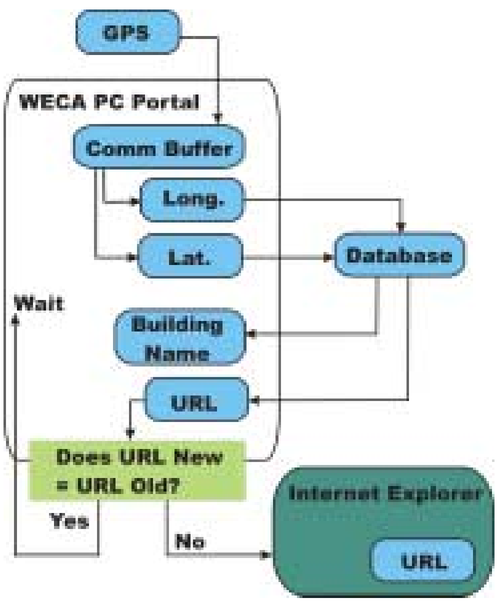

Figure 5 - System Architecture

Thus the URL that is sent to Internet Explorer is specific to the location of the user, allowing location-based contextual information to be presented.

4 Context

Location-based context as described in the systems above is only one possible component of context. Most context research has used location as their main context identifier, however more accurate and useful descriptions of context could be achieved by using other identifiers; these may include time, body position, other people around the user an many others.

5 Interacting with the Technology

Since noted above location is a key component (and the most commonly researched) of context, it is therefore likely that contextual computer will be mobile. It is therefore necessary to investigate possible input methods for mobile wearable computers. A number of methods have been found.

5.1 ISlide

One interesting input method is gesture recognition. A simple flick of the wrist or wave of the arm could be used to interact with a presentation about a painting. Imagine the presentation as a 3-dimentional space, where a flick right takes you forward, left takes you back, pushing into the painting gives you more detail about a certain area and pulling out reduces the detail.

This has been achieved with ISlide. A Digital accelerometer is attached to the wrist; a flick of the wrist produces acceleration measured by the accelerometer. The value of acceleration is sent periodically to a master node that converts the raw value into a measurement of g (gravitational field strength). The value of g is then passed to the computer controlling the presentation, when this value passes above a preset threshold a routine to move to the next section of the presentation is activated.

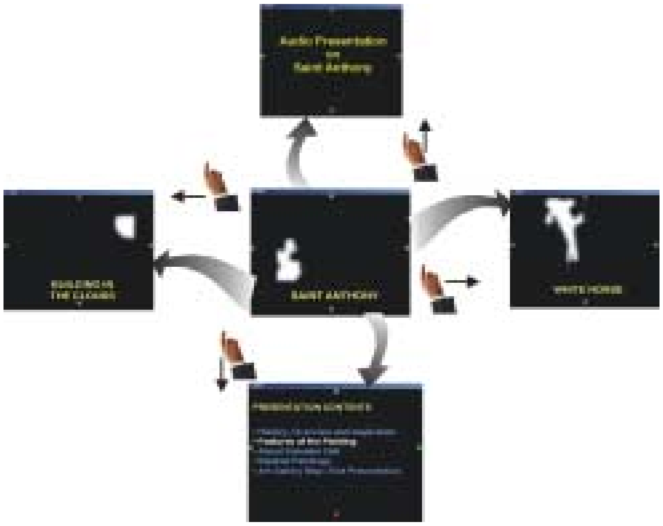

Figure 6 - Interacting with ISlide

The presentation above would be projected through a head-mounted display or LCD projector over a painting or other artifact. The white areas will highlight the area of the painting that the users can then get more in-depth information about. Through the HMD, the white areas appear transparent, while the rest of the painting is covered with an opaque ground. This focuses the viewer's attention onto the highlighted area, and provides a 'guided tour' of the painting. Since at present ISlide is aimed at presentations that are augmented over paintings, the analogy of moving into an object (for more detail) is rather nice. The system would also be well suited to ancient artefacts, such as old books where people could not touch the pages but could virtually turn the page using ISlide, or historic coins that the user could look at both sides of by twisting their wrist as they would to turn over a real coin.

Figure 7 - A user using ISlide

5.2 Conversay Voice Surfer ™

Conversay[1] Voice Surfer ™ is a commercial product and we are reviewing as a useful tool for wearable systems. Voice Surfer ™ allows the user to navigate web pages using their voice. Any hyperlink on a page may be read out to activate the link, buttons are assigned numbers and these can also be activated in the same fashion. In addition there are a number of key phrases such as "go back", "scroll down" that may be used.

For many systems like WECA PC that use web pages as their presentation method Voice Surfer™ is a superb input method.

6 Conclusions

To date we have conducted several user trials to evaluate these design concepts. For the IMPS trials (e.g., Baber et al. [11]), three points are of relevance to this paper. First, it was found that the head-mounted display could not only obscure the viewing of objects in the world, but also led to problems in perceiving and recalling features from these objects. Thus, ironically, a handheld display sometimes leads to better interaction with objects in the world. The display of information via the HMD was modified and resulted in some improvements. Second, the use of the IR links to call up information worked well. Third, the use of displayed information depended very much on users prior knowledge. This means that we need to concentrate on developing user models to modify the manner in which information presented. A project has just commenced to investigate these issues. For the WECAPC trials, it was shown that contextually information significantly enhances users' ability to find information about buildings on a university campus, in comparison with no computer support or with surfing the Internet (Bristow et al. [13]).

References

[1] Cheverst, K., Davies, N., Mitchell, K., Friday, A. and Efstratiou, C., 2000, Developing a context-aware electronic tourist guide: some issues and experiences, *CHI'2000*, New York: ACM, 17-24

[2] Milosavljevic, M., Dale, R., Green, S.J., Paris, C. and Williams, S., 1998, Virtual museums on the information

superhighway: prospects and potholes, *Proceedings of the Annual Conference on the International Committee for Documentation of the International Council of Museums (CIDOC'98)*, 10-14 October, Melbourne

[3] Oberlander, J. and Mellish, C., *Final Report on the ILEX project*, http://cirrus.dai.ed.ac.uk:8000/ilex/final.htm

[4] Petrelli, D., de Angeli, A. and Convertino, G., 1999, A user-centred approach to user modeling, In J. Kay (ed.) *UM99 User Modelling*, New York: Springer Verlag

[5] Sarini, M. and Strapparava, C., 1998, Building a user model for a museum exploration and information-providing adaptive system, *Proceedings of the Workshop on Adaptive Hypertext and Hypermedia*, 20-24 June, Pittsburgh, PA

[6] Cooper, A., 1999, *The Inmates are Running the Asylum: Why high-Tech Products Drive us Crazy and How to Restore the Sanity.* Indianapolis, In.: Sams

[7] Falk, J. and Dierking, L., 1992, *The Museum Experience*, Ann Arbor, MI: Whalesback Books

[8] Opperman, R., Specht, M and Jaceniak, I., 1999, Hippie: a nomadic information system, In H-W. Gellerson (ed) *Handheld and Ubiquitous Computing*, Berlin: Springer-Verlag, 330-333

[9] Not, E. and Zancanaro, M., 1998, Content adaptation for audio-based hypertexts in physical environments, *Proceedings of the Workshop on Adaptive Hypertext and Hypermedia*, 20-24 June, Pittsburgh, PA

[10] Baber, C., Harris, T. and Harrison, B., 1999, Demonstrating the concept of physical hyperspace in an art gallery, In S. Brewster, A. Cawsey and G. Cockton (eds.) *Human Computer Interaction INTERACT'99 (volume II)*, Swindon: British Computer Society

[11] Baber, C., Bristow, H., Cheng, S-L., Hedley, A., Kuriyama, Y., Lien, M., Pollard, J. and Sorrell, P., 2001, Augmenting museums and art galleries, In M. Hirose (ed.) *Interact01*, Amsterdam: IOS, 439-446

[12] Cross, J., Woolley, S.I., and Baber, C., "Wearable Computers for Field Archaeology" The *Fifth International Symposium on Wearable Computers.* pp169 171

[13] Bristow, H., Baber, C. and Cross, J., submitted, "Evaluating contextual information for wearable computers"

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[1] www.conversay.com