Towards More Natural Interfaces for Museum Guides: the New Scan-and-Tilt Interaction Paradigm

Jani Mäntyjärvi, Fabio Paternò, Zigor Salvador, Carmen Santoro
ISTI-CNR, Via G. Moruzzi 1,
56126 Pisa, Italy
{Jani.Mantyjarvi, Fabio.Paterno, Carmen.Santoro, Zigor.Salvador}@Isti.Cnr.It

Abstract. This paper presents a new interaction technique –scan and tilt– aiming to enable a more natural interaction with mobile museum guides. Our work combines multiple modalities –gestures, physical selection, location, graphical and voice. Physical selection is obtained by scanning RFID tags associated with the artworks, and single handed tilt gestures are used to control and navigate the user interface and multimedia information.

Keywords: Mobile guides, Gesture, Tilting, Physical selection, RFID

1 Introduction

Seamless interoperability of intelligent computing environments and mobile devices is becoming more and more popular in various application domains. A potential application area is the so-called "intelligent virtual guides". Several location-aware, context-aware and multi-modal prototypes have been developed since the beginning of ubiquitous computing in the early 90's [see for example, 1, 2, and 3]. In this paper, we present our work on enabling gesture interaction through the scan and tilt paradigm, by extending a previous museum guide [3]. To this end, we have designed an interaction technique based on two important concepts:

- it should not be intrusive on the user experience, by leaving the visual channel open to enjoy the artwork;
- it should be able to somehow directly interact with the available physical objects.

Previous analysis of how museum visitors perceive the support of computer-based devices [3] clearly indicated that the users would not be interested in spending much time understanding how the electronic guide works, since they will probably not visit the museum again. On the other hand, the information usually provided by museums regarding artworks is rather limited, which raises the need for additional support to be dynamically activated when something interesting is found during the visit. Our solution is characterized by a more natural interaction paradigm, by pointing at the artwork of interest and controlling audio information with small single hand gestures, so as not to overload the visual channel, and resulting in a less intrusive interaction technique. In this paper we first provide some information on the previous version of our guide, then we present the novel paradigm and we report on an early evaluation and, lastly, we provide some concluding remarks.

2 Cicero

Our interaction technique for museum visitors has been applied to a previously existing application for mobile devices: Cicero [3]. This is a location-aware application developed for the Marble Museum located in Carrara, Italy and provides visitors with a rich variety of multimedia (graphical, video, audio, …) information regarding the available artworks and related items.

3 Scan & Tilt Interaction

Our concept of guide interaction potentially benefits from the fact that artwork metadata can be structured in a nested, tree-type structure. The scan modality operates on a higher level (i.e. it can be used to choose the main element of interest), while the gesture modality enables operations between elements in the metadata structure (i.e. horizontal tilt allows navigating among pieces of information at the same level), see Fig.1. When a visitor enters a space, this is detected through the infrareds signals, and a map of the room is provided automatically. A visitor then scans a RFID tag associated with an object by physical selection, and the object is highlighted graphically on the room map. In the detailed data-view, navigation among different pieces of information can be done by tilting horizontally. Alternatively, when users enter a room and get information regarding it, they can use the tilt to identify/select different artworks in the room through simple horizontal tilts. Whenever a new artwork is selected, then the corresponding icon in the room map is highlighted and its name is vocally rendered. In order to access the corresponding information, a vertical tilt (down) must then be performed. In order to improve the usability of the interaction technique, the tilt event can also be enabled/disabled through a PDA button on the PDA: the user is made aware of the tilting activation status through a circle visualised in the bottom right-hand corner of the display (see Fig. 1), assuming two colours depending on the status of the tilting (green: active, red: inactive). In general, the tilt interface follows a simple to learn pattern: horizontal tilts are used to navigate through different pieces of information at the same level or to start/stop some activity, vertical tilt down events are used to go down in the information hierarchy and access more detailed information, whereas vertical tilt up is used to get up in the information hierarchy.

4 The Interactive System

The scan modality is used to orient users in a physical environment and to select data on a higher level. After summary information is provided on the mobile device, gesture modality is used to navigate between various views/levels of detail by tilting. In the architecture of our interactive system, when users receive scan data through the RFID manager, it is communicated to the museum application, and when the device is tilted, the tilt manager feeds the tilt data to the application accordingly.

- **Tilt Modality** - The gesture modality in our approach utilizes 2D acceleration sensor hardware from Ecertech. The sensor hardware is attached to an iPAQ PDA (through the universal synchronisation connector) with Pocket PC operating system and produces signals that are interpreted as events (TiltLeft, TiltRight, TiltBackward, TiltForward) by the tilt manager-data processing module of the mobile device; such events are used to execute interactions (selection, navigation or activation) on the UI.
- **Scan Modality** - The scan modality employs RFID technology by Socket Communications. The RFID reader (ISO 15693) is connected to the Compact Flash socket of a PDA. Artworks in the museum environment are equipped with RFID-tags: a user can obtain information related to a work of art by placing the device near the tag (the read range depends on tag antenna size, in our case is about 5 cm).

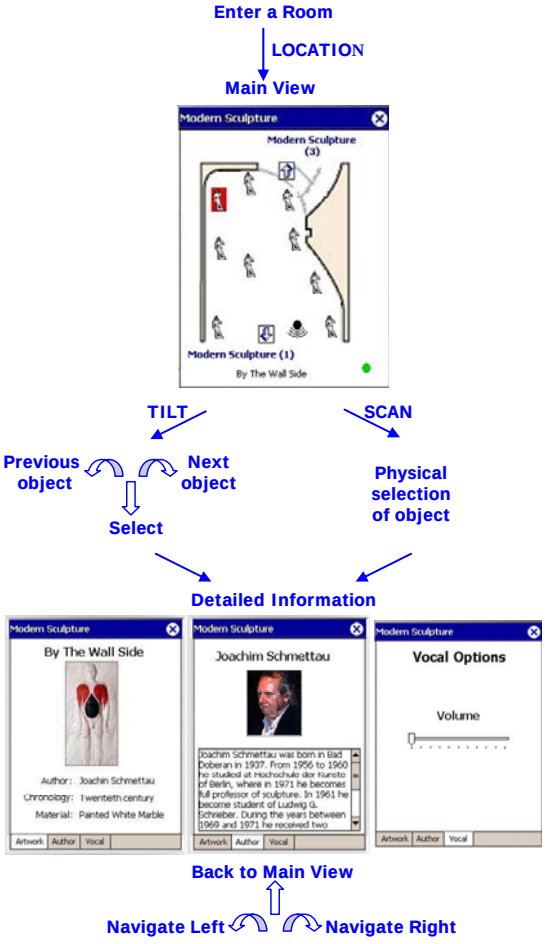

Fig. 1. The use of gesture and physical selection modalities.

4.1 The Algorithm

The first release of the software prototype uses a simple tilt monitoring algorithm based on static angle thresholds and taking into account the initial tilt angle of the device when the application starts. The tilt of both horizontal and vertical axes is measured every 1/10 second. These values are then compared to the original tilt measurement performed at application start-up time, and if a 15 degree threshold is exceeded for over 500ms in one of the axes, this is interpreted as the appropriate tilt gesture for that axis: 'forward', 'backward', 'left' or 'right'. If the user, after having performed a tilting movement does not put the device to the initial position, this situation is automatically interpreted by the algorithm as a further tilting movement (although no movement has been actually done by the user), until the user puts the device to the initial position (we called it *continuous tilting*). As for the RFID tags, a separate thread is dedicated to continuously monitoring signals coming from them and, as soon as a signal is detected, the algorithm activates the information related to the identified artworks also pausing for 2000 ms before listening again for RFID tags. Furthermore, in order to improve the usability of the interaction technique, within the algorithm it was introduced the possibility for the users of deactivating/reactivating the detection of the tilting event by means of pushing a hard button on the PDA.

5 The First Evaluation

We have performed a first evaluation of our prototype to assess the ideas associated to this novel interaction technique. The test involved 12 people (10 men, 2 women), ages ranging between 24 and 50 years old with an average age of 32, recruited in the institute community: 3 had secondary school education level, while the others had university degrees or higher levels of education.

Before starting the exercise, users were instructed to read a short text in which the different movements that have to be done in order to activate the scan and the tilt procedure were explained. Then, a short description about the task that they were expected to carry out was provided: users were asked to scroll a number of artworks belonging to a specific section (main window); then, they were expected to select one artwork (secondary window) and navigate through the different pieces of information available (e.g.: author, description, image, ...), to finally get back to the initial window in order to finish the exercise. After carrying out the exercise, users were asked to fill in a questionnaire, which was divided into two parts. In the first part some general information was requested by the user (age, education level, level of expertise on using desktop/PDA systems, etc.). The second part was devoted to questions more specifically related to the exercise. People involved in the tests reported to be, on average, quite expert in using desktop systems, but not particularly expert in using PDAs. Roughly half of them had already used a PDA before the exercise (7/12), only a few reported to have ever heard about scan and tilt interaction. On average they judged scan and tilt useful, with interesting potentialities.

The majority of them (8/12) reported some difficulties in performing the exercise. Only 2 reported no difficulty, while other 2 reported many difficulties. People that

experienced difficulties, generally self-explained this fact saying that it could have been motivated by the novelty of the technique and their complete lack of experience with such an interaction technique. As for the kind of difficulties encountered, there were aspects connected to the initial difficulty in using the technique and understand the tilt thresholds expected for activating the tilt event, but most of these problems diminished after the initial interaction phases. Vertical tilt was found to be the most difficult interaction, while horizontal tilt was found the easiest one for the majority of users. Almost all the users judged the application user interface to be clear (in a 1-5 scale, only one reported a value of 2, whereas the others reported 4 or 5). Users judged scan and tilt interaction fairly easy to use (on average, the mean value was 3 in a 1-5 scale) and in fact several of them pointed out that it is just a matter of time to get used to it. They judged that scan and tilt makes interaction slightly easier with respect to traditional graphical interfaces, even if they conceded that it would be quite difficult to use it without looking at the PDA. All in all the feedback was positive, even if we are aware that more empirical test is needed.

6 Conclusions and Future Work

We have proposed a new interaction paradigm – scan and tilt – for mobile museum guides aiming at enabling more natural interactions: our solution for a mobile museum guide considerably extends interaction towards more natural ways of interacting with the environment. Related approaches which focus on scan modality, such as [4], exploit similar ideas, but our solution offers a greater degree of freedom for users to move around and more control in obtaining information only when they want; moreover, single hand tilting also allows for not overloading too much the visual channel. Some future work is also planned for the algorithm that manages tilt events to allow for a more natural interaction with the device.

References

1. Burigat S., Chittaro L. (2005). Location-aware Visualization of VRML Models in GPS-based Mobile Guides, Proc. of Web3D 2005, ACM Press, pp. 57-64.
2. Cheverst K, Davies N, Mitchell K, Friday A, Efstratiou C (2000) Developing a context - aware electronic tourist guide: some issues and experiences. In: Proceedings of CHI 2000, ACM Press, The Hague, The Netherlands, pp 17–24.
3. Ciavarella, C., Paterno F., The design of a handheld, location-aware guide for indoor environments Personal Ubiquitous Computing (2004) 8: 82–91.
4. Valkkynen P., Korhonen I., Plomp J., Tuomisto T., Cluitmans L., Ailisto H., Seppa H., A User Interaction Paradigm for Physical Browsing and Near-object Control Based on Tags, Physical Interaction ’03 – Workshop on Real World User Interfaces.