BOOK OF ABSTRACTS

SYMPOSIUM PROCEEDINGS

VAMCT 2015

International Symposium on VIRTUAL ARCHAEOLOGY Museums & Cultural Tourism

Organized by:
University of the Aegean (GR)
'Athena' Research Center (GR)
Coastal Carolina University (US)

23-26 September, 2015
Delphi, Greece
http://vamct.syros.aegean.gr/2015
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October 2015

VAMCT2015

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A word from the organizers

The debate on issues concerning digital processing and presentation of museum collections, monuments and sites started in the late 90s and it continues today. Interest now focuses on the relationships between museums, artefacts, digital technologies and the Web (WWW), and their role in the redefinition of the museum itself as "communication engine". The interaction between real ontologies, the empirical perception of material culture – objects – and their virtual ontologies – the digital representations - creates new perspectives in the domain of data analysis, data sharing, data contextualization and cultural transmission. In this way, every museum is a meta-museum since artefacts, sites and objects exist in relation and interaction with cultural processes. The meta-museum promotes the action of recontextualization of sites and objects, otherwise impossible in an exhibit or museum display. In other words, in the digital domain, a museum artefact is the outcome of a very sophisticated informational and communicational process, contextualized in a virtual network of relations. The museum and its collections are themselves a site or a "sitefact", because they create new contexts and territories of knowledge.

The international symposium entitled VIRTUAL ARCHAEOLOGY: Museums & Cultural Tourism aims at investigating all new trends in the field of digital (e.g., online, virtual) museums, virtual communities, archaeometric studies, digital cultural tourism and related topics.

The symposium is open to students, museum and cultural heritage professionals, scholars, archaeologists, historians, ethnologists, IT specialists and engineers and others working on digital applications in cultural heritage, public and private museums, etc. The symposium is intended to enable collaborations and projects on Greek and international archaeological case studies.

October 2015
The VAMCT2015 Chair

SESSION 1 – KEYNOTE SPEECHES ON VAMCT

Session Chair: Ioannis Liritzis and Spyros Vosinakis (University of the Aegean, Greece)

Digital technologies & trends in cultural heritage

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Abstract
The New technologies alter our lives and the way in which we perceive it beyond the imaginable. This 'Beyond' over is the point in space-time in which coalition of science, technology and art openly combined for the 3rd Industrial and Cultural Revolution, and for environmentally sustainable abundance.
This time, 'Beyond' not only explores the dynamic 3D screen, it moves on from the bits to the atoms and incorporates 3D-printing and digital cloud-distribution, which combined to relevant scanning or photographic technologies create a virtual environment as a real world. We are entering the central source for current and emerging trends in cultural heritage informatics. The presented virtual archaeology case studies, as a result of advanced technology emerging from computer sciences, however, stress the naturalistic methodology, challenges digital reconstructions and serious games [1]. There may provoke also harassment and emergence of fundamental hermeneutical questions, which serve as the basis of a synoptic and synthetic philosophy that combines *art and science* corresponding to classical *techne and logos* [2].

Fig 1. The "digital brain"

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Ludic Challenges For New Heritage and Cultural Tourism

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Abstract

There is a huge amount of influence, coverage and profit in the world of computer games. In 2014 Microsoft bought Minecraft for 2.5 billion US dollars. In 2015 Minecraft became the second highest selling game of all time, at $54 billion USD [1],[2]. I am not suggesting that Minecraft is a viable framework for many virtual heritage projects, it is both slow and very low-resolution but the way in which the young can learn to participate and design their own levels in the game is truly extraordinary. So, given their success for entertainment and even for school-based education [3], why have we not successfully applied computer games knowledge to virtual heritage projects? Computer games can offer open-ended learning experiences as well as provide counterfactual histories but they don't scale easily and they are not cultural learning experiences in a strict definition of culture. How do we thematically include conjecture and interpretation? How can game technology be used to creatively connect to archives and scholarly infrastructures in general in order to further virtual heritage as both a preservation and communication medium? And how can these projects be made more accessible to the general public?

Fig 1. 3D Archaeological Tool for Presenting Heritage Models (Champion, Warnock and Li)

In this short talk I will first outline why I think the fundamental problem is more an issue of limited interaction design and a conflation of digital heritage (as a preservation medium) with virtual heritage (as a communication medium). I will then provide examples of computer games, interactive tools and virtual heritage environments that attempt to address the above questions both for virtual heritage projects and for heritage content that may be more engagingly integrated into cultural tourism applications.

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3D Digitisation of World Heritage: Digitizing UNESCO Heritage (the case of 3DICONS)

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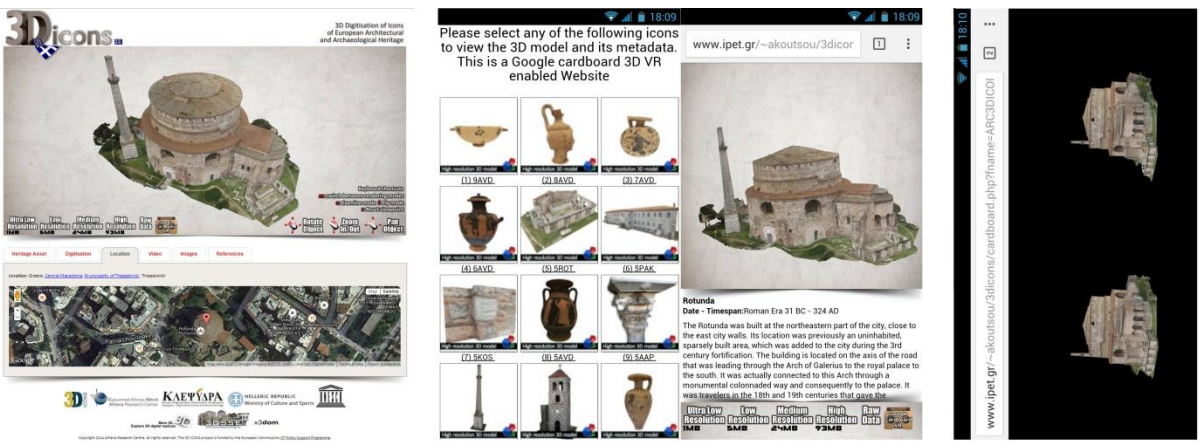
Abstract

Web-based dissemination of cultural heritage 3D content has been vividly increased over the last decade. EU-funded research and development projects established affordable pipelines in order to allow efficient 3D documentation and dissemination. Such an example is the 3D-ICONS project that was focused on the 3D digitisation of outstanding cultural importance European monuments and their Web-dissemination through Europeana.



Desktop / Laptop / Tablet Rendition — Mobile Phone Rendition — Google Cardboard

Fig 1. Screenshots of the 3D content landing page as viewed on different desktop and mobile devices

This presentation describes the methodologies applied by the Athena Research Centre digitisation team in order to provide high-resolution 3D digital replicas of six medium-to-large scale monuments. It summarises the important aspects of the digitisation pipeline that was able to deliver high quality 3D models that are not only efficient for dissemination but also applicable in numerous scientific applications such as archiving, documentation, monitoring and curation. It focuses on the primary challenges of terrestrial and aerial data collection phases as well as on a versatile data processing pipeline [1][2]. It continues on the Web-based dissemination technologies being used in order to deliver the primary 3D content and its derivatives (e.g. video sequences, orthophotos, etc.) to both desktop and mobile devices as well as to support the Google cardboard for interactive VR exploration [3].

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Using Cultural Content for Education. A Case Study of the Byblos Roman Theatre

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Abstract

Can cultural content be used for education? There seems to be a growing opinion that our rich cultural material can serve more than educate us about our past but also provide a tool for learning and acquiring fundamental skillsets in arts and sciences, in engineering and architecture, and maybe even in health sciences. Far from being arbitrarily created, most of the work in our museums and archaeological sites about us today were originally generated by people who relied on theory, who respected studied rules, who followed systematic experimentation, and worked hard and long to deliver the magnificent pieces that we relish today. In light of these facts, it seems intuitive that by uncovering these techniques, the resulting information can be used to teach the fundamentals to students at different scholastic levels; from primary school all the way to more advanced university-level courses. In other words, the education/cultural-content-generation path can take a reverse direction by using cultural content to educate instead of the other way around. Learning in context and by example provide an alternative to traditional learning techniques [1][2] and promise to be more enriching,

immersive, and impact a stronger and deeper perception of educational concepts. This talk will present a case study to reinforce the hypothesis stated above. I will first describe the virtual reality application we developed for the roman theatre of Byblos in Lebanon (shown in Figure 1) and by doing so uncover the tools and skillsets that were necessary for the development of this cultural content. Then, in the second part of the talk I will reverse the role of teacher/student---where cultural content becomes the teacher---and attempt to highlight what concepts in specific fields and levels of education could be learned using the Byblos theatre as a tool. Examples of topics that could be relevant include geography, physics, languages and translation, mathematics, architecture, and computer science.

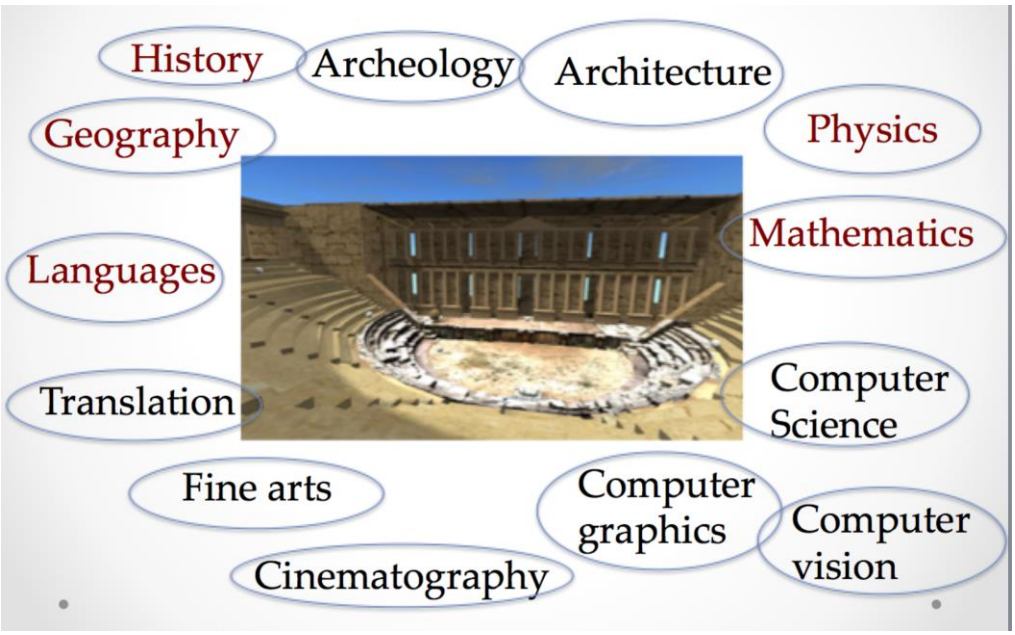

Fig 1. Reconstructed scene of the Byblos Roman Theatre, along with topics in education that could be explored through the analysis of the theatre

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SESSION 2 – DIGITIZATION OF CULTURAL HERITAGE

Session Chair: Anestis Koutsoudis (Athena Research Centre, Greece)

Block by Block by Digital Block: Reconstructing Delphi's Treasuries

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Abstract
The Ashes2Art program at Coastal Carolina University[1] has digitally reconstructed various monuments at Delphi since 2007. In addition to earlier reconstructions of the Tholos, the Temple of Apollo, and the plunge bath (Arkansas State University), there are newly completed archeaometric models of the Cyrene Treasury, the Athenian Treasury, the Theban Treasury, the Athenian Stoa, and partially complete models of the Theatre, the Naxian Sphinx, the colossal tripod, and the Siphnian Treasury. While the focus of the present examination deals explicitly with these digital models, the larger Ashes2Art project engages the use of the same models in a comprehensive, GIS-based immersive environment, as my colleague Susan Bergeron, discusses in her paper.
The digital models of 4th century BCE Delphi built by undergraduates at CCU are based on the archaeological reports of the French School published over the past century. At times, the conclusions of those reports have been challenged by scholars; the Ashes2Art models and their corresponding texts reflect those controversies, sometimes resulting in multiple versions reflecting dissenting opinions. In some instances, such as the Theban and Cyrene Treasuries, the models signify the earliest digital reconstructions anywhere of those respective structures, and they often reveal idiosyncratic cultural and stylistic anomalies that are manifested in the buildings themselves. All have presented exceptional opportunities for research and collaborative, heuristic learning and deductive problem solving.
Beginning with the Cyrene Treasury, each digital model has been built block by block. This painstaking process extends the worktime tenfold, but it is necessary to ensure the construction of accurate models, to accommodate later adjustments or corrections, and for future use. And, as a collateral benefit, the process forces students to confront various problems and inconsistencies, whether textually, spatially or mathematically. More importantly, block by block constructions allow us to recognize problems early in the process, solve the problems or develop strategies, and continue without compromising the overall model.

[1] http://www.coastal.edu/Ashes2Art

Retracing the Sacred Way: developing an immersive virtual exploration platform for ancient Delphi, Greece

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Abstract
This paper will discuss the ongoing Ashes2Art initiative at Coastal Carolina University, which has sought to reconstruct the ancient structures and landscape of Delphi, Greece. The Ashes2Art project began nearly 10 years ago with the goal of incorporating undergraduate students in the process of researching and digitally reconstructing the architectural features of the sanctuaries at ancient Delphi during the period of the 4th century BC.
Since early 2013, the Ashes2Art project expanded its focus to include the development of an immersive, interactive virtual exploration platform that integrates these models into a virtual Delphi landscape. One of the main goals of this new phase of Ashes2Art is to move beyond the static reconstructions of Delphi's monuments and incorporate them within a dynamic, interactive platform that presents not only the models themselves, but also scholarly information and associated media. In order to achieve the high-resolution graphical and dynamic interaction functionality that such an immersive platform requires, the project is utilizing state-of-the –art videogame technologies through the Unity 3D engine and development environment. Unity allows users to develop graphics-intensive virtual landscapes that leverage common videogame interaction tools, such as collision detection, dynamic physics systems, and interactive menus and information display.
As a demonstration of the Ashes2Art virtual exploration platform, this paper will focus on recent work in building out the natural and cultural landscape features and several structures within the Temenos sanctuary enclosure at Delphi, as well as the development of embedded multimedia and exploration screens for points within the virtual landscape.

References

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Investigation of archaeological findings of the Acropolis Museum based on laser scanning, X-ray tomography and neutron tomography

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Abstract
The modelling of geometry of valuable objects, such as archaeological findings, in order to investigate them and make copies it is a very difficult process. Because of the fact that many objects have internal configurations is

important, for their investigation, to know exactly the structure of their internal geometry and of their material. For this reason is necessary the usage of appropriate technologies, that capture both the external geometry and the internal configurations and structures of the object [1,2,3]. Using such innovative measurement technologies, as X-ray tomography and neutrons tomography is possible to have the complete modelling of archaeological findings without touching the original object; this eliminates the risk of damage or deterioration. The possibilities of these innovative technologies are perceived by the presentation of the investigation of specific findings. More specific shows the recording of the solid geometry of five archaeological objects (see left part of Fig 1) from the Acropolis Museum (marble, ceramic, bronze, etc.) with the use of X-ray tomography and neutron tomography. The choice of the technology to be used each time depends on the size, material and complexity of the geometry of the object. After suitable processing of the files generated from these measurements, the fully solid geometry of the objects can be represented. With the investigation of the same files reveal significant information can be revealed, information, which make it possible to find out the possible way of formatting them in antiquity. It is also possible using these data to produce exact copies of the findings using rapid prototyping techniques.

Three more objects (see right part of Fig 1) were measured by 3D-laser scanning method. Laser and white light scanning with the three-dimensional technology is a fully automatic and highly accurate method. The main principle of operation is the scan of the object outward from point to point, the combination of all data for the simulation of the object on the computer and finally the representation of the geometry of the object.

The investigated archaeological findings were selected to be from different materials, marble, ceramic, bronze and ivory to determine the ability of the two kind's tomography (X-ray and neutron) relative to the materials of the measured objects. The tree of these objects (see Fig 1): a ceramic lamp, a fragment of the hair of a marble statue and an ivory statue of Sarapis, because of their materials ware measured easily and without problems with both methods. The quality of the representation of the object's geometry is very good, showing all the details of the originals with great accuracy. The bronze statuette of the goddess Athena (see upper right part, in Figure 3), could not be measured by X-rays because of its size and the material, but was easily measured by neutron beam. The quality of the representation of the object's geometry is amazingly accurate (see Fig 3).

Fig 1. Investigated Archaeological findings of the Acropolis Museum

Fig 2. Modelled geometry of the statuette of the goddess Athena

Based on various sections, it is resulted that the statuette is solid. Regarding the casting of the statuette, only few pores are visible, in a vertical section in the lower right part of the statuette. From the examination of various sections, generally derives that the casting of the statuette is very meticulous technologically. At the base of the neck of the statuette, a geometric configuration is visible. The observation of vertical sections at the base of the neck, leads to the conclusion that probably the lost head of the statuette was a separate part, which was mounted to the statuette. The last measured object is a hand of a marble statue, broken just above the wrist (see upper left part of Fig 1). Internal the hand, on the side of the fracture, there is a metal (lead), which at the base of the wrist reaches the outer surface, through a circular hole that exists in the marble. It is assumed that the hand was broken in antiquity and again reassembled on the statue. In Fig 3 on the left site, the modelled geometry is presented as it is revealed by neutron tomography. Sections A-A and B-B, which resulted from the processing of the measurements made by neutron beam shows the internal configuration of the hand. It is clearly distinguished the contours (outlines) of the marble, of the lead and of a pyramidal hole along the wrist. Contrary in the section shown at right of the left part of Fig 3, which resulted from the processing of measurements made with X-ray beam, the pyramidal hole along the wrist is not visible because the x-ray radiation could not penetrate the lead.

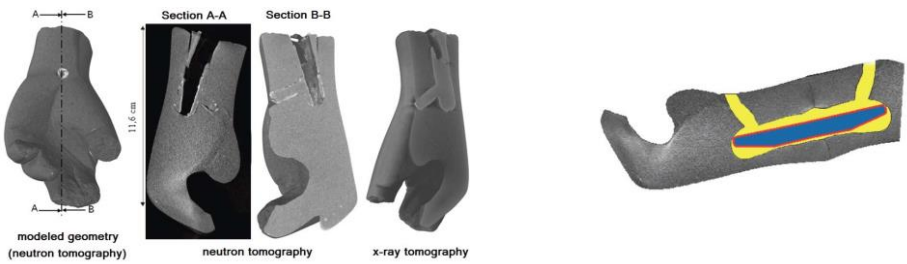

Fig 3. Modelled geometry and Vertical sections of the hand of a marble statue and possible reassemble procedure of the hand of a marble statue in the antiquity

Based on the sections A-A and B-B of Figure 3, somebody can assume that the craftsman in antiquity, in order to reassemble the fragment in its initial position, had opened two holes in the hand; one along the wrist in a depth approximately until to the point of beginning the thumb and a transverse one on the base of the wrist. He must also made similar holes in the other part of the hand of the statue. Then he created a stem of iron. This iron stem was placed in the empty space (hole) along the hand and the hand (with the iron stem inside) was then assembled in the statue. Then he had casted lead from one of the two transverse holes, until the lead was overflowed from the other transverse hole, in order to be sure that the whole empty space around the iron core was filled (see right part of figure 3). The casted lead in the traverse holes secures the two parts of the hand, and not allowed them to be moved along the length of the hand. The use of the iron core is necessary, due to the reduced strength of lead in case of transverse forces on the hand. The iron core was not found in the hand. Considering that the iron core was rusted, exposed for too long to air and moisture, it lost its contact with the lead and fell, leaving its clean footprint, as it is resulting from the neutron tomography.
The use of innovative measurement technologies, such as X-ray tomography and neutrons tomography allow complete modelling of archaeological findings without touching the original, which eliminates the risk of damage or deterioration. The information resulting from these technologies help significantly to investigate the formatting methods of archaeological findings in ancient times as well as and their operation. Furthermore, it is possible, using the modelled geometry to produce accurate copies of them. In the frame of this work, is presented the modelling of the geometry of various archaeological findings, using these technologies. The resulted modelled geometries represent very accurately all the embossed decorations as well as and the internal configurations and structures of the objects. In some of these findings the way of manufacturing them in antiquity was investigated.

Acknowledgements

The research was conducted in the frame of the project: "Digitizing of Parthenon frieze". We acknowledge Paul Scherrer Institute in Switzerland, where the measurements took place and specially M. Skoulatos, D. Mannes and E. Lehmann for their support on the experimental work and data analysis.

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Photogrammetry: From Field Recording to Museum Presentation (Timiryazevo burial site, Western Siberia)

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Abstract
A 3D-recording project was brought into practice by Tomsk State University during the investigation of Timiryazevo burial site (5th–10th centuries AD) in 2014. During the excavation, three-dimensional records of the whole archaeological site were made at each stage, as well as individual records of all artifacts. 3D recording was provided by the SFM technology. The data obtained was used for research and was also applied in the development of the exhibition project «Secrets of Timiryazevo Burial Site: The Circle of Life and Death in Siberian Shamanism». The exposition revolves around unveiling the meaning of the rite of burying lookalike dolls of the deceased, which was practiced by many indigenous peoples of Siberia. The tools used to develop the topic included a stereo video created with Autodesk 3D Studio MAX 2014 and displayed in the exhibition.

Buried underground and "invisible" to the public at large, archaeological sites of Siberian taiga don't enjoy the visual appeal required to popularize science. The projects designed to popularize the heritage of ancient Siberian cultures have to meet extraordinary conditions, due to the absence of stone monuments and to the poor prominence of sites in the modern relief. A particular problem also lies in museumification of archaeological sites deep in Siberian taiga with no tourist infrastructure or routes of communication.

The recent decade has introduced the methods of three-dimensional documentation and visualization of information uncovered by excavations, opening up entirely new opportunities in presenting scientific discoveries and bringing home their significance to the public. Now, photorealistic interactive 3D models make it possible for anyone to see archeological sites. Stereo videos displayed by specialized museum equipment create the total participation effect, enabling any visitor to watch excavations step by step, in all details and from all perspectives.

Unfortunately, however, laser scanning and close-range photogrammetry have not yet gained due currency in Siberian archaeology, nor anywhere else in Russia. A 3D-recording project was brought into practice by Tomsk State University during the investigation of Timiryazevo burial site (5th–10th centuries AD) in 2014.

During the excavation, three-dimensional records of the whole archaeological site were made at each stage, as well as individual records of all artifacts. 3D recording was provided by the SFM (Structure from motion) technology using a Nikon D700 reflex camera equipped with a 24-70mm

1:2.8G Nikkor lens. Local georeferencing was provided by a Trimble M3 DR5" TST. Reconstruction of three-dimensional models was performed using a desktop PC running Microsoft Windows 8 64-bit with a 12-core Intel Core i7-3960X 3.3GHz processor, 64Gb of RAM, a 2Gb nVidia Quadro K5000 graphic card, and Agisoft Photoscan pro software. On the whole, more than 60 3D records were made.

The most significant artifacts were digitized by an Artec Spider manual optical 3D scanner using the Artec Studio software. The output 3D models had a resolution of 0.1–0.2 mm, depending on the size of digitized artifacts. Refinement of all three-dimensional models was performed with Geomagic Wrap 2014.

The data obtained was used for research and was also applied in the development of the exhibition project *Secrets of Timiryazevo Burial Site: The Circle of Life and Death in Siberian Shamanism*. The exposition revolves around unveiling the meaning of the rite of burying lookalike dolls of the deceased, which was practiced by many indigenous peoples of Siberia. Timiryazevo burial site reveals the most ancient and prominent records of this rite. When someone died, their soul would go into a small specifically designed doll. They would treat the doll as a living human being, feeding it, getting it into bed, and dressing it in special clothes—exact miniature copies of shirts and fur coats worn by living people. Some years should have passed before the soul would pass into a newborn of the same family. That was when the doll would be taken to the cemetery and buried with its "personal" possessions.

The exposition is designed to let the visitor go through the whole cycle of knowledge extraction together with archaeologists, "detectives of the past": from a bunch of strange miniscule objects found in the sand to reconstruction of the whole sophisticated rite of "ultimate funeral" including the burial of the deceased's lookalike doll.

The tools used to develop the topic included a stereo video created with Autodesk 3D Studio MAX 2014 and displayed in the exhibition. The first part of it demonstrates all stages of burial site excavation and discoveries of buried dolls together with miniature objects found nearby: knives, arrows, and vessels manufactured specifically for the rite. The visitor can see everything that explorers could see during the excavation. The second part of the video shows the process of reconstructing the look of the deceased's lookalike dolls.

Popularity of the exhibition *Secrets of Timiryazevo Burial Site: The Circle of Life and Death in Siberian Shamanism* currently on show in Tomsk Regional Museum of Local History proves the efficiency of using 3D tools for visualization of archaeological heritage.

Acknowledgements

The reported study was funded by the Russian Federation Government Grant for state support for research, according to the research project No14.B25.31.0009 "Man in a Changing World. Problems of Identity and Social Adaptation in History and at Present".

SESSION 3 – SPECIAL SESSION "CULTURE-TECHNOLOGY-EDUCATION"

Session Chair: George Pavlidis, Stella Markantonatou (Athena Research Centre, Greece)

KEYNOTE SPEECH

Art & Technology in shaping the new Human

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Abstract
From the caves of Altamira, we know very well that the urge of artistic expression is ancient as man himself. If this was a necessity for psychological outgoing, or a need for beauty through decoration, this will remain a question unanswered. Art, through the ages, travelled from the utility + beauty artefacts of the artisans, to the personalized and signed works of Greek pottery makers, or even celebrated sculptors and painters, like Phidias and Apelis to the companionship of the cathedral builders and polyphonic compositions to the Castrati and Star Soprani of the baroque and romantic eras to the role of the artist as the saviour of society, as described by Richard Wagner and his followers. The work of art itself being exclusive and either unique, or rare, began to be a part of the everyday life of non-aristocrats, which is the new bourgeois class, developed during the Lumières and before through two main kinds of artistic expression: chamber music and still art. This is because this form of music and that form of painting match cheaper than a symphony orchestra or a monumental battle depiction.
This rather short and subjective historical review is necessary, if we are to realize the big change that came about with new technologies, regarding the reachability of the works of art, whether fine art or music. What was yesterday a privilege of the rich happy few, has now became a common right exerted by each and everyone through the internet and thanks to many databases containing almost everything the human being created at its effort to express itself artistically. Goethe needed to travel to Italy, in order to see actually the Greco-Roman works of art that shaped his aesthetic views. The French even created an educational centre as famous as the Villa Medici in Rome, for the French artists and musicians to study in the formidable Vatican museums and the great museum that is Rome, to study the classical and renaissance masterpieces of the great creators.
Money was an advantage for an artist that could buy expensive books containing reproductions- gravures of the great sculptures or lithographies of great paintings. All this is now within the reach of a poor student in a public school or even at an Internet café. These facts will not of course alter the intrinsic value of the original work of art, and that is why museums and

galleries remain centres of knowledge and culture throughout the world, but this is not enough. The real problem that arises with this fantastic quantity of information concerning the arts is the criteria through which a person and especially a young one will evaluate this great amount of works of art. There is a danger that this abundance of choice will result in a superficial knowledge and appreciation of the work of art. This real situation that is also affecting, through the multitude of information, other sectors of human life could bring a big change in our perception of the aesthetic phenomenon and the role of culture in human life. A generalized relativism could result in the devaluation of everything that makes a difference from beast to human.

I deem there, the role of educational institutions such as museums, most critical in helping the young person to make choices in total freedom, but at the same time permitting him to create a relationship with the art object to such a degree, that will permit him to build a scale of values that will enrich his life and stabilize his psychological condition. This will facilitate the organization of social networks created through preferences and even tastes that permit to the humans to reach another level of human relation and communication. At this point, and speaking of young people, we must find ways to present the specialist's view of what is important, in such a way that can be easily integrated in the young person's favourite activity: the game. Art presented through digitalized, avant-garde games can shape the young person's taste and uplift its psychology. This should be done in connection with real-life experiences at the museum and an aftermath of digital tools such as Internet based databases and games. Interactive sights are of course of great value, although difficult to sustain. This combination of a museum visit, the deployment of game in the museum with real works of art and the continuation of the experience through new technologies described already and others to come, will help the young person to realize and appreciate the work of art in the two dimensional reality people live in nowadays, real and virtual. We believe that this combination will not only enhance the art experience, it will also offer a necessary connection of the two worlds, something that remains a demand for sane life and a sane society.

The Theocharakis Foundation for Arts and Music, of which I have the privilege to be the General Manager, is a relatively new institution of public benefit, aiming to present important works of art and quality music to the Greek public. We investigate also the relationship and the interaction between music and fine arts, with an accent to twentieth century and contemporary art. Our educational programs have been developed based on the following principles: real-life experience with the artwork (e.g. sleepovers), interactivity, intimacy with the performers and their work, innovation and use of new technologies.

To give an example, although today it sounds banal, we were the first in Greece to organize a digital painting contest using iPads. Our most recent experience is a programme for high school education called Synthesis. This was implemented with the collaboration of Athena Institute, Mr Pavlidis and Mrs Markantonatou were of great help, and consisted in a pilot effort to

introduce fine art in the actual horary programme of high school classes in such subjects as math, geography, French language, history, physics and other subjects. The main idea is not to speak about art in a separate lesson, but to use art in these lessons in order to replace the usual descriptions of the official book with tools taken out of the great fine arts creations. Just to give you an idea, instead of just showing in the map of Paros Island, we present to the students the paintings of Paros by the painter Papaloukas. Or to speak about geometrical analogies, or the golden ratio, we use the relevant paintings of the same artist. This is of course supported with video and other digital materials and continues after school through a dedicated server and a comprehensive portal presenting the whole project with a use of pleasant video games. So the main idea is that art is something we live with, it is a part of our everyday life, it is a necessary nutrition for our souls and minds, it is integrated in our knowledge system and should be lived like any other human experience, not be admired as something distant and different. This is the only way to infuse art in our lives, to enhance our aesthetic vision, to uplift our spirits.

KEYNOTE SPEECH

Cultural Heritage Objects for the Digital School: The case of the Greek National OER Aggregator

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Abstract
Digital educational content is an increasingly important part of national educational policies worldwide. The creation and effective use of digital learning resources and the development and establishment of content-based online services constitute key pillars in many national and European initiatives for the integration of ICT in education [1].
The Greek Open Educational Resource (OER) Aggregator (Photodentro) is a large scale effort at national level, constituting the backbone of the Digital School infrastructure and implementing state-of-the-art technologies and services for school education in Greece [2]. Photodentro comprises several collections with thematic content ranging from specially developed school-related resources to broader scope educational videos, cultural resources and user-generated learning content and facilitates the implementation of seamless, transparent and user-friendly learning resource access services. Photodentro accumulates resource information in the form of descriptive metadata that are harvested from digital libraries and repositories of other organisations (museums, libraries, audiovisual archives, etc.), facilitating a workflow for quality control and enrichment of educational metadata, thus making apparent the content's added value for the educational community. Last but not least, Photodentro constitutes the framework over which services

can be developed in a quick and easy way, as well as interoperable systems can make benefit of Photodentro's resources and associated metadata.
This presentation intends to provide a concise overview of the constituents of this enabling infrastructure, focusing on the introduction and the exploitation of digital cultural heritage resources within education and learning contexts [3], [4].

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Metadata for learning objects containing cultural objects

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Abstract

Standardised metadata for the development and storage of learning objects (LOs) that draw on cultural content (CC) have not been provided as yet. There are well established standards for documenting LOs, such as the IEEE/LOM and the LRE/LOM, and for documenting cultural content, such as the CIDOC-CRM and the SPECTRUM. However, these standards do not provide for descriptions of the type *Alpha is a LO made by X and contains a digital image of Joconda made by DaVinci* nor for a solid framework for building a DB that could answer to questions such as

- *Provide me with LOs supporting Geography lessons about Greece that are addressed to 14-year olds and contain pictures by one of Papaloukas, Vassileiou, Tsarouhis*
- *Provide me with either LOs or digital pictures of pieces of art on harvesting wheat*

Furthermore, existing large repositories of digital objects do not provide for such hybrid objects. Thus, EUROPEANA[2] contains only cultural content while the LRE[3] and the national "Photodendro"[4] only LOs.

[2] http://www.europeana.eu/portal/
[3] http://lreforschools.eun.org/
[4] http://photodentro.edu.gr/lor/

In the overall, it is clear that if education at a European level is meant to profit from culture according to EU plans (Eurydiki 2009), the process of developing and storing LOs that contain cultural content should be strengthened with standardised full documentation and storage tools.
We report here on the development of an ontology that is the unification of LRE/LOM and CIDOC-CRM. We will call this ontology LRE/CIDOC from now on. We also report on the development of a database that conforms to the LRE/CIDOC ontology.
CIDOC Conceptual Reference Model (CRM) provides definitions and the necessary formal structure for the description of concepts and relations used in the documentation of cultural content. A newer version of the standard was published on 15/12/2014[5].
LRE (Learning Resource Exchange) is an international repository with own national portal[6] supported by the Ministry of Education. Its functionality rests on an combination of **IMS LODE Information for Learning Object eXchange specification (ILOX)** with **IEEE Learning Object Metadata (LOM)** IEEE 1484.12.1 – 2002 Standard for Learning Object Metadata. LOM describes LOs and resources for the education aiming at facilitating retrieval. It is an open standard with wide acceptance.
CIDOC-CRM ontology comprises two main branches, that of objects (concrete or abstract) and that of events that involve the objects. In this way, CIDOC-CRM offers a more general conceptual model that can incorporate the LRE/LOM model.

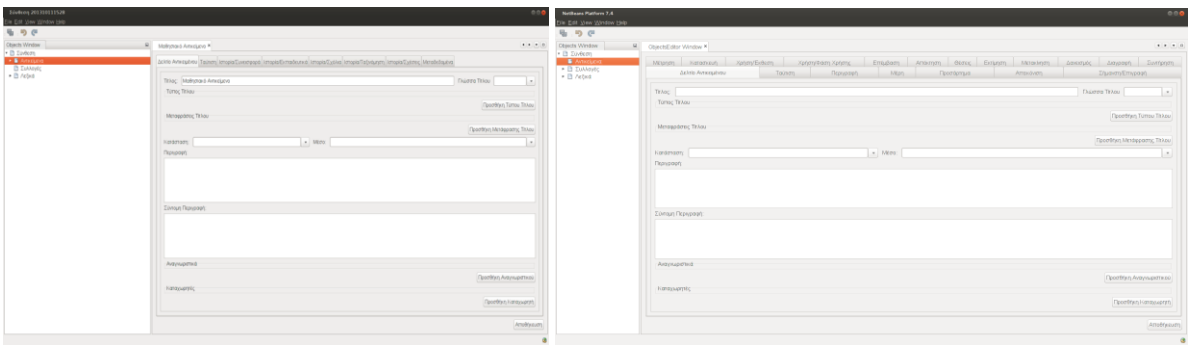

Fig 1. Documentation of Learning Object (left) and Documentation of Cultural Object (right)

We proceeded by unifying those classes of the two ontologies that could be unified. To start with, the top class of the new ontology CIDOC+LRE is the class CRM Entity_LRE WORK; it is the unification of the top class E1 CRM Entity of the CIDOC ontology and the top class 'WORK' of the LRE/LOM ontology. Table 1 shows the definitions of the two classes in the respective frameworks and the definition of their unification in CIDOC+LRE. The unified classes are both very general and their content could be described as "all what one can say about a LO or a cultural object".

[5] ISO 21127:2014
[6] http://lreforschools.eun.org

Table I. Definition of the top node of the three ontologies

CIDOC+LRE	CIDOC	LRE-MAP 'WORK'
CRM Entity_LRE WORK: Anything that can be said to describe a cultural object or a LO.	E1 CRM Entity: This class comprises all things in the universe of discourse of the CIDOC Conceptual Reference Model. It is an abstract model providing for three general concepts: Identification by name or appellation, and in particular by a preferred identifier Classification by type, allowing further refinement of the specific subclass an instance belongs to Attachment of free text for the expression of anything not captured by formal properties"	LRE-MAP 'WORK': 'Work' corresponds to the abstract concept of LO"

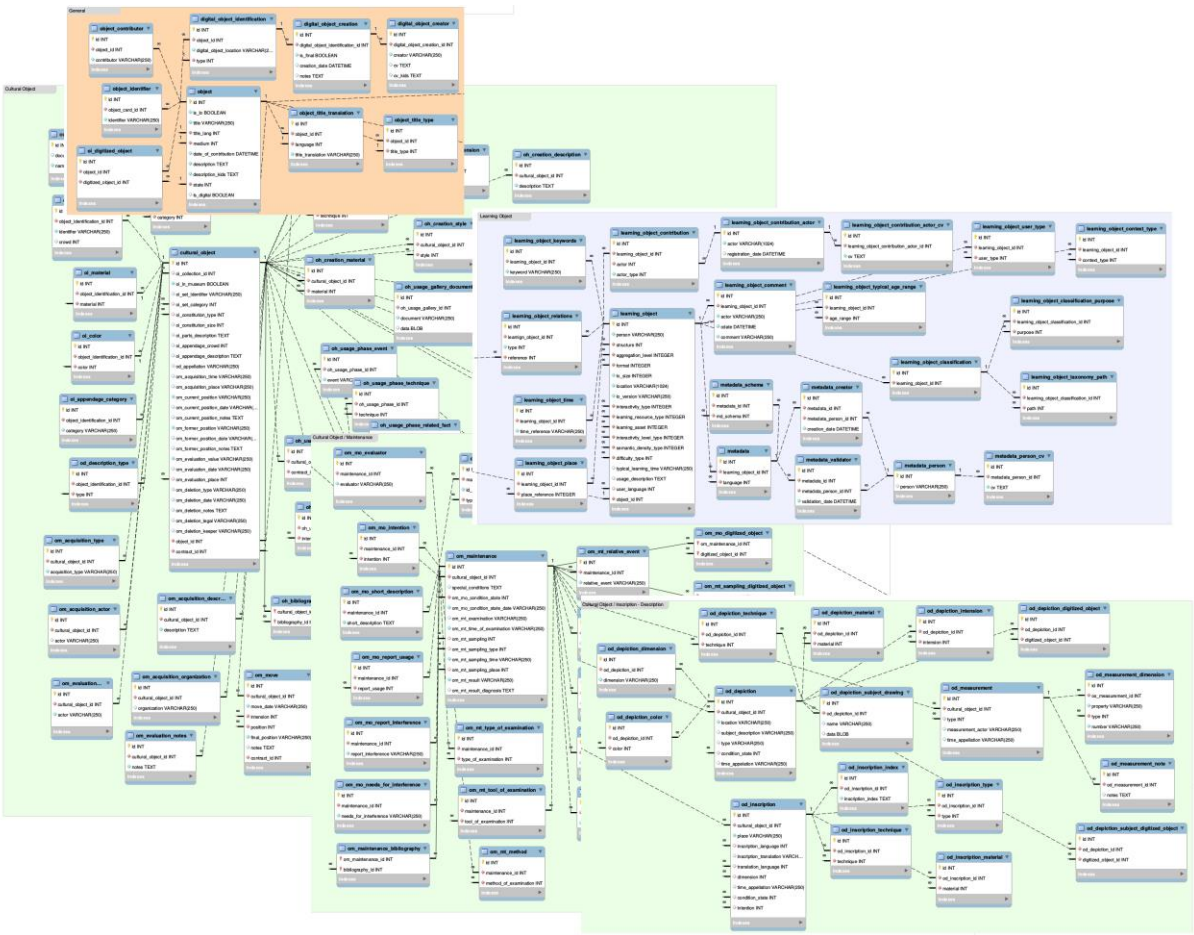

Fig 2. The database schema

We also introduced new classes, if it was necessary. For instance, CIDOC-CRM, being a standard for the description of cultural objects, does not contain LOs. CIDOC+LRE ontology is defined to include the new class LO as a subclass of E90 Symbolic Object of CIDOC. A set of properties of LOs are derived from its integration in the ontology or are defined locally. Both the LO and the cultural objects can be documented in the database that was

developed in accordance to the CIDOC+LRE ontology. The database is completed with a set of controlled vocabularies. For LRE vocabularies have been drawn from the Vocabulary Bank for Education – VBE[7]. There are several controlled vocabularies for cultural objects. We have been developing Greek controlled vocabularies that are compatible with the established Getty Vocabularies[8]. The GUI is an expandable, platform-independent Java application for storage and retrieval of Cultural and Learning Objects that is being created on the NetBeans Platform. It can use many Relational Database management system (e.g. Apache Derby, MsSQL, MySQL) and makes full use of the underlying database schema.

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Investigating the potential for meaningful cultural education supported by cutting-edge technologies

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Abstract

During the last few years societies and individuals have been experiencing rapid technological advancements which have radically transformed everyday activities and habits. Availability of a range of digital devices, with ever increasing processing capabilities, and ubiquitous Internet connection allow for accessing any kind of information, anywhere and at any time. Moreover, Web 2.0 technologies have enabled a more active user role by facilitating content creation and sharing instead of mere information consumption. All the above have direct implications for the provision of formal education which needs, more than any time before, to adopt a holistic approach to the development of young people's personalities. Culture, defined as "*the set of distinctive spiritual, material, intellectual and emotional features of a society or a social group*", should be at the core of

[7] http://aspect.vocman.com/vbe/home
[8] http://www.getty.edu/research/tools/vocabularies/

contemporary educational systems due to its potential to help people become confident and creative community members able to keep pace with ongoing developments (UNESCO/UNFPA/UNDP, 2015). Besides, cultural awareness and expression has been defined as one of the key competences for active citizenship in today's knowledge societies (European Commission, 2006).

Access to content by anyone, anywhere, through any device and platform, at any time has also blurred the line between formal and informal learning. Therefore, as far as cultural education is concerned, there is number of institutions (e.g. museums and libraries), apart from formal education establishments, which may facilitate its promotion. Through the use of methods of presenting cultural artefacts that match the characteristics and needs of different target groups, these kinds of institutions can enhance their educational role by providing well-structured access to valuable learning resources and fostering critical thinking skills (UNESCO/UNFPA/ UNDP, 2015). However, according to the European Commission (2013), a notable decrease in European citizens' participation in cultural activities took place from 2007 to 2013 with the lack of interest and lack of time being the major reasons. More specifically, visits to historical monuments or sites were reduced by 2%, visits to museums or galleries by 4%, and visits to libraries by 4% too. On the other hand, more than half of European citizens have reported that they use the Internet for cultural purposes with 30% doing so at least once a week. Such a finding is indicative of the technology's potential to strengthen the role of culture in everyday life and education, especially if we consider the degree of technology penetration into young populations.

Technology has indeed the capacity to enhance cultural experiences by offering opportunities to access digitized cultural artefacts in ways that are relevant and meaningful to the user and in this context, the aim of this contribution is to provide an account of the potential for quality cultural education supported by cutting-edge technologies. Such technologies are Cloud computing, which is currently gaining momentum in the education sector, and digital gaming technologies, which hold a prominent position in the technology-enhanced learning research agenda. To be more specific, the intention is to describe how the issue of promoting cultural education is addressed within the context of two ongoing research projects (namely the School on the Cloud and the GameIt projects) that focus on these technologies. The School on the Cloud project (http://www.schoolonthecloud.eu/) is concerned with the investigation of how education should adapt and respond to Cloud computing developments with the aim to contribute to the narrowing of the gap between available Cloud technologies and their uptake by educational institutions. To this end, a network of 57 partners from 18 European countries, including universities, schools, adult education and VET providers, research institutes, teacher training departments, NGOs, SMEs, a library, and a European professional association, has been set up to undertake a three-year research project (from 01/01/2014 to 31/12/2016). By targeting at all contexts

of use and levels of education, the School on the Cloud network seeks to explore, through the adoption of all involved stakeholders' perspectives, how Cloud computing technologies may facilitate personalisation of learning. For this purpose, network partners have been assigned to four (4) Working Groups (WGs) according to their fields of expertise and interests. These WGs are: (i) the innovative Manager (i-Manager) WG, (ii) the innovative Teacher (i-Teacher) WG, (iii) the innovative Learner (i-Learner) WG, and (iv) the innovative Future (i-Future) WG. Table I below provides brief descriptions of all WGs.

Table I. Descriptions of the School on the Cloud network's Working Groups

WG1: i-Manager	WG2: i-Teacher	WG3: i-Learner	WG4: i-Future
Examines aspects of educational leadership, management and organizational change. Aims to identify and share technological, social, economic, cultural and other experiences in different educational contexts, as well as provide guidance to educational organizations.	Explores the impact of the Cloud on the roles of teachers and trainers and examines how Cloud-based developments can find their way in education. It attempts to identify barriers and required competences, review learning and teaching approaches, and provide essential guidance for teachers and teacher trainers.	Brings together teachers and educators, schools, colleges, and adult education organizations with the aim to exploit the opportunities resulting from both formal and informal learning situations. WG3 will define personalized learning, and from existing best-practice case studies, will develop a guide on how to facilitate it.	Deals with topics like the role and the impact of open (education) resources through the Cloud, new generation Cloud-based tools, and issues such as ethics. Efforts aim to attract the interest of organizations, as well as researchers, educators, and policy makers.

Given the broadness of the project's scope, which among others targets at the publication of guidelines for mainstreaming Cloud technologies into various educational situations, research of the impact of the Cloud on cultural education appears to fall within the network's efforts. Besides, through a number of available services and a range of deployment methods, Cloud technologies have the potential to enhance cultural education by offering: (i) specialized services for storing and managing different types of digital content, (ii) processing power and content delivery mechanisms that may allow access to high quality (cultural) material, and (iii) low implementation costs. Furthermore, Cloud technologies can significantly improve the learning experience either through their integration with existing educational technologies (e.g. Cloud-based services integrated with functionalities of LMSs), or by contributing to the development of next generation educational services and tools. For instance, much research has been undertaken with respect to benefits from learners' engagement in well-structured learning activities. Critical to the learning activities design process is the utilization of the appropriate resources, access to which is facilitated by Learning Object Repositories (LORs). LORs are online collections of digital content (termed as learning objects) whose operation is based on widely adopted storage and retrieval methods. A special type of learning objects are cultural objects the

use of which can add value to formal education by helping learners benefit from their interactions with virtual instances of monuments and works of art. EUROPEANA (http://www.europeana.eu/portal/) is a characteristic example of a cultural objects repository offering access to a wealth of digitized cultural artefacts. In such a context, the potential of the Cloud lies at the emergence of Cloud-based Learning Object Repositories which can balance supply and demand, improve availability of digital resources, respond better to queries for learning objects, and facilitate interoperability (De la Prieta et al., 2014). The fact that there are providers of Cloud-based services specializing in the storage and management of specific digital content types (JISC, 2012), along with a possible compliance of providers of digitized cultural content with open standards, may result in new, decentralized LOR models that will enable storage of different types of digital cultural content to fit-for-purpose spaces and access to it through appropriate channels and delivery mechanisms.

The educational potential of EUROPEANA has also been realised and utilised in the context of the GameIt research project (http://www.gameit.gr/). The project aims to fulfil the vision for a ubiquitous virtual school, able to cater for learners' and educators' needs by providing, anywhere and at any time, rich learning experiences designed with the exploitation of digital content that is made available through existing LORs. By drawing on well-documented benefits of digital game-based learning, the project has been concerned with the development of a web-based platform for creating, sharing, and delivering gamified learning scenarios. Through the use of a built-in authoring tool, educators are able to create learning scenarios by defining learning activities and associating them with learning objects (e.g. instructional videos, text files, presentations, simulations, assessment quizzes, etc.) that can be retrieved from LORs accessed through the platform. The potential to make also use of gamification elements (e.g. virtual prizes, leaderboards, rules, progress bars, challenges, mini games, etc.) leads to learning scenarios that take the form of educational digital games delivered through a 3D virtual world. EUROPEANA is one of the accessed through the GameIt platform digital repositories that facilitates creation of learning scenarios targeting at cultural education. In this case, game elements provide users with a meaningful context for the execution of cultural learning activities. Another key characteristic of the GameIt platform is the emphasis on nurturing an expertise sharing culture among educators. This objective is achieved through the availability of functionalities that allow for: (i) the development of educational scenarios from scratch, (ii) sharing of educational scenarios, and (iii) accessing and editing existing scenarios so as to meet different learning needs. The option to track changes made to available scenarios helps frame interactions within the necessary ethics context.

To conclude, both the above-presented research projects illustrate cases of technology-enabled initiatives that may well promote cultural education. Developments, in relevant technological fields, may offer learners and educators a range of opportunities for accessing quality cultural material (either stand-alone or as part of created modules and courses) anywhere,

anytime, according to their needs. By taking advantage of cutting-edge technologies, and without being bothered with issues of technical nature, educators can be innovative and creative through the design and delivery of high quality cultural learning experiences and thus, become facilitators of cultural education and all of its benefits.

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Rethink and revisit Renaissance religious art – A virtual educational approach to museum collections

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Abstract

Renaissance art, as yet another privileged area for the study of virtual reality and how it can be experienced through digital means of creating immersive educational environments at museums, is the focus of this paper.

In 'Della pittura'[1], Leon Battista Alberti wrote: 'No one would deny that the painter has nothing to do with things that are not visible. The painter is concerned solely with representing what can be seen'. What Alberti does not mention is that during the Trecento, as well as in his own time, painted surfaces were populated with things that are not visible, with saints and angels, seraphims and cherubims, even the Madonna herself, Jesus and the Almighty God.

The reality of all religious paintings of the Renaissance is virtually inhabited by heavenly and otherworldly creatures, taking the viewer onto a metaphysical level of experience and mystical union with the celestial cosmos. Physical space is intertwined with the supernatural environment that holy figures occupy, and religious paintings systematically form another actuality, a virtual reality for the viewer to experience.

In most cases this dynamic new world is the result of the combined efforts of the artist and the client (or patron), as specific details regarding the execution, content, materials, cost and time of delivery were stipulated in contracts. Hence, the scenographic virtuality of sacred images was produced by real people who wished to construct an alternative reality in which they are portrayed alongside holy men and women. In themes such as

the Annunciation, the scene often takes place in their homes under their family coats of arms, virtually in their very own bedrooms.

So far, research on these matters in the art of the Renaissance has been focused on perspective, continuous narrative and illusion [2] without sufficiently looking into the ways in which religious iconography [3] created alternative realities or how they can be transfused in museum environments. Through the study of portable paintings for personal devotional purposes and altarpieces of the Trecento and Quattrocento, virtual reality [4,5,6,7] will be discussed as manifested in sacred images and will be put in context from a recently developed socio-political point of view, as well as from a historical, psychological, artistic, symbolic and theological standpoint. At the same time, the importance of changing the way Renaissance religious art is presented and exhibited at museums so as to convey its virtual aspect will also be discussed.

Among other motifs, the iconography of the sacra conversazione, the maesta, the hortus conclusus, martyrdoms and visions of saints as well as the presence of donors in the company of saints will be explored. Moreover, techniques such as the perspective along with composition, the use of colour, light and shadow, etc. will be discussed as means of creating a reality other than the physical. Museum settings are dramatically different to the original place of the paintings. We are used to considering museum exhibits detached from their original function - this barren environment deprives us of the chance to put them into context. We can only resort to imagination and hypotheses missing out on the essential feature of it which is educational. Museums rely only on the sense of sight by keeping our other senses blunt, without focusing on the virtual reality of the paintings and by not using new technologies to build environments that can recreate the elements of the pictures, for example trigger the sense of smell, or touch [8,9,10]. We first enter a reality through our senses and then do we furnish a rational structure or meaning for it. Images create rather than merely represent reality. This insight is the cornerstone of how people shape experience and sense the world around them through images. Looking shapes thinking and art enables us to identify emotions [11].

In the religious iconography of the Renaissance not only is the heavenly sphere depicted but also a specific sensory impact is produced by the objects represented as well as by the scenography of the pictures. The painted surface thus becomes a kind of a theatrical 're- presentation' manipulating objects or the very expression of emotion to establish a specific atmosphere or mood and elicit sensory impact from the viewer. It creates an all immersive environment [12,13,14] through the depiction of lighting, set, clothing, as well as the suggestion of the senses of smell or hearing, touching, tasting, through, even, the implication of temperature and texture. Museum goers could benefit far more from interactive, three dimensional environments than by simply looking at a picture on the wall. A work of art is a microcosm of multiple meanings and psychological nuances. Focusing on several case

studies, this paper will examine how the sensory impact is communicated and emerged through the microclimate of each piece.

Art is a means of perception, a means of cognition [15]. Perception makes it possible to structure reality and thus to attain knowledge. This paper's scope is the need to rethink and revisit the way Renaissance religious art is exhibited in sterile museum environments and propose interesting ways to recreate in 3D, immersive and interactive environments the virtual essence of it. Virtual learning environments (VLE) simulating a virtual classroom by concurrently mixing a number of communication technologies, along with the state-of the-art technology-based style of exhibiting the works of art will be the direction museum collections should head to in order to be more functional and attractive to modern and future museum goers who are familiar with new technologies and interactive methods of learning [16].

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The 'Synthesis' Virtual Museum – an open virtual exhibition creation tool

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Abstract

The continuous development of web services and computer infrastructures complemented by the increasing availability of game development software engines, contribute to an on-going expansion in the release of serious games (SG) in diverse areas, ranging from entertainment, cultural heritage (CH), education, artificial intelligence (AI), sociology, military to health systems [1]. In this sense SGs can be thought of as bridging culture and education with gaming. By utilizing contemporary visualization and simulation technologies SGs are able to enhance the user experience in realistic environments with enhanced interaction [2]. This form of stimulation is considered to be one of the basic factors for the successful user activation, being the force that promotes focusing in the activity process and encourages users to continue. Stimulation may be considered as a targeted mechanism to achieve the desired results, and is greatly supported by using SGs [3]. The notion of virtual museums and exhibitions has been introduced as a means to overcome the limitations of the physical space and to provide a vivid experience to remote visitors [4]. An overview of virtual museum technologies is presented in [5].

Numerous works utilize various technologies to support cultural heritage purposes, such as historical teaching and learning, or to enhance museum visits. In [6], a management system of 3D digital models and a dynamic virtual exhibition showroom was introduced as a dynamic web-based virtual museum framework. In addition, in [7] a more realistic framework for digital museums has been presented with the creation of a non-realistic digital replica of a museum that presents its educational activities and not its exhibits, aiming at producing more actual museum visits. In [8] interactive SGs for the promotion of a prehistoric heritage site of the Gargas caves were presented. In [9] a state-of-the-art review was presented for the existing theories, methods and technologies utilised by SGs as cultural heritage promotion tools, showing several case studies representing those technologies. Taking a step further, works like [10] focus on a generalization of the task-based learning theory with great advantages of smartphone support. In addition, the researchers in [11] proposed a new approach in navigating within complex cultural scenes by exploiting content-based descriptions. Scaling down to the smaller scale, the researchers in [12] propose a content-based navigation framework for a virtual museum, based on metadata that describe the exhibits, thus providing semantic-similarity-based navigation. In a recent work [13] a multi-user virtual exhibitions framework has been proposed that adapts to the visitors' preferences. In [14] an SG is proposed based on a cultural heritage scenario, and tries to enhance knowledge of cultural heritage by spreading a mystery in the ancient world.

Differentiating from previous works, we present a novel content-dynamic web-based SG system primarily focused on creating virtual exhibitions (the 'Synthesis' virtual museum), which relies and exploits the rich content of both internal and external web cultural resources to empower users to generate their own exhibitions through the usage of cross-platform gaming technologies. The 'Synthesis' virtual museum is not like any other virtual museum in that it is not the stakeholder of the exhibits; it is just the host virtual environment. It is built upon the Open Linked Data concept, thus supporting the creation of virtual exhibitions for cultural and educational purposes by maintaining purely persistent URIs and URLs. The 'Synthesis' virtual museum offers:

- VR-like, non-immersive 3D visualization, navigation and interaction
- Cross-platform functionality
- Purely user-driven dynamic exhibitions
- Interconnection with external resources based on data interoperability

Fig. 1 presents an overview of the functionalities supported by the system. The current implementation of 'Synthesis' Virtual Museum supports exhibitions in the form of 2D images mapped onto flat surfaces, like painting frames. Both exhibition visits and exhibition administration are provided through the same, unified, Graphical User Interface (GUI), thus making administration much easier and more intuitively coupled with the end-user experience.

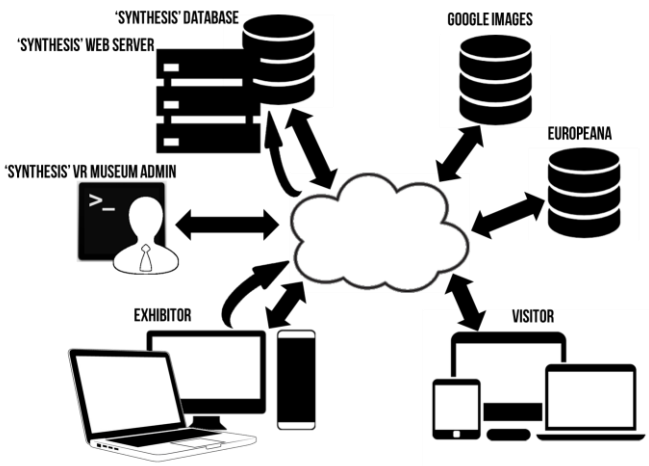

Fig. 1. Abstract functionality diagram of the system

The system requires that all users be registered. Each registered user is able to either browse and visit exhibitions, or become an exhibitor and administrator of his/her exhibitions. All exhibitions are viewable by all registered users. Currently, as shown in Fig. 1, the main image data resources are Google Images, Europeana and the 'Synthesis' database (developed for project 'Synthesis'[9] that funded this work). Exhibition management by the users (creation and editing of exhibitions) is screened by a system super-

[9] *'Synthesis' project homepage at http://synthesis.ceti.gr*

administration (SA) responsible for activating exhibitions after a typical content verification. The exchange of data between the core of the system and the external web-based resources is being done using JSON[10]. The overall graph of requests and data exchange is illustrated in Fig. 1. The virtual building hosting the exhibitions was inspired by the building of the "B&M Theocharakis Foundation for Fine Arts and Music", Athens, Greece. Fig 2 shows screenshots of the exterior and the interior of the virtual museum.

Acknowledgements

This work was supported by the Action 'Synthesis of Ideas, Forms and Tools for Cultural and Artistic Education' financed by the Ministry of Education & Religious Affairs, Greece, under the framework 'Education and Lifelong Learning', co-financed by the European Social Fund.

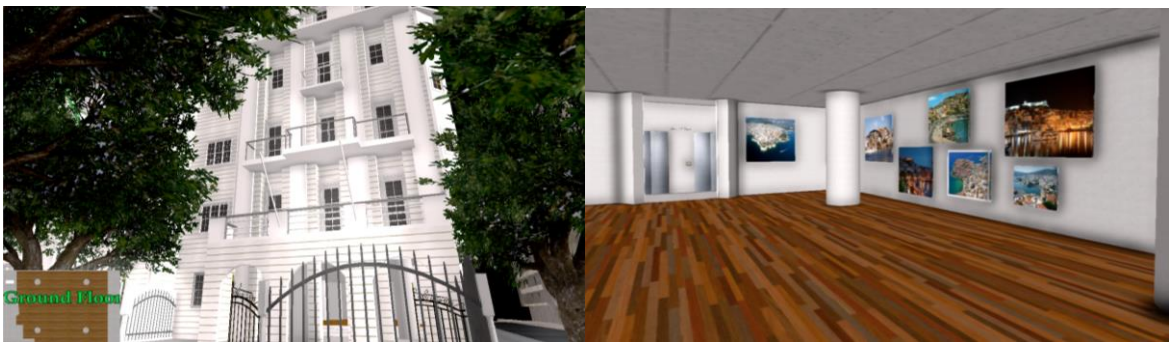

Fig 2. Screenshot of the virtual building's exterior and of an exhibition in the ground floor

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Towards a playful education

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Abstract

In the recent decades there has been significant investment in the incorporation of games in the educational practice. This has taken either the form of game-based learning or serious gaming. Today, a literature research on gaming and education results in numerous works tackling different aspects of the approach. Even a simple search on the Web on "gaming and learning" produces multi-million results. In this work we try to touch not only the surface of this paradigm and provide typical game-based learning evaluation results but also to explore its inner workings and provide an even more concrete foundation of a playful education.

Playing is an archetypical activity that arises from primordial biological structures existing before the conscience or the capacity for speech; it is not something a person decides to do [1]. According to the same study, playing is an activity with specific qualitative features that could be summarised to the following:

- It is seemingly pointless (say, it is not being pursued for money or food) (
- It is voluntary (
- It genuinely attracts (makes a person feel nice) (
- It releases from time (
- It reduces self-consciousness (one does not care how he looks beautiful, smart, etc.; even stops thinking about thinking) (
- It enhances improvisation (may even lead to ideas for other activities) (It creates a desire to go on and on (

In addition, according to Scott Eberle[11], vice president for play studies at The Strong National Museum of Play[12] and editor of the American Journal of Play[13], playing could include: (

- Anticipation (what will happen) (
- Surprise (the discovery, the unexpected) (
- Entertainment (pleasure) (
- Understanding (new knowledge or synthesis) (
- Power (coming from the understanding of the world through the experiences) (
- Balance, grace, poise (

Following the definition of play, let us know consider if playing can be a positive activity and explore the scientific approach to this issue. Neuroscientists Sergio Pellis and Andrew Iwaniuk along with biologist John Nelson in their research [2][3] discovered strong positive association between the size of the brain with the propensity to play in mammals in general. Senior researcher of play Jaak Panksepp in numerous works as in [4] has shown that participation in playing selectively activates a brain derived neurotrophic factor (which stimulates growth of neurons) in the amygdala (where emotion processing takes place) and in the dorsolateral prefrontal cortex (where executive decisions processing takes place). The animal play expert John Byers [5]-[7] speculates that during play, the brain creates a sense of self through simulation and testing. The play essentially helps in the formation of the brain. (

During the play the brain is able to experience situations without threatening its physical or emotional integrity. Neuroscientist Marian Diamond and her colleagues in the landmark 1960 survey [8] reported the development of rats with larger and more complex brains using play: the rats just played in a constantly changing environment of "toys" with intense socialization (not like in typical experiments in solitary mazes). According to Brown [1], the genius in play is that while playing new cognitive combinations are being created using fantasy. In creating there now cognitive combinations, the knowledge of the function of this world emerges. Playing seems to be an advanced method devised by nature to support a complex brain in its attempt to self-develop.

A question that naturally emerges from the previous analysis is that, if playing is a simulation mechanism what is being simulated?

According to Thomas Metzinger [9], there is an objective world out there, but as we try to make sense of it using unconscious filtering mechanisms, we are creating our own interpretation of the world, our own "reality tunnel". We are never in touch with the objective reality as those filtering mechanisms (senses, the brain, experiences and hypotheses) prevent from seeing the world as it is;

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[11] https://www.psychologytoday.com/experts/scott-g-eberle-phd
[12] http://www.museumofplay.org/
[13] http://www.journalofplay.org/

we only see what can be seen through the reality tunnel we construct in a process that is totally transparent to us. We know the world using reflections, since a (correct) reflection is ultimately what we call knowledge. Each one lives in a virtual world, with the conscious experience being a virtual reality created by nature as a real-time and ever operative world model that supports the interaction between living organisms. In this world model, the ego is nothing more than a pointer on a space-time map, putting a self on the stage of time and space that defines the now and the where.

Surprisingly, according to all these researches, we seem to be living in a simulation (created by our brain) and we use play in order to simulate additional possible realities in a protected manner, without even noticing. So, play could be envisaged as a tool to explore potential realities in an attempt towards understanding of the world and towards self-discovery and self-development. It seems valid, in this respect, to adopt an approach towards gamification in education (as in other fields also). According to Scott Nicholson of *Because Play Matters Lab*[14], gamification is the nothing more than the use of specific approaches and techniques in various environments in order to attract people in problem solving and in contribution enhancement. Gamification draws its theoretical framework on various approaches including:

- Self-determination theory / organismic integration theory (
- Situation relevance (
- Universal design for learning (
- Player-created content (
- User-centred design

Nicholson also commented the distinction between $Play$ and $Game$ using a "playful" (mathematical approach as follows:

$$Game = Play + Goals + Structure \Rightarrow \begin{cases} Game - Play = Goals + Structure^{15} \\ Play = Game - (Goals + Structure)^{16} \end{cases}$$

In an attempt to establish that gamification actually produces positive outcome, recent studies have concluded that gamification is expected to produce positive results [11], although there might be some differentiation in personal and contextual level [12] related with the continuous usage (the more the usage the less the perceived positive value) and the gender (women showed a greater social dimension than men in perceived positive value). In any case the study showed there is no difference whatsoever with the age, i.e. regardless of the age the perceived value of gamification is the same. It should be noted here that there is a light distinction in gamification and game-based learning, as in the second there is a specific targeting towards the learning process.

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[14] *Because Play Matters Lab* http://becauseplaymatters.com
[15] *BLAP gamification model (badges, levels, achievements, points)*
[16] *Solution for Play: emphasis on the play and the player*

In this respect, educational games are games that are either those expressly designed for educational purposes or those with educational value that emerges randomly or secondarily. These games are being designed to aid in learning about specific subjects, in expanding concepts, in stimulating growth, in understanding a historical event or a culture, in developing a skill while playing. All kinds of games can be used in an educational environment. The above analysis thus supports a conclusion that play in education is a well-established paradigm not only because studies have indicated so and not only game-based learning project have shown positive evaluation results, but mainly due to the nature of the inner workings of the process of play, towards self-development and the acquisition of knowledge and the understanding of the world.

Acknowledgements

This work was supported by Project *Gamelt* (code 864-BET-2013) that was financed by the General Secretariat of Research and Technology, Greece, under the framework 'Industrial Research and Technology Development Programme'.

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GameIt and a new paradigm on gaming in education

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Abstract

Gamification is a process that targets the engagement and involvement of people in problem solving and development in various environments and in a pleasing manner. Gamification can draw its theoretical framework on various other fields and approaches. Recent studies have already indicated the positive effects of gamification [1][2]. Game-based learning is a special case of gamification where educational games are games that are either those expressly designed for educational purposes or those with educational value that emerges randomly or secondarily. These games are being designed to aid in learning about specific subjects, in expanding concepts, in stimulating growth, in understanding a historical event or a culture, in developing a skill while playing. All kinds of games can be used in an educational environment. The use of games to promote student's learning has been based on the motivation aspect that games involve [3], which in turn encourages curiosity [4] and creates the impression of controlling the learning process. In the recent literature, the use of games in education has been explored in various aspects. [5] and [6] study the case of data structures and programming courses. Other studies included game projects [7], interprocess communication [8], operating systems [9] and more. In games (in general), players engage in processes such as proactive/anticipatory, recursive thinking, organisation of information, general search heuristics, means–ends analysis, and the generation of alternative solution paths [10]. Game-based learning engages players in learning activities, usually by means of educational video or serious games [11]. It has already been shown that game-based learning can be combined with similar learning methodologies as Collaborative-based Learning [12], Problem-based Learning [13]-[15] and Project-based Learning [16][17].

The work presented here is a description of the approach taken by *Project GameIt*, a Greek national funded project that aimed at a novel paradigm on gaming in education. The vision in GameIt was to create a single integrated and easy-to-use educational game development platform based on educational principles and scenarios using content from national and international repositories and supporting commercialization. GameIt would not change the usage model – which is a typical first-person game. GameIt would definitely contribute with a new content integration model, a new model approach to the content, a new model and incentive for creators and a new business model in education. The GameIt approach is cantered on a novel knowledge integration and game development paradigm, contemporary gaming and effective entrepreneurship. The *knowledge integration* part of GameIt is a novel and innovative approach towards the integration of national and international resources into a single searchable knowledge system to support the creation of educational games, based on

state-of-the-art technologies and international standards. This system is based on a novel CIDOC-CRM and LOM integration to seamlessly support cultural and educational resources. The next highly novel approach within GameIt is the *game development* part. This represents an innovative approach towards a cross-platform educational game-authoring environment based on state-of-the-art gaming technologies. This game authoring system supports the creation of game templates and complete game scenarios based on educational templates and contemporary educational approaches for effectively any kind of subject, using digital content provided by the knowledge integration system. The *gaming part* of GameIt is based on a first-person (and also third-person) gaming approach using cross-platform gaming technologies that actually implement the game scenarios developed by the game authoring system. In overall, the whole construct of GameIt was built to support entrepreneurship using innovative techniques to include both business to business marketing and business to client approaches. An overview of the GameIt platform, which also includes the basic level functionalities is shown in Fig 1. The innovative knowledge management system includes a subsystem to accommodate management of external resources of cultural and educational content along with the management of user content stored in GameIt.

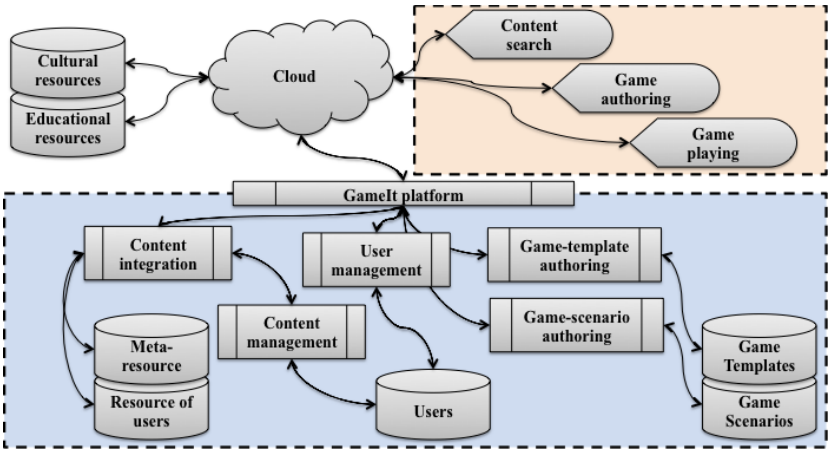

Fig 1. Overview of the GameIt platform

Fig 2. The GameIt island – concept art

The adopted exploitation plan that reflects the entrepreneurship part of the system targets both developers and end-users, whereas it focuses mainly on developers and was inspired by the mobile app stores model. In this model developers have a prominent role in developing educational game templates and educational game scenarios. All these are based on well-established pedagogical approaches and can be supported by model-templates that already exist in GameIt. Game development is based on game templates, games scenarios and the content. Developers can distribute their games through the GameIt platform either for free or for a fee. They can also distribute their game templates. The games developed in GameIt are played on an island (see concept art in Fig 2). The island consists of various building and spaces to implement any educational game scenario; it is cross-platform and was implemented using the Unity game engine.

Acknowledgements

This work was supported by Project *GameIt* (code 864-BET-2013) that was financed by the General Secretariat of Research and Technology, Greece, under the framework 'Industrial Research and Technology Development Programme'.

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SESSION 4 – ADVANCED TECHNIQUES IN VAMCT

Session Chair: Daniel Asmar (American University of Beirut, Lebanon)

The Loupe: An Educational AR application for Learning to Look at Ancient Greek Art

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Abstract
Our contribution presents the Loupe, a mobile AR prototype for museum visiting and the lessons we learned evaluating the prototype with 22 adult museum visitors using as a case-study the collection of Greek Antiquities of the Allard Pierson Museum in Amsterdam. As its name suggests, the Loupe has the form of a magnifying lens (Figure 1). An I-Phone is enclosed in the wooden encasement running an image recognition algorithm that recognizes museum objects for which interpretation materials are available. The visitors have thus to use the magnifying lens interaction metaphor to scan and examine from closer museum objects and exhibits. When one of the objects is recognized, digital content, in the form of text, animations and images appears on the Loupe display. Different interaction metaphors are available (shaking the Loupe, tilting to the left, tilting to the right, zooming). Our study comes to provide insights in the steadily growing literature on museums and Cultural Heritage institution introducing AR applications in their digital engagement strategies [1], [2], [3].
The Loupe concept and prototype have been developed and validated within the European meSch project (http://mesch-project.eu/) [4]. Prior to the study presented in this paper the Loupe had already been validated in two European museums: Museon in The Hague, the Netherlands and the National Museum of History in Bulgaria [5]. These first validation studies targeted mainly children and raised concerns as to whether the focus for the visitors was the Loupe or the exhibits themselves, raising questions about how to introduce this digital interpretative medium and its AR features in such a way so as to encourage the visitors to look at the real museum object. In order to test whether the digital contents and the narratives revealed through the use of the Loupe can be tailored in such a way so as to incite the visitors to focus on the real as in contrast with the digital, a new narrative was implemented entitled "Zeus and his children". For a visitor going through all the content, the tour lasted approximately 15 (+/- 5) minutes.

Fig 1. The Loupe and the study set-up, Allard Pierson Museum, Amsterdam

When the Loupe was picked up, a small introductory text appeared on the screen informing the visitors that an outline of a displayed object will appear on the display and that it has to be matched with one of the objects on display. When the virtual outline is matched with the corresponding object in the showcase, the outline grows, pulses and then fades out (Figure 1c), to make appear the digital content for each one of the objects that are included in the tour. For each object, at least 5 to 6 short chunks of text, images and animations with iconographic parallels are available. To navigate through the content, visitors could tilt right to go forward in the narrative or left to go backwards. At the end of each story and narrative revealed for each object, a new outline appeared prompting the visitors to look at it carefully, then identify the next commented object in the display.

The main research questions that informed the design of the Loupe prototype were the following: Can simpler but also cheaper forms of digital content (i.e. text and 2D images as in contrast with expensive 3D animations registered in 3D) be effectively combined with a mobile AR application? Can the Loupe be shared among visiting companions? Is it easy and intuitive to use? Is it easy to switch from the museum object on display to the content provided by the Loupe and vice versa? Is it easy to navigate in the digital content? Would the visitors consider using the prototype should it be available in museums and other Cultural Heritage settings? Part of the study sought to use psychometric, semantic differential scales in an attempt to start investigating whether the visit in the museum itself as well as using the Loupe can be associated with positive or negative emotions and affective states (i.e. a visitor might feel "in control" while using the Loupe or "overwhelmed" while trying to master its use, pleased or disappointed by the museum visiting experience etc.). The survey thus consisted of 29 questions and was divided in four sections:

demographics, affective impact, cognitive impact and utility and usability of the Loupe AR prototype.

The study took place over a period of 7 consecutive days with 22 participants who volunteered to participate in the study either alone or with a visiting companion, through an invitation that was disseminated via mailing lists for the Friends of the Allard Pierson Museum and university library staff, as well as social media. The participants were informed of the protocol of the study and were given a pre-visit questionnaire. Then they were observed using the Loupe in the Gallery of Greek Art. After using the Loupe the participants filled in a 2nd questionnaire and were interviewed. Thus the data collected consisted of: twenty-two coded observation notes, fifteen interviews and twenty-two filled-in surveys.

Fifteen women and seven men participated in the study with their demographics and museum visiting habits matching the profile of the Allard Pierson Museum's returning visitors. Among them twelve visited with a visiting companion and ten alone. One of the main findings of the study coming from the interviews that were conducted during the visit is that despite the fact that –intentionally- most of the content provided through the Loupe had the form of short text chunks, most of them underlined that they read all the text included in the AR tour (nine out of fifteen interviewed participants). Though all of them visit museums frequently (2-3 times a year) or very frequently (4 or more than 4 times a year) the interviews and observations in correlation with the survey answers showed that the more "experienced" the museum visitors were in "reading" and interpreting, the less distracted they were by the Loupe display. Another very interesting finding is that "easy to use" does not necessarily imply "intuitive"; most of the participants thought the Loupe was easy yet not so intuitive to use at the beginning and more specifically until participants managed to successfully reveal the content for the first featured object on the "Children of Zeus" tour. The statement "If the loupe was available in the museum, I would consider using it" scored 4.41 on a 1 to 5 Likert scale (1=Strongly Disagree, 5=Strongly Agree). The survey section on the cognitive impact of the AR tour was also very encouraging with the means for the statements "I learned at least one thing about mythology I never knew before", and "I recalled at least one thing I had learned in the past" reaching 4.55 and 4.59 respectively. Finally one of our most important findings in the "Affective Impact" section of the questionnaire was that the among eleven sets of opposite moods and feelings, the states and moods of being "curious" and being "interested" came on top of the participants' preferences confirming thus the relevant literature on the role of interest [6] and curiosity [7] for creating engaging and memorable museum experiences. In conclusion, the Loupe application was found to be useful and enjoyable by our study participants. As scientific evidence is not yet conclusive as to whether more traditional or experienced visitors are less favourable in using digital interpretation media for museum visiting, our study found that more experienced museum visitors and frequent museum goers

did seem to appreciate the potential of the Loupe though it is still only a research prototype.
The content delivered through the Loupe and the study itself were designed in such a way so as to allow us to run a new comparative, parallel study with the same textual and visual content delivered through a more traditional medium (i.e. a brochure) so as to compare the utility, enjoyability and self-perceived cognitive and affective impact of a digital versus a paper interpretative resource and medium.

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Object- Panorama using SIFT/SURF descriptors and Tamura texture features

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Abstract

The digital visualization of an object derived from the Cultural Heritage Domain has always been of great importance in order to provide a harmless way of examining and studying various aspects of the artefact. Panoramas provide a way of highlighting some important aspects of the object. Apart from the examination purpose which is enriched by the use of panoramas, they are also important for documentation purposes.

In this work we propose a technique for generating object panoramas. The proposed technique is based on a combination of the Scale- Invariant Feature Transform (SIFT)[1] and Speeded Up Robust Features (SURF)[2] descriptors and the powerful texture features of Tamura [3]. SIFT and SURF feature extraction techniques are used due to their insensitivity to changes in illumination, scaling and orientation of the images. At each extracted feature location a characteristic scale and orientation is established and the descriptor is computed by accumulating local gradients in orientation histograms. Due to this, visible edges can shift slightly without altering the descriptor vector. Furthermore the vector of gradients is normalised giving invariance to affine changes in intensity. Initially, using SIFT and SURF algorithms invariant local feature points are extracted. Hence the image is described by two sets of compact descriptors. Then a limited number of best matching points with respect to their proximity in each image are selected. The selection is based on the spatial consistency of the detected feature points between the descriptor sets. In addition, in order to strengthen the point matching phase, for each of the candidate feature points the Tamura texture features from the neighbouring pixel area are extractred. The Tamura texture features are used due to the fact that they correspond to the human visual perception and exploit the texture information apart from the feature points detected by SIFT or SURF that operate on grayscale images. In order to find the corresponding feature pairs in different images the similarity measure used in the proposed method is the Manhattan distance.

The result of the above procedure is to finally choose the best matching feature points and eliminate the weak-erroneous ones. A projective transformation is then applied using the matching points to achieve image alignment with a minimum error. Finally, an image pyramid blending is applied in order to diminish the variation in terms of contrast and brightness and thus acquire a natural blending.

These object- panoramas produced are going to be made publically available through a mobile devices-based tourist guide application that is being developed within the framework of the iGuide project.

Acknowledgements

This research has been financed by Greek National Funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) - Research Funding Program: iGuide.

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A computer platform to analyse the shape of museum objects in 3D

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Abstract

Museum professionals all over the world have always shown great interest in acquiring automatic methods to register and analyse the shape of cultural heritage artefacts. Thanks to recent advances in 3D scanning and photogrammetry techniques, it is now possible to model the surface of objects with very little effort and in a relatively short time.

The continuous adoption of these techniques in cultural institutions has generated thousands if not millions of 3D digital models. Unfortunately, after these resources are produced, very little effort is spent in making them accessible to researchers or the general public. Part of the problem is a lack of efficient computer mechanisms to search, retrieve and classify 3D data.

The conventional way to search and retrieve 3D models consists in composing a query based on text descriptions. However, textual annotations are necessarily constrained by the database application domain, ontology, etc., as well as by language and other factors. Consequently they are inadequate for shape oriented searches.

This paper presents results of an on-going project focused on developing a computer platform to automatize the search, retrieval, recognition and analysis of 3D object models. The platform processes queries based on geometric properties instead of text. Simply stated, the computer program takes a 3D surface mesh as input (i.e. the *query model*). Then, a search engine compares it to hundreds or even thousands of 3D scanned objects stored in a repository identifying those that approximate the shape of the query model. Next, the matching models are retrieved, ranked by degree of similarity and displayed to the final user. Afterwards, additional tools can be deployed to perform some kind of analysis on the objects retrieved.

A platform like this is much more powerful than a text search engine because it avoids mismatching situations, such as when a person queries the database looking up for "bowls" and retrieves nothing just because the bowls are labelled as "*cuencos*" (a Spanish term) or "*cajetes*" (i.e. a term common in Mesoamerican archaeology to described the same type of vessels). Moreover, the platform is able to exploit mathematical analysis algorithms for automatic classification of shapes.

During the presentation, we discuss the specific requirements that a shape recognition platform must satisfy to be useful in museums and cultural heritage research. In archaeological projects, for example, we encounter objects that are not necessarily identical in terms of geometry and yet they are considered to belong to the same class. Figure 1 shows a case like this. Both sculptures are globally similar but differ in some details such as the

headdresses and ornaments of the characters. In this case, the recognition platform must retrieve both sculptures despite not being completely similar. To be useful in archaeology, the platform should also retrieve two or more instances of the same class of object regardless if one of them is missing some parts or show variations in orientation or scale.

Fig 1. Two sculptures of Aztec deities showing similar global shapes but with different ornaments and headdresses

The fields of computer vision, machine learning and pattern recognition have produce a vast literature on 3D matching and retrieval [1], but this is just starting to be applied to cultural heritage situations [2]. Our approach to the analysis of 3D models follows 5 general steps:

1) Extraction of shape descriptors for each 3D model. A shape descriptor is a measure of some geometric attribute that characterizes the particular form of each object. In this project we have implemented four methods of shape description:
   a) Extraction of local shape descriptors based on calculating spherical orientations, a new technique developed by members of our team [3].
   b) Analysis of shape distributions of distance functions, as proposed by [4].
   c) Application of reflective symmetry functions, following work by [5].
   d) 3D shape matching through the computation of harmonic functions [6].
2) Building an efficient index structure to store the shape descriptions in order to facilitate search and matching operations.
3) Calculation of a dissimilarity distance between a particular query model and the rest of the objects in the database. In this way, matching similar objects becomes a task of comparing the shape descriptors stored in the index structure.
4) Implementation of a fetching algorithm, which provides functionality such as the ranking of objects according to their level of similarity.
5) Finally, development of efficient tools for visualization and/or interaction with the user.

As part of this presentation we intent to show the first part of this platform, namely the search engine for matching and retrieval of 3D Objects, as illustrated in figures 2-4.

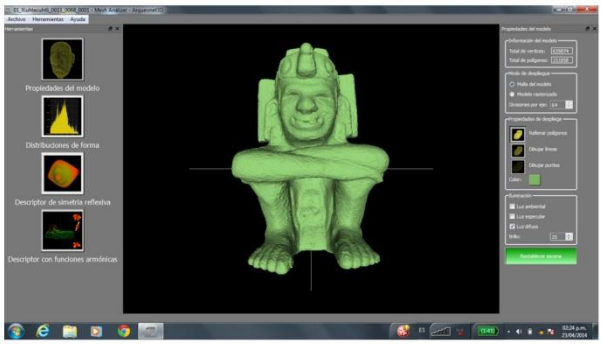

Fig 2. 3D model of an Aztec deity used as input query for the recognition system

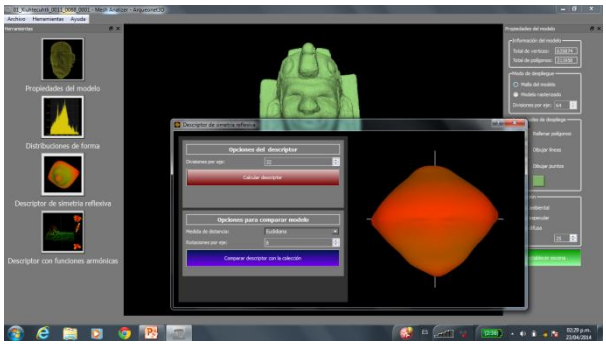

Fig 3. Extraction of shape descriptors for the query model in order to use it later during the matching step

Fig 4. Query results retrieved by the recognition system.

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Hyperheritage: New Forms of Human Cultural-Information Communication

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Abstract

The term HyperHeritage covers every hybrid cultural heritage environment (augmented with digital information) that allows to explore new facet's of cultural information perceiving and practicing.

Massive development, and impressive uses, of ICT (Information and Communication Technology) and immersive devices (Augmented and Virtual Realities) have allowed exploring new forms of Human Cultural-Information Communication. ICT has established new ways, often independent of space and time, to access, process and to deal with interconnected Cultural-Information. Emerging "Mediatised" Socio-Cultural Life as well as new Human-to-Human "Mediatised" Communication Protocols, are inviting information designers to reconsider the Cultural-Information environment. However, it is important to notice, that the idea of HyperHeritage doesn't aim to question the Traditional Cultural Institutions, it suggests other ways of seeing and treating Cultural-Information growing in an interconnected unlimited spaces.

Thus, HyperHeritage, that refers to "Hyper Perception" of Cultural-Information, leads to consider a doubly exploratory adventure: on the first hand, to replaying / rediscover some of Human Perceptual and Operational Capabilities (in handling cultural information) and on the other hand, as consequence, to re-design (re-engineer) the Cultural-Information itself.

This proposal addresses the issue of "Mediatised" Human Cultural-Information Communication following two angles more or less restrictive:

- Augmented "Mediatised" Communication
- Cultural-Information Design

Our purposes, observations and reflections will be illustrated by three technological concepts that are studied in the CITU team:

- Autonomous Social Avatar, this project emphasizes the social dimension of cultural information that is required by their Consumers
- Theatromania, Game Documentary to promote part of entertainment arts archives
- Correct: This project suggests a social network to correct digital old books

SESSION 5 – VIRTUAL ARCHAEOLOGY, MUSEUMS AND THE NEW NARRATIVES

Session Chair: Arne Flaten (Ball State University, USA), Susan Bergeron (Coastal Carolina University, USA)

Visitor Experience in Google Art Project and in Second Life-based Virtual Museums: A Comparative Study

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Abstract
The advances of real-time interactive 3D technologies and the rapid expansion of the Internet in the last two decades has led to the development of a wide variety of solutions for the dissemination of cultural heritage using digital technologies. One such promising approach are Virtual Museums, i.e. digital spaces for the presentation of exhibit collections, in which visitors are embodied as avatars and navigate around a virtual space observing the exhibits in a manner that aims to imitate the physical museum visiting style. [1] Virtual Museums have been based on various display technologies and interaction styles including immersive, desktop, mobile, augmented and haptic. Furthermore, they have been enhanced with a number of features, such as interactive exhibits, virtual guides, personalized exhibitions, community feedback, etc. A distinguishing characteristic of these environments is that they offer an enhanced and compelling experience compared to browsing exhibit photos in a museum web page and their main aim is to motivate users learn about the museum contents in an engaging way.
Currently one may identify two distinct trends in Virtual Museums, which are based on different technologies and have significant differences in terms of modelling, visualizing and interacting with the content: approaches based on Virtual Worlds, such as Second Life, [2] and the Google Art Project. [3]
Second Life is a general purpose Virtual World created by Linden Labs, which allows users to participate and collaborate in shared environments that are built and maintained by the users themselves. Second Life is considered the most popular general purpose Virtual World, but the open source alternative Open Simulator is also gaining popularity. The popularity of the medium and the freedom to build and formulate spaces, to program the interactivity of objects and to customize the user interface, led to a variety of applications in cultural heritage, including Virtual Museums. A number of popular museum spaces emerged in Second Life. Some have been created by motivated users, and others by museums and cultural institutions, such as the Second Louvre that replicates parts of the physical museum of Louvre.

The Google Art Project is a more recent approach by Google for disseminating art and cultural heritage. Artwork collections from popular museums and exhibitions are presented in very high resolution and the user can zoom in and observe the details. Furthermore, the project offers a virtual walkthrough in the interior of most of these museums where visitors can see the exhibits placed in their physical space and navigate around the place. The modelling of the interior spaces has been based on a multitude of panoramic photographs of the actual space and the navigation experience is similar to Google Street View. The user does not freely move around, but switches between predefined spots from which she can look around or zoom and observe the space and its contents.

A common characteristic of these approaches is that they both aim to replicate the experience of visiting the physical museum space and observing at the exhibits. However, looking deeper into several aspects of their interface, one can notice significant differences: modelled vs digitized exhibition space, low-res vs hi-res image presentation, single- vs multi-user visiting experience, static vs interactive exhibits, etc. The aim of our research is to compare the two environments in terms of their effect on the visiting experience and to attempt to identify the critical design features that contribute mostly to the experience.

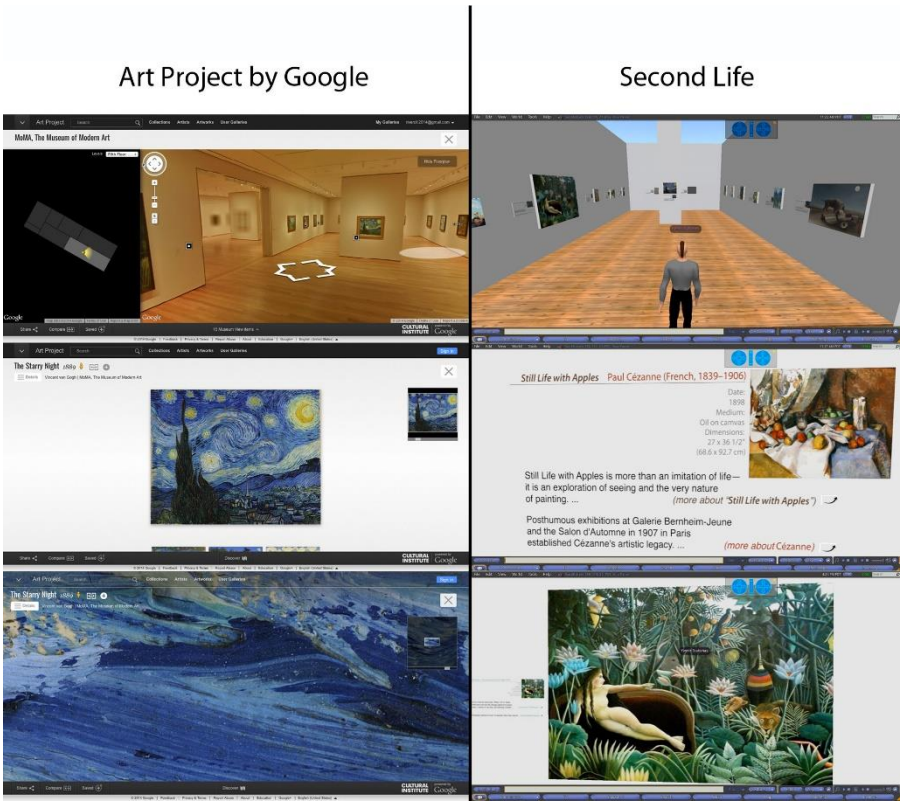

Fig 1. Screenshots from the museum environment as presented in Google Art Project and a Second Life - based Virtual World

We have setup a study for the comparative evaluation of the two approaches based on the visiting experience of the same museum space. We have chosen a museum already present in the Google Art Project (the 5th

floor of the Museum of Modern Art) and modelled a replicate of it in Open Simulator (Fig.1). The study involved 11 participants aged between 18 and 30, which have been asked to visit both spaces and to learn about specific exhibits based on a given scenario. We used a number of data collection approaches, including observation, questionnaires and open discussion. Initially we asked users about their expectations from the Virtual Museum visit. After each visit the questionnaire involved several questions, including the user satisfaction with respect to their initial expectations, the rating of a variety of features in terms of their quality and importance, the chances of using the platform again and the reasons for doing so, etc. The analysis of the results indicate that both approaches have been found attractive by the users, but for different reasons, and led to the identification of a number of features that positively affected the experience and have been considered important by the participants.

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Enhanced navigation and natural interaction for virtual heritage using a 3D game engine

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Abstract

Videogames have been one important field of application of Computer Graphics since their very beginning and, from more than a decade ago, they have fostered the advance of graphic hardware more than any other computer related technology.

By means of the use of modern graphic cards, one can display three dimensional environments in real time with unprecedented realism. Simulations of virtual spaces and digital buildings now have a quality reserved to frame-by-frame animations just a few years ago.

Nowadays, game engines are becoming popular as a mean to develop high-end, real time presentations of virtual environments not necessarily related to the game industry. Many examples of their use in the field of architectural and urban visualization can be found, and therefore, virtual reconstruction of historical heritage using game engines has been the logical next step in the direction of their use in Virtual Archaeology. The videogame industry itself has been a great motivator for developers of virtual reconstructions with the release of games such as Assassin's Creed, which show astonishing reconstructions of full cities such as Rome in the Renaissance or Acre in the time of the Crusades.

Professional 3D videogame engines such as Unreal Engine, Unity3D or CryEngine provide the author of visual simulations with very powerful tools to develop interactive presentations of a 3D environment, including:

- Complex shaders for extreme realism in the appearance of the materials
- A character system, both in first and third person view to control the player/user interaction within the environment
- An input system that can deal with all sort of control devices, from mice to gamepads, touchscreens and depth cameras (such as the Kinect system)
- A programming environment specially designed to produce exploratory and interactive experiences
- High resolution display for a wide variety of device configurations, from monitors to smartphones, including HMD's such as Oculus Rift.

Many interesting examples can be found today. They create visual recreations of archaeological reconstructions using videogame engines being mainly centred in achieving a high visual quality, while offering the possibility to walk through the virtual recreation and the capability to interact in different ways with the virtual replica, from the display of metadata to the activation of mechanisms and simulation of phenomena. (1,2,3,46)

Nevertheless, until today, little attention has been given to the study of the walkthrough itself, crucial for the ease of exploration of the environment; in fact, the movement of a game character in a virtual space is far away from the manner in which human explore the built space. The general approach to a character movement (being it an avatar or simply a first person camera) consist in letting the user move forward or stop and turn, and rotate the camera view in any desired direction with movements that are often impossible to achieve by a human neck.

This paper describes the work being done by the authors to develop and implement a new way to navigate inside virtual architectural environments such as those used in the field of Virtual Archaeology. The approach will be based on the study of human movement inside real buildings trying to mimic the human attention process. It will be implemented on a computer aided navigation system to help visitors of virtual reconstructions walk through 3D environments in a way more related to human movement than the usual navigation paradigms.

In most part of the literature related to human exploration of the environment two concepts stand out: *navigation* and *wayfinding*, being the first a type of the latter. Although they are sometimes used indistinctively due to the fact that the cognitive, behavioural and neuronal processes are similar, there are important differences between them (7). Navigation is more related to the use of reference points, landmarks and even other aids such as maps. The importance of such reference points comes from visual, cognitive or structural factors (8) and its presence is crucial to attract the interest of the user to any given direction.

On a given environment, the analysis of the presence of those key elements in a zone surrounding the user, can be used to model the amount of attention that the area that contains every single element may arise from the user. Any environment may have elements that are worth to be observed to some degree. The designer of the virtual experience can enrich the virtual environment by identifying the objects, places, spaces, etc. that make the visit interesting, especially considering that in many cases, the user does not know where to go or what to look for when he or she enters the virtual place for the first time.

This identification can be done in a way invisible to the user. We have implemented this by designing an element that can be placed anywhere in the virtual model called *attractor*. This element is defined by several parameters that include interest, range of attraction, decay and other variables that describe the willingness to look at it based on the distance to the user and direction in the scene relative to the character's sight direction.

The presence of several attractors in the viewable area surrounding the user can be weighted using models from the field of Psychology of Perception such as the one proposed by Lewin (9) that defines a *hodologic* space (the space surrounding the user that contains zones that push or pull his or her attention based on personal interest related to each one). In Lewin's model every area has a valence that quantifies the attractive effect to the user. The resultant of all forces of attraction describes the final intention of the subject to point his or her attention to a particular direction. Nevertheless, Lewin did not describe a particular method to calculate the valence nor did he explain a procedure to weight the attracting forces.

We are actually researching in a formulation to reproduce this effect, obtaining interesting results by turning the continuous Lewin's space into a discrete one, populated with attractors with given interests, and considering every attractor as generator of a field of attractive force, being the geometry of this field a function that involves distance, direction relative to user's sight and two values of willingness for distance and angle described earlier. Then, a vector of attention of this attractor is defined, being the valence the value of its module.

The centre of attention is then calculated as a centre of force, and will be used to drive smoothly the user sight toward it when no turning input is detected. By placing attractors in every interesting point, the movement of the user can be controlled by the system based on the characteristics of field of attention that surrounds the user in every moment. Interest of atractores can decay with exposure to the user contemplation.

The effect of using the system is that when the user releases the control of the turn and limits to input when to go forward and when to stop, the system will lead his or her view to the most interesting point of its surroundings. By pressing forward, the system will take him or her toward that point. The centre of attention is being recalculated every frame considering the change in location and orientation of the user.

Since the user can always retake the full control of the input, and move as he or she wills, every situation in the virtual model is different, since every location and view direction provokes a different suggestion of what to look at.
The system is implemented as an autonomous agent inside the character representing the user in the game environment. This agent subtly modifies the view and movement direction based on the presence of attracting elements in the scene. The user is aware of this intrusion, which only takes place under his or her consent during the simulation, taking place only when the input system does not detect any action from the human.
By placing attractors and calibrating them adequately, it is possible to design walkthrough experiences suited for different kind of users based in their particular interests.
The system is implemented on the Unreal Engine 4 game engine as a toolkit for designers of virtual environments. In this working environment, any 3D model can be imported, so the designer can place attractors to influence the way that the model has to be travelled.
For demonstration purposes, the system is being tested on a model of a 4th century roman villa made as a virtual installation for an interpretation centre. The system is combined with a Kinect2 depth camera to get the input from the user from slight movements of his or her arms. The combination of natural interaction an enhanced navigation using the procedure described here makes the walkthrough on this model extremely easy and intuitive. This is a must considering that the visitor of the exhibition is expected to drive the virtual travel with zero previous training.

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Cultural and Educational Mediation meets multimedia-based adaptive storytelling - A profile-sensitive system for personalized presentations

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Abstract
In this article we present the advanced stage of a project already introduced at VAMCT 2013. The work was also funded by the 3DMOOC project, a project within the framework of "Cominlabs" of the European University of Brittany (UEB: http://goo.gl/SynPWn)
The aim of this work is to develop a system able to support multiple cultural and educational mediations, built up mainly using 2D and 3D granular video units; but multimedia resources of different format (as images, texts, sound recordings, etc.) can also be used. The general purpose of such resources is to support presentations (for instance, different types of courses, exhibitions, expositions...) that fit multiple profiles of recipients. These recipient-focused virtual presentations may be applicable to almost any topic, whether it is artistic, scientific, technical or even commercial.
The project recognize two kernel practices and therefore two main user categories: the mediation tutor (who sets up a mediation strategy or proposal; typically, a curator, a professor, etc.) and the mediation addressee (who takes benefit of the mediation activity, by receiving what the mediation tutor proposes; typically, a visitor, a spectator, a student, etc.). The mediation in question takes the form of a presentation, through a dedicated storytelling. An important innovation of the project is the concept of "elementary grain", which is the fundamental mediation-oriented unit. Cornerstone of the intended storytelling, a grain presents an indivisible narrative autonomy. By the combination of "grains" the system allows the construction of a compositional narrative structure, which supports various mediation rhetorics. Technically speaking, the grain is actually the smallest content that can be found in a database of resources, available for any user found in the position of a presentation creator. It is a short, atomic but reusable unit, interchangeable, manageable, depending on user's presentation target. "Grains" can be reshaped and assembled in many ways, almost endlessly. However, the project focuses on the customization of these grains and gives to the user specific benchmarks for organizing the whole content.
Indeed, such marks are given by an edition tool, which facilitates the building of a presentation (as a combination of grains). This is done through two steps. Firstly, the system gives a set of functionalities for the construction of a "matrix of grains", according to a knowledge organization that classifies the grains by means of:

- a list of points of view (each point of view proposes an (ontologically) different analysis of the topic engaged in the grain)
- a list of depth levels (levels allow the gradual discovery of the resources proposed, depending on the degree of difficulty or refinement of their

content) and/or a list of thematic variations (different treatments, in different versions, of the same theme).

The matrix is somehow the conceptual framework on which rely presentations; it stands as the back-office of the system as far as the creation is concerned. The system supports an arbitrary number of such matrices that are flexible and accept various reconfigurations (it is possible to define as many viewpoints and levels/versions as one wishes, to edit parts, etc.). In each cell of such a matrix, the designer of the matrix slips a "grain" (a video or an image or a text, etc.) that is upstream indexed by type, name and domain. When the matrix is completed, it enables to create a set of presentations freely tuned according different profiles of and objectives.

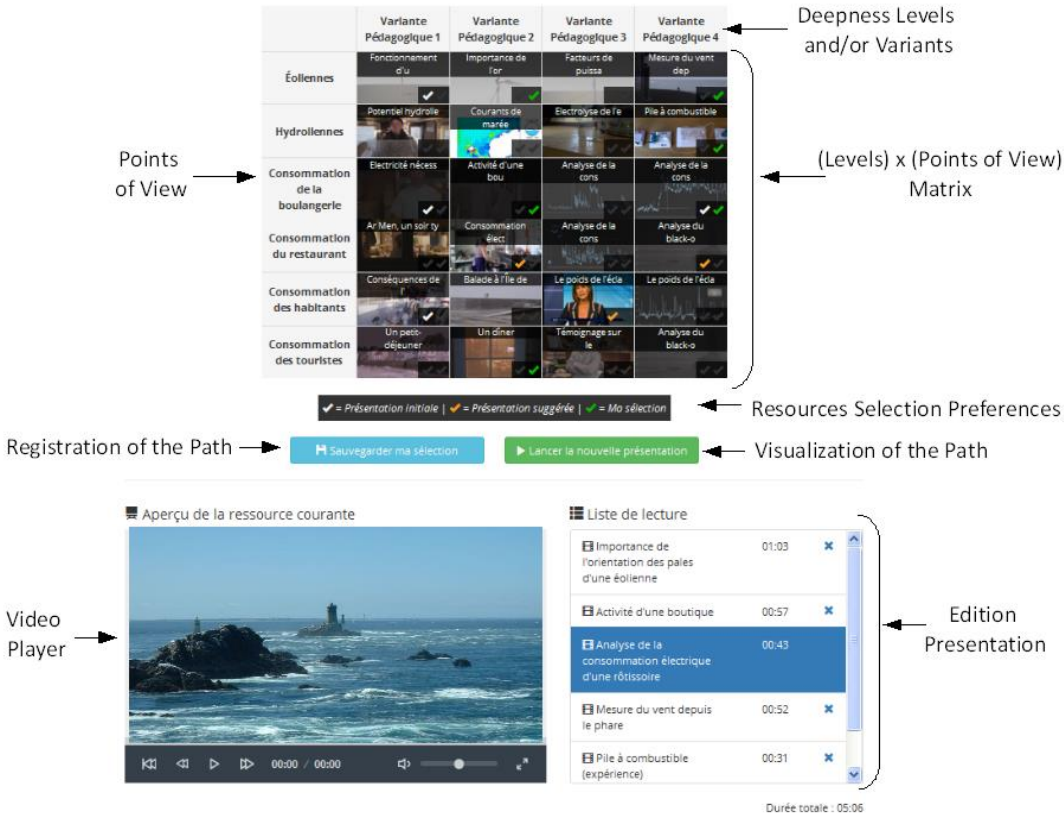

Fig 1. Matrix setting up

Secondly, the user establishes the final presentation on the interface level (front-office). While doing a presentation, the user remains within the framework of the matrix defined in the back-office. (S)he chooses the grains/resources of interest for her/him and sets up incrementally her/his own presentation (possibly reajusting their order). Moreover, (s)he can import a new resource (not already existing in the library) and integrate it in her/his presentation. (S)he can even create and share her/his work in a purpose-built space, common with other users.

The mediation addressee (i.e. the presentation recipient) is not reduced so some passive spectator. A specific completion algorithm is implemented allowing her/him to refine or to extend an initial presentation adjusting it to her/his needs. The contextual complements are generated by points of view, on the basis of what the user has already viewed. The purpose is to provide rational support to the user so that (s)he could complete actively, gradually

and consistently her/his reading path. The major challenge is to point out the aspects that the user could miss during the presentation, by redirecting its attention and interest towards these aspects. Another advantage is to help the user to target, accurately and rather quickly, the contents (s)he considers relevant (or just interesting) for her/him.

The user must have the possibility to seek grains through the library. In order to satisfy this need, the system design provides an internal search module. The logic of the search engine is designed as a correspondence between the user search categories and the internal organization of knowledge (local ontologies corresponding to the considered points of view) so that her/his search is fully optimized. Indeed, the whole system is rooted on a specific knowledge structure. To model a domain, a dedicated module allows the creation and editing of knowledge structures underlying any content organization. Furthermore, the system allows the definition of attributes and relationships between elements of the structure. These structures are the basis of the indexing procedure and give grounds to the search module. Generally, each resource is indexed by type (video, text, audio, image), by name, by point of view and by level of analysis and/or variant. This ensures internal consistency and promotes the adaptability of the system, in terms of architecture, layout and content.

In the current development phase, the library contains resources from several fields: architecture, painting, geology and environment. The application example that we present here concerns a scientific and a cultural mediations, addressing presentations for two kinds of museums or courses, etc. In the first case, we target the subject of energy transition, a crucial subject in various scientific presentations; in the second case, we are concerned by an pictural case, the Judith and Holofernes theme. Given the difficulty of access to the meaning complexity of such subjects, these subjects lend theirselves well to an individual and intelligent assistance to users.

An interpretative argument gives evidence to our approach. The project goal is to stimulate users' motivation and foster their interpretative skills in the study, observation or exploration of a work, an object or a theme. In fact, the developed device facilitates mediation by allowing adaptations of levels of explanation, the analysis categories and topics addressed, so that each user can enjoy an authentic and personalized experience. It can be used both in a school setting (primary, college, high school or university) and in a broader cultural context such as museums, libraries or any cultural institution that deals with the mediation. Moreover, it can be used as an adaptive extension for SPOCs (Small Private Online Courses) and even for MOOCs, upgrading them to 2.0 forms, i.e. rendering them able to integrate reusable social contributions, symetrising the roles of tutor and student, by their ability to moulded and shaped by the user.

Acknowledgement

Particular thanks to Cominlabs for financial support of the study.

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Implementing QR code in museums and archaeological sites

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Abstract
This paper is intended to showcase that QR code can be use as a tool in order to provoke and inspire visitors to participate in a powerful way of finding enrich content and make exhibits and displays more interactive by using current technology. A QR code is abbreviated from Quick Response code and it's basically a type of barcode (funny-looking square bar codes) that when scanned with your smartphone or tablet it can launch a webpage, pulling up videos, images, and other additional multi-media content. Over the past year, QR codes are easy to generate through any number of sites on the internet and have moved into mainstream marketing, appeared in entertainment and advertising, but also have even attracted the interest of museum's curators. Most mobile phones have QR code reader applications available.

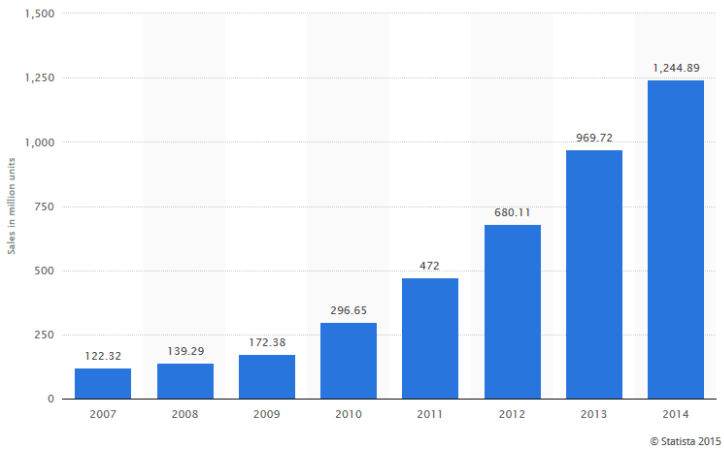

Fig 1. Numbers of smartphones sold to end users worldwide from 2007 to 2014 (in million units)

Implementing QR codes in museums and archaeological sites is an engaging motive for the visitors to take action, because when they recognize a QR code as something to be deciphered, they take out the smartphone or tablet and scan the barcode in order to discover what lies behind. A QR code may be printed on a sheet of paper or a sticker and it can be installed on or next to the object/building labels of museums and archaeological sites.

Object/building labels in museums and archaeological sites, unlike websites, have limited space and often have no pictures or graphics about the artifacts or the sites, so being able to direct visitors to further information with a QR code has clear benefits. The most useful ways that you can use a QR code in museums and archaeological sites are:

- to link on a website, where visitors would have the opportunity to view more information about the exhibition (
- to link directly on a video that would explain the story of the artifact or the story of an excavation (storytelling) (
- to link on a photo gallery where you can look behind the scenes material (
- to use it as part of an interactive game for children (
- to automatically download an app that it would be useful for the visitors (
- to link on a tour guide where you can listen audios tracks about the artifacts or view a (map about the interesting spots of a heritage site (
- to inform visitors about up coming events (
- to link on a social media page (facebook, twitter) in order to take feedback and hear (what your visitors want. (

As long as the QR code directs the visitor to an interactive and relevant web page, this should ensure the success of the undertaking. Moreover, this presentation explores various case studies of how museums around the world have begun to use the QR code technology, with the idea on enhancing the visitor experience, by providing interesting and relevant information in an exciting, convenient media. Although not everyone has a smart phone or a tablet, but this is likely to change as time progresses, QR code can offer opportunities to broaden visitor engagement and provide additional information in museums and archaeological sites.

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SESSION 6 – VIRTUAL ARCHAEOLOGY, MUSEUMS AND THE NEW NARRATIVES

Session Chair: Susan Bergeron (Coastal Carolina University, USA)

Virtual Agora: Representation of an Ancient Greek Agora in Virtual Worlds using Biologically-inspired Motivational Agents

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Abstract
Populating virtual worlds with computer-controlled characters is a key issue in virtual heritage applications, an argument that can also be held as valid for the majority of virtual world applications. Virtual heritage worlds usually tend to be either devoid of people, or include computer-controlled virtual characters that function as animated props, demonstrating pre-scripted and repetitive behaviour [1]. In more advanced approaches, computer-controlled characters in special roles, such as virtual guides, may also be situated in the virtual world.
The principal interest of virtual heritage application developers is usually achieving high visual quality and architectural fidelity of the digitally revived site of interest. However, visual realism is just one of several important factors for an experience that allows users to immerse themselves in the environment. In fact, as has been discussed by Mori in the form of the infamous "uncanny valley" argument [2], a high, but not perfect degree of visual realism can even function in a negative way in regards to its acceptance from the user, as it creates higher expectations in all aspects of its behaviour, including its motion, the way of expression but mostly the coherence of its decisions and actions given the context it belongs to.
Recent virtual heritage reconstruction works seem to acknowledge the necessity of incorporating non-human controlled characters (more widely known as virtual agents - VAs), that include intelligence in order to enhance presence and provide the user with an engaging experience [6]. Arguments against introducing VAs in virtual heritage applications have been expressed [3], although the objections stated mainly relate to the lack of intelligence and limited interactions that can be supported by characters of low sophistication.
A key issue for the development of intelligent, believable VAs for virtual world applications is the incorporation of affective features [4] and elements of autonomy [5]. As has been argued by [5], VAs developed as autonomous agents, in the sense that they possess their own set of goals rather than merely following a set of given instructions, maintain the capacity to demonstrate purposeful behaviour and continue acting whereas a pre-scripted character would exhaust its repertoire of behaviours, resulting in

repetitive sequences of actions or purposeless trivial behaviour, reducing itself to an animated prop. This is of particular importance in persistent open virtual worlds, where the user is allowed to freely explore and is not limited to specific pathways, while also the world continues to exist even after the user exits. In order to achieve autonomy, VAs need a mechanism to select their own goals, that is, a motivational subsystem that drives the agent towards particular courses of action, aimed towards satisfying its self-interests.

This paper presents the design and development of Virtual Agora, a virtual heritage application in the Open Simulator environment aiming to replicate daily life in an ancient Greek agora using biologically-inspired motivational agents. The application follows a multi-layered motivational model for VAs that includes biological, as well as psychosocial needs. Every agent possesses a set of basic attributes that relate to its biological and physical characteristics, as well as its personality. Following a needs hierarchy, needs arising at the lowest motivational level are assigned greater priority than needs on a higher level, therefore the corresponding goals are queued first for satisfaction. Need priority is also determined by the intensity of each corresponding motivation, as well as an internal priority index corresponding to the relative urgency of needs within the same level.

At the lowest level, a biologically inspired model monitors and regulates the VAs thirst, hunger, hygiene and sleep needs based on the value of corresponding reserve variables. When the value of a reserve variable moves outside a defined comfort zone, a corresponding need rises, activating a behaviour that aims to satisfy the particular need.

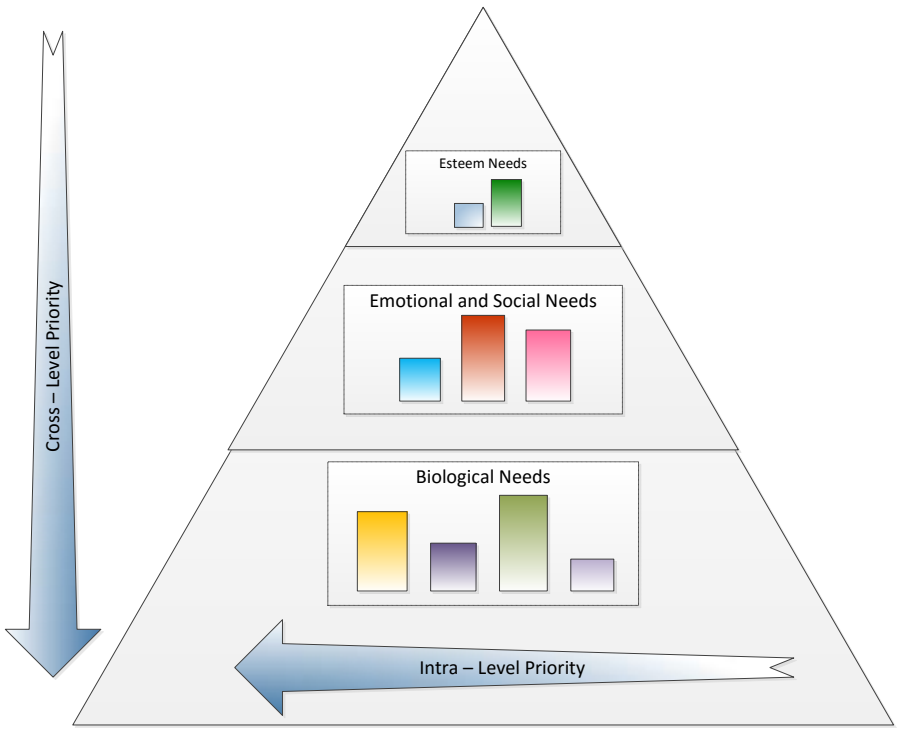

Fig 1. Motivational Hierarchy in Virtual Agora

Every VA is endowed with a set of behaviours that satisfy particular goals and consist of a sequence of actions towards achieving this goal. In addition to this generic action set, every VA possesses an extra set of actions, based on its assignment of a role or profession. The available agent roles of Virtual Agora are shown in table 1. The roles and the respective behaviours have been designed and selected based on available resources regarding life in the ancient agora of classical Athens.

Table I. Professions and common behaviours of Virtual Agents

Profession	***Sub-role***	**Profession Behaviours**	**Common behaviours**	**Actions**
Priest		Perform offering Perform libation	Acquire offering Visit temple Offer item Request libation ritual Buy item Satisfy hunger Satisfy thirst Satisfy hygiene Rest	pick up item drop item put on table/put in place give item to other agent take item from other agent eat drink wash sit sleep
Craftsman	Metalworker	Gather materials Craft item Sell item		
	Basket weaver			
	Potter			
Food Vendor		Gather food/wine Sell food/wine		
Citizen				

All citizens, craftsmen and commoners alike, have a need of spirituality. When this spirituality need exceeds a predefined threshold, dependent on the agent's personality, the agent initiates the "preform_religious_duty" behaviour, which causes the agent to first cleanse itself by visiting the fountain and then visit a shrine or a temple. At a shrine, the agent can satisfy the spirituality need by kneeling and praying to the god the shrine is devoted to. At the temple, in addition to praying, the agent can also interact with the priest and worship the god either by offering wine and requesting a libation or by giving the priest a votive offering, such as food, pottery or a metal ornament, to be acquired at the corresponding vendor or craftsman.

A Craftsman's typical behaviour is working, to be interrupted when some biological need or their spirituality need has risen. Working involves the use of a raw material (clay, metal or straw), to be processed into pottery, ornament or basket. These items are then put on display, to be sold to prospective clients.

A food vendor has a gathering behaviour, picking fruit from nearby trees as well as a selling behaviour, selling fruit to clients. The food vendor also sells wine to interested clients, stored in small size amphorae. Food and wine purchased by the food vendor can either be used as an offering in the temple, or directly consumed by the virtual agent, to satisfy its hunger or thirst.

The Virtual Agora application is an interactive edutainment environment for observing and learning about life in ancient Greece. Out of the multitude of buildings typically contained in a classical ancient Greek agora, it was

decided that a Temple, a shrine, craftsmen workshops, a food vendor's stand and a fountain would be included, to be potentially enriched by additional buildings in future work. In the current implementation visitors can walk around the environment observing daily activities performed by the Virtual Agents and interact with them by asking questions about aspects of their profession. Future development will include exploratory learning activities through quests that involve interaction with the characters and objects of the environment.

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The 'Virtual Museum': Digitizing the Cultural Heritage of the Sculpture Collection Housed in the "Theodoros Papayiannis" Museum of Contemporary Art, Elliniko Ioanninon (Municipality of Northern Tzoumerka)

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Abstract

This paper discusses the concept of a 'virtual museum' with a particular focus on:

a) the cultural heritage conservation of the sculpture collection housed in the 'Theodoros Papagiannis' Museum of Contemporary Art, located in the Helliniko village of Ioannina (The Municipality of Northern Tzoumerka), and
b) the outdoor sculpture collection which is displayed en route from the entrance of the Helliniko village, continuing towards the 'Theodoros Papagiannis' Museum, and ending at the Byzantine Monastery of Tsouka.

The project is financed by the 'John S. Latsis Public Benefit Foundation' and its purpose is to create a 'virtual museum' that provides visitors a virtual tour of the indoor and outdoor exhibits using primary digital materials, more specifically images, audio recordings in addition to interactive digital maps,

360° tours and educational applications. The virtual museum's key features will showcase and document the collections for educational purposes. It will be accessible via the Internet so as to make it appealing to the general public both in Greece and abroad.

Human Animatronics in Museum Experience: *Casa Parlante - The Living Museum*, Corfu, Greece

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Abstract
This paper presents a museum based on human animatronics, as well as relevant research results based on a visitor study on the impact of the animatronics in visitors' museum experiences. The museum under study is the *Casa Parlante - A Living Museum* in Corfu, Greece, established in March 2014. *Casa Parlante* is housed in a 19th century Corfiot cosmopolitan aristocratic residence, which attempts to revive everyday life of the island's 19th century upper class by employing animated human models, using robotic technology and accurate reproductions of the décor and domestic furnishing. This paper presents the first visitors' study conducted on this museum.

Fig 1. The logo and entrance of the *Casa Parlante - A Living Museum* in Corfu, Greece

Our paper is presented in four parts. Part 1 discusses the notion of the modern museum, which focuses on visitors' experiences. Part 2 refers to the use and the impact of animatronics in museum exhibitions. Parts 3 and 4 present the *Casa Parlante* museum, its exhibition and animatronics as well as our research on visitors' experience.

In the first part of this paper we discuss the inclusive role and the challenges of the 21st-century museum with emphasis on visitors' experience [1]. Modern museums have shifted from object-oriented to interactive exhibitions and care to operate both for their visitors and for the wider society in where they operate. Museums have encouraged visitors' and society's participation [2] and used new and innovative technologies in their exhibitions, including the use of robots (animatronics). A Modern museums should aim to attract visitors and offer beneficial and holistic experiences [3].

In the second part of this paper we discuss animatronics in museum exhibitions. Animatronics (animation electronics) are life-like robots that resemble to people or animals. The term is attributed to the whole process of creating and handling robotic models. Animatronics usually have motion and in advanced versions they are equipped with extra features beyond movement. They are mostly used in film and in entertainment or educational environments, such as museums. Animatronics are constantly evolving and comprise particularly interesting applications of new technologies in museum exhibitions.

The emergence of animatronics numbers several years of presence. It is based on the fact that people have always been fascinated by supernatural beings that could move themselves and things. Such examples include an ancient Indian legend about mechanical elephants that could move as well as statues of the ancient Egyptian gods equipped with moving arms. Priests hidden in the statues during religious ceremonies triggered the mechanisms, in order for the arms to move and provide the impression that statues were activated by gods [4].

Contemporary museums are attracted to animatronics. The latter have become an interesting and useful option for museums. Science museums choose to use animatronics as effective means to exhibit scientific methods and principles, such as rules of physics or the function of the human body. Natural history museums use animatronics to liven animals, with dinosaurs being the most frequent choice [5]. A good example is the London Natural History Museum with its The era of dinosaurs exhibition in 2011 [6]. In Greece, animatronics in museum exhibitions are virtually nonexistent. In fact, the only one known is the *Casa Parlante* museum, discussed in this paper, which is why it is the only museum that has chosen to include animatronics as part of its main exhibition.

In the third part of our paper we present the *Casa Parlante* museum and its animatronics-based exhibition. *Casa Parlante* was established as a museum in March 2014. It is housed in the Old Town of Corfu, which is listed in the UNESCO World Heritage List [7]. "Casa parlante" in Italian means the "speaking house". The house / museum is located in the center of the Old Town of Corfu, on Nikiforou Theotoki St., one of the most crowded and historical streets. The *Casa Parlante* is a typical Corfiot mansion of the period 1814-1864. At this period, the Ionian Islands were under British protection and favorably treated, since Corfu Town was the capital of the newly established state of the United States of Ionian Islands. Corfiot mansion houses of the era differ remarkably from other comparable houses in the in Greece, because of the influences that Corfu had from its Venetian, French and English history. The museum exhibition unfolds inside the building where the everyday life of a typical noble 19th-century Corfiot family is represented by nine animated human figures (animatronics), smells and sounds of that era, and a guide that accompanies visitors, presents the exhibition, offers drinks and sweets, and answers questions. The museum aims to guide visitors in the past by offering a unique and holistic experience, involving human senses other than sight, such

as hearing, smell and taste. The museum won the Greek Entrepreneurship Award 2013 and it is at the top of the TripAdvisor list for Corfu since its opening.

Fig.2. Animatronics in the *Casa Parlante - A Living Museum* in Corfu, Greece

The last part of our paper presents a visitors' study we conducted on this museum and consists of a research-based discussion on visitors' experience at this unique and special museum. Our visitors' study has been the first visitors' study on the *Casa Parlante* museum and it was focused on the presence, the impact and the contribution of animatronics to visitors' experiences. Through interviews, focus group discussions and questionnaires, we evaluated this impact. Issues that have arisen refer to exhibition impact and educational results, as well as visitors' involvement, impressions and feedback.

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Developing Emotions: Perceptions of Emotional Responses in Museum Visitors

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Abstract

From recent studies within the cultural and heritage sector, it is apparent that the role of emotion in terms of learning, experience and customer satisfaction is strongly represented.[1] Emotions are key to understanding customer satisfaction.[2] The growing trend towards customer orientation means that museums need to address their features and objects directly to the individual. However, the question arises as to whether both sides of this exchange are operating on the same assumptions and expectations.

In theory, by engaging in this dialogue, the visitor is presented with a more personalised experience, and an experience that is ultimately more satisfying.[3] Much of these improved experiences are linked to ideas of interaction – and this includes interactions at both an intellectual and emotional level. It is this emotional engagement that is subject to increased interest.[4] This can be created through immersive scenarios, or the application of technology to the viewing experience. Passive reception of information is not longer viewed in the same light, and there is a desire to avoid such situations wherever possible.[5]

The idea that museums are in the 'experience business' is well established.[3] By improving such experiences, the museum adds value for the visitor. The interest between visitors and museums indicates that audiences want to feel connections between themselves and the environment they are experiencing. These connections take the form of both intellectual and emotional experiences. Emphasis is placed more heavily on positive emotions and emotional experiences.[6] However, the question remains as to how people will connection emotionally.[7] It is apparent that differences in opinion, background and experience in visitors will generate different, and potentially unanticipated, responses; nor does every visitor wish to engage emotionally.[8] However, initial observations based on survey data suggest that certain emotional responses are common regardless of visitor context.[17]

However, most responses within the contexts discussed here are described as 'natural, unprompted and unexpected'.[3] There is a fear that visitor experiences can become artificially scripted, with the organisation guiding and shaping how audiences view and respond to the scenarios and material presented at an unnatural level. Manipulation, indifference and overstimulation are recognised as potential problems when developing new spaces.[1][3] If museums go too far with their development of collections, are we at risk of alienating visitors, or potentially introducing the risk of a wholly passive experience?

Data has indicated that specific emotions are prominent from visitor surveys, notably interest, curiosity and excitement.[18] However, questions arise when we consider how emotions relate to exhibition and display development. Do emotions play a significant role in how these are created? Are museums specifically targeting certain emotional responses?

The study (to be conducted during Summer 2015)[19] will approach the role of emotions in museums from the practitioners' perspective, with reference to visitor data provided from the meSch project. Interviews will be conducted

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[17] Personal communication with the meSch project. Resources / data will be made available in the near future for the forthcoming study.

[18] Personal communication, observation based on previous meSch surveys.

[19] The study forms the basis for my dissertation for the completion of the MSc in Library and Information Studies, Department of Computing and Information Science, University of Strathclyde.

with museum staff and hypotheses developed from this information. This qualitative data will then be compared with visitor surveys in order to highlight similarities or differences.

By determining if there is correlation between the emotional approaches of the museum and the visitor, we can develop models for exhibition development that could, in effect, counteract the issues mentioned above. This tailoring effect would reduce the risks of indifference and overstimulation, improving the visitors' overall experience. For the museum itself, it would move the process away from fears of manipulation by responding directly to visitors' needs and desires.

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Architectural Heritage Communication: Using Social Networking Tools to Promote Modern and Contemporary Monuments

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Abstract

The Internet and especially the social network are used in order to communicate cultural activities and programmes, so that the public can become acquainted with cultural goods and also be encouraged to exchange views and cultivate a dialogue on cultural issues. The Internet environment provides a remarkable number and variety of cultural updates along with the opportunity to have a beneficial communication [1].

The promotion of cultural heritage on the Internet uses all the means possible: more commonly, articles of the electronic press concerning cultural events are shared through social networking sites, as well as cultural subjects discussed on blogs or Facebook accounts [2]. In those cases there is a gradation depending on the significance of the users' activity, since some of them are more dynamic (they produce information, they criticize the articles

they share and shape certain ways of thinking), while others consume information participating less.

A brief tour on the Greek online cultural material shows that all periods of art and culture are represented on the net, although not equally. If we accept the tripartite division of Greek history into ancient, medieval/Byzantine and modern, we shall find out that information relating to the classical period is numerically more. The numerical superiority does not necessarily imply a scientific basis or the verification of the sources of the printed information. It shows, however, the Internet users' increased interest on that period of history and civilization. For example, the Facebook page "Ancient Greek Civilization – Arhaia Hellas" (Ancient Greece) has more than 47.000 friends, both Greeks and foreigners.

The e-groups that are centred on discussion forums about the Byzantine era and civilization do not gather so many friends. In many cases the shared information and the style of the posts do not make it clear whether the administrators' and participants' main interest is scientific or religious. However, this separation proves to be false, since, regardless the participants' initial motivation, namely their scientific or religious orientation, it is important that at the same group all participants can find the information that interests and expresses them.

The web pages that focus on modern and contemporary civilization have a special importance. Without reflecting national ideologies, as some of the groups about classical heritage do, or any religious sentiments, like some of the Byzantine civilization groups have, blogs and Facebook pages aiming at the research and documentation of neoclassical and modern style buildings attract friends who are interested in architecture, structured and natural environment, as well as modern heritage management.

The social network groups that are interested in neoclassical and modern monuments differ from the other groups with cultural interests in an additional element. According to the law, the 19th and 20th century architecture, namely the buildings dating from the Treaty for Greek independence in 1830, are protected by the State when they are recognized as important architectural monuments and their protection and maintenance costs are borne by the owner. So, there is much discussion about developing a private initiative for the preservation of these buildings. Therefore, the Internet pages about neoclassical and modern architecture invite their friends to take action or at least participate in interesting discussions on ways of protecting and managing architectural heritage.

The aim of this paper is to present the significance of online communication to the development of activism in order to protect and maintain 19th and 20th century buildings. Therefore, the paper will focus on the social networking contribution to the promotion of modern and contemporary architectural heritage. In this framework, it will be important to answer the following questions:

- Under which conditions the different social media pages and websites manage the modern and contemporary architectural capital?

- What is the nature of the posts and the degree of their scientificity?
- Are there any specific proposals following the posts?
- How interactive is each social networking group?
- What is the profile of the participants in groups discussing architecture?
- Is their involvement with cultural maintenance defined by the possibilities and limitations of the communication media?

In order to answer these questions and taking into consideration the wide range of information and the variety of actions concerning the monuments, different approaches to the architectural heritage of Athens were chosen to be examined. Athenian architecture was chosen, since a large majority of social networking groups about neoclassical and modern architectural heritage is dedicated to buildings in Athens. As a case study, the posts of five blogs and social media groups will be examined; some are created by private initiative ("Athens through time", "atenistas", "MOnuMENTA") and others by the public body ("Service of Modern Monuments and Technical Works of Attica, Eastern Sterea Ellada and Cyclades" and "Directorate of Protection and Restoration of Modern and Contemporary Monuments").

- "Athens through time": The Facebook page posts photographs and videos of Athenian buildings, as well as photos of people working at traditional occupations or having fun during leisure time at the end of the 19th and at the beginning of 20th century. During the five years of posting pictures and videos, this Facebook page has attracted more than 38.900 internet friends. However, the variety of the subjects posted seems to disorientate a clear aim of the page. On the other hand, this flexibility encourages some of the participants to seek for relevant online material and take part in the dialogue. Moreover, it appears that the administrator's researches are appreciated by the group.
- "atenistas – Athenians in action": The group has a website and a page on Facebook, through which it communicates its activities. The website was created as an "open community of citizens of Athens, who love their city and consider that Athens is … a field of inventive and effective actions that we make us realize the potential of improving and promoting the city". The aim is clear, the character of the group is dynamic, social media are used for a call for action. Although the group is not systematically involved with the history of architectural structures or heritage conservation issues, activities as tours to historical sites and neoclassical monuments show a special interest. The group offers a digital tour guide to the Athenian neighbourhoods preserving late 19th and early 20th century architecture.
- "MOnuMENTA": MOnuMENTA is a non-profit organization having as main purposes the research, documentation, preservation protection, promotion and management of natural and architectural heritage in Greece and Cyprus. Moreover, the organization aims at the information and raising of public awareness in order to protect cultural heritage. The website confirms the scientific objectives by posting articles about modern and contemporary architecture written by

architects, art historians, archaeologists, historians and other scientists. The Facebook page informs about the organization's actions and communicates the electronic press articles or blog posts on architectural heritage. Although more than 4.800 people like the page, the posts do not seem to inspire commenting and dialogue is not cultivated.

- "Service of Modern Monuments and Technical Works of Attica …": The Service of the Ministry of Culture protects modern and contemporary monuments in Attica and nearby areas. The Facebook page informs about the activities of the Service, such as workshops or presentations and moreover, it publishes photographs of the buildings and areas protected. The Servise also posts articles about restoration methodology and discusses scientific issues. However, the posts have no temporal regularity and sometimes there are no posts for several months. Therefore, the Service has not managed to develop a dialogue on maintaining and promoting architectural heritage.
- - "Directorate of Protection and Restoration of Modern and Contemporary Monuments": The Directorate of the Ministry of Culture is responsible for the protection and restoration of monuments dating from 1830. The Facebook page informs the public about the Directorate's activities, the educational programmes and the presentations in conferences. The number of the online friends went sky-high when the Directorate launched the "Monument of the Week" in November 2014. This activity presents to the public a monument of 19th and 20th century architecture each Monday. According to the Directorate, the creation of a Facebook account has the purpose to communicate the value of protecting the monuments and the environment and to encourage the exchange of views and the promotion of dialogue on architecture, restoration and cultural management. The regularity of the posts, as well as the connection of the monument presented with the timeliness or the historical events that had occurred during the week each monument was posted, contributed to the success of the action. Despite the growing number of online friends, comments are still limited and the goal of developing a dialogue between the Directorate and its friends has not yet been achieved.

In conclusion, there are several sites, blogs, pages and groups on Facebook regarding the promotion of modern architectural heritage. Social networking groups show the public's interest for the 19th and 20th century architecture, and can also propose specific actions for their protection and their management. The Internet communication process has changed the traditional character of cultural activities; participants achieve an interactive communication on architectural issues and promote the culture of taking action and taking responsibility for the protection of cultural heritage.

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Interaction Design for Archaeological Content: from Edutainment to Serious Games

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Abstract

This research targets the scientific area of interaction design for archaeological content. Our previous work has shown that we can develop multiple interactive scenarios using the same information markers and triggers [1],[2]. In this work we particularly focus on the design of edutainment and serious games applications [3],[4]. We present a framework, which can simplify the game-design process, enabling direct identification of the desired content aspects, which have to be communicated to the user. In other words, the process aids content experts (archaeologists in this case) to identify and easily select the desired gamification characteristics of the content, enabling developers to focus their interaction design methodologies on specific content presentation requirements. This process is complemented with interaction design research relating to important issues such as game complexity, interactivity, multimedia content use, storytelling and overall game aesthetics, while multiple game modes are addressed: from single-player to multiplayer and score-based applications. Ultimately, the use of state-of-the-art hardware is addressed, where we discuss the adaptability of interactive content in order to cover multiple platforms, particularly when user-based hardware is employed in order to cover the presentation requirements and provide a unified and solid game experience.

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SESSION 7 – SCIENCE AND ART IN VAMCT

Session Chair: Ioannis Liritzis (University of the Aegean, Greece)

Pikrolimni Lake as a natron source in Glassmaking Technology

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Abstract
In studies of ancient glassmaking it is of great importance the possibility to distinguish the origin of glass raw materials i.e. west Asian glass raw materials from those from Mediterranean areas. An approach concerns the origin of the source of soda that was used, which is one of the three basic components of glass. In particular two main sources of soda were existed: Natron (Na_2CO_3) and halophyte ash. The archaeological glass findings in Greece from Archaic, Classical and Hellenistic times are all made of natron [8]. It has been suggested [6] that the lake Chalastra is the modern lake Pikrolimni based mainly on the Pliny's reference, as glass products were abundant in Macedonia during his period. Pikrolimni is a saline lake that is characterized by alkaline brines, 20 km to the NW of the town of Thessaloniki, in the region of Macedonia, in Northern Greece. Spa and mud bath installations also exist.
In order to investigate whether or not Pikrolimni Lake could reflect a natron source as raw material in glassmaking technology fresh water, spring water and samples of brine and salts from the lake itself were collected. Also samples were taken from the thermal spa of Pikrolimni (which is located at the banks of Lake Pikrolimni with depth approximately 250 m). The sampling took place in different seasons (2002, 2003, 2004, 2005, 2006 and 2007), twice during a year (winter and summer), covering sufficiently the surrounding area of the lake. Samples were subjected to chemical analysis according to standard analytical methods [1]. Samples were also subjected to isotopic analysis of $\delta^{18}O$, δD and $\delta^{13}C$ (CITD). The $\delta^{18}O$ compositions of water were determined from CO_2 equilibrated with water [5]. The δD compositions of water were determined from H_2 generated by the Zn-reduction method [2]. Measurements of the isotopes in water ($\delta^{18}O$ and δD) were made at the Stable Isotope Unit, National Centre for Scientific Research "Demokritos", Athens, Greece on a Thermo Scientific Delta V Plus mass spectrometer and at the laboratory of Isotope Hydrology and Geochemistry, University of Paris, Orsay, France. The results for $\delta^{18}O$, δD, $\delta^{13}C$ are expressed in the conventional notation: as δ‰ differences from Standard Mean Ocean Water (SMOW) for ^{18}O and for ^{2}H; and from PDB (Peedee Belemnite) for $\delta^{13}C$. The error for $\delta^{18}O$, $\delta^{13}C$ and δD is 0.2‰, 0.2‰ and 2‰ respectively.
Conclusions drawn from the geochemical analysis result that Lake Pikrolimni is a saline lake and it is characterized by alkaline brine, poor in Ca^{2+} and Mg^{2+}

(Figure 1). The dilute HCO_3^- spring fresh water (<0.2 g/L dissolved solid) evolves into alkaline Na–Cl (CO_3^{2-} SO_4^{2-}) brine (>350 g/L dissolved solid). The dominated factors of brines formation are high solute concentration due to solar evaporation of water, mineral precipitation, fractional dissolution and solute recycling. The extensive evaporated conditions and the progressive concentration of brines in alkaline lakes lead to hydrogeochemical environment capable to provide "nitrum chalestricum" (trona) with a preferential precipitation of sodium carbonate followed by sulfates and chlorides. This conclusion comes in agreement with the results. Also, the mineralogical analysis (X-Ray Diffraction of salts), the evaporation simulation and the thermodynamic model showed that salts of trona, burkeite and halite, deposit from these brines. So, the conditions that are responsible for the formation of soda seem to be present in the basin and confirm Pliny's description.

The $\delta^{18}O$- δD relationship with the global meteoric water line (GMWL) [3], the local meteoric water line (LWML) [4] the domain of seawater (Standard Mean Ocean Water) and the Magadi brines [7] were plotted in Fig. 2. The isotopic data for the samples that collected from boreholes and springs around the Pikrolimni Lake ranged from -7.9 to -10‰ for $\delta^{18}O$ values (vs SMOW) and from -52.4 to -67.9‰ for δD values (Fig. 2). Borehole water samples do not exhibit any notable variability in their isotopic compositions, suggesting a homogenous groundwater aquifer feeding the boreholes. Moreover in Fig 2 are grouped very close to that of mean meteoric water, confirming its purely meteoric water composition. The correlation equation between $\delta^{18}O$ and δD values for these samples was $\delta D=1.66+7.19\delta^{18}O$. A regression equation similar to the above is reported for the springs of Macedonia ($\delta D=2.2+6.73\pm0.43\delta^{18}O$; [4]). The δD and $\delta^{18}O$ contents of all water samples of Lake Pikrolimni lie to the right of this meteoric line (Fig. 2) with a regression equation: $\delta D=4.74\ \delta^{18}O$ - 13.38. The isotopic data indicate, as expected, the evaporative sequence evolution of the lake water during time, leading to the isotopic enrichment from winter to summer. Through this procedure brines with notable $\delta^{18}O$ and δD enrichment are produced as well as salts like Na-carbonate-bicarbonate minerals, Na-sulfate and Na-Chloride minerals. The circulation of seasons results the completely dilution of brines and the recycling of the earlier salts, reflecting most probably a past climatic event by the new meteoric water fills the lake. This sequence of events may have been taking place for a period of hundreds to thousands of years. A satisfactory correlation exists between the chloride contents and the $\delta^{18}O$ until Cl concentration reaches the value of 10 g/L. After that, the evaporation alone cannot account for the parallel increase of $\delta^{18}O$ (and $\delta^{2}H$) and chloride concentration. When the loss of water by evaporation is very important, the $\delta^{18}O$ value, in the diagram $\delta^{18}O$ *versus* Cl, is almost stable (Fig. 3).

The $\delta^{13}C$ was equal to -6.5‰ for mantle component, and for both crustal components is 0‰ for limestone and -30‰ for sedimentary organic carbon (vs. VPDB) [9]. The data of the sample collected, excluding a significant contribution of fluids originating from organic-rich sediments, indicate a

mixing of the mantle, in very small percentage, with crustal components (carbonate), suggesting that silicate mineral hydrolysis is driven by injection of deep CO_2. Hence, the deep CO_2 plays a role in driving the chemical evolution of waters in Pikrolimni water aquifer, as indicated by the geochemical investigation.

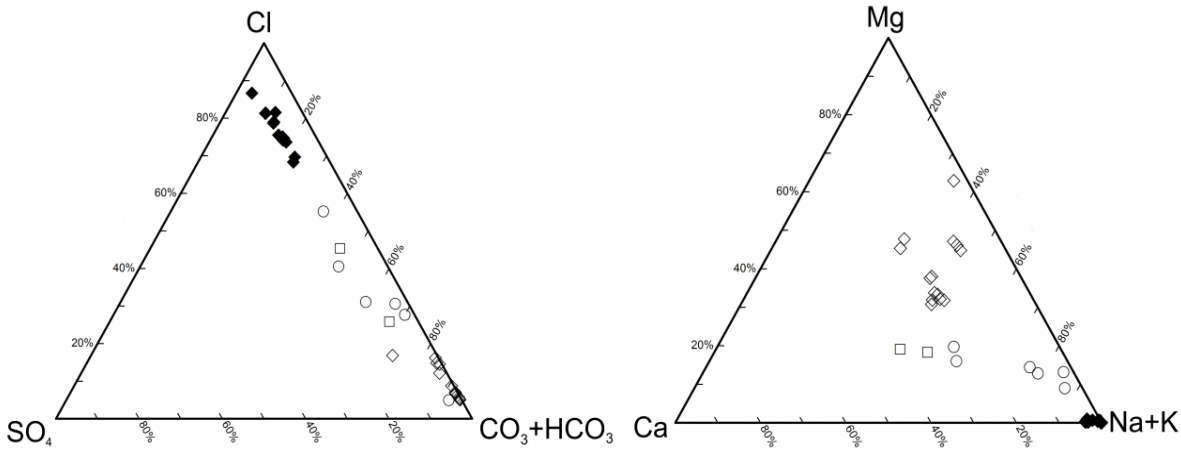

Fig.1. Ternary diagrams of water samples from Pikrolimni area. White diamonds: Mg–HCO_3 groundwaters; white circles: Na–HCO_3 groundwaters; white squares: Ca-HCO_3 groundwaters; black diamonds: Pikrolimni Lake brines.

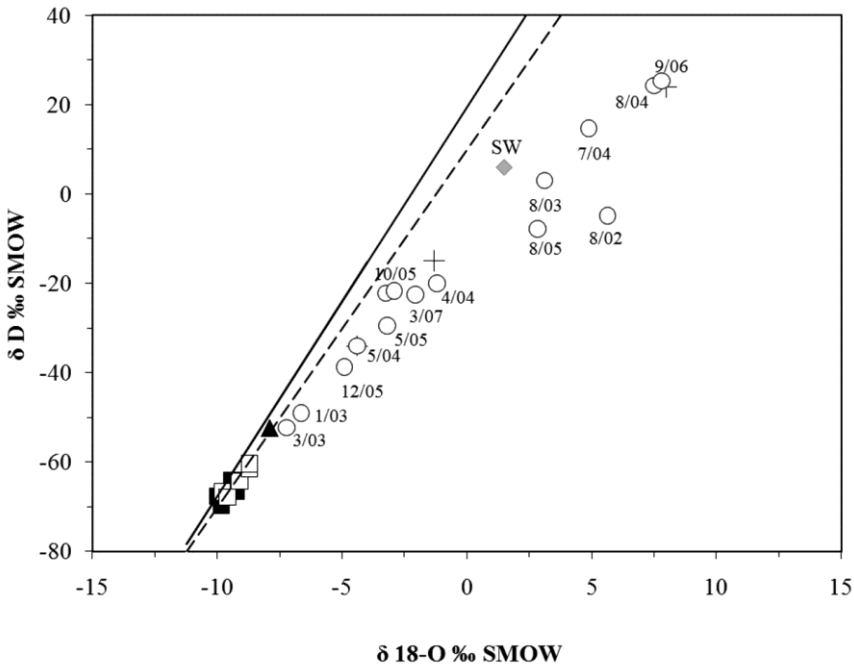

Fig.2. Isotopic data of the study waters. Blank squares: Borehole waters. Black squares: groundwaters. Crosses: Lake Magadi water. Grey diamond: Seawater. Black triangle: spring water PL source 7/07. Blank circles: Pikrolimni Lake. Solid line: Local Meteoric Water Line δD = 8.7 δ18O + 19.5 [4]. Dashed -line: Global Meteoric Water Line δD = 8 δ18O + 10 [3]

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Stable isotopes as part of restoration research for historical monuments and buildings

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Abstract
Historical buildings and monuments constitute an important chapter in the cultural heritage. However they are exposed to a range of deterioration mechanisms: hydrogen carbonate crust, salts crystallization, erosion of mortars, capillary rising moisture and soluble salts, organic corrosion, with atmospheric conditions to govern their development [3, 7, 8, 10, 13]. Therefore there is a need to secure historical monuments against these mechanisms retaining their archaeological value. In that basis the restoration interventions should follow the principles of authenticity, compatibility, reversibility [11] in order not to disturb the authentic physicochemical, mechanical and architectural signature of historical monuments. Through the study of historical mortars two main types of rehabilitation mortar were arisen depending on the nature of the binder: aerial and hydraulic mortars. The first type is controlled by carbonate reaction between $Ca(OH)_2$ and atmospheric CO_2 producing $CaCO_3$ (calcite matrix) which is responsible for chemical and mechanical characteristics of mortars. Regarding the second type the addition of water, except that favors the fluidity of the paste, interferes to chemical reactions with the activation of alumino-silicate compounds (in the raw materials) and the formation of hydrated compounds giving the mortar some different properties to those obtained in the case of aerial mortars. Intending to suggest restoration mortars consistent to the aforementioned requirements two different compositions were prepared corresponding two both mortar types. The first type for aerial mortars concerns lime, natural (volcanic ash) and technical pozzolan (finely ground ceramics) in the binder as well as quartz sand and crushed bricks as aggregates. The binder/aggregates ratio established as 1/3 reflecting the proportions of historical mortars while lime/pozzolan ratio defined as 1/2 considering a satisfactory reaction between lime and pozzolan in order to achieve adequate hydraulic characteristics in mortars [8]. The hydraulic type

designed exactly as the aerial except that the lime was replaced by hydraulic lime. In both compositions polypropylene fiber was added to control capillary cracks («cracking») during drying and temperature variations [5]. The materials for the preparation of mortars were mixed with mechanical mixing. Aggregates and binder mixing first conducted and then water was added to the designed quantity, until the mixture becomes homogeneous. The consistency of mortar was checked by flow table based on EN1015-3 [1]. Mortars were casted in metallic prismatic moulds of 40x40x160mm and they were left to cure for 24 hours. Then they submitted to standard conditions of 95% RH and 20± 1°C T°C for 28 days where on to 29th day the stored at 20 ± 1°C and 65 ± 5% RH in a climatic chamber. Their development tested at intervals of 3, 6 and 9 months maturation. The microstructure of the specimens was tested by X-ray diffraction (XRD) and SEM/EDX and methods. Compositional and micromorphological analysis resulted that both types of mortars were mainly characterized by calcite ($CaCO_3$) and to a much lesser extent by portlandite [$Ca(OH)_2$] gradually until ninth month indicating the sufficiently evolution of carbonation reaction. Moreover the pozzolanic reaction was more evident to hydraulic lime mortar as more amorphous phases were detectable. This observation was consistence with mechanical strength measurements as performed according to EN 1015-11 (1999) [2]. The mechanical strength developed faster in hydraulic mortars (flexural strength in third month 1.4Mpa) enhanced by C-S-H and C-A-H active hydrated phases than in aerial (flexural strength in third month 1.0Mpa) where carbonation reaction only involved. In both mortar types recorded satisfaction strengths with their flexural strength values to reach 1.7Mpa and 1.9Mpa in ninth moth of maturation, for aerial and hydraulic mortars respectively. However as it has already been mentioned atmospheric conditions (ambient temperatures and atmospheric CO_2) control the formation of calcite [8]. So, some specimens exposed to high humidity environment trying to identify the way that calcite matrix is affected. As chemical analysis presents limited ability to detect different origin of carbon stable isotope techniques were used to address this question [4]. Therefore, in order to get into the environmental conditions of calcite formation the $\delta^{13}C_{matrix}$ and $\delta^{18}O_{matrix}$ were determined. The isotopic analyses took place in the Stable Isotope Unit of Institute of Nanoscience and Nanotechnology (NCSR Demokritos) where $^{13}C/^{12}C$ and $^{18}O/^{16}O$ ratios were expressed as $\delta^{13}C$‰ and $\delta^{18}O$‰ relative to the international PDB standard. $\delta^{13}C$‰ and $\delta^{18}O$‰ values for lime mortars were ranged from -19.6‰ to -13.8‰ and from -18.7‰ to -15.1‰ respectively while for hydraulic lime mortars ranged from -18.3‰ to -13.9‰ and from -19.1‰ to -15.2‰ respectively (Fig. 1). Samples that plotted along the area between 1A and 1B lines correspond to the "healthy" samples because their isotopic change of the initial $\delta^{13}C$ and $\delta^{18}O$ values of carbonate matrix is attributed to the continuous calcite formation as carbonation reaction is a mechanism that progresses very slowly [12]. However a deviation to more negative $\delta^{18}O$ values is observed indicating dissolution processes/re-deposition on the surface layers of the material. Recrystallization of calcite was performed by

the participation of biogenic CO_2 through secondary (recrystallization) water balance with atmospheric CO_2, indicating extensive damage by moisture and biological factors [4].

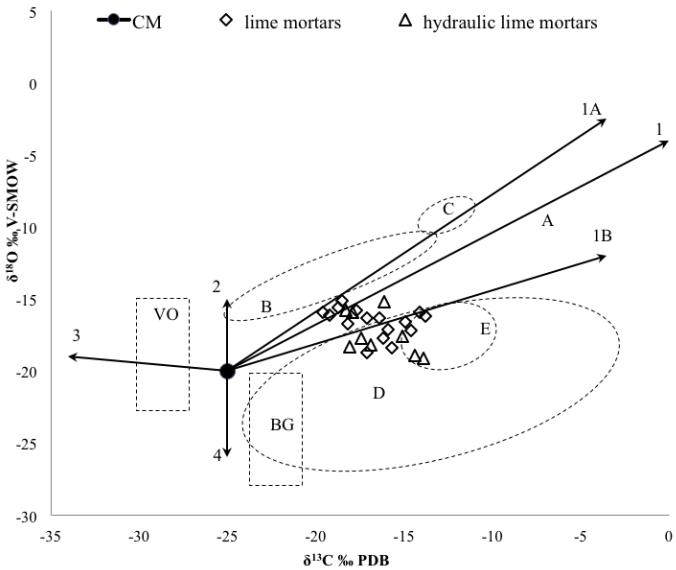

Fig.1. Schematic diagram [2][4] of exogenic processes causing changes in δ13C and δ18O of calcite of lime mortar. CM precipitated calcite formed directly by the absorption of atmospheric CO2 in strong alkaline aqueous environment; area A precipitated calcite formed from atmospheric CO2 and contaminated by residual natural limestone, line 1 the primary source of water used for setting of the lime mortar is coming from heavy source, evaporation effect, area B precipitated calcite formed from atmospheric CO2 and heavy, evaporated water; area C: enrichment of δ18O of calcite due to the reequilibrium with the silicate minerals; line 2 the primary source of water used for setting of the lime mortar is coming from light source, condensation effect; area D precipitated calcite formed from atmospheric CO2 and isotopically light local meteoric water or isotopically light re-condensed primary water, line 3 depletion of C and O isotopes indicating recrystallisation of calcite with light water and CO2 of mixed origin (atmospheric and soil origin), area E depletion of C and O isotopes, indicating also human influence (surface treatment) and biological growth; Lines 1A and 1B: deviation from line 2 due to relicts of local limestone used for burning or contamination by limestone aggregate; VO vegetable oil (oil painting), BG biological growth

Acknowledgments

This research is part of the project entitled "Development of new resistant pozzolanic mortars with crushed ceramics and nanomaterials for the restoration of historical monuments and buildings" of the act "Support of New Enterprises for Research & Technological Development" funded by the General Secretariat for Research and Technology.

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Street Art: The alchemy of turning city walls to museum paintings

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Abstract
The purpose of this paper is to discuss the cultural phenomenon of street art, the art on walls, of public spaces, the art left outside private collections and museums. Street art is informal, it addresses everyone - not just the elite, and usually it is not commissioned.
Street art developed from graffiti and constitutes one of the main tendencies of urban art. Due to its association with urban space street art can be examined through the methodology of social sciences and be understood as social practice, as resistance to the mainstream or to any form of authority. Following this concept one might wonder whether street art is just the evolution of a social phenomenon or the parallel expression of it, is it art of social character and objective or social behaviour sprinkled with artistic elements? A cultural approach which unites the methodology of social sciences as well as a mondus operandi borrowed by the history of art will help investigate this question.
The most common question regarding street art is 'who owns it?'. The artist rarely does. According to law, graffiti and street art are considered acts of vandalism excluding the cases that it has been commissioned. Being afraid of prosecution artists do not claim their creations, which results to the ambiguous legal status of street art. Scholarship considers street art as a negative space of intellectual property that is unprotected by law. Without claiming ownership, street artists cannot even claim the protection and preservation of their creations. The unique character and legal situation of street art leads as to another question of vital importance:
Can street art be moved to museums? From a legal point of view, the owner of the surface the creation is on is the one who decides about it. Without the

artist claiming his rights on the artwork, the owner of the surface can sell or even destroy it. Street artists accept the precarious character of their work as well as the very danger of its destruction. They consciously choose this ephemeral type of art. Nevertheless, selling or moving, in general, street art to a museum negates the role and its purpose or social dimension. Public space is a sine qua non of street art, it is imbued with essence by the surroundings and especially the surface on which it is created. Unlike religious art, moving street art to a museum with just a historic/subject reference leaves it out of context. Arguably collectors and museums trying to stay in touch with the contemporary cultural movements are embracing street art by recognizing its artistic value through its exposition and acquisition. Need for preservation and danger of destruction play also a very important role regarding the consideration of the subject.
In order to support these arguments case studies of street art murals located in the city of Athens will be examined, discussed and put into context.

Photogrammetric Automation: Is it worth?

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Abstract
Nowadays museums are definitely going virtual ([1], [2]). This fact means that two dimensional or indeed three-dimensional digitization of artifacts is an emerging necessity. For many decades photogrammetrists were developing methods and techniques for the 3D digitization of objects, including in the cultural heritage domain ([3], [4]). This development was decisively enhanced after the fusion of computer vision and photogrammetric scientific fields, which started in the late 80's. This led to the possibilities to include 3D visualizations in virtual environments, like virtual tours, virtual museums serious games applications etc.
In this process, the need for fast, low cost 3D digitization and effective visualization of large number of artifacts is ever increasing. Consequently the use of terrestrial laser scanners boomed during the past 15-20 years. However, these instruments were expensive, bulky and very often not suitable for the job. One needed a multitude of such devices in order to be able to confront all possible applications. The alternative, which emerged during the recent years supported by the increase in computing power, is the automated implementation of classic photogrammetric algorithms. This development provided interested parties with a rather cheaper, faster and perhaps more reliable solution to the problem.
This paper focuses exactly on this last point, i.e. how accurate and reliable are the products of these automated algorithms and how efficient they are for providing the necessary 3D material for the virtual environments.
For the three dimensional documentation of an object, large or small, the acquisition or production of a point cloud is necessary. Preferably this point cloud should also include colour, i.e. texture, information. The most common

way to acquire such a point cloud is by means of a terrestrial laser scanner. These instruments are in essence active sensors and do not necessarily record texture information with the position of the points. The alternative is image-based techniques. These are algorithms that process a sequence of digital images with large overlap and produce point clouds, which also convey texture information extracted from the images.

These algorithms are known as Structure-from-Motion (SfM) algorithms and they actually determine a large number of points on the images, find their correspondences and thus reconstruct the object imaged and align the images, i.e. the bundles of rays. These processes are actually the classic photogrammetric processes, which combine overlapping images in order to allow for stereoscopic imaging and -usually manual- 3D reconstruction of the objects imaged in the overlapping part. The photogrammetric processing of a sequence of images is known as photo triangulation in the photogrammetric community. The development of these automated algorithms has been greatly boosted by the relevant computer vision algorithms, such as interest operators, feature detection, matching etc.

This automation has made the 3D reconstruction widely available and popular, as implementing photogrammetry has always been a complicated action. This "democratization", however, has been escorted with a lot of skepticism, as the masses were

not able to control the results and evaluate them in terms of accuracy and reliability. Hence questions arose as to whether these algorithms are producing usable and efficient 3D reconstructions.

The implementation of this innovative approach became very popular also in the field of Cultural Heritage. Non-specialists found a way to easily produce 3D reconstructions just by taking a few images. However, this fact led to debatable results, as a lot of ambiguities are lurking hidden in the happiness of automation. In order to prove this argument several implementation examples are briefly presented. They make use both of commercial SfM software and open source solutions.

The error sources hidden in the implementation of these automated algorithms are many and diverse. Camera geometry is often overlooked and leads to unpredictable deformations. Although most of the available software provide for a camera calibration module, it is often not good enough to model the camera. Image quality is another source of ambiguities. Especially when compact cameras are used and the pixel size on the digital sensor is small, the algorithm may fail, or may lead to erroneous correspondences and unreliable reconstructions. Moreover the network geometry plays an important role for the final result. Images should be taken in a well-planned sequence in order to assist the algorithm to produce a complete reconstruction. Finally the ground control should also be carefully selected and introduced. This will give the desired scale and perhaps position to the 3D reconstruction, which most often is decisive for the quality of the final product. Al the above error sources and their effects are presented and discussed in detail.

It becomes obvious that the necessity arises to evaluate the performance of these algorithms in terms of reliability and accuracy. In the relevant literature, few reports can be found on that subject ([3], [5], [6], [7], [8]).
In order to assess the metric performance of these algorithms an innovative metric evaluation strategy has been designed. A very accurately measured test field, set up for camera calibrations, was used as an object of ground truth. It was imaged with two different digital cameras and the two sets of images were processed separately. The resulting 3D reconstructions were compared to the known values of the targets of the test field. The resulting differences have been statistically examined in order to draw conclusions as to the metric performance of the algorithm. In this case the commercial software Photoscan by Agisoft was used, which implements the SfM algorithm. In addition it provides to the user with certain tools in order to enhance the processing of the image sequences. The results of this thorough evaluation are presented in detail and conclusions are drawn for the metric abilities of the algorithm.
It was established that the accuracy of the resulting 3D reconstruction depends on the spatial analysis and general quality of the original digital images, on the careful selection of the parameters provided by the software, the properties of the object itself and the computing power available.

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POSTER SESSION

Towards a unified cultural and educational portal prototype for museums and exhibitions

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Abstract
Technological innovations have rapidly increased over the recent years as well as e-learning usage and thus museums have increased e-learning investment in order to adapt their services in a better and more efficient way for their visitors. While museums offer a diverse range of personal digital collections systems on their websites it seems likely that a small but important core of visitors find such facilities extremely worthwhile [1]. The majority of online museum visitors understand the role of the website in encouraging this relationship, and are interested in developing a complementary relationship with the museums and museum websites they visit [2]. The purpose of this paper is to present a portal prototype, which combines educational applications, blog, advanced search options, a forum and social integration and can be adapted to various museums as an integrated solution in favor of online visitors.
Most Greek Museum web sites, such as the *National Archaeological Museum*[20] and the *Archaeological Museum of Thessaloniki*[21], offer limited functionalities to their online visitors, as there is an obvious lack of online applications and interoperability. Museums choose to create activities for visitors with physical presence and especially for children, though few museums offer online applications with interaction, like the *Acropolis Museum*[22]. Another point that should be mentioned is that museums do not empower online visitors to search in their databases for exhibits, which do not appear in their web site. Finally, the interoperability with Europeana is available in a limited number of Greek museums [3]. Europeana is an EU funded database, which provides access to authenticated, reliable metadata records from more than two thousand cultural heritage institutions across Europe, made available through the mediation of a large number of national and thematic aggregators [4]. As can be perceived, there is a need for the creation of a universal system that would combine knowledge, creativity, education and socialization, and also support interoperability with the Europeana database.

[20] *National Archaeological Museum at http://www.namuseum.gr/index-en.html*
[21] *Archaeological Museum of Thessaloniki at http://www.amth.gr*
[22] *Acropolis Museum at http://www.theacropolismuseum.gr*

Seeking the components that satisfy the requirements of the specialized portal and allow functionalities to meet the design criteria, we propose a general portal structure as shown in Fig. 1. In particular, the overall schema consists of the representative attributes of *"Portal Core"*, which includes *general information*, *user management*, *forum*, *applications*, *social integration*, *search tools* and the *blog*. "General information" includes all necessary information for the purpose of the portal along with basic information about the project partners or the museum. The "Blog" hosts published articles of general or special interest that are written by the administrators and authorised users of the portal. "User Management" includes the user support functionalities, providing opportunities for registration and editing of user profile information; in addition, here, one registered user may find the scores and achievements in the educational games. The "Forum" is a typical place for exchanging views that supports group discussions among members of the portal, providing opportunities for team building discussions and general social engagement. The basic structure of the portal includes the "Social Integration" functionality, which connects the portal with Social Media Networks, including a Facebook page, a Twitter account and a channel on YouTube and also a set of sharing options for pages, articles or applications in social media. An advanced feature offered by the portal is the search functionality in articles and museum data, which is divided into *"Search in Portal"* and *"Advanced Search"*. "Search in Portal" searches within the data of the portal, while the "Advanced Search" returns search results by querying the central system database (which is a prototype CIDOC+LOM composition including educational and cultural data), the web (through Google) and Europeana. This functionality is supported in a standardized manner, offered through a web service that sends and returns data in the form of JSON (or JavaScript Object Notation) and runs continuously in the background. JSON is a programming language model data interchange format and as a minimal, textual, and a subset of JavaScript [5] so it could be used in every database. The last component is "Applications", which includes web-based educational games, a virtual museum and other experimental educational activities, which may vary depending on the purpose of the portal.

On the lines connecting the Portal components there are parts that are labeled by *"User"*, as shown in Fig.1. This label indicates that the corresponding components are available only to authenticated users. This is necessary, as the corresponding functionalities should either identify the user, such as the forum, the scores, the educational games.

A case study of this prototype was utilised in *Synthesis Project Portal*[23], which is a comprehensive portal that was designed and developed to meet the

[23] *'Synthesis' project homepage at* http://synthesis.ceti.gr

needs of digital visitors of the *Theocharakis Foundation*[24] in a way that *game meets education*. In particular, the *Applications* in Synthesis Portal consist of a virtual museum of the Theocharakis Foundation, educational web based games such as "Tour in the works of Papaloukas", mobile 3D educational game and on line courses in Geometry, Geography, Physics, Chemistry, and foreign language (French), based purely on museum material. The project includes a complete *social integration* with presence in Google+, YouTube, Facebook and Twitter. The portal is multi-language and supports Greek, English and French.

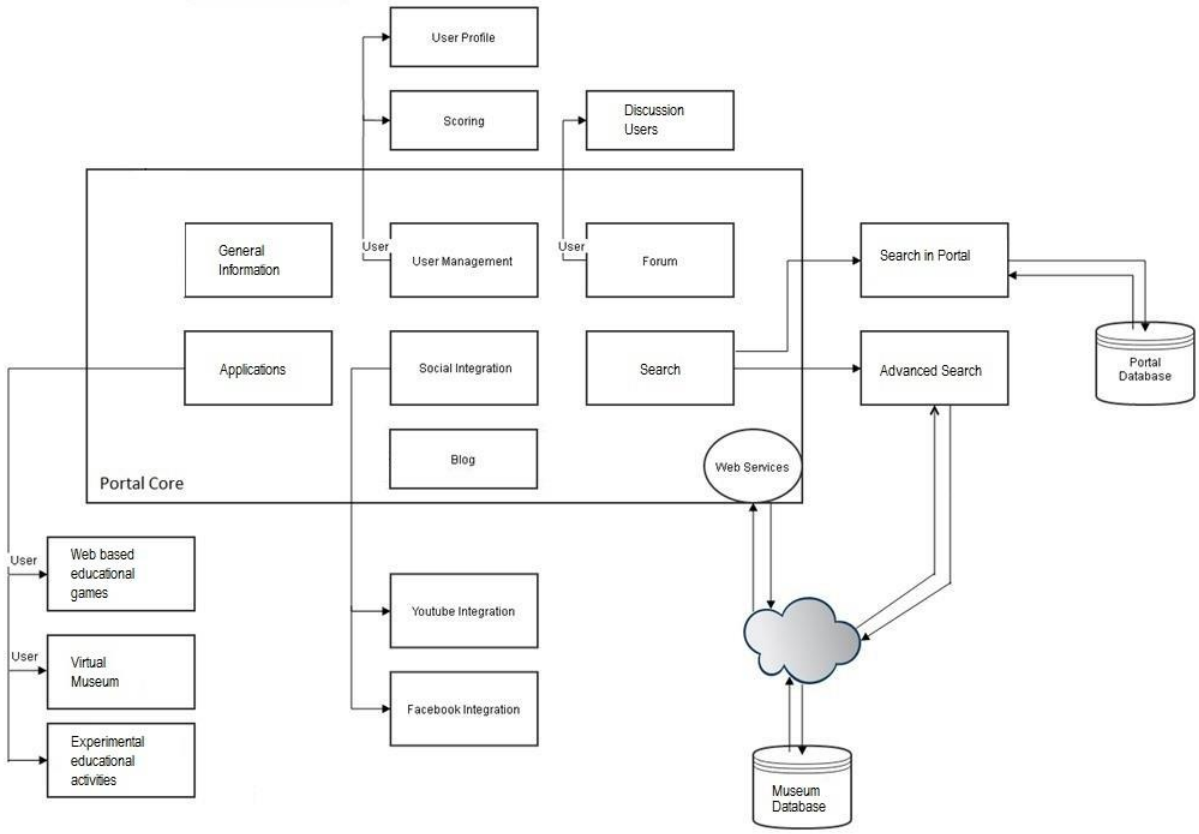

Fig 3. Portal structure

Acknowledgements

This work was supported by the Action 'Synthesis of Ideas, Forms and Tools for Cultural and Artistic Education' financed by the Ministry of Education & Religious Affairs, Greece, under the framework 'Education and Lifelong Learning', co-financed by the European Social Fund.

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The Plundering of Archaeological Artefacts and Sites from Turkey by British and German Imperial Diggers in the 19th Century

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Abstract
In the second half of the 19.th century, the expanding cultural colonialism and exploitation by European, especially by the British and German empires have very negative effects also on the archaeological sites of Turkey, the country, which has been already named and mentioned by Europeans as Turkey ever since.
The pseudo counterfeits and madly interests of royal leaders from the British and German Empires towards the archaeological items of Aegean Countries, mainly of Greece and Turkey were so terribly increased, that they had forced to their pioneers to dig and bring historically very important artefacts to their capitals in spite of plundering and damaging in the archaeological sites of Turkey by every harmful and illegal means very drastically.
Well known Charles Thomas Newton, John Turtle Wood, Carl Humann and Heinrich Schliemann had been used by imperialist royalties as pioneers for exploitations and smugglings of historical items from archaeological sites and remains belonging to Turkey.
Charles Thomas Newton, who had been sent by the Government of British Empire in the year 1856 as a spy and diplomat to the Ottoman country side named Turkey, was used as vanguard for illegal diggings and takings away of archaeological items from one of the seven wonders of the World, famous Mausoleum and from St. Peter castle in the Carian Capital City of Halicarnassos and from other ancient cities, such as Constantinople, Knidos, Stratonicea etc. in Turkey.
John Turtle Wood, who was a railway engineer in Selcuk town of Izmir, Turkey, had plundered the ancient sites of Ephusus City, including the items of the ancient World wonder, the Temple of Artemis.
A German engineer and businessman, Carl Humann, whose grave is now in the ancient site of Pergamum, had stolen the historical items, including the marble fragments of Zeus Altar from Pergamum City of Turkey.
German, US American and honorary Russian citizen, Heinrich Schliemann had damaged the archaeological sites of Troy with so called Schliemann Trenches

very badly, where from, he and his Greek wife Sophia had stolen 8800 pieces of historical items from Turkey for the favour of German Emperor, for which he had been punished by Greek and Turkish Courts.

In this paper presentation we want to discuss these and similar illicit cases and the conditions of the diggings and stealings from archaeological sites of Turkey and Greece to start and take a collaborative worldwide action to bring the cases, if necessary to UNESCO, to WAC and into international courts, for the return of the stolen archaeological items back to their original places to Turkey and Greece.

International Symposium on VIRTUAL ARCHAEOLOGY Museums & Cultural Tourism

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