Exhibiting in Shared Virtual Environments: Realistic 3D Museum Representation over the Web

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ABSTRACT
The work proposed in this paper is part of the development of an integrated environment for the exhibition of digitised museum artefacts. This environment will enable the realistic representation of the virtualised (i.e. digitised 3-D surrogates of physical objects) exhibits and the Museum's interiors. The system is currently under development and will enable geographically dispersed users to visit this virtual museum at any time inside a shared digital environment where they can meet, associate and interact with each other and the exhibits over the World Wide Web. The system will be the basis of an integrated learning environment and this system aspect is also investigated. Other services like general info and guidance for the visitors will also be implemented. This work is currently funded by the project "ANASTILOSIS" [1] of the Greek Ministry for Development.

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INTRODUCTION
Virtual Archaeology was first proposed by Paul Reilly [2] to refer to the use of 3d computer models of ancient buildings and artefacts. The key concept is "Virtual" and signifies an allusion to a model, a replica or the notion that something can act as a surrogate or replacement for an original. Virtual Reality is being used as a generic word to refer to the growing range of dynamic-interactive visualisation [3],[4]. Virtual Reality is such a hot concept that many people tend to use it even when its use is logically inappropriate. It should be defined as those environments where the human operator is transported into a new interactive environment by means of devices that display signals to the operator. This process is called "User Immersion" and is fundamental to all Virtual Reality systems.

The work presented in this paper, is based on the technological advances in the field of Virtual Environments and the potential of accessing this type of computer interfaces over the Internet. A Virtual Environment (VE) is a computer system, which generates a 3-dimensional (3D) virtual environment, with which the user can interact, in such a way that he receives real time feedback. If multiple users use the VE and they are able to interact with each other the above definition would be extended to multi-user or Shared VE (SVE).

SVE technology has been comprehensively considered in order to support the activities of the Benaki Museum in Athens, Greece. This technology will be used for the enhancement and dissemination of the planned actions related to the opening of the new Islamic Wing of this important Greek museum. Prior to this opening a number of related events have been scheduled and the proposed system will also be used to inform the public as well as provide access to simulations of the actual exhibits to a vast number of visitors over the Web.

MUSLIM STUDIES IN GREECE: THE BENAKI MUSEUM ISLAMIC BRANCH

Even though it plays a broader role, which serves more than one social need, the Benaki Museum is perhaps unique among the complex of Greek museums in having a composite structure. The scholarly study and the cataloguing of its Islamic collections were put in hand with the more particular and immediate objective of promoting Islamic studies in Greece. The primary focus of this scheme is not only to disseminate Islamic artistic creation but also for the Museum to function as a Centre for the Study of Islamic Civilization.

Despite the cultural proximities between Greek and Islamic civilizations, and despite the presence of Muslim minorities across Greece, Islamic studies in Greece remain at a premature stage. The Benaki Museum has organized a series of important events, which will precede the opening of the Museum Islamic branch in order to sensitize the public and provide access both to the actual and the digitally replicated exhibits as well as to historical and other sources of information related with them.

On February 2002 the Benaki Museum, in association with the Metropolitan Museum of Art, New York and the Corning Museum of Glass, Corning New York, is planning a major exhibition that will explore the most significant aspects of the production of glass from Islamic lands and its influence on Europe. The exhibition is entitled 'Glass of the Sultans' and will include over 150 of the most culturally impressive objects in glass, ranging from the seventh to the nineteenth century originating from twenty different countries. Another important event that will be shown at the Benaki Museum from November 2001 to January 2002 and is closely related to it in subject matter and historical sequence is the exhibition "Ancient Glass from the Holy Land", organised by the Israel Antiquities Authorities. This exhibition will trace the origin and development of glassmaking in the periods immediately preceding the Islamic era.

E-ISLAM: A VIRTUALISED SPACE

Two major considerations govern the e-Islam project in regard to the final system's enforcement. The first is the use of e-Islam environment for disseminating the Museum's Islamic collection to the public, notably actual museum visitors and virtual visitors of

the e-Islam web environment. The second major consideration is the use of the e-Islam environment as an educational tool, for the study of the Islamic culture. Both of these issues are the conceptual bedrock for the design considerations and the derived system architecture. Key system features and components are described in following.

The Digital Objects Library

Central to the e-Islam environment will be the Digital Objects Library (**DOL**) system component. This will hold not only the 3D digitised exhibits but also metadata and other linked information that fully qualify and interpret the archived exhibits. The **DOL** system will be the core system both for the presentation of the e-Islam artefacts and the related educational material. Certain rules will be embedded within this system and different user profiles will be documented and supported. The **DOL** will structure the data information according to standardised information architecture.

The purpose of the information architecture is to represent the riches and variety of library information, using the building blocks of the **DOL** system. From a technical view, the digital library is built up from simple components, notably **digital objects** [5], [6]. A digital object is a way of structuring information in digital form, some of which may be **metadata**, and includes a unique identifier, called a **handle**. However, the information in the digital library is far from simple. A single work may have many parts, a complex internal structure, and one or more arbitrary relationships to other works. To represent the complexity of information in the digital library, several digital objects may be grouped together. This is called a **set of digital objects** [7].

All digital objects have the same basic form, but the structure of a set of digital objects depends upon the information it represents.

The different types of material in a digital library, information can be divided into **categories**, e.g.: text with XML mark-up, VRML objects, supporting software tools, or digitised multimedia material. Within each category, rules and conventions describe how to organize the information as sets of digital objects. For example, specific rules will describe how to represent a VRML quality digitised exhibit or a higher quality textured version of the same exhibit in Cult3D format. For each category, the rules describe the digital objects that are used to represent material in the library, how each is represented, how they are grouped as a set of digital objects, the internal structure of each digital object, the associated metadata, and the conventions for naming the digital objects.
A user interface that is aware of the rules and conventions applying to certain categories of information is able to interpret the structure of the set of digital objects. Complex information can be presented without the user having any knowledge of the complexity. Since the user interface recognizes how material is represented, it can provide unsophisticated users with flexible access to rich and complicated information [8].

For the implementation of the **DOL** subsystem certain relevant standards will be followed in regard to the metadata that will be used for the annotation and management of the digital objects. The Consortium for the Interchange of Museum Information (CIMI) [9] has made some important

advancements in the field of standards for museum resource description. Phase 1 of the CIMI Dublin Core Testbed Project [10] was undertaken in 1998 with the goal of testing "assumptions related to the flexibility and simplicity of the Dublin Core element set, and its suitability and readiness for deployment". Seventeen CIMI member organizations worked to create object-level descriptions using the Dublin Core standard, and identified issues surrounding the functionality of Dublin Core for resource discovery on the Internet. One of the problematic topics that was raised as a result of this project was "characterizing resources as either item-level or collection-level -- i.e., determining the unit of analysis for description such as with an exhibition, a collage of photographs, or other aggregated objects" (Section 5.2 Issues). Phase 2 of the Dublin Core Testbed Project [11], which began in 1999, includes the publication of a "Guide to Best Practice" for museums using Dublin Core, and an "examination of Resource Description Framework (RDF) as an effective method for enabling interoperability between applications that exchange meta-data [12].

The Educational Aspect

The enhancement of the **DOL** with courseware directly related to the digitised exhibits, defines a concrete educational target for the e-Islam environment. The courses provided will be in accordance to the Greek Muslim Studies Curriculum and could be expandable with additional courses and supporting material in the future. In this way the e-Islam environment will be the basis of a unified learning environment where the learning experience will exceed the domain knowledge of the Museum's Islamic collection and will be used for the needs that are directly implied by the Greek Muslim Studies Curriculum.

In order for this educational dimension of the system to succeed, certain learning scenarios will be developed in cooperation with educators and cognition specialists. These learning scenarios will be developed early on in order to take full profit of the e-Islam infrastructure, approach and unique content. These will also form the basis for the educational subsystem to build upon.

A special purpose subsystem - the Courseware Manager Subsystem (CMS)- will be developed inside the e-Islam environment for the presentation and management of the embedded courseware. CMS will be directly linked to the **DOL** and will use the profile information to present the users with personalised views of the available data. At this early stage CMS will be the sole subsystem for the support of learning inside the e-Islam environment, however extensions to this subsystem are already planned in order to fully support the educational procedures thus leading us eventually to a complete Learning Management System that will fully support the Centre for the Study of Islamic Civilisation. The overall architecture indicating the entry points and different presentation layers of the e-Islam environment is depicted in Figure 1.

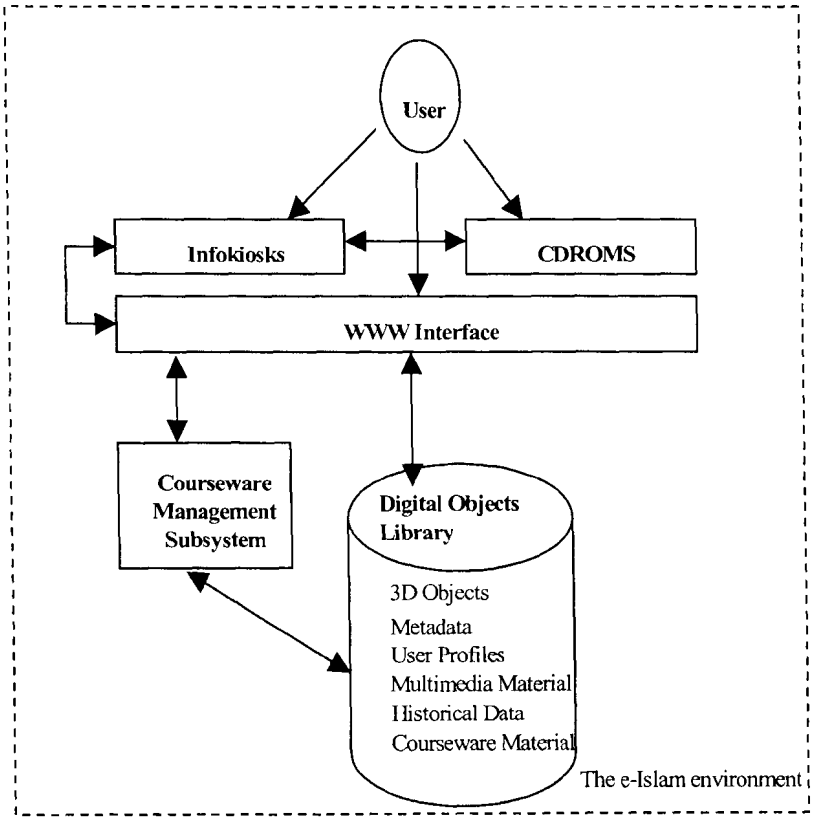

Figure 1: The e-Islam entry points

CLUSTERING OF 3D OBJECTS

The integration of visualisation technologies into a new advanced digital library model that could support development and access to cultural resources raises a number of technical and non-technical issues. Identifying current trends in what the research community is working on as well as to what new technologies have to offer for the digital library, is essential to any development effort in this field.

Technical considerations for the collection and final selection of Islamic art objects according to clustering disciplines include monitoring of strategic areas for research and development at European and international level, deliberation of key technological challenges and priorities in the immediate and longer term and close examination of applications and service areas that will support a continuing leading role in the digital environment for cultural and memory institutions.

The underlying technological challenges have, therefore, to deal with:

- multilinguality of the content and in making it available to and presenting it to users;
- interoperability and comparability between sources;
- the diversity of the content over time;
- ensuring developments are user-centred, based around emerging and distinct communities of users
- quality of service and quality of information, including branding.

Moving on to the non-technical considerations, a number of important questions are emerged in the context of digital libraries for memory institutions, most notably including:

- What can add value in context of the past and the digital future?
- What do people (users) do with new technologies and how to capture that?
- How to address the booming online communities?

As far as copyright issues are concerned, heavily protected data can have implications in interactivity and performance. These implications are not beneficial to either content owners or to its users. Tension between copyright and business models can also be a burden to creativity. The issue is to find the right balances between protection of rights, free use and commercial exploitation.

The considerations described above, define a framework of rules according to which the Islamic art objects will be clustered (selected and deployed) within the e-Islam environment. The aspect of digital objects being used as learning material with supplementary courseware within the same environment, adds further significance to the clustering and selection of the exhibits to be included [13].

DIGITISATION TECHNOLOGIES AND TECHNIQUES

There are currently a number of available technologies that allow the viewing and interaction of 3D objects on the Internet. As far as the E-Islam environment is concerned, two technologies are going to be utilized, namely VRML and CULT3D.

VRML (Virtual Reality Modeling Language) provides the technology that integrates three dimensions, two dimensions, text, and multimedia into a coherent model for the World Wide Web. When these media types are combined with scripting languages and Internet capabilities, an entirely new genre of interactive applications are possible [14].

Cult3D is an interactive 3D solution that allows designers to easily build and display high-quality interactive 3D graphics for Web sites. Cult3D is a multi-platform 3D object-rendering engine. It is 100% software. No additional hardware-such as 3D accelerator cards-is required [15].

Data Capture

The digitization of real objects can be achieved using various technological approaches. Different methods are currently available for achieving the digitization of real objects. The most common used methods are either the use of a 3D scanner or the use of software that can generate 3D models from 2D photographs.

Using a scanner has proven to be the most efficient way in order to produce good quality 3D objects from real objects. However, the cost of obtaining a 3D scanner is high and the time and effort required to produce the desired results depends on various parameters like, lighting conditions of the environment, coloring of the scanned object, transparent areas, size of the object,
shape complexity in three dimensions and hidden curvatures. For the E-Islam environment the Minolta VIVID 700 3D laser scanner is to be used [16].

Several software vendors have produced software that allows the creation of 3D models from photographs. For the purpose of the E-Islam environment, two software packages have been tested. Image Modeler from REALVIZ [17] and Softface 3D by EPTRON [18]. Further more the use of Shapesnatcher by Eyetronics [19] will be investigated. A major drawback of this approach is the amount of time required to achieve the desired results.

Online Communities

Blaxxun Interactive's Community Platform is going to be investigated during the development of the E-Islam environment. Blaxxun Community Platform is a client-server architecture that supports VRML-based, interactive networked SVEs. Several applications and multi-user environments have been developed on the Blaxxun platform, and a particular focus is on product promotion. [20] [21]. Other systems that utilize SVEs for the support of online communities are particularly impressive [22].

CONCLUSIONS – FURTHER DEVELOPMENT

In this paper we presented the concepts, considerations and key issues involved in the construction of a user- friendly and widely accessible virtual museum – the e-Islam environment - that will also form the basis for a more generic educational environment. e-Islam will not only replicate physical structures in detail over the Internet but will also provide information and courseware for different types of users. In achieving the desired outcomes, different information technologies have been evaluated and integrated.

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