

Photographic Virtual Reality and Architectural Heritage

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ABSTRACT

Multimedia applications concerning Cultural Heritage represent a great opportunity to spread the knowledge about the history, culture and tourist environment of a specific site. But this kind of applications requires a large effort in term of costs in order to guarantee the high quality needed. This requirement has also a remarkable impact on the technology used to realize the multimedia contents as well as on the lifecycle and the methodology adopted to develop the application software.

The application described in this paper is related to the architectural heritage, which, due to the specifically visual impact of sculpture and architecture, needs a special photographic technique to be displayed in a virtual tour.

We describe, moreover, how, by using a HDM methodology, we developed a general-purpose run-time engine reducing the costs needed to realize new applications.

KEYWORDS: HDM, photographic virtual reality, architectural heritage, virtual tour

INTRODUCTION

In order to develop a multimedia application able to completely present a particular architectural heritage, unlike applications concerning other forms of

cultural heritage, the designer must take into account that the traditional multimedia usable units, such as images, sounds, texts and videos, allow the final user to have only a partial outlook of such heritage without appreciating either the harmonious structure of its halls and cloisters or the surrounding natural environment.

Furthermore, there are two metaphor of visit:

- The user is guided through a static visit using image and text;
- The user can look round a building having the sensation to be there.

Both these kinds of visit are effective but in the second way the common visitors are more involved in the tour.

To satisfy these requirements it is important to realize a virtual tour by using photos at 360° edited using tools such as QuickTime VR.

The use of photographic virtual reality is necessary but it is not enough. The visitor needs also an in-depth study of some aspects of the heritage such as paintings and sculptures, as well as the particular stone used to build the architectural heritage and other examples. So, it is important for a designer to model a traditional hypermedia application that provides also a virtual tour.

Hypermedia applications were, at the very beginning, hand-coded pages: the

information handled by each page was structured "ad-hoc" and the links among pages were set "manually". This production method was acceptable when only a few pages had to be produced, linked and maintained. It became rapidly unmanageable when applications of several hundreds or thousands of pages with complex interactive objects had to be considered. In particular, two related problems became rapidly relevant (and still are very relevant): how to ensure the "usability" of modern large hypermedia-applications [1-3], and how to improve the efficiency of the production-maintenance process for the same applications.

In good hypermedia applications, in fact, the reader should be able to effectively exploit the potential information managed by the application: i.e. he/she is able to quickly locate the objects of his/her interest, to understand the inner structure of the objects, to easily move (navigate) from one object to another, to easily accomplish complex access sessions. Several factors concur to the achievement of usability, and one of the most important factors is to have a good structuring of the information objects and a good structuring of the navigation patterns. Several authors and several communities have recently proposed the adoption of design models [4-8], and design patterns [9-12] in order to improve the quality and usability of hypermedia applications, at least for those aspects concerning structure and navigation. Design models provide, in fact, the primitives that allow structuring the information objects and the corresponding navigation patterns along regular and systematic features, improving consistency, predictability

(for the user), robustness of the design, and therefore improving usability. The ancestor of these models can be traced to HDM [13] that since its initial definition has undergone a number of changes and improvements. Almost all the other design models that have been proposed for the Web over the years have features similar to those of HDM.

To come to the point, the adoption of a model (like HDM) to design the internal structure and the navigational features of hypermedia applications is desirable for almost three reasons:

- resulting applications are usable;
- the production process can be decomposed in sub-problems easy to manage;
- the application model can be directly "executed" by a suitable "interpreter" to create the application pages in a way that is independent from the specific application.

The remaining part of this paper is divided into: section 2, where we describe the technology used for photographic virtual reality; section 3, where we examine the main concepts concerning the HDM interpreter which SETLAB developed; in section 4, we describe the application to the Olivetani monastery built around the interpreter; in section 5, we draw the conclusions; section 6 is for references and bibliography.

THE PHOTOGRAPHIC VIRTUAL REALITY: TECHNOLOGY ASPECTS

There are several technologies to realize 360° photos to be used in photographic virtual reality and the most known is the IPIX technology [17] that has a complete system.

The IPIX system realizes the full 360°images by capturing two opposing photographs, called "hemispheres," with

a fisheye lens in vertical direction (for example from the top to the bottom); this photos are later linked together by means of an IPIX tool and can be delivered in a Java environment.

This system is cheap and easy to use and we used IPIX for some Web applications describing room interior of buildings.

In fact, this kind of systems isn't suited for external environments where the variation of light could create high contrast between objects. This problem affects also large interior environments when it is impossible to have a uniform light.

The Olivetani monastery and the adjoining church aren't in a situation of uniform light due to the architecture and to the particular stone and sculptures that turn out dark in the sunlight.

For this reason we adopted a different system, more expensive in term of costs and manpower, but that guaranteed high quality results.

The system is based on a traditional camera mounted on a tripod. A steel hemisphere is fixed horizontally on top of it, reflecting the 360° environment. The camera photographs an image, obtained with the use of mirror effects, inside the hemisphere.

Several photos are taken for each node with a different aperture of diaphragm to best capture all the elements of the image. Then, the little spots on the film are digitalized by using a special scanner at 2600 dpi and the results were life-size images. In the editing phase all the photos taken for the node are combined to reach the best results of light for all the elements. In the last step images are linked together with the use of QuickTime VR.

This system was adopted to realize the virtual tour of two important sites in

Italy: the Cathedral of Milan and the Basilica of St. Peter in Vatican (Rome). This activity is more expensive than the IPIX solution in term of 1:4 requiring the lights expert, the photographer and the director to tell the story.

THE HDM INTERPRETER

A short introduction to HDM is essential for the comprehension of the following part of the paper.

In brief, for HDM a multimedia application consists in a Hyperbase, an Access Layer and a Visual Layout. The Hyperbase contains the actual information objects and their basic connections; the Access Layer provides access paths to the objects of the Hyperbase, the Visual Layout description is made up of page templates used to create the application. The Hyperbase consists of Entities grouped in Entity Types. All the entities belonging to the same type have similar structures and similar basic connections (e.g. "Artist" and "Masterpiece" in an application on painters and paintings). In HDM, entities may have an inner structure: in general they consist of nodes arranged in some way (hierarchy is the most commonly used topology). Structural Links are used to "keep together" the different nodes belonging to the same entity type, and also to provide "navigation" across the nodes. Application Links, grouped in Link Types, are used to connect different entities, belonging to different types or to the same type (such as the link "Has-created" in the painters-paintings example, connecting an "Artist" to one or more "Masterpiece"). The definition of the Entity Types and Link Types is called, in HDM, "Hyperbase Schema in-the-large".

The "Hyperbase Schema in-the-small",

instead, details the inner structure of the nodes, i.e. the smaller structuring units permitted for entities, and the inner structure of links. In brief "Slots" are the smallest (atomic) pieces of information defined in-the-small, Frame are aggregate of slots and/or other frames. A Frame is associated to a Node and to one or more Link instances. The interested reader is deferred to the bibliography for more details [13,14].

The Access Layer of an application is organized into Collections (e.g. "all the Artists in alphabetical order" or "Artists in the Cubist movement"). A Collection groups together entities (of one or more types) and/or other Collections (nested Collections). A Collection is not simply a set: it must have a Topology, i.e. a way to organize its members (Sequential, Tree and Lattice topologies are the most commonly used), and it must have a Center (with a Frame associated to it), i.e. an additional information structure that helps the user to make an effective use of the Collection itself. The center may be used to "introduce" the collection, to "synthesize" its content, and to reach the collection members. A Collection introduces new connections within the application, called Collection Links. Collection Links are of two different categories: Index Links and Guided Tour (or Topology) Links. Index Links connect the center of the collection to its members and vice versa; Guided Tour Links connect the members together, according to the topology of the collection. "NEXT" and "PREVIOUS", for example, are typical navigation primitives for Sequential Guided Tours. Again the reader is deferred to the bibliography for more details.

According to the previous description a

database can be used to store the application components described by the model, then a run-time engine can be used to extract that components from the database and to display it to the reader as an interactive multimedia presentation.

THE APPLICATION: THE OLIVETANI MONASTERY IN LECCE

Using the same run-time engine already used for other hypermedia applications [18] we have developed an application to present the Olivetani Monastery, now seat of the Department of Cultural Heritage of the University of Lecce.

The monastery was built at the end of XII century by the Norman Count Tancredi di Altavilla according to the style of the great coeval buildings realized in Sicily by the Normans. During the time, in the XVII and XVIII centuries, the monastery was enriched with the typical elements of the baroque of Lecce, famous in the world for the embroideries of its sculptures, which exploit the properties of the local stone particularly soft and easy to work.

The monastery combines some XII century-style elements, such as the dome similar to the one of the Holy Sepulchre in Jerusalem, with baroque elements in a splendid harmonious building.

The application provides also some monographs meant to present the Salento region in terms of culture, history and natural heritage so as to attract a high level tourism.

According with HDM the design model of the application is shown in fig.1.

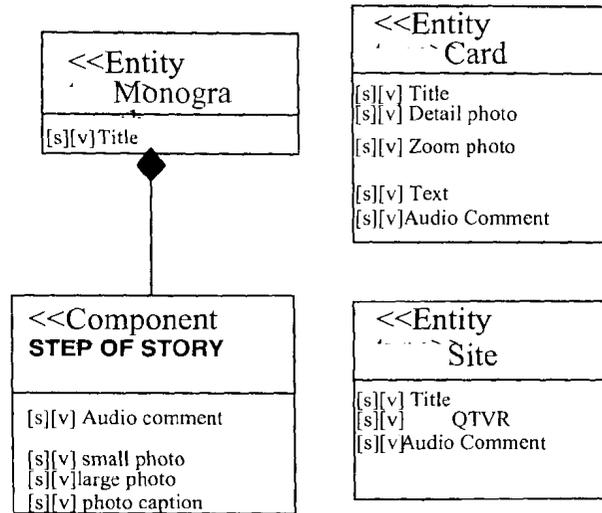


Figure 1: The Olivetani Hyperbase

The entity type Monograph is used to study in depth arguments related to architectural elements, to the history and to the symbolism. Each monograph is composed by steps, each of one supported by an image and audio comment. The monograph can be appreciated in two ways: as an automatic or a manual guided tour. The instances are: the Monastery from its origin to present time, the Tancredi's period, the Olivetani Order and its history in Lecce, Water as a source of spiritual life and the Baroque. The entity type Card allows the description of the architectural details of the monastery by using about 30 instances. The entity type Site is used to realize the photographic virtual tour in association with an audio comment. Fig.2 shows the semantic links that represents the navigation capability provided to users. The hyperbase of these applications is very simple but there are more complex applications

where the navigation links must be designed carefully.

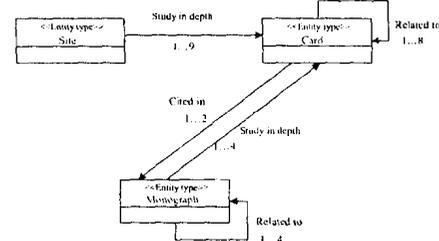


Figure 2: Navigation Links

The structure of the hyperbase with its entity types and the navigation links, according to HDM, allow the designer to develop a run-time engine independently from the specific application.

So, the designer can devote himself to designing the hyperbase in the large (definition of entity types and links) and in the small (definition of multimedia unit for each entity types named slots) without worrying about the software development.

The application design is completed by

the definition of Access Structure, i.e. the best way to allow the user to enjoy the application information. (Monograph collection, Virtual Tour, Cards Index, Site collection..)

Fig.3 shows the Home Page of the application, in Fig.4 we see a node of the Virtual Tour with the position on the map in the left side and in Fig.5 we show the monograph about Monastery from its origins to present time with its component in the left side.

CONCLUSIONS

The development of high quality multimedia applications requires a large effort in term of costs and work mainly related to the realization of contents and to the software approach.

The software costs are strongly reduced by the construction of a reusable engine for hypermedia applications based on the HDM model that is the logical extension to the model-based approach. The reusable engine, in fact, is able to implement hypermedia titles in an independent way from the specific application. The generality of the approach is based on the ability of HDM to describe a wide range of complex hypermedia applications. So, it is possible to concentrate the efforts on the development of high quality multimedia contents, which are, together with the usability granted by the methodology, the key to success of an application aimed at spreading the Cultural Heritage.

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Figure 3: The Olivetani Home Page



Figure 4: The Olivetani Virtual Tour

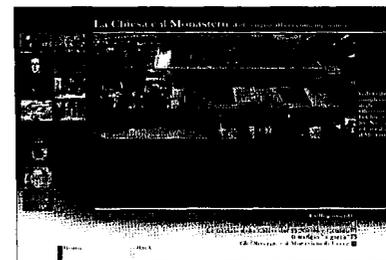


Figure 5: The Olivetani Monograph

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