VIRTUAL ENVIRONMENTS AND TECHNOLOGICAL SOLUTIONS FOR AN ENRICHED VIEWING OF HISTORIC AND ARCHAEOLOGICAL CONTEXTS

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Abstract
Specialist studies and researches related to historic-archaeological contexts are usually not properly disseminated. This vast academic literature rarely corresponds to a certain awareness of the importance of those results among the public. In many cases, peculiar features of cultural heritage are totally misknown, causing a relevant loss in terms of economic exploitation if not the abandonment of the heritage itself to oblivion. This phenomenon commonly happens in many archaeological areas all over the world, where a misleading perception of the importance of ancient architectonic spaces is inspired by the scanty conditions of the ruins, as poorness of remains could be synonymous of poorness of data.
Several research groups interested in those issues have achieved methods and technologies aimed to obtain products able to contain problems of scarce knowledge and to allow tourists of being more involved during the visits. In this paper, the experiences gained in a decade of research, undertaken by the ITLab (Information Technologies Lab, CNR IBAM), aimed to study, valorisation, promotion and use of historic and archaeological contexts are elucidated. Those emerging and promising technologies that have marked a significant advance in the field of virtual archaeology will be discussed with emphasis on their potential in enhancing communication processes and edutainment.
Many of those research activities have become real products, exploited by tourists and scholars for enriching their interaction experience, with a consequent growth in terms of tourist flux and diminishement in the misknowledge of the main contexts.
Ancient Greek cities, as Metaponto, Herakleia, Siracusa, Taranto, Roman sanctuaries, Medieval and Modern monuments, have been virtually recreated of elucidated in stereoscopic videos in order to provide an alternative interpretation and for giving the emotion of a travel back in time blended with a high scientific rigor.

Virtual environments and enriched vision
The use of the term Virtual Heritage has become fairly common. Anyone concerned with cultural heritage, museums, historical and archaeological research, uses it to define innovative methodologies and technologies based on 3D digital technology used to represent, communicate and transfer diverse information about Cultural Heritage. The term Cultural Heritage defines all those material and immaterial components that make up the cultural patrimony of a particular society. This category includes tangible objects such as buildings, archaeological sites, works of human ingenuity, works of art, manuscripts, sites with special natural characteristics, sites with great scientific or anthropological value, but also immaterial heritage such as oral traditions, popular songs and artistic forms of expression that are closely tied to a cultural identity.
In order to preserve sites or ecosystems that have particular cultural or natural importance, UNESCO draws up a list every year, called the World Heritage List (FIG 01), where places and monuments that deserve special attention from institutions and the public are included.

Fig. 01: Sites of the World Heritage List

In the early Nineties, the phrase Virtual Reality, coined in 1989 by the IT guru Jaron Lanier, spread rapidly amongst people working in the fields of communication and scientific visualisation (FIG 02). “Seize reality through illusion” is the most convincing synthesis of what this new discipline represents in the simulation of physical processes, the interactive manipulation of machinery, and the very representation of material reality.

Fig. 02: The reconstruction of the sanctuary of Jupiter Anxur in Terracina
The birth of Virtual Reality marked a new path forward and somehow gave a new view of reality, allowing alternative ‘readings’. Soon, this new way of representation and simulation was associated with the term *Virtual environment*, used to indicate those interactive three-dimensional models that could be navigated, and that simulated a place, a building or a synthetic scheme in real time. A virtual environment doesn’t necessarily have to be a digital copy of a material object, because, as already noted, its utility is undoubtedly linked to the possibilities of introducing new ways of acquiring knowledge ([FIG 03](#)).

![ACTUAL STATE / RECONSTRUCTION](image)

**Fig. 03:** An example of direct reading of contents using mobile device. The actual state and original state related to an inaccessible house in Pompeii (Casa dei Ceii).

So a virtual environment can be created either by starting with a realistic representation of a material element that really exists, or with an abstract and schematic reconstruction. In fact, a virtual environment is like a “microscope for the mind” that allows you to elaborate amplified projections of the material world, to “look beyond” simple appearances and to make logical connections between elements grouped together. This makes it clear to what extent the world of simulation and representation have benefited from the use of *virtual environments*, especially evident in sectors such as industrial design, rapid proto-typing, augmented reality for medicine, the entertainment industry, the training of pilots and soldiers, the simulation of emergency plans, and also in all of those areas where digital simulation permits the saving of precious human resources or the execution of risky activities in safety.

For those of us who work for the promotion of Cultural Heritage, possibly the most interesting aspect is the association of *virtual environments* with a new way of learning and communication, not just dealing with the characteristics of the actual physical heritage, but above all considering the stimulus that comes from interpretation and problems of reconstruction tied to long-lost civilisations, in short, to archaeology.
The use of simulation techniques coincides with a clear attempt to reply to one of the fundamental issues of modern archaeology; how to reconstruct an ever-wider picture of ancient civilisations with the highest level of trustworthiness and likelihood possible. One of the aims of every generation of archaeologists is to study a monument in order to reconstruct it. But the input provided by the arrival of these new technologies has demonstrated how important it is to combine historical and humanistic knowledge with the enormous possibilities offered by IT, not just useful for interpreting objects and works of art, but also and above all for transmitting the knowledge acquired to a vast, heterogeneous audience, at many levels of interest and comprehension.

I believe that archaeology is enjoying a moment of great vitality and awareness on the part of a wider public, thanks also to the communicative force those new tools of communication use, with which it is possible not only to recreate shapes and materials of the past, but also to evoke details of everyday life (FIG 04).

Fig. 04: Reconstruction of a residential area of ancient Syracuse, in Greek period

The explosion on the web of virtual, thematic museums, virtual collections and galleries that all have the same desire to promote and publicise archaeological sites and monuments using Computer Vision and virtual environments, testifies to this interest. In this context, the 3D image is no longer just a pure iconic representation, an artistic fantasy, but it becomes a tool for synthesis that transmits and communicates information deriving from scientific research in a graphic form, and represents the elements necessary for a correct interpretation and understanding of information with a very direct language. The integration of diverse forms of knowledge has demonstrated an ease of learning, understanding and transmission, not just applied to historical-archaeological or morphological aspects of an object, but also of technical aspects used in the hard sciences and usually represented by graphs and tables. Archeo-metric data that is essential to the reconstruction processes can be integrated within virtual scenes, giving quality to an often-misunderstood field. (FIG 05).
“The Virtual” becomes a starting point for the creation of an artificial world that enriches and decodifies the “real world”, recreating it in a 3D form suited to a simplified interpretation of the information it is designed to transmit. There is no doubt that a three-dimensional usage permits a direct reading of complex information and that many 2D representations of architectural detail or structural anomalies with notable three-dimensional development can be difficult to read, especially for non-experts.

In virtual scenarios, the 3D real-time visit can be associated with almost any media, in a single environment of use; the users can explore the 3D model from any angle, but can also activate links at any given moment that will take them theoretically to a limitless source of information. This is the start of a voyage of discovery that goes beyond simple aesthetics, where the object is no longer exposed in its purely morphological or aesthetic state but where the visit can lead to resolution and avoid the exclusive contemplation of the object in itself. This voyage leads principally to the deciphering of the specific contents of the object being studied, starting with the visible contents and concluding with the invisible ones; that corpus of information, anomalies and hidden structures that lie beneath the skin of the monument and that only artificial vision can reveal. The object, as a bearer of values, can be analysed in its mineral, petrographic, chemical and physical components, but also in its formal and artistic ones, and in its relationship with the original context. In this way, virtual space can accelerate and strengthen cognitive capacities, capable of generating ‘virtuous’ processes of extremely effective learning, based on metaphors of the real world, but easy to use and understand (FIGG 06-07).
Fig. 06: The reconstruction of ancient Metapontum sanctuary

Fig. 07: The reconstruction of Temple of Apollo in Syracuse

Virtual environment for the fruition of inaccessible contexts

Projects of promotion and digital fruition of inaccessible monuments or artefacts separated from their original context of provenance have become rather popular. The international scenario offers numerous cases of sites for which the approach is limited. On one side, there are monuments located in private properties or in problematic environments unapt to be open to the public, or sites whose state of preservation and climatic conditions are not compatible with the presence of visitors.
Figg. 08-09: Virtual platform for the distant visit of inaccessible monuments. The Hypogeum of Festoons in Taranto. The platform start from 3D model acquired by laser scanner.

On the other side, there are categories of monuments, without particular musealization issues, which due to their articulation or location have a limited accessibility level. On the other hand there are some categories of monuments that do not have particular problems of a musealization, but they are equally not easily accessible due to the not very “comfortable” location, or because their morphology makes the visit difficult. To those main groups, it can be added some monuments that for the application of certain conservation strategies, are restricted to the public. That is the case of
those contexts where the high number of visitors represents a serious threat, in particularly when is consisted over time. An emblematic example is that of archaeological sites as Herculaneum and Pompeii, where the unconscious damage daily inflicted by visitors is worse than that caused by the eruption of Vesuvius. “Save Pompeii from the damages of time and tourists” is the title of an article, published in 2009 in the New York Times in the section about art history, where the author invited Italians to do their utmost to find a solution for the damages caused by tourists to one of the most famous archaeological world heritage. What can be done to limit those damages? What can be done for the fruition of those monuments with limited accessibility? How can be properly musealized the decontextualized heritage? A viable solution is offered by certain technologies of visual computing, which try to develop communication tools to implement the experience of a visit without expecting to get the end of the debate (FIG 08-09). As abovementioned, the use of virtual environments enhances and enriches the comprehension and sometimes this approach represents the transmission of cultural messages embodying the awareness of their importance and value and not just a method to allow the visit of the sites. In the “Marta Racconta, storie virtuali di tesori nascosti” project there are three distinct levels of transmission: the interactive virtual visit of the “Hypogeum of festoons”, the non-interactive video where the hypogeum is described and contextualized and finally a series of documents where those elements necessary for the comprehension of the reconstructions are elucidated. A traditional approach of multimodal visit in which heterogeneous information are combined and presented in different ways to produce the best educational and communication impact (FIG 10).

Fig. 10: 3D reconstruction of Hypogeum of Festoons in Taranto as basis of narratives.

In the virtual visit the user can visualize the site as it is nowadays, with option of getting information about grave goods and pigments used for the frescoes. In the non-interactive video, based on the production a stereoscopic clip, monuments object under study are presented in a narrative way, where their relation with the original historical and cultural context is recreated. After a general
introduction about cult practices and funerary rituals in the Greek culture, the user is informed about the original aspect of the monuments, that is the reconstruction. The main aim of this approach is to take the user/visitor to another level of comprehension of the presented object. To comprehend means to know before understanding. Principal components of every comprehension process are essentially two: comprehension and motivation. The first a cognitive component and corresponds to the comprehension of the object of the study. The second is more dynamic and it coincides with the motivation, that is the interest bringing us to know and understand. If a major motivation determines a major comprehension, it can be inferred that the digital technology characterized by an innate appeal conditions positively both factor of comprehension, producing from a strong motivation a successful communication. In this context the virtual reconstruction, as final step of a multidisciplinary research, represents the most direct and simple way to communicate the splendour of the past, enriching it with emotional values coming from the of narrative and visual effects (FIG 11-12).

![Image](image1.png)

Figg. 11-12: The real object exposed in a museum and the same frame with the object recollocated in its original context.
Bibliography


