Contextualization of archaeological findings using virtual worlds. Issues on design and implementation of a multiuser enabled virtual museum.

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Abstract. This paper describes the use of Virtual Worlds technology to implement a virtual museum for an interpretation center on the theme of the use of mosaics in ancient Roman villas. In order to foster the comprehension of the meaning of these archaeological remains, incomplete mosaics were completed digitally and placed in virtual rooms to recreate the atmosphere. A musealization of the virtual *domus* was then carried out. The environment was developed on an OpenSim based virtual world, which was prepared to hold groups of avatars characterized as Roman males and females, children and adults. Text chat and sound enable every visitor to share opinions with other remote users, and to perform guided tours. The system also permits to give lectures to remote audiences utilizing telepresence.

Keywords: Virtual worlds, e-learning, virtual museums, virtual archaeology, roman mosaic

1   Introduction

What makes the difference between a humble piece of stone and a weapon used in a terrible fight for survival thousands of years ago? Every fragment of an archaeological remain has the power to trigger the evocation of the past in the mind of the person who contemplates it. This power resides in the object itself but the observer can release it with the knowledge needed to imagine the object in a precise space and time to recreate a situation. The deeper the understanding of the context that surrounds the existence of this object is, in terms of the different layers where the object can be inscribed e.g., material, industrial, historical, social, etc., the better the evocation may arise.

For museums and interpretation centers, especially those devoted to the fields of archaeology and historical heritage, transmitting context to their visitors is crucial in giving meaning to the exposed pieces.

Virtual worlds provide a very effective tool for the dissemination of the cultural goods of museum or interpretation center. The display and placing in context of virtu-

al replicas allow for a better understanding of their role in history. Those virtual environments provide onsite simulation of historical reconstructions. They also have a very relevant value as a means for remote visits, gathering attention from visitors from all over the world, thus reaching people who would probably never visit the physical place. This is especially important for small institutions located a distance from touristic poles of attraction, small villages, etc., which is the case of many interpretation centers.

Computer virtual recreation of historical heritage has been a technique used in museums for the last two decades, commonly in the form of computer animation of architectural over flights, walkthroughs and depictions of virtual models displayed in video format. This is a very effective way to provide the user with an adequate knowledge of the context of the topics displayed, but implies a passive role for the visitor who is merely a spectator of things of a time past.

The user can be much more involved in this learning process by means of participation instead of merely contemplation, from looking to experiencing. In fact, the capacity of virtual worlds to make the user perceive their own presence in the simulated environment through immersion and engagement is one of the points that make them compelling [1]. In relation to the use of this technology for teaching, the feeling of presence is strongly linked with the overall satisfaction of the students with the learning activity [2]. The use of virtual worlds as a mean for joint activities between schools and museums received good results when tested [3].

In numerous cases of the use of heritage reconstruction in virtual worlds, [4,5,6] most appeared exclusively in the domain of virtual communities such as Second Life. Very few examples appeared that run in the context of a real museum, such as the case of the reconstruction of Villa Livia [7].

The case presented here describes the use of a virtual world as a means for contextualization of archeological findings as part of the exhibition designed for an interpretation center in Casariche (Seville, Spain). The center is dedicated to the theme of mosaics in ancient Ro-man villas, particularly those found in the archeological dig of El Alcaparral.

The virtual models had two main objectives. They should display a complete recreation of the mosaics found in the nearby excavation, allowing the visitors to contemplate the appearance of the pavements in their full size instead of just fragments. The villa model also had an objective to build an environment that could provide a context for the interpretation of the mosaics.

Designers took into account the capability of virtual worlds to act as an environment for simultaneous multiple users. The design of the virtual villa fulfilled the requirements of remote access, virtual presence, and multiuser communication via chat and voice.

2   Methodology

2.1   Background

In 1985, thirteen mosaics contained the remains of a late roman villa close to Casariche. The state of conservation of the different pieces is very dissimilar, ranging from small parts to full pavements, being specially notable the piece representing the Judgment of Paris. (Fig 1)

Fig. 1. Mosaic depicting the Judgement of Paris

Reports were made of traces of the ancient villa (Sierra 1985) (Hoz 1987). They constitute one of the bases for the virtual reconstruction described in this paper. (Fig. 2)
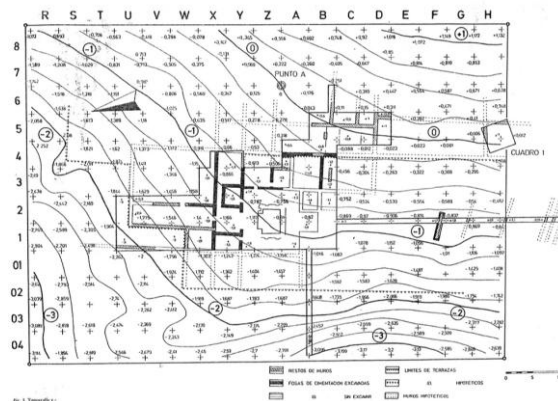
Fig. 2. Layout of the foundations and location of the mosaics at the roman villa

Taking into account all preliminary documentation, this work was carried out in two phases; the first one, consistent in the construction of the virtual model to hold

the virtual exhibition and activities, and the second one included all aspects of virtual musealization.

2.2   Construction of the virtual model

Reconstruction of the mosaics

The mosaics displayed comprise two groups. The first one includes those only formed by geometrical motifs. Here, the modular and repetitive characteristics of the formal structure of the drawings allow one to obtain a possible full version of every original design. Patterns repeated, in search of a coherent formal structure for every case according to the dimensions and shape of every room. Apart from possible unknown irregularities or unexpected lost elements, that could break the homogeneity of the design in the original mosaic, the reconstructed versions offer an image of every mosaic that would correspond very approximately to the appearance of those ancient pavements. (Fig 3)

Fig. 3. Geometrical mosaic displayed in the atrium of the *impluvium* and reconstruction. (Photos from the intervention report – left- and from the virtual world – right)

Mosaics composed by those containing figurative drawings make up the second group. There were three mosaics on this group, with very different states of preservation. The mosaic depicting the "Judgment of Paris" was almost complete, and only needed to include a few retouches to obtain its virtual replica. The second mosaic, called "The Spring," had a big part of the face of the person represented missing, but the characteristics of the shape of the human face permitted reconstruction fairly well (Fig. 4).

The third case, the mosaic that covered the bottom of the *impluvium*, was almost lost and only small parts were present. Nevertheless, those parts indicated clearly that the original drawing depicted a scene containing two Nereids riding a Triton. The detailed formal analysis of the remaining fragments displayed multiple similarities with other mosaics of the same age and similar theme found in excavations located in neighboring regions. That took the authors to consider a great influence of even a common school authorship that may induce one to think that the motif depicted in the original mosaic could be very similar. The associated descriptive panel floating over

the reconstructed scene, indicate the clear character of hypothesis of such reconstruction. Nevertheless, the virtual version helps to understand the frequent use of marine scenes in *impluvia* and other hydraulic elements (Fig. 5).

Fig. 4. The mosaics of the Judgment of Paris – left- and The Spring –right- in the virtual world

Fig. 5. The *impluvium* in the virtual world with the reconstructed mosaic of two nereids riding Triton

Finally, a generic mosaic was designed to be used in the rooms that presented more uncertainty in their layout, as a mean to remark them as the most hypothetic part of the interpretation of the house.

Reconstruction of the *villa*.

In order to facilitate a better comprehension of the late Roman architecture, the three-dimensional representation of this *villa olearia*, made for this project, tries to be

as accurate as possible, based on all the data obtained from the archaeological dig, but considered the fact that the remains were neither abundant nor well preserved. Additionally, the authors interpreted the historical and ethnographical data available and the analysis of other near *villas olearias* that present a similar terrain organization based on terraces of the same period such as the *villa vinicola* of Fuente Alamo and the *villa agricola* of Villaricos.

Other reconstruction criteria for the making of the model bases design on the archaeological current of thought named Archeology of Architecture [8,9]. This discipline provides analytical models and methodological tools that contribute significantly to the study of the different dimensions of the built space. This work used the constructive analysis to obtain the characteristics of the domestic architecture of the archaeological site, the formal analysis to construe and understand the functionality of the structures and the syntactic analysis of the space to grasp the subjacent social significance.
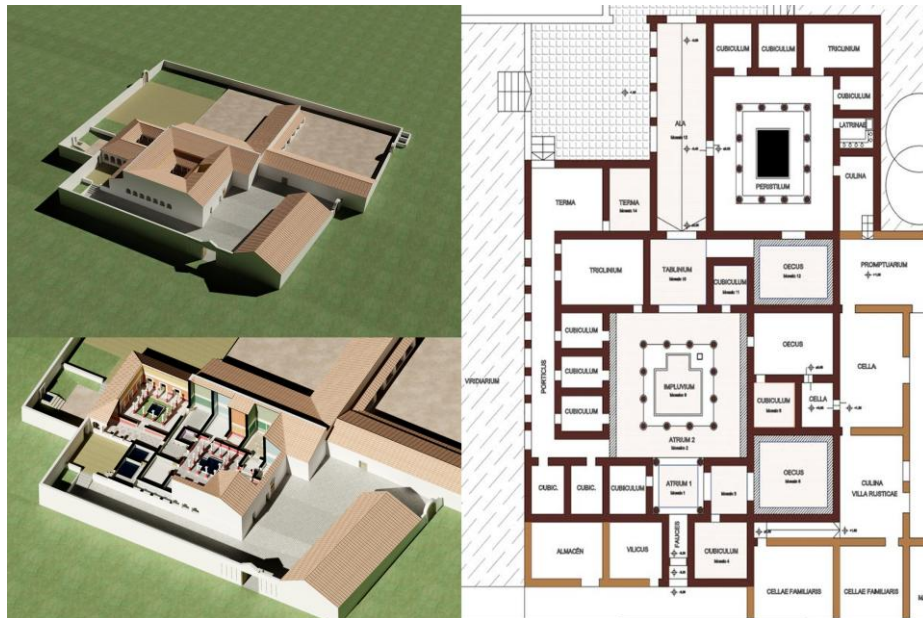
Fig. 6. General views of the villa – left- and hypothesis of distribution of the of the *pars urbana*. Pavements with mosaics are remarked –right-

The virtual reconstruction mimics the constructive materials found in the dig properly described in the corresponding excavation reports [10,11]. Those reports also give important clues about the possible distribution of spaces and how they are grouped in terraces following the slope of the terrain. Those clues were especially taken into account to obtain the hypothetical layout of the complex.

From the previous analysis, design of the model of the villa, organized in three zones followed the alignments of the terraces found in the site. The first one corre-

sponds to the *pars urbana*, the noble area where the *dominus* and his family lived, and the area dedicated to the thermal baths *(balnea)*. The second one related to the accommodation of the servants, slaves and all personnel who worked on the crops in the surrounding fields. The third area includes the spaces for storage of farm equipment and stables. The figures display the final distribution. (Fig 6)

2.3 Virtual musealization

Musealization of the model.

The virtual representation of the *domus* provides one with a site fully accessible to visitors. The user, represented by his or her avatar and dressed as a Roman inhabitant of the villa, can walk freely throughout the complex. The enjoy not only the architecture of the building, but also the wall paintings, furniture, mosaics, and other elements of material culture, *anphoras* for oil and wine, *tegulas*, oil lamps, etc. (Fig. 7). The setting of the different spaces (a*tria, peristila, lararium, triclinium, tablinium*, etc.) helps to interpret the daily life in such facilities. The focus is the mosaic of the "Judgment of Paris" since this piece is unique in Hispania. It is one of the only five known cases found in all the Roman Empire depicting this theme [12].

All notable elements in the virtual villa have a descriptive panel written in Spanish and English (switchable) that gives information about every specific topic. Some rooms act as containers of descriptive elements like maps, pictures and videos related to the activities in the villa and the art of mosaic making. (Fig. 7)
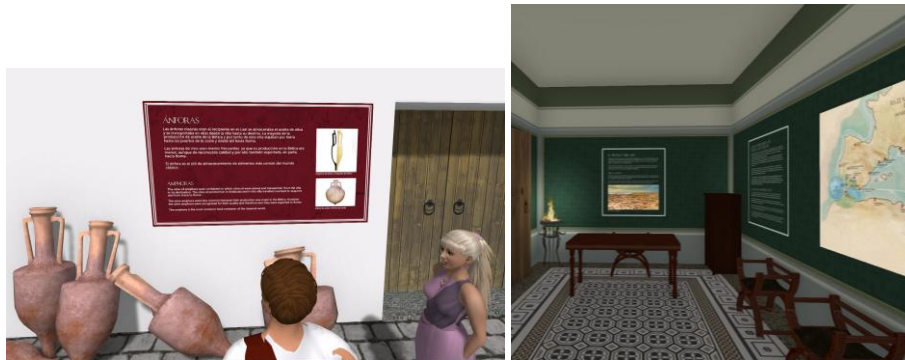
Fig. 7. Amphoras for oil and wine and explanatory panel – left-. Maps and videos in the virtual rooms – right-

Implementation and support for the interpretation center

The database containing the virtual villa is implemented on an OpenSim server, accessible through the Internet using any compatible viewer such as Singularity, Kokua

or Imprudence. Nevertheless, users can download a custom configured viewer from the virtual world website.

Independently from the remote access, the virtual world is usable as a local simulation of the ancient house from within the interpretation center, using a regular personal computer located in one of its ex-positive rooms. This way, this virtual museum is capable of accomplishing several objectives:

- o Depiction: The virtual world displays formal aspects and characteristics of the elements to interpret, their full shape, location and use in the villa, relative importance, etc.
- o Evocation: The virtual villa fosters the use of the imagination to make the visitor feel as part of the ancient world, thus helping to understand the key concepts and grasping better the knowledge that is offered.
- o Experience: The visitor can perceive the villa and the mosaics located inside through a virtual, but vivid experience, feeling the relations among the spaces, contemplating the elements displayed, and experiencing the visit to the virtual villa as he or she would do it in a real museum.

2.4 Avatars and gamification

As it was mentioned above, users enter this world using avatars that can be chosen from a small variety of male and female, adult and child, examples. Users dress their avatars in Roman garments and jewelry and personalize them. This reinforces the feeling of presence of the visitor in the virtual world.

Fig. 8. Some of the avatars available to visitors of the virtual villa

There is a quiz game implemented in the virtual world, specially designed for young visitors. The player has to face a bas-relief sculpture of Medusa that will ask

them a question with an easy answer if the visitor has paid attention to the information displayed all over the villa. If the player succeeds answering the question, Medusa gives them an image of a golden apple like the one depicted in the Judgment of Paris mosaic (Fig. 9).

Fig. 9. Visitor playing the question game

2.5 Multiuser capabilities

Finally yet importantly, the multiuser enabled remote access brings the possibility to put distant visitors in touch, allowing meeting in the virtual facility with text and voice chat enabled. This makes it possible to organize events such as lectures, guided visits to remote groups of visitors (i.e. schools) in the virtual villa, expert meetings, etc. (Fig 10)

Fig. 10. Educational activity with remote users

3   Conclusions

Virtual worlds are a very effective tool for contextualization of historical heritage remains and archaeological findings, with virtual replicas displayed in a historical referential environment, allowing for a better understanding of their cultural meaning. Those virtual environments can be used both as on-site simulation of historical reconstruction and also as a means for remote visits, gathering attention from visitors from all over the world, thus reaching people who would probably never visit the physical place. All of this makes virtual worlds a notable tool to enhance the didactic capabilities of centers. This paper describes the steps to follow in order to achieve an efficient example of such a class of virtual museum.

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