VIRTUAL HERITAGE IN THE DIGITAL ERA

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Abstract. These instructions are intended to guide contributors to the *Second International Conference of the Arab Society of Computer Aided Architectural Design (ASCAAD 2007)* when preparing papers. The abstract is in 10 pt Times with 11 pt leading.

Abstract. In the last years we have witnessed an enormous interest in the idea of the virtual, triggered by the increasing availability of advanced information technology. The capacity of this technology to model and simulate the behavior and the perception of environments have raised enormous expectations about the possibilities of producing synthetic, virtual environments that will eventually replace reality in the forms we know it. But if this virtual trend is a very recent phenomenon associated to the development of information technology, the idea of the virtual is not new. Virtual reality takes place, also, in architecture. Virtual architecture is not a design problem to which architecture and architects can offer any answer that they please. It is the condition, under which we have come to live in the 21st century through the physical and sensual encounter with the computer. It is only as a violence of this nature that virtual architecture can become a virtual thing and have the power to change the architectural thought of the era. Virtual reality could be used in different fields but essentially, the goal of this piece of work is the development of a generic set of tools that provide users with the means to recall represent and document the heritage in a new way, in order to preserve and make it accessible to as many people as possible.

1. Introduction:

The architecture has an event driven design, i.e. components start the information processing after receiving an event. After processing, the components can generate new events and the processing can be done in parallel. Architecture is as much an art form as a technical discipline; the system resulting from this approach is more robust and easier to understand.

Engineers expend a great deal of effort to eliminate ambiguity from their terminology and methodology, so that problems and solutions can be communicated in a manner where there is only one possible interpretation. Similarly, architects strive to create spaces and meaning in the built environment that can be interpreted in more than one way.

It would be interesting to develop computer-based design tools that implicitly recognize the need to design at multiple length scales. It is interesting to note that design for mechanical response at more than one length scale is an open issue in current research on Virtual Reality in architecture. (R. B. Haber, 2000)

This paper points out the effectiveness of VR in the study of historical layering of sites and monuments.

2. Dilemma of study:

As the cultural heritage is a unique expression of human achievements, this cultural heritage is continuously at risk especially in regions occupied by terrorism and in disasters zones example in Palestine, Iraq and Lebanon; and as these countries have numerous precious monuments, they unfortunately, suffering from the military operations which destroy and demolish its valuable heritage.

Moreover, the recording of these heritage buildings is one of the principal ways available to give meaning, understanding, definition and recognition of the values of the cultural heritage; so logically, the traditional values need to be preserved, researched and transmitted. (George Tambu, 2002) Figure (1).

Figure 1, Askariya Mosque, Samraa, Iraq after and before bombing.

The responsibility for conserving and maintaining the cultural heritage rests not only with the owners but also with conservation specialists, the professionals, managers, politicians, administrators working at all levels of government and with the public. In fact it is the responsibility of all the human kind.

Museum stands as a major way in preserving and conserving of heritage, but can traditional museum play this vital role? So, this paper will analyze the existence of incompatibility or unsolved contrasts between the physical museum and the virtual museum related to tasks, purposes and representation. (Roberta Buiani, 2003)

3. Research objectives

There are traditional methods of documenting architectural heritage as writing, photographing, video taping, sketching and physical modeling. However, digitizing culture is not just about shifting knowledge from books to computer screens; it is changing the amount of information that can be consulted and the way to access and present knowledge. (George Tambu, 2002)

This study is going to find new techniques to revive the heritage in order to preserve and make it accessible to as many people as possible. Specifically, this research aims to:

1. Recall and represent the heritage in a new way in order to conserve it.
2. Find a new way to revive heritage virtually as a new conceptual model in computer.
3. Bridge the gab between generations by revitalizing of the old heritage. (Samar Sheweka, 2006)

4. Virtual Architecture

One technology that is catching everyone’s attention lately is Virtual Reality. This VR has its unique applications in all fields of sciences; Virtual Architecture is one of its applications.

Virtual Architecture is a networked spatial environment designed using the metaphor of physical architecture; so that it inherits many visual and spatial characteristics. However, in order to further explore its potential, Virtual Architecture need to go beyond its physical metaphor to develop its own theories and styles. One important step of this process is to establish a formal foundation for designing virtual architecture. (Ning and Mary, 2005)

5. Design in Cyberspace:

The designing places in Cyberspace can, indeed must, be informed by the principles that have been guiding physical place–making for centuries, for environmental, social, and cultural richness sake. The argument, however, that achieving such place–ness is not a matter of emulating physical form in electronic environments: Cyberspace cannot be 'spatialized' by simply appropriating physically–based spatial metaphors. On one hand, objects and spaces that were functionally and perceptually 'appropriate' in the physical world lose their appropriateness in Cyberspace. On the other hand, the digital realm offers place–making opportunities that do not exist in physical space.

Today, there are four categories of environmental 'shells' for developing place in Cyberspace: (Yehuda and John, 2006)

5.1. HYPER-REALITY CYPERSPACES:

Hyper Reality attempts to mimic the physical world in every detail. The level of quality required to be believable is quite high, and not easily achieved. Hyper Reality environments can be used to re–create historical places that no longer, or have never existed or places that do not yet exist. (e.g., Muva, the Virtual Museum of Arts Al Pais, Figure 2).

Figure 2. MUVA, the Virtual Museum of Arts Al Pais (http://muva.elpais.com.uy/Ing/info/zoom-muva1.html).

5.2. ABSTRACTED REALITY CYPERSPACES:

Abstracted reality obeys enough laws of nature to engender believability, but does not attempt to create a 'perfect' reality. Objects and textures are abstracted, not perfectly rendered, but there is an attempt to avoid disorientation or the unfamiliar.

There is quite a bit more artistic freedom in Abstracted Reality than in Hyper Reality, which allows for stretching, or accentuating, place–making qualities such as scale and time. Abstracted Reality can be used to create places that are too expensive to construct in the physical world, but buildable

in a virtual one.3D–MUDs (Multi–User Domains) are probably the best example of Abstracted Reality Cyber–places. They employ a strong spatial analogy, with the explicit intent to facilitate multi–user (i.e., social) interaction. Like textual MUDs, they typically use 'rooms' as partitioning mechanisms, to restrict the visitor's attention to activities in one room at a time. To move one's attention, the user must 'change rooms': in some systems users can jump from one room to another, whereas in others they must 'walk' or 'fly' to their destination, passing through points in between.

5.3. HYPRID CYPERSPACES:

Hybrid Cyberspace freely mixes 'Real' and 'Virtual' experiences. It does not need to obey the Laws of Nature. One could, for example, move through walls, or fly. The range of artistic expression is quite limitless, and could easily become surreal, by the nature of unusual juxtapositions. Many elements of the site may be unbuildable in the physical world.

5.4. VIRTUAL SPACES:

Hyper Virtuality drops all relationship to the physical world and the Laws of Nature. Each site creates its own set of virtual rules, which could challenge our sense of reality, materiality, time, and enclosure of space. Common building elements such as walls, doors, windows, or floors have no meaning here.

Of the four types of cyberspace, Hyper Reality seems the most fertile relative to opportunities offered by the digital medium in dealing with heritage. There is the potential to expand the realm of sensory experiences by taking advantage of the computer's ability to organize time, data, and space bounded by the physical spatial metaphor. Hyper Reality also may lose the sense of familiarity, along with the social cues that derive from it. The freedom offered by Hyper Reality, along with its rejection of original place principles, threatens to marginalize this type of Cyberspace to a form of place–less environment. (Yehuda and John, 2006)

6. THE USE OF VR IN HERITAGE: VIRTUAL HERITAGE

Virtual Heritage is the utilization of technology for interpretation, conservation and preservation of natural, cultural and world heritage.

'Virtualize' heritage means to actualize it digitally, to stimulate it using computer graphics technology. Practically, virtual archeology refers to the use of three dimensional computer models of ancient buildings and artifacts visualized through digital interface technologies that offer some degree of

immersion and/or interaction with the content. In this sense, virtual heritage involves the synthesis, conservation, reproduction, representation, digital reprocessing, and display with the use of advanced imaging technology. Well-conceived and well-directed programming and presentation of the cultural heritage on VR may create tastes that persist for a long time as a pattern of social behavior. (Samar Sheweka, 2006; George Tambu, 2002)

Virtual Heritage should take place in the world heritage, it reassemble together the best work being done around the world in the reconstruction of historical sites and objects using virtual reality techniques.

Virtual Reality has a lot of advantage in the field of heritage and architecture as following: (Samar Sheweka, 2006)

1. To document, record and conserve the international heritage all over the world.
2. It is the main tool in the Virtual Recovery of the Lost Heritage.
3. It helps in the education process for student, especially for architecture students. It can transfer them to another world and make them feel if they walk at the site with its details and history.
4. It makes a rich library to architect to help them when they are going to build in a historical sits.
5. It spreads the nation culture; heritage and tradition add to that it helps in the field of tourism to attract the tourists to the country.

The research undertaken will concentrate on the first two advantages since the following ones are out of our concern.

6.1. VIRTUAL DOCUMENTARY OF HERITAGE:

The documentary heritage deposited in libraries and archives constitutes a major part of the collective memory and reflects the diversity of languages, peoples and cultures.

The most urgent need is to ensure the preservation, using the most appropriate means, of documentary heritage of world significance and to promote that of the documentary heritage of national and regional importance. It is just as important to make this heritage accessible to as many people as possible, using the most appropriate technology, whether inside or outside the countries of its location. High quality text, sound and image banks could be set up and made available on local and global networks, reproductions made on all sorts of media. (Samar Sheweka, 2006)

6.2. VIRTUAL RECOVERY OF A LOST HERITAGE:

Another valuable and unique application of VR is in the reconstruction of archeological sites or inaccessible architectural sites. The reconstruction of a demolished historical building is another venue where VR simulations become an optimal solution. (Daniela with David, 1997) Figure (3).

Figure3, Delphi, Greece, the recent and after VR reconstruction.

The process of recovering is symbolic of repairing a link in a chain of convention extending back to the beginning of the faith, broken in the rejection of craft that followed the Industrial Revolution, and manifested in the disappearance of ornamental detail.

Replication is a necessary, unavoidable first step on the convoluted pathway back to where the rupture between craft and mechanized product occurred, and this point must be reached before typologically based invention can begin again, chose to use mechanization to return to the point before it destroyed the craft and trying to reconstruct in order to protect the heritage against the depredation to do so. (Laurence King, 2001)

6.3. VIRTUAL HERITAGE MODELING TOOLS:

There are different ways to make a virtual heritage model on the computer can be known as geomantic methods: (Samar Sheweka, 2006)

1. Remote Sensing and Aerial photogrammetric:Remote Sensing is preferred to produce maps covered big regions because it saves time than other methods. Aerial photogrammetric is a method to extract lines boundaries which is important to heritage recording.
2. LIDAR (Light Detection and Ranging): Topography models, contour maps, elevation control points are refined as basic information to represent excavated and unexcavated areas in archaeological plans.
3. Photogrammetric: Recoding special data of dimensions, details, site.
4. Laser Scanners: The main advantage is the availability of real time 3D coordinates for regular surfaces.
5. Geospatial Information Systems: All the obtained data from different method need to be organized in a good program give the chance to put and recall the stored data by using (GIS system) add to that it can updates the heritage information.

6.4. VIRTUAL ENVIRONMENT SYSTEM:

After choosing the suitable tools for data collecting, there is certain system to treat this data in a way producing virtual environment. This system consists of the following layers: (Michael, Roland, Markus, Jens, and Roland Wagner, 2000)

1. Repository: All objects used for describing a scenario, such as maps, photos, drawing and historical data, are stored in the repository.
2. Repository Manager: All editors do not access the objects in the repository directly, but through the repository manager. This insures that the objects do not have to be managed separately in each module.
3. Editors: Instead of having one tool to generate a virtual environment, the system is based on several independent tools which however are combined and communicate with each other.
4. Scenario description files: This describes the objects and their properties for the actual scenario. Starting from these files, the system generates the virtual world, including the simulation and the trainer module
5. Virtual world simulation: Reconstruction the model by choosing programs to build VR model.

7. The Digital Museum:

A digital museum is an innovative museum which extensively utilizes computer technology to organize and display information about its materials. The term "Digital Museum" refers to more than just a structure; it is the archetype of a museum which utilizes computers in all areas, including hardware, software and presentation techniques.

Of course, a digital museum incorporates elements of the virtual museum by digitizing information related to items in the collection. The information is then stored in a database for use in a wide variety of applications. This system allows for the use of an extensive array of information, not only by storing simple information such as an object's name or reference number, but also by allowing for searches by an object's appearance or structure. In other words, the digital museum includes features of the virtual museum.

With a virtual museum, objects are reduced to information, which is used to create virtual displays via a network. A virtual museum has no physical exhibition rooms at all. By organizing real space and real objects using an information-based model, we can create an overlapping of the real museum and virtual museum to achieve one unified system. (Ken Sakamura, 2005)

Virtual museums remove geographic barriers, bringing monuments to those who are interested, but may lack the opportunity to travel around the globe or even across town. Virtual museums help decentralize monuments

by making it more accessible which attracts new audiences and fosters greater appreciation for traditional museums.

The vast majority of virtual museums are electronic reflections of traditional museums, i.e., museums that have a physical location, a permanent collection, and special exhibits. The web sites of traditional museums act as ubiquitous cyber outposts of the home institution. Example:

http://www.williams.edu/art/architectureVR/neresheim/index.html;

http://www.williams.edu/art/architectureVR/palazzoDelTe/

These virtual museums serve primarily as information portals for the museum, featuring descriptions of the permanent collections, promotions for special exhibits, hours of operation, and, of course, the obligatory museum store.

The purpose of the digitization projects is more than simply making unseen items available to the general public. Many of the museums are working collaboratively towards linked databases to create, in effect, "a catalogue of the world."

No matter the range or scope of virtual museums, they share the basic purpose of their more traditional counter-parts: collection, preservation, education, and exhibition; nevertheless, virtual museums are a distinct departure from the generally accepted traditional concept of a museum. (Christophe Voss, 2004)

8. New Vision: Virtual Museum as Cyberspace:

In the first one asks what is the actual purpose of the museum, it is not simply to display some artifacts. Instead the goal is to create an ***impression*** on people and to make them ***imagine***. The question remains whether displaying real artifacts in real settings for people to pass by and passively look at is the only or the best way to achieve such goal. Many changes already present in museums point to the contrary.

Here comes into spot the Virtual Museum as Cyberspace which takes advantage on the traditional museum in many characteristics. First, Some artifacts are too large, or may be incomplete, making their display difficult; expensive measures have to be taken to assure security for the artifacts; and the displays need environmental conditions which preserve the artifacts and make it comfortable for people to view them.

Second, as the number of artifacts increase, both new and old, museums have difficulty providing their archival and storage, let alone their display. As a result, a great number of artifacts have little possibility of ever being displayed. Third, people have to travel to reach the museum and then circulate inside to see the artifacts. While this encourages tourism, in general it is debatable whether it is the best approach. The people rarely see the

artifacts where they were found, but instead where they can be concentrated for historical or financial reasons: artifacts end up being displayed where people are rather than in their natural environment. In addition, moving artifacts is dangerous and expensive. (Dennis and Simon, 2001)

Cyberspace offers an avenue of representation and appreciation heretofore unavailable in the physical world. Other than in special exhibitions, a set of monuments are rarely assembled in one place. Even given the possibility of a special retrospective exhibition, it still would be impossible to gather different monuments in one place. The scale and grandeur of the online reproductions pales in comparison, of course, to the original, physical works; nevertheless, the virtual museum accomplishes a previously impossible feat. Most virtual museums offer the possibility of viewing quality details through a medium that is well suited to image intensive exhibits. In addition to internationally renowned artifacts and monuments, cyberspace can also offer an opportunity of representation for more obscure monuments. (Christophe Voss, 2004)

We have taken a conceptual approach regarding this theme, then by organizing real space and real objects using information –based model, we can create an overlapping of real museum and virtual museum to achieve impressed virtual environment:

8.1. EXHIBIT CAPSULES:

The Exhibit Capsules are computerized display cases which display the actual collections. The capsules include a computer screen as standard equipment. Since the screen is a touch panel, information related to the exhibited objects is brought up interactively in accordance with visitors' interests. (Ken Sakamura, 2005) figure (4).

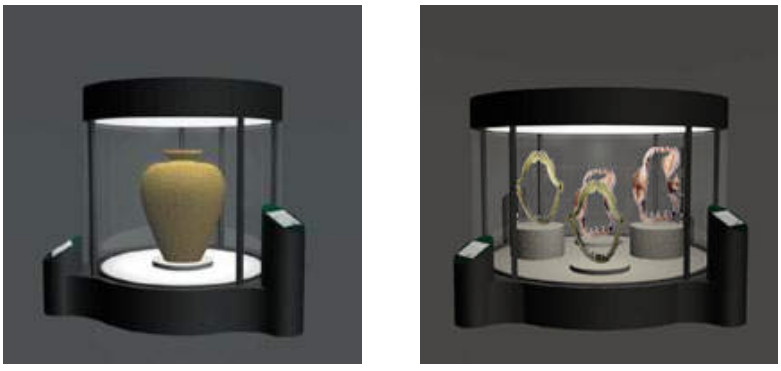

Figure 4. Exhibit Capsules.

Visitors can access all of the information stored on the servers, allowing them to see parts of the collection not on display. Since the screen is a touch panel, information related to the exhibited objects is brought up interactively in accordance with visitors' interests. Visitors can access all of the information stored on the servers, allowing them to see parts of the collection not on display. There are two methods to access this information: by following a hyperlink from a definitive standpoint or by navigating in so-called virtual space to access the desired object by location.

The former can, also be handled by using the World Wide Web. To achieve the second, MUD (Multi-User Dungeon) technology was developed at our research center. Through the MUD framework, visitors can create a "double" of themselves in virtual space. By controlling this "double" in virtual space, they can see objects in virtual space, hold "conversations" with the doubles of other visitors or give presentations. MUD space uses the arrangement of actual capsules in the digital museum as a base, but it is not limited to this. It can virtually expand the floors to offer access to the entire collection, including objects not on display. The virtual floors contain virtual capsules.

It is possible to see the images of actual surroundings of the Exhibit Capsule accessed through virtual space screen. Also, visitors who have entered virtual space through the screens of the real Exhibit Capsules can be projected in virtual space as real images taken by a camera. "Visitors" who have entered the virtual space via the Internet are projected in virtual space as abstract human images, and can "converse" with the other visitors. (Ken Sakamura, 2005) figure (5).

Figure 5. Exhibit Capsule accessed through virtual space screen.

8.2. RIDE CAPSULES:

Unlike the Display Capsules, Rides are capsules which involve People. They run along aerial tramways, overlooking the exhibition floor. This makes it

possible to give visitors a tour of the main objects on display in the museum, with customized explanatory images and verbal explanations. Several stations within the exhibition floor allow visitors to get on and off when they like. Also, through the use of a computer, flexible circuit management and shortcuts can be utilized to create a mini transportation method. This lets staff travel to their desired destination in the museum without having to follow the standard route.

The Ride Capsules can be used for a wide array of purposes, if a virtual floor is specified as the desired destination; a rider is automatically taken from the standard route and conducted to a small room which has an all-encompassing screen, creating a ride in virtual space.

A flat floor construction was used to maximize the potential of this design. However, Rides are not restricted to horizontal movement. They can also move up and down in a spiral motion, effective for multi-story museums built on small spaces. (Ken Sakamura, 2005)

9. Architectural Overview of the Digital Museum:

Digital museum is designed around the fundamental concept of providing "space," using a giant flat floor plan. This design is able to draw out a "primitive" response causing us to feel the unusual emotion provided by the enormous scale while conforming to the information model in which everything is included in Display Capsules. The only area above ground is the flat exhibition floor. Since it is a non-partitioned flat open space, trusses can be constructed in the open space when needed for special exhibits and so forth. These trusses can be used to set up new capsules, creating a "museum in a museum."

PDMA (Personalized Digital Museum Assistant) is a compact electronic portable device that carries out commentary of the digital museum. Electronic tags are affixed to the exhibits of the digital museum. These tags are then read by the PDMA, and when the user points the PDMA at an exhibit, the PDMA automatically provides commentary on that exhibit on the screen and by voice. (Ken Sakamura, 2005) Figure (6).

Figure 6, Digital Museum

Visitors to the museum are able to access data on the server through the PDMA they are carrying, and conversely it is possible to transmit data from the server to the visitor. By gaining a clear picture of the location of visitors, the PDMA in its normal state shows the current position in a map of the museum, and displays a guide for the surrounding exhibits. When looking for a particular exhibit, the PDMA shows the route to the display capsule in which it is displayed, and if it is not being displayed, the visitor is invited to a virtual floor from a nearby capsule that is not being used. The PDMA is the means of communication within the museum, not only for visitors but also for museum staff. (Ken Sakamura, 2005)

9.1. ADVANTAGES:

The virtual museum does have a variety of advantages:

1. The two major reasons why people no longer go to museums are that there is no museum nearby, and that they are not provided with an appropriate commentary. The digital museum provides methods to solve these two problems.
2. One of the most immediately recognizable advantages is that geographic barriers are, at least, superficially eliminated. Allowing for the assumption of internet access, a person can browse the collections of museums in far corners of the globe. The ability to visit such a diverse array of establishments with such ease is simply staggering.
3. The opportunity for education is another fantastic attribute of virtual museums.
4. One of the most interesting and useful manifestations of the virtual museum is the digital cataloguing of extensive collections. The most significant limitation on any physical museum is the finite nature of exhibition space. A virtual museum is not bound by such earthly constraints. In an effort to use technology to their advantage, a number of important museums have

undertaken the major project of digitizing their collections to be brought online. (Christophe Voss, 2004)

5. Distances are elastic to the extreme: one can hyper–jump from place to place without having to visit points in between. (Yehuda and JOHN, 2006)

9.2. DISADVANTAGES:

There are those who simply dismiss virtual museums as inherently anti-art, vapid content, and alienation:

1. An artwork's scale, texture, and color can not be as readily appreciated when digitally reproduced.
2. There is also a persistent suggestion that virtual museums are anti-social. In theory, rather than facilitating social interaction and discourse, the virtual museum fosters isolation and fragmentation by removing the museum experience from its civic context. (Christophe Voss, 2004)

10. Conclusion:

In the future, museums from around the world which have digitized their collections using the standard data format for museum-use will be connected to the network. This will permit the free exchange of data at high speeds. It will also make it possible to hook up to the exhibition floors of other museums through virtual space. If this happens, it will be possible to create a meta-museum by connecting all of the museums around the world, just as a museum can be achieved by connecting the Display Capsules on the floor. (Ken Sakamura, 2005)

It is obvious that information technology has been a very important tool in the development and in the achievement of the form of virtuality: not so much as a tool for the simulation of reality, but rather as a tool for "modeling", in the broad sense of the term. So making virtual model for a monument and its context is a trail to reflect the shape of time in information technology age and to have a life for our history to be dynamic. (Alejandro & Farshid, 2005; Samar Sheweka, 2006)

Virtual museum such on line is not a new way to preserve and represent the Heritage, but what is new is to make "**Physical Virtual Museum**" in order to represent the Heritage over the world on spot, no need to travel if time and finance are not allowed. "**Physical Virtual Museum**" is more effective for visitors than visiting sites on line, the physical surround touch sense of humanity to be on site of monument. All this offers the possibility to preserve in the most complete and adequate way not only its external view, but also its architecture, the peculiarities of its decorative elements and other aspects of its existence. (George Tambu, 2002)

11. Recommendations:

Culture will actually finally see the light when the country's cultural heritage becomes virtualized. "**Physical Virtual Museum**" must be able to make people aware of the fact that the foundations of the future lie in the past, and so they have to turn, from time to time, to their traditions and reshape their society anew, and create a modern society that incorporates the best of the over world culture. (George Tambu, 2002)

This piece of work will help in different field such as:

1. Tourism: in order to attract the tourists from the entire world by putting the application in the **Physical Virtual Museum**, the user can navigate through the building and its context.
2. Education: by using it in the architectural schools to teach the history of architecture.
3. Digital library: for architects to document historical areas and monuments. (Samar Sheweka, 2006)
4. In the domain of conservation, there are many tasks that can be resolved only by means of an electronic production. One such task is the virtual conservation of monuments and works of art.

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