Natural Interaction for Cultural Heritage: the Archaeological Site of Shawbak

Thomas M. Alisi¹, Gianpaolo D‘Amico², Andrea Ferracani³, Lea Landucci³ and Nicola Torpei³
Media Integration and Communication Center, University of Florence, Italy
¹alisi@micc.unifi.it, ²damico@dsi.unifi.it, ³{andrea.ferracani, lea.landucci, nicola.torpei}@unifi.it

ABSTRACT
One of the most interesting issues in the field of cultural heritage is the adoption of multimedia systems for the visualization and organization of information. In this paper we present a natural interaction based system designed to represent multimedia contents related to the archaeological site of Shawbak, situated in the Petra region of Jordan. Contents are composed of texts, images and videos showing and explaining the archeological site areas and the history of the castle. This system was installed at the Limonaia di Palazzo Pitti (Italy) for the archeological exhibition called "From Petra to Shawbak".

Categories and Subject Descriptors
D.2.10 [Design]: Methodologies and Representation
D.2.11 [Software Architecture]: Data abstraction and Domain-specific architecture.

General Terms
Design, Experimentation, Human Factors.

Keywords
Archaeology, Shawbak, Multi-touch, Tabletop, FTIR.

1. INTRODUCTION
Multimedia tools are becoming more and more present in the design of cultural exhibitions aimed at communication of scientific results.

In the approach discussed later on, the perspective is centered on users interaction with digital devices specifically designed to reduce the cognitive effort in the fruition of multimedia contents: this means that the interface design allows users to interact and actually concentrate on contents rather than thinking about how the interface has to be used.

The implemented project thus proposes a solution focused on skills integration in the areas of Human-Computer Interaction and Archaeology. Object of the research has been the development of innovative technologies in support of communication protocols for Mediterranean archaeology. The research has been carried out in collaboration with a research unit of the University of Florence working on a Middle East archaeological case study: the Crusader-Ayyubid and Mamluk castle site of Shawbak situated in the Petra region in Jordan.

Our goal was to provide an innovative, intuitive, attractive way to show and explain to common people the main steps of the archaeological process, the methodologies and the results.

As it will be described in this paper, the information architecture spans both temporal and spatial dimensions, since the results have to deal both with the history of the castle throughout ages and with different levels of resolution while examining construction techniques and materials. The interface has thus been designed for immediate and easy access to all the combinations of historic periods and spatial resolution. Multimedia contents are displayed on a multi-touch surface and can be organized with natural gestures such as multi-touch drag, drop and pinch.

2. A NATURAL HCI APPROACH
Visual information is addressed as one of the main issues in Human-Human interaction. Computer interfaces based on artificial vision can offer a similar experience, allowing a natural and appealing way of exploiting such kind of interaction in a Human-Computer way of communication [1].

The research of new kind of Natural Human-Computer Interfaces has become a growing field in computer science [2], which aims to attain the development of more natural, intuitive, efficient and satisfactory interfaces.

Natural Human-Computer Interaction (NHCI) task is to make user interfaces more natural by taking into account the ways in which people naturally interact with each other and with the world. NHCI systems can usually exploit various topics such as: speech recognition, computer vision, graphical animation and visualization, language understanding, touch-based sensing, visual and sound feedback, ergonomics, cognitive psychology, conceptual modeling. An important advantage of NHCI when using computer vision algorithms [3] is the non-intrusiveness on the user: no special suits, cumbersome devices or sensors are needed for user's gesture recognition, thus using these techniques does not limit users body motion and offers the chance of interacting with natural gestures, poses or face expressions. Among such systems, interactive surfaces that allow multiple users touch are suitable [4] for collaborative applications, especially in educational, professional and entertainment environments.

3. SYSTEM OVERVIEW
In order to design a natural interaction system for intuitive and easy-to-access multimedia contents related to the Shawbak site, we chose to develop a multi-touch interactive table (fig. 1).

The technique chosen for the development of the vision engine was based on the Frustrated Total Internal Reflection (FTIR) proposed by Jeff Han [5] in 2005. It uses in a smart way the optical phenomenon of Total Internal Reflection between materials with different refractive indexes [6].

The work was then concentrated on the techniques used for recognize user input and the interaction design of the system [7].

From a high level point of view, the computer vision engine sends all the interaction events performed by users to the framework. Through the TUIO 1.1 protocol [8] these events are then dispatched to each graphical object, or layer, on the interface. Each layer can understand if the touch is related to itself simply evaluating if the touch position coordinates belong to the layer area: in this case the layer activates the recognition procedures and, if a gesture gives a positive match, the view is updated accordingly.

The Gesture Recognition module and all the graphical widget has been realized through the development of a complete framework from scratch: CocoNUIT [9], the Cocoa Natural User Interface & Tangible. This framework is designed to be lightweight, flexible and extensible; based on Cocoa, the framework helps in the development of multi-touch and tangible applications. It implements gesture recognition and let developers define and setup their own set of new gestures. The framework was built on top of the Cocoa technology in order to take advantage of Mac Os X accelerated graphical libraries for drawing and animation, such as Quartz 2D and Core Animation.

4. INTERFACE DESIGN

The initial definition of the structure of information showed that all the contents available were related to two different dimensions: the time period and the definition level. The time span along with the fortress was studied is roughly divided in 5 parts:

- 2nd crusade, The coming of the Crusaders;
- 3rd crusade, Rise and fall of the Crusaders;
- Ayyubid, The Ayyubid conquest;
- Mamluk, The rise of Mamluks;
- Ottoman, The Ottoman expansion.

The different level of resolution, or zoom detail, through which the territory can be explored are five as well:

- Transjordan region;
- Shawbak castle;
- The fortified gate;
- Masonries elevations;
- Stones.

Multimedia contents are made of videos, pictures and texts that show and explain the archaeological site for each of the described time span and zoom level.

A matrix can be thus built, where each column is related to a specific period of time and each row is related to a zoom level: in this way every cell is composed of different multimedia contents, as shown in fig. 3.

The interface design is based on a set of circles, where the external area can easily resemble the metaphor of a watch with its hand, and the internal is composed of a series of concentric circles, the color of which give a sensation of depth (see fig. 4).

A selection made towards the internal area is equivalent to a search for a narrower detail. Such circles are opened and de-
saturated (as shown in figure 4); by a single touch over one of them, an animation makes them closed and colored (saturated) and a label describing the selection done appears on it.

The bezel visualized around the clock shape is divided into five different periods of time. When a user rotates the watch hand, the label associated to the period of time scrolls on the screen.

After the selection of a spatio-temporal couple, users can visualize the related multimedia contents by touching the active area in the center of the screen. This area is always visualized in the foreground in order to let users switch anytime from the spatio-temporal metaphor to the content visualization and vice versa (see fig. 5).

When multimedia contents are shown on the table, users are able to interact with them by applying move, scale and rotate gestures. Moreover, users can scroll texts and activate play/pause commands on.

5. RESULTS

The system was installed at the exhibition «From Petra to Shawbak, Archaeology of a Frontier» [10] at the Limonaia di Palazzo Pitti, Florence (Italy) and run for 4 months (see fig. 6).

During the exhibition untrained users could easily have access to multimedia contents and this fact was greatly appreciated, even considering the average lack of digital interactive contents in this kind of exhibitions.

The exhibition was planned to itinerate across Europe and finally settle down at the visitors’ centre of the Shawbak archaeology site in Jordan. This will let the project become not only a solution for digital natural interaction with multimedia contents, but also a mean of communication between different cultures which is able to spread the knowledge of subjects usually belonged to the scientific community.
6. ACKNOWLEDGMENTS
Our thanks to Nicola Martorana for his contribution to this work.

7. REFERENCES


