Combining Multimedia Resources for an Engaging Experience of Cultural Heritage

Carmelo Ardito, Maria F. Costabile, Rosa Lanzilotti, Adalberto L. Simeone
University of Bari
Dipartimento di Informatica
Via E. Orabona, 4, 70125 Bari
+390805443300

{ardito, costabile, lanzilotti, simeone}@di.uniba.it

ABSTRACT

ICT technologies have a great potential not only for preserving and increasing awareness about cultural heritage, but also for allowing people to better experience this huge legacy. Various application tools have already been developed which provide different types of multimedia resources, such as 3D representations of objects and places, videos, graphics, sounds, in order to augment the physical context by providing virtual, location-specific information, so that people can experience some aspects of ancient life which would otherwise be very difficult to figure out. The effort spent to create multimedia resources is considerable; therefore, it is worth reusing them to produce applications suited to other types of visitors. In this paper, we present our on-going work to provide tailored applications that support different types of visitors. Such applications are developed according to a model that describes how multimedia resources can be combined, also depending on the type of users and devices. Examples of these solutions are briefly illustrated.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User Interfaces - *User-Centered Design, Interaction Styles, Theory and Methods.*

General Terms

Design, Human Factors.

Keywords

Cultural heritage, multimedia.

1. INTRODUCTION

In the last years a substantial amount of work has been carried out in exploiting technologies for a better experience of cultural heritage. Most work is related to web systems that provide information about museums or other historical sites, events, etc. Since its early stages, mobile technology has been employed for supporting museum visitors with electronic guides designed to help them to understand the value of the exhibition (artistic, historical, religious, etc.) while being on site.

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Visitors of historical sites such as archaeological parks, ancient buildings, castles, etc., are in large part middle school children, aged 10-12 years old, who are accompanied by their teachers. These visits are an important part of school curricula since they can promote in students the passion of history learning and a keen interest in cultural heritage. However, teachers often complain that these visits tend to arouse little involvement in young people. In fact, this is especially felt when students are faced with the ruins of ancient settlements whose current appearance no longer reflects their original aspect and purpose. In order to stimulate students' interest, it is necessary to have skilled guides that accompany them during the visit. Unfortunately, due to the abundance of Italian cultural heritage and their chronic shortage of funding, it is impossible to provide guide service in all sites of interest and most of them are left unmanned.

The electronic guides currently available in several museums are not well suited for young students, who need more challenging tools supporting their learning while visiting historical sites. It is well known that games, especially when exploiting innovative and engaging technologies, can be successfully used for learning purposes [7][10]. Educational games are able to create pleasant environments, in which students can learn in a less tiring and more interesting way. Based on these considerations, we have developed educational games that support students learning history during visits to historical sites, such as archaeological parks [1][2][4]. Such games present different multimedia resources (pictures, animations, videos, contextual sounds, etc.) in order to communicate historical information in an amusing and pleasant way. The effort spent to create this information is considerable; therefore it is worth reusing it in producing tailored guides suited to other types of visitors, such as adults, for which educational games are not very appealing. In this paper, we present our on-going work which, based on previous experience, aims at providing tailored applications that support different types of visitors in an engaging experience of cultural heritage. Such applications are developed according to a model that describes how multimedia resources available in a repository can be combined, also depending on the type of users and devices. Examples of these applications are briefly illustrated.

The paper is organized as follows. Section 2 briefly reports some related work. Section 3 summarizes two educational games that support students learning history during visits to cultural heritage sites. The model describing how to combine multimedia resources is presented in Section 4 and examples of how to create tailored applications are illustrated in Section 5. Section 6 illustrates conclusions.

2. RELATED WORK

The first systems employing mobile technology for supporting experience of cultural heritage during museum visits used PDAs with no connections with other devices nor context-aware capabilities. Examples of such systems are eXspot [8] and PortableCicero [3]. Recently, in order to give to mobile guides context-awareness capabilities, RFID tags and IrDA beacons are placed near every museum exhibit: they are identified by the mobile device, provided that it is integrated with specific cards able to interact with the sensors placed in the environment (see [6]).

The few systems developed for archaeological parks are proof-of-concept prototypes developed for testing specific technologies and/or techniques including virtual reality and wearable computing, rather than systems actually adopted by the parks. Examples are [5][14][15]. Such prototypes have been evaluated in pilot studies primarily to test system reliability. No results about user experience are actually reported.

Last generation guides go beyond and become visitors' multimedia companions, designed not only to provide useful information, but also to improve the overall visitors' experience and support a more engaging experience of cultural heritage and fruitful acquisition of historical information (see [4][13]). Various multimedia features, such as 3D representations of objects and places, videos, animations, graphics, sounds, are exploited in order to augment the physical context by providing virtual, location-specific information.

Designers must be careful in analyzing the trade-offs between functionalities and ease of use, since most visitors only want basic features, in order to experience a relaxing visit without being frustrated by difficult-to-use technology. This has been a guiding principle in designing the educational games illustrated in Section 3, which exploit last generation technology but provide simple interaction mechanisms.

3. MULTIMEDIA GAMES

Contextual enquiry of student behavior while visiting historical sites as part of their school activities challenged us to create electronic tools able to stimulate such students. Therefore, we have developed Explore!, a mobile learning (m-learning) system which exploits gameplay with the aim of helping students to learn about ancient history while making their visit to historical sites more enjoyable [1]. The system is characterized by several multimedia features, e.g. it provides 3D reconstructions of historical buildings, objects and places, and contextual sounds imitating ancient people, animals, or objects used in daily activities. Such features help visitors immerse themselves in the historical atmosphere. Explore! proposes a type of educational game, called excursion-game that is like a treasure-hunt in that groups of 3-5 participants are invited to roam around the archaeological park and identify some historically important places. Each group receives two cell phones, a paper map of the park and a backpack containing a pair of loudspeakers. The first cell phone provides clues useful for discovering places while the second one displays help and suggestions. During the game, by exploiting the GPS system, Explore! emits various contextual sounds to ensure a realistic as well as engaging environment (e.g., carts rumbling on the paved road, people chatting, etc) through the loudspeakers connected to the first cell phone. The group has the opportunity to view the 3D reconstructions of the identified places on the phone and visually compare the existing remains to what it could probably have looked once.

Explore! relies on XML files that describe the game content, the layout and the relationships among the various multimedia elements of the user interface. In this way, it can be easily adapted to propose new excursion-games to be played in other archaeological parks, by adapting both the interfaces of the applications (icons, labels, etc.) and the multimedia content (text, sounds, images, 3D reconstructions). These XML files can be easily created with an authoring tool. The excursion-game technique has been tested in the field with 124 middle school students, who played the game at the archaeological park of Egnathia, southern Italy (see [1][4] for details on the evaluation).

We have recently developed other games in order to allow children to get further knowledge about historical sites. They use some of the multimedia resources created for Explore!, but are implemented on different devices. In particular, we exploited the information about the places, the 3D reconstructions, and the sounds Explore! uses for the game in the archaeological park of Egnathia to develop History-Puzzle [2]. It proposes a game to be played by a single student or a group of students interacting with a large multitouch screen, whose size is 2 x 1.2 meters. History-Puzzle asks participants to complete a jigsaw puzzle depicting historical monuments, such as places or exhibits that students have observed during the visit. The puzzle is not solved by just putting the different pieces depending on their shapes, as in usual puzzles, but by overlapping an incomplete statement about history with a cell containing the right word completing such statement, since the aim is to rely on history knowledge students have. At the beginning of the game, the players choose the puzzle to play among those available (one for each important landmark in the park). The chosen puzzle appears as a square of 3x3 cells, each containing a hint about that landmark. Outside this square, there are several other cells which may be associated to a statement of one cell (some are misleading on purpose). If the selected association is correct, the square will reveal one ninth of the image of the original building (Figure 1). The game continues until the image is completed. Thanks to the interaction modality allowed by the multitouch screen, young students easily interact with History-Puzzle by hand gestures which move, rotate, zoom or pan the interface elements.

Figure 1 – Discovering the original aspect of the "Via Traiana" in History-Puzzle

4. CHeR MODEL

The efforts needed to create, convert in digital form and maintain the multitude of data related to cultural heritage sites are very high. If data are adequately modeled and digitalized, they can be easily exploited to develop different applications.

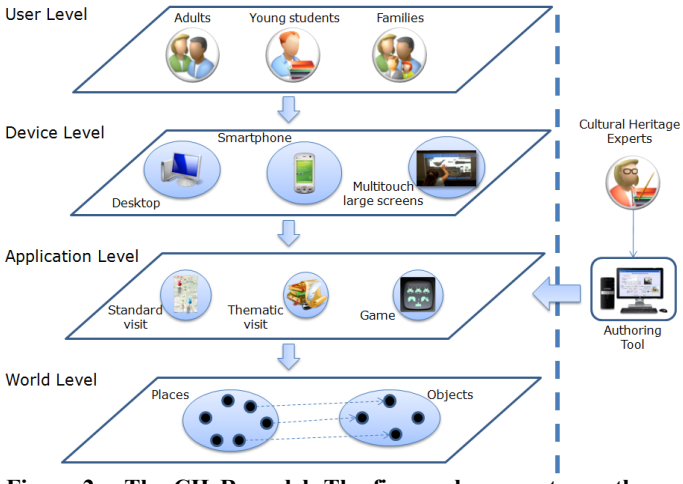

Figure 2 – The CHeR model. The figure also reports, on the rightmost side, an Authoring Tool that allows cultural heritage experts to create applications by combining resources of the CHeR model.

In fact, Explore!, available on mobile phones, and History-Puzzle, running on large multitouch screens, propose two types of educational games which share many multimedia contents originally created for Explore!.

By extending this approach, we are developing the CHeR (Cultural Heritage Resources) model: it aims at organizing the various resources exploited by different applications which are designed to support people in an engaging experience of cultural heritage. New applications may employ them, thus limiting data redundancy and speeding up the development process. The CHeR model encompasses several levels (Figure 2):

- *User level*, which refers to the categories of potential users of an application supporting the experience of cultural heritage.
- *Device level*, which refers to the variety of devices supported.
- *Application level*, which specifies the types of applications, e.g. standard visit, thematic visit, game.
- *World level*, which refers to the different multimedia resources used to create specific applications.

4.1 User Level

Deeply understanding the needs of the different types of visitors is important during the design phase, in order to provide them with the type of visit that enhances their experience. We do not report here all the possible type of visitors but we mention some broad categories of visitors. The most significant characteristics which have an impact on the type of visit more suitable for such visitors [12] are highlighted. For example, the *Adults* category includes people interested in visiting the historical site simply for pleasure, but also people interested to see and learn more due to their passion about history, art and science; finally, professionals such as history experts or scholars. Another large category of visitors are *Young students*, ranging from elementary to high school, who visit the cultural heritage site as part of their school curriculum. Because of their age, traditional visits are not appealing. Young students should be provided with a type of visit that supports them in developing a keen interest in cultural heritage. Often archaeological sites are visited by *Families*, i.e. adults and young children together, who need a type of visit that is, at the same time, interesting for parents and fun for children.

4.2 Device Level

The Device Level describes different devices that allow users to interact with cultural heritage applications. The CHeR model currently considers three main categories: traditional desktop, mobile devices, i.e. smartphones, and multitouch large screens. The users can interact with the applications using their personal computers either at home through the web, or at kiosks placed at strategic locations in a cultural heritage site. When visitors are physically on-site, applications on smartphones support their visit driving them around. Multitouch large screens, installed in some locations of the site, offer the possibility to interact with the multimedia content through gestures [11].

4.3 Application Level

Taking into account the user categories and the available devices, the CHeR model currently proposes three different types of visit at the Application Level. The *Standard visit* is designed for the most common visitors, who are interested in visiting the most important attractions of the cultural site, following a predefined path, learning the main content of the exhibit. However, some people could have a particular interest in visiting exhibitions or areas sharing a specific theme or point of view; e.g.: visiting Rome by seeing the famous surviving monuments of the Roman Empire era or by visiting the churches of its more recent past. Usually, these visitors are people that are either revisiting a cultural site, or with a cultural heritage background or professionals in this domain. Such visit is defined in the CHeR model as *Thematic Visit*. *Games*, as the excursion-game described in Section 3, is another type of visit more suited to engage young students or families with children.

4.4 World Level

This level of the model refers to the multimedia resources related to places and objects of cultural heritage sites. Places represent physical buildings (or ruins) with a precise geographical location. Objects instead refer to all those other entities that can be found in a cultural site or are related to it. Places and objects are described by different multimedia data, such as text, images, 3D reconstructions, contextual sounds, etc.

The multimedia content describing each place or object must be tailored according to the different applications. For example, the multimedia description of a place/object provided in a standard visit for adults is different from the one provided to young students in a game. To this aim, each multimedia resource is characterized by several properties, such as GPS location, function, indoor/outdoor placement, presentation aspect, etc. Such information is exploited by the Authoring Tool (see Figure 2) to support filtering and categorization tasks.

5. APPLYING THE CHeR MODEL

Let us consider the example of a cultural heritage expert that has to create a new multimedia application for a thematic visit to an archaeological park. As first step, the expert chooses the Thematic visit template provided by the CHeR model through the Authoring Tool. The Authoring Tool shows a list of places and objects currently available in the associated database/media repository. The cultural heritage expert can filter them depending on several properties (as indicated in Section 4.4) in order to find

those better suited to the visit theme s/he has in mind. Once the cultural heritage expert is satisfied with the set of places and/or objects to include in the thematic visit, s/he can conclude the creation process. The Authoring Tool automatically generates an XML document which describes the contents of the visit and the abstract specification of the application interfaces. Depending on the chosen device on which the thematic visit application will run and on the type of users that will be addressed (e.g. tourists with not specific interests on historical details), the content of this XML file will be used to instantiate the final software applications. If the objective is to create a type of application not already available in the model, e.g. a new type of game, it is necessary to set up a participatory design team which will create the template of the new game and add it to the type of applications at level three of the model.

6. CONCLUSIONS

This paper has illustrated an on-going work that aims at defining a model and a software framework in order to combine multimedia resources to create applications that support people in an engaging experience of cultural heritage. The model derives from our experiences in this domain. It encompasses various categories of users, devices, types of applications and multimedia resources. The model is at the basis of a software framework, currently under development, which supports the creation of applications tailored to users, devices being used and types of visit.

Literature reports several proposals of automatic or semiautomatic frameworks that generate the interfaces of a same application to be visualized on different devices. For example, in [9] different user interfaces are automatically created starting from an abstract description of the users' tasks to be supported. The contribution of the CHeR approach is that not only the user interfaces layout is adapted to the different devices but a more general framework is provided which supports the combination of various multimedia resources to create applications that are different also in the interaction modality and in the way in which the content is made accessible (e.g. excursion-game vs standard visit). Moreover, CHeR relies more on an end-user development approach. Experts in the cultural heritage domain, e.g.: history experts or park/exhibit curators are provided with an Authoring Tool that allows them, who are acting as non-professional software developers, to create or modify available application templates.

It is worth mentioning that, at the current stage of definition of our model, there is not any attempt to be exhaustive about any type of resources at the different levels of the model (type of users, type of devices, etc.). Our only concern is to make clear that many of them are possible.

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