

Between the Real and the Virtual: 3D visualization in the Cultural Heritage domain - expectations and prospects

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Abstract

The paper discusses two uses of 3D Visualization and Virtual Reality (hereafter VR) of Cultural Heritage (CH) assets: a less used one, in the archaeological / historical research and a more frequent one, as a communication medium in CH museums. While technological effort has been mainly invested in improving the “accuracy” of VR (determined as how truthfully it reproduces the “CH reality”), issues related to scientific requirements, (data transparency, separation between “real” and “virtual”, etc.), are largely neglected, or at least not directly related to the 3D outcome, which may explain why, after more than twenty years of producing VR models, they are still rarely used in the archaeological research. The paper will present a proposal for developing VR tools as such as to be meaningful CH research tools as well as a methodology for designing VR outcomes to be used as a communication medium in CH museums.

Key Words: DATA RELIABILITY, MIMESIS, SCIENTIFIC REQUIREMENTS, NEW MEDIA

1. Introduction

Following major shifts in the geo – politics of Europe [COLLINS AND TAYLOR, 2006] of the late 19th century, as a consequence of new ideas regarding economies, societies and national identities, also the concept of "Cultural Heritage" (hereafter CH), simply regarded here as the legacy of physical artifacts and intangible attributes of a society, inherited from past generations and bestowed for future ones, shifted and became "open" – a multi – layered concept shaped by the way nations constructed their identities and collective memories. Consequently, referring to CH as a collective consciousness [DURKHEIM, 1967] that acts as a cohesion force of a society, based on shared beliefs that stands between society and its cultural practices, we may also regard it as a major actor playing a substantial role in shaping the modern society of today. As such, the places where CH is mostly exposed to the public, the museums of their different types, should be regarded as "open", following the transformation of CH itself and the ways people refer to it

Museums, regarded as a social establishment, gradually changed from an original "exhibits of wealth" and "cabinets of curiosities" of first displays of artifacts to the public of the 18th and 19th centuries, to supposedly "something else", following shifts in the political, social and economical structures of what we label today as Modern and Post Modern era [LYOTARD, 1984], which left a mark in other fields as well, such as aesthetics, philosophy and art. For example, the invention of photography at the beginning of the 19th century released art from its traditional limitation of representing reality, and moved towards other fields and modes of representation.

Another shift occurred with the "Information Age" of the 80's, when, by digital means, the concept of large scale of information distribution was spread to the public and visual communication, which apparently had priority as a main means of communication at humanity's dawn, (re)gained importance in an otherwise (still) language dominated communication world, after several hundreds of millennia. Consequently, Information Communication Technologies (ICT) became a common term, and allowed another "quantum leap" in the modern non-linear way of thinking, providing tools for approaching, designing and representing content, among it CH as well.

The emergence of ICT and the resulting revised aspects about museology, as a reappraisal of the scope and function of museums, triggered the organization, on a more systematic basis, of the communication policy of museums. Aiming either at the contextualization of objects or to improve the quality of information provided by CH institutions or simply to increase audience appeal, ICT offer today the means for transforming experience without violating the primacy of the artefact. The legalization of the adoption of mediated means for representing CH can be seen as an attempt to lay out the theoretical and factual presuppositions of this use.

Turning back to museums, this time regarded as a "non a priori environment", i.e. as spaces where different social interactions, not all as yet clear, take place, we question how new technologies, and in particular VR, integrate in their communication strategies, as to cope with the demands of a modern, technology driven society; in other words, understand the social context in which VR operates and what are their prerequisites, from a social sciences point of view.

VR is perhaps a buzz word, due to various factors, such as excitement for new technologies, the influence of cultural industries that suggest the possibility of existence into another reality to live in, or the possibility to create our own reality, through other non-linguistic symbolic systems. Given particular aspects of VR (when used as a communication tool [BIOCCA AND LEVY, 1995] in museums), our basic claim is that in fact we may regard VR as a medium of human expression, and, as such, a new kind of media [MCLUHAN, 1964], with a language and symbolic system of its own. Thus, the article will focus on trying to understand the nature of VR itself (regarded as a dialogue between internal reasoning and visual exteriorization), the dynamics between the information sources of VR, its transmission conditions (e.g. the museum space) and the responding receiver (museum visitors) and how meaning, derived from VR, develops as a modern non-linear way of thinking, providing tools for approaching, designing and representing (CH) content, stimulating a process of interaction between the user and the (VR) technology.

Closing the circle, we will investigate how VR, regarded as a medium for archaeological research, may affect the interpretation of CH. This analysis will be done taking into consideration three basic (and yet fundamental, in our opinion) assumptions about the archaeological reality: "...[Archaeology is] the discipline with the theory and practice for the recovery of unobservable hominid behavior patterns from indirect traces in bad samples..." (CLARKE, 1976), Clarke reminding us that we should keep in mind and always remember our data from the past is fragmentary and partial; "...the past is a foreign country: they do things differently there..." (HARTLEY, 1953), indicating that no past societies had norm of behavior and conduit and social dynamics not always clear nor accessible to us in our modern times; and third, "...[W]hat the world wants is for archeology to teach it something about humanity's past ... about Olduvai Gorge, and Stonehenge ... People ... look to archaeology as the only science ... with the power to uncover that past..." (FLANNERY, 1982), reminding us that we have a social duty, as archaeologists, to enable the past for the citizen.

2. VR – SOME CLARIFICATIONS

VR applications to humanities and social sciences have already a long history of more than two decades, traceable to the early 80's of the last century. Related theoretical and methodological issues have been discussed in the past [REILLY, 1989, REILLY AND SHENNAN, 1989, SIMS, 1997, FULK AND STEINFELD, 1997, BARCELO, FORTE AND SANDERS, 2000, NICCOLUCCI, 2002, FORTE, 2000]. In general terms, VR can be viewed as a simulation of a real or imagined environment [ROBERTS AND RYAN, 1997], while (3D) models help to understand, represent and analyze the complexity of the real (modern or past) world, understanding a particular problem or predict the behavior of a particular (modern or past) phenomenon.

Researches in cognitive psychology have shown the positive relationship between visualization ability [EKSTROM, FRENCH AND HARMAN, 1976] and the use of visualization tools thus perceiving the information in a more appropriate way. The information visualization process primarily aims to amplify human cognition with different options in order to facilitate data meaning associations and to extent the interpretative or de-codifying skills of users. The Information Visualization (IV)

process is summarized in transforming data, information, and knowledge into visual form. VR environments assist in this visual processing by, for example, getting an insight of the abstract data values. [SCHREIBER, ET AL., 2000] describes the components of the IV process as follows:

- data values are input signals to sensory and cognitive processes,
- information is data with an associated meaning,
- knowledge is "the whole body of data and information together with cognitive machinery that people are able to exploit to decide how to act, to carry out tasks and to create new information".

The implication is: the better the visual tool, the better the explanation and the interception. Thus, VR allows the 3D visualization of concepts, objects or spaces and their contextualization – it gives a visual framework in which data is displayed. VR also enables interaction with data organized in 3D, facilitating the interaction between human, data, and information [FRISCHER, ET AL., 2002] It also transforms information, making it more accessible to the human eye and thus more easily perceptible, enhancing perception in the context of its interrogation. VR as a system of organizing and conveying information deliver to users multiple meanings which arise and develop by re- interpreting spatiality. It produces thus a sort of duality between virtual space, which is often tied to an imaginary context and real space, closer to our every day life or experience. Information becomes thus the point of contact between real and virtual. VR should therefore be regarded as an intentional activity, and constructed as such. Therefore it requires a decision making process based on information from different sources, incorporating aspects and views of varying actors and offering different possibilities open to visitors. The whole process is also followed by the imperatives of convenience and transparency [SELMAT AND MINTZ, 1998] allowing among others an understanding of the processes of perception and cognition. Transparency and convenience include not only the vision of the whole synthesis, but as well as the representational system, the participation process for the users and the development of edutainment content and services.

However, since man – made objects are imitable and replicas and copies were always created [BENJAMIN, 1969], a legitimate question to ask it is to which extent the VR outcome, seen as a replica to something yet to be defined, can reproduce the original? Two major drawbacks characterize this replica: its presence in the spatio-temporal context (related to the original) and the degree of matching between the original and its replica. Moreover, since human sense perception depends on the way it is organised, the medium in which it is accomplished and the historical circumstances into which it is active, we can pose again the previous question: what are reconstructing when creating a VR ? Which facet of the original object's nature we want to capture and reconstruct? VR offers an experience of a multi-layered reality, and as such should be conceived. VR is not "the reality", but the representation of "one", or, several "instances", possibilities among others, various under different circumstances and contexts.

Since VR can be perceived as a visual exteriorization of an internal reasoning process (analysis and interrogation, creation of a fiction and a narrative), a dialogue between the internal cognitive process and its external manifestation occurs. Therefore, the user of the VR should be aware of the intended identity of this outcome and the intentionality of its producer.

Another aspect to take into consideration is the amount of information provided with the VR outcome – should we consider all facets of a CH object and thus presumably letting the user to choose what to observe (a content oriented approach), or, taking into consideration the historical circumstances of the potential user and his/her previous knowledge (if the target user is identified, which, in museum environments is yet a difficult task), applying a user oriented approach. But, since in most cases evaluating how a user accumulates knowledge and absorbs it is extremely difficult, and the characteristics of target groups can be defined only in very generic terms, we are facing an apparent tough choice when creating a VR, balancing between "an objective representation of the whole", and a "selected visualization", choosing only particular aspects of the real object to be virtually represented.

VR should be regarded in our opinion as a dialogue between the characteristics of the real object and the user, VR being not a digital "monolith", but rather an entity with a "changing shape" and a "shifting geometry", allowing the creations of different "metaphors". As such, we should regard visual communication in general and VR in particular, not as an "objective truth", parting from the Platonian perspective that "seeing is believing" [BUR83], but as only one truth among possible others [HERMON, NICCOLUCCI AND D'ANDREA, 2005]. This means that the construction of a VR environment is not merely a technical challenge.

Choices made about the conceptualization step, the interpretative frame, the extent of mimic external realities, the narrative structure and functions to adopt, make VR appealing to a wide spectre of disciplines with prevalent epistemological issues. Such a point of view takes into consideration the processes or effects of using VR environments, provides a conceptual framework and the epistemological basis upon which design synthesis is operated, provides the aesthetic premises for the creation of media products, the type of interaction or encounter with users experience and the interpretative frame of the virtual space.

3. VR as a communication medium

When creating a VR, we should be aware of the fact that we are using a different language for gathering, packaging and conveying knowledge; as such, we must be aware of its syntax and the "symbol system" it employs [SALOMON, 1980]. Since VR offers new ways of internal, cognitive representations, it can be seen as cultivators of mental abilities as well. However, these systems are requiring different mental skills – how can we, or should we, adapt, or address, VR to particular targets with (unknown, perhaps only hinted) mental skills? Without a very deep understanding, how can we balance between simplicity of "3D message" and complexity of its structure? How do we balance between simplicity (basic facts) and complexity (more fiction)?

If we are willing to accept the assumption that people represent the world to themselves and manipulate it mentally through a number of internal symbol systems, we cannot avoid the possibility of interdependence between external-communicational and internal-cognitive symbol systems [SALOMON, 1980]. Consequently, we should identify and characterize these symbols, and express them in the VR outcome, since one of the major advantages of using VR derives from the fact that it uses similar methods of representing the

world as we internally do, assuming that when we think of a concept, we visualize its structure and geometry and also spatially reconstruct its context. So, if the distance between the external and internal modes of representation is short, we do not need to invest much effort in translating the external information, it is in a way more intuitive.

By addressing VR as a new language, a new media, we cannot limit the relation VR user to a mere passive observation by the later, we need an active interaction in order to acquire this language. Following this idea, while learning by acquiring and storing information is an inert knowledge, interpreting reality (or virtual reality) and making sense of it is an active knowledge.

Since basically VR is a non- linguistic symbolic system, we can address it through the prism of ideas deriving from visual communication theories. As such, an attempt to characterize VR, mainly as an experiential product [LAUREL, 1992], could derive from theories of social sciences, in an attempt to identify its nature and the relationships with the user. In this sense, VR is a unique technology which enables a very intuitive way of processing data. We can thus refer to the (VR) medium using the Aristotelian terms of mimesis, emphasizing its characters as a form of artistic imitation, which strengthens the relationship between user and technology, and encourages the user of a technology to develop a first person, rather than third-person relationship with his or her mediated environment [STEUEUR, 1992].

In other words mimesis is necessary in order to cultivate a direct contact through the subject and its mediated environment. Hopefully, if the mediated environment provides us with different modes of representation; one of our tasks at this stage would be to create group of events relatable to the mimesis, in order to facilitate the interaction user VR system. Moreover, since in many cases there is a discrepancy between a de facto representation and the intended expression [GOODMAN, 1076], we need the mimesis in order to "better relate to the transmitted information"; mimesis can be viewed as the event that connects the user to the mediated environment (in the VR system).

4. Issues concerning interpretation

We can summarize our discussion by delineating the main features of VR [DAVIS, 2006]. The following distinction is established only for methodological concerns as the three components appear interrelated in VRE:

1. Spatiality
2. Virtuality
3. Representation

Space is not only the frame into which action is located. It is abstract in the sense that is related to the interior life of the objects and the user. Its construction is based primarily upon certain properties of reception and perception of the real world and at the same time it is carrier of determined cultural values. However this space rich of significations, cannot stand alone without being related to the interpretation of the real or the imaginary space by the user. Users recognize and derive pleasure from familiar images of their vision. Virtual space plays a double

role by contributing to the virtual environment acquiring its coherence and verisimilitude.

Virtuality refers to the relationship between the user and the system. It is essentially reposed on the idea of direct manipulation as it is determined by the human computer interaction. It characterizes in a large extent the interaction style or interaction paradigm. Graphical display of interaction is linked to direct manipulation by a visible feedback to any operation on the VRE. The 3-D graphical environments offer the possibility of exploration to more realistic environments and interaction with both virtual and autonomous agents. Anthropomorphic interactions, build around interface agents, establishes the human computer interaction in a conversational style, usually as a dialogue with a wizard. Virtuality invalidates the distinction between control interface and user interface. By this distinction we can avoid the confusion occurring when we deal with the meaning within a space (spatiality) from the actual relationship of the user to that space (virtuality).

Once we have decided what to model and by what means, the problem of the representation emerges. The choice of the representational means, appropriate to our task, obeys to several parameters which must fulfill several functions:

- The visual embodiment of the user,
- The interaction means and modes with the world,
- The means of feeling various attributes of the world using the senses.

Representation models try to respond to the problem of access and visualization of the huge quantity of data stored in a VRE. The semantic representation of 3D CH objects captures the functions, characteristics and relationships between virtual objects. Semantic representation turns objects into a virtual environment and the tools used to display and communicate, the interface, into meaningful entities.

The meaning of virtual objects and their relationships in a scene provide an alternative image of the real object, conveying meaningful information that would be impossible to represent otherwise [HERMON, NICCOLUCCI AND D'ANDREA, 2005]. Attached metadata help users to find access and use virtual reality worlds in a more convenient way and for multiple purposes as engineering, interpretation and reconstruction, evaluating methods of mediating and presenting information, exploring the artistic views, and supporting educational activities. The whole enterprise can be seen as a way of structuring information in a digital form. At this point, the use of different

communication channels, such as pointing, linguistic utterances, or facial expressions, in an intermixed way expresses the multimodality capabilities of a VRE. It demonstrates the specific channels through which information can be conveyed. It refers to the ability of a VRE of mimicking and understanding humans' natural use of multiple modalities.

6. Epilogue

The paper focused on presenting VR as a communication media and a suitable platform for archaeological research, and, as such, to define its basic characteristics, presented above. Our starting point was that VR should be regarded as a media, and thus defines its language and internal system, either when employed as a research tool in archaeology, or is incorporated in the communication strategy of a CH museum. Therefore, the creation of the mediated environment (the VR content), should, in our opinion, be designed according to the characteristics that identify VR as a communication medium. This would imply that starting from collection of data content, creating the VR content (the mediated environment) and ending with the interface design and the physical place of the exhibited VR, these attributes should be taken into consideration. Thus, apart from the requirements from VR when considered as a "cognitive partner" in the archaeological research, discussed elsewhere as well (HERMON, 2008, HERMON AND NIKODEM, 2007), we propose to regard VR as a medium of human expression, and as such, a new kind of media communication, when employed into the communication strategy of (CH) museums, considering also the particular roles museums may fulfill in the modern society. As such, several aspects should be taken into consideration when designing the VR outcome: what is the reality, or realities that we want to virtually reconstruct, how we mediate between a content oriented, "objectively" recreating all possibilities, and a user oriented approach, visualizing selected attributes, presumably of higher interest than the others and related to the potential target user. The VR product should address aspects such as vividness, creating a rich sensorial environment and interactivity, i.e. the possibility to shift geometry and change content by its users. Moreover, internal, cognitive modes of representation should be taken into consideration, and creating the VR accordingly, in this manner shortening the distance between the internal and external modes of representation, obtaining a VR accessible in a more intuitive way, and as such, also its transmitted message. For such a task, we are suggesting to adopt a "mimesis" approach, as a mediator between the user and the VR.

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