THE DEVELOPMENT OF AN E-MUSEUM FOR CONTEMPORARY ARTS

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ABSTRACT:
The increasing development of interactive techniques and new information technologies' software and hardware and the decreasing of their costs have facilitated their use by a wide range of cultural institutions, such as museums. These new technologies also provided solutions for the lack of exhibition space, considerable exhibitions' costs and the fragility of some artifacts whose possible damage museum curators want to prevent. The value of these new tools and formats have been recognized and fruitfully exploited by curators for visualizing the cultural context of museum exhibitions. In addition, museums changed their way of conveying information about their cultural artifacts to the wide public, through new communication methods, like virtual museums, which have made the content and context of the museum collections more accessible and attractive to the wide public. During the last decade various kinds of 'virtual museums' have been developed either in the museums' environment, or over the World Wide Web. A virtual museum can be a digital collection that is presented either over the WWW, or to an intranet or even to a CD-ROM and it can be an extension of a physical museum, or it can exist only in a digital form. Furthermore, the virtual museum can have various forms. It can be a 3D reconstruction of the physical museum, where, in the virtual rooms of the museum exhibition, the visitors can navigate and explore its collections. Alternatively, it can be a completely imaginary environment, in form of various rooms, where the cultural artifacts are placed. This study describes all aspects of the creation of an e-museum for contemporary arts. Emerging tools, technologies, 3D digitization processes of museum spaces as well as artifacts are presented, public acceptance polls are discussed and educational scenarios are exercised. All presentations concern the actual case of the Macedonian Museum of Contemporary Arts in Thessaloniki, Greece.

1. INTRODUCTION

1.1 ICT and museums

Research work (Jones and Christal, 2002; Scali et al., 2002) and an extensive survey of the European museum sector (ORION Report) have shown that information technologies such as the World Wide Web (WWW) enhanced by three-dimensional 3D visualization tools can provide valuable help to achieve the aims mentioned above. Furthermore, the ever-increasing development of interactive techniques and of new information technology software and hardware accompanied by a decrease in cost resulted in their use becoming easier by a wide range of cultural institutions, such as museums. These forms of information technology are in effect empowering tools in the hands of the experts working at ensuring that the museums' goals materialise successfully. They provide solutions to issues of space limitation, of the considerable cost of exhibitions and of curator's concern with preventing any possible damage being incurred by fragile artifacts. The value of these new tools and formats has been recognized by curators who have effectively put them to use to ensure the visualization of the cultural context of museum exhibitions. Conferences such as the ICHIM Conferences on Hypermedia and Interactivity in Museums, which started in 1991 (available at: http://www.archimuse.com/conferences/ichim.html), and Museums and the Web established in 1997 (available at: http://www.archimuse.com/conferences/mw.html), highlight the importance of introducing new technologies in museums. The utility and the potential benefits of emerging technologies such as Virtual Reality (VR) (Pletinckx et al., 2000; Roussou, 2001; Wojciechowski et al., 2004), Augmented Reality (AR) (Brogni et al., 1999; Liarokapis et al., 2004; Liarokapis and White, 2005) and Web technologies (Sinclair et al., 2003; White et al., 2004), for museums have been well documented by a number of researchers.

In the 1980s museums began to change the way they conveyed the information surrounding cultural artifacts to the wider public. There was a shift in the museology concept towards considering that the context and the information surrounding an item were more important than the item itself (Pearce, 1986; Washburn, 1984; McDonald and Alsford, 1991; Alsford 1991). By means of innovative methods and tools and through taking advantage of the potential of the WWW as a source of information for all, virtual museums were created. This has made the content and context of museum collections more accessible and appealing to the wider public and has enriched the whole museum experience. Over the last decade various kinds of virtual museums have been developed either within the actual museum environment, or over the World Wide Web. There is no official figure yet for the number of virtual museums presently existing worldwide but we know that there are thousands of them and that their number is rapidly on the increase (Information today, 2005).

A virtual museum is 'a collection of digitally recorded images, sound files, text documents and other data of historical, scientific, or cultural interest that are accessed through electronic media' (Encyclopaedia Britannica online). A virtual museum can be also called "electronic museum" or "e-museum", "digital museum", "cybermuseum" or still "on-line museum" and "Web museum".

With no standard definition prevailing for the term 'virtual museum', the definition adopted for the purpose of this article describes it as "(…) a logically related collection of digital objects composed in a variety of media, and, because of its capacity to provide connectedness and various points of access, it lends itself to transcending traditional methods of

communicating and interacting with the visitors being flexible toward their needs and interests; it has no real place or space, its objects and the related information can be disseminated all over the world" (Schweibenz 1998).

According to ICOM (ICOM 2004) there are three categories of virtual museums on the Internet that are developed as extensions of physical museums: the brochure museum, the content museum and the learning museum. The brochure museum is a website that aims at informing future visitors about the museum. It usually contains administrative information about the museum, such as opening hours, services, types of collections, floor plan of the museum, map of the area where it is situated, contact details, etc. The content museum is a website created with the purpose of making information about the museum collections available. It can be identified to a database containing detailed information about the museum collections, with the content presented in an object-oriented way. The learning museum is a website which offers different points of access to its virtual visitors, depending on their age, background and knowledge. The information is presented in a context-oriented, rather than object-oriented, way. Moreover, the site is educationally enhanced and linked to additional information intended to motivate the virtual visitor to learn more about a subject of particular interest to them and to visit the site again. The goal of the learning museum is to make the virtual visitor come back and to make him/her establish a personal relationship with the online collection.

In the case of the virtual Macedonian Museum of Contemporary Art the last category of learning museum was selected. With the aid of emerging technologies, such as Web3D, and innovative approaches, such as educational games, a virtual environment that contains extensive information about the exhibits and their context, as well as additional research material, is under development.

1.2 Aim of study

The aim of the study is to present the tools and techniques used for the design and the creation of the virtual Macedonian Museum of Modern Art. The purpose of the virtual museum is to contribute to a complete and comprehensive presentation of the history and the exhibits of the Macedonian Museum of Contemporary Art. The presentation of the exhibits and their context will provide valuable help to the virtual visitors in understanding the museum exhibitions. The online navigation to the 3D space of the museum, as well as the presentation of virtual exhibits will invite the virtual visitors to participate in an enhanced museum experience and in museum meaning-making. Virtual games will also be added to the learning environment, in order to provide the opportunity for creative learning and entertainment at the same time.

2. STEPS UNDERTAKEN FOR THE CREATION OF THE E-MUSEUM OF CONTEMPORARY ARTS

2.1 Define potential virtual users

The design of the virtual Macedonian Museum of Contemporary Art is user-centred, it takes into account the user needs and it ensures the efficient and effective content, as well as the usability of the system by evaluation and feedback.

Its users are researchers and specialists of Contemporary Art, as well as students, or virtual tourists interested in art. They can have various backgrounds concerning their interests, knowledge, preferences, age etc. and it is considered important to satisfy the different profiles and characteristics. Thus, the potential users are interviewed and evaluate the system from its current early stage. For satisfying their needs the virtual Macedonian Museum of Contemporary Art will include information with various information depths in information layers.

2.2 Creation of virtual museum exhibitions

We used the most usual structure for virtual exhibitions that is defined by the structure of *exhibition spaces* (White et al., 2004). Each exhibition space may represent an entire exhibition, a part of the exhibition related to a particular subject, a museum gallery, etc. Subspaces may be used to divide exhibitions into smaller parts, e.g., focused on a particular topic. The exhibition spaces consist of two types of elements (ibid): the *Virtual Galleries* and the *Cultural Objects*. For their creation past research on/regarding the issues for consideration concerning the 3D representations was taken into account (Sylaiou and Patias, 2004).

The virtual exhibits are the principal means through which the virtual museum will communicate its mission objectives and they can be static or interactive. According to research the key features of an online interactive exhibit are: (a) multiplicity of contexts for the user to connect with the exhibit in a seamless manner, (b) good instructional design, (c) pro-active learning contexts, (d) good balance between learning and leisure, (e) no text-heavy pages to interfere with the learning experience (Tan Wee Hin et al., 2003).

Over the last decades there has been an effort to shift the focus from the aesthetic value of museum artifacts to their context as well as the historical information they encompass and the ideas they foster (e.g. Vergo, 1989; Pearce, 1992; Hooper-Greenhill, 2000). This changing perspective led museums to concentrate on telling stories about the objects, thus enabling visitors to construct semantic meaning around them. Historical narrative communicated establishes connectedness between the museum objects, visitors and various layers of information concerning their past context (Hoptman, 1992), and exposes cultural objects to new audiences around the world.

2.2.1 Visualization of exhibition space

In our case the permanent collection was digitised by imaging technology and visualised by means of 360-degree Quicktime VR technology developed by Apple (Apple, Quicktime VR). It allows animation and provides dynamic and continuous 360° views. It has been preferred among others because it is a low-cost, but easy-to-use and efficient solution for enabling the

users to experience and interact with the permanent collection of the museum exhibition.

The space of the temporary collection was created by 3D Studio Max and visualised by Web3D technology. According to 2D digital drawings and accurate on-site measurements a 3D model of the temporary exhibition space was produced. Real textures from the building were used in order to produce a more photorealistic result. Internet technologies that have the tremendous potential of offering virtual visitors ubiquitous access via the WWW to the virtual museum environment. Additionally, the increased efficiency of Internet connections (i.e. ADSL) makes it possible to transmit significant media files relating to the artifacts of the virtual museum exhibition. Thus, virtual visitors can have access to the virtual Macedonian Museum of Contemporary Arts exhibitions via a PC and an Internet connection at any given time and from any given location. The most popular technology for the WWW visualisation includes Web3D which offers tools such as VRML and X3D, which can be used for the creation of a virtual museum environment that is much more interactive than many current museum web sites available, i.e. a catalogue of pictures and text in a web browser. The characteristic of Web3D systems is that they can transform human-computer interaction techniques and allow the creation of a new category of interactive applications that could very well act as the catalyst for launching the virtual museum revolution (Sylaiou et al., 2005). This new generation of tools can assist not only with the integration of museum archives into a reliable and low cost solution, but also with allowing remote access over the Internet.

The virtual museum is divided into two levels and each level consists of various rooms. Each room contains a number of exhibits. The layout of the virtual exhibition space can be seen in Figure 1.

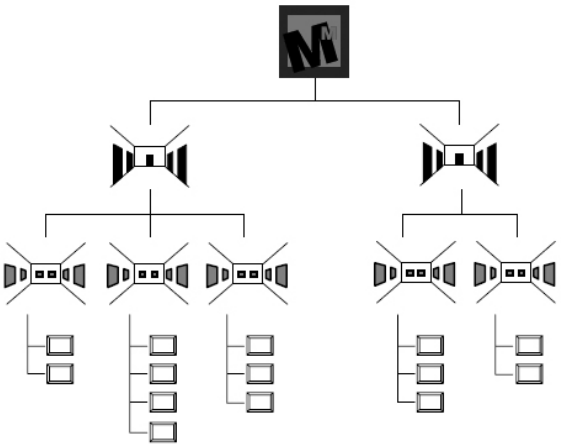

Figure 1: Virtual Macedonian Museum of Contemporary Art layout

2.2.2 Digitization of exhibits

The exhibits that were digitized for the creation of the e-museum of the Macedonian Museum of Contemporary Arts were of different sizes, shapes and materials. The digitization process was different depending on the complexity and the form of the exhibits. The exhibits were divided in two major groups two dimensional and three dimensional objects. Different techniques were used for each group ranging from photogrammetry to laser scanning.

2.2.3 Digitization of 2D exhibits

For the digitization of the two dimensional objects of the MMCA traditional photogrammetric techniques were used. The exhibits were photographed using a high resolution 10 MP digital camera (Canon EOS 400D), with different lenses depending on the size of the object. Then the images were rectified using the projective transformation. The final images have a pixel size resolution of 0.5 mm. In figure 2 we can see the raw image (top) and the produced rectified one (bottom).

Figure 2: The initial image (top) and the rectified image (bottom)

2.2.4 Digitization of 3D objects

For the digitization of the 3 dimensional objects different techniques were employed depending on the complexity of the objects. For objects with low complexity, photogrammetric techniques were used. For their digitization an external orientation device was used and the data was processed using the Photomodeler software. The more complex objects were digitized using laser scanners. Depending on their size two different laser scanners were used. For large objects the Optech ILRIS 3D laser scanner was used, while for smaller objects the Minolta laser scanner was used. In figure 3 we can see an example of digitization for a small object of low complexity. The first two images are a subset of the initial images that were taken for the mapping of the object. We can see the external orientation device and the object from two different views. The external orientation device has 24 premarked control points measured with high accuracy. In the other two images we can see a partial model of the object that was created using the Photomodeler software.

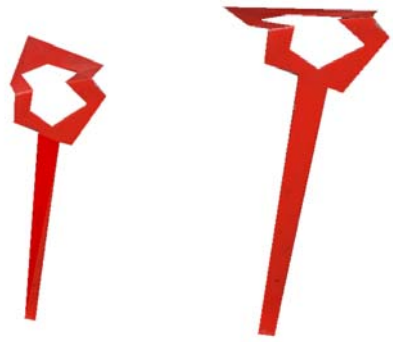

Figure 3: Subset of initial photos (top), views of the reconstructed 3D model of an exhibit (bottom)

For more complex objects the laser scanners were used. Next we are going to show an example of a respectively large object. For the reconstruction of this model the Optech laser scanner was used, while the processing was done using the Polyworks software. Initially four scans from different angles were performed. The different scans were aligned using Polyworks Imalign. In figure 4 we can see the aligned model and digitizer positions. In figure 5 the different views of the object from each position. In order to facilitate the scanner the object was put in a revolving base and was rotated to acquire the scans. Finally the four scans were merged using Polyworks Immerge producing the final triangle model. Further processing to fill the model holes and clear the model was performed in Polyworks Imedit. The final model was rendered using photos from an external 10 MP camera (Nikon D80) exported in VRML format and inserted in 3D studio Max for further processing. In Figure 6 we can see different views of the photorealistic model.

Figure 4: Aligned 3D model and digitizer positions

Figure 5: The four different scan angles

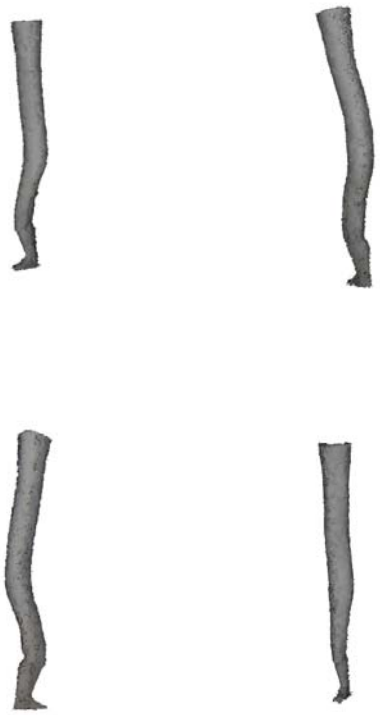

Figure 6: Captions of the final photorealistic 3D model

3. VIRTUAL MUSEUM FUNCTIONALITIES

3.1 Navigation to the permanent museum exhibitions

The navigation to the permanent exhibition is created, as already mentioned, by means of Quicktime VR. More specifically, the virtual visitor will have the opportunity to look around the exhibition space.

3.2 Navigation to the temporary museum exhibitions

Two options will be provided to the virtual visitors of the temporary museum exhibitions:

i) Free navigation in which more experienced in these environments users will create their own navigation path, defining the direction, the objects, the speed and the time they will spend to each exhibit.

ii) Navigation with the aid of map window choosing the place that s/he will visit by clicking on the 3D map with the exhibition spaces.

The navigation to the permanent and the temporary exhibitions will be real-time and they will have some space constraints to prevent the virtual navigator from reaching a deadlock and to avoid the sense of disorientation.

3.3 Examination of the exhibits

The QTVR and panoramas files are connected with other files containing information about the exhibition space and the exhibits will be added by hotspots. The visitor can click on the exhibit and open a window with a scalable image that allows panning and high-quality zooming and provides the desired

level of detail and information about it (e.g. text about the artefact, the artist, bibliography, sound).

The 3D exhibits can be examined from various points of view by rotation. Information about them can be extracted by clicking on them and opening a window with information concerning their context.

3.4 'My Gallery'

My Gallery is a functionality of the virtual museum that provides the opportunity to the virtual visitor to become a "curator" and to create its own exhibition in an empty 3D space. By the Search option the virtual visitor can search for exhibits by keyword concerning the title of the virtual artefact, the artist, the material that is created etc. The results of her/his search are visualised as thumbnails from which it can choose and "drag and drop" the exhibits to its own virtual exhibition space. Furthermore, s/he can take snapshots and send them by e-mail to friends, or save them to her/his PC in order to keep the information about the exhibition that created.

These functionalities are both entertaining and educational. They can provide aesthetic satisfaction and contribute to creativity, but at the same time, they can be a valuable tool in the hands of architects and museologists and students of these Departments for experimenting and evaluating ideas about exhibition approaches.

3.5 Educational games

After the navigation to the 3D exhibition space the virtual visitor will have the opportunity to play some games in order to test the educational effectiveness and measure the impact of the virtual exhibition to its visitors.

3.5.1 Quiz

An educational quiz is provided by choice to the virtual visitor with multiple choice questions about the exhibits of the virtual exhibition. The correct answers will provide points and the high scores will be followed by bonus and awards connected to the exhibits of the museum, in order to increase the motivation of the visitors.

3.5.2 Hidden treasure

The hidden treasure is a game in which the virtual visitor searches for an exhibit with specific characteristics (e.g. an exhibit made by papier mâché). The virtual visitor will be driven by instructions and s/he will watch the path chosen and position to a ground plan. The game will have various levels of difficulty and it will also have a "point system" connected to awards.

4. NEED FOR EVALUATION

In order to test the efficiency of the virtual Macedonian Museum of Contemporary Art, it shall be evaluated under real circumstances, not only by a demonstration of its capacities, but also through the contribution of real end-users, so the necessary system improvements will be made. It will be based on interactive and user-friendly interfaces that meet current end-users' demands and contribute to their education and entertainment.

Its usability will be assessed with the aid of the usability evaluation guidelines: learnability, efficiency, memorability, errors and satisfaction developed by J. Nielsen and his colleagues (Nielsen 1994). Heuristic evaluation and cognitive walkthroughs will be used. Heuristic evaluation guidelines (Nielsen 1994) were used to evaluate the user interface of the system inviting human observers. According to these guidelines, a system must provide feedback and visibility of the system status employing simple language with clearly marked exits. Consistency of user interface elements is required and user's memory load must be minimised. The user interface shall have aesthetic and minimalist design and it has to be able to deal with errors. Finally, help and the appropriate documentation should be available. Cognitive walk-through methods (Nielsen 1994) involve the 'walk-through' of a number of tasks, exploring the systems' characteristics, locating and identifying potential problems and their causes.

A mixed-methods evaluation approach combining quantitative and qualitative research methods will be adopted (Sylaiou et al., 2004; Sylaiou et al., 2008). In the evaluation not only simple users, but also experts will participate. The methodology undertaken will also involve experts that will evaluate the virtual museum. More specifically the virtual museum will be evaluated by:

- the domain experts, the curators that do have no direct knowledge of technological usability evaluations,
- the usability experts, who were aware of the usability aspects, that will act as visitors of the virtual museum (Karoulis et al., 2006a),
- the end-users (Karoulis et al., 2006b).

5. CONCLUSIONS AND FUTURE WORK

In this paper the first steps undertaken for the creation of the virtual Macedonian Museum of Contemporary Art are presented. The methods, tools and techniques that will be used are discussed. The virtual Macedonian Museum of Contemporary Art has the potential to both preserve and disseminate the cultural information in an effectively and low-cost method through innovative methods and tools. It will be an engaging medium with great appeal to a variety of groups of visitors and can promote the 'real site' by providing information about museum exhibitions and offer an enhanced display of museum artifacts through emerging technologies. The visit to the virtual museum will be an enjoyable and productive experience that draws the user into involvement and participation and help the promotion of the real museum (Jackson et al., 1998). The virtual Macedonian Museum of Contemporary Art can be a ubiquitous place for expression, where users can become creators as well as consumers of information (Frost, 2002).

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