A NEW METHODOLOGY FOR THE 3D PHOTOREALISTIC VIRTUAL RECONSTRUCTION OF THE ARCHAEOLOGICAL SITE "CASTELLET DE BERNABÉ" (LLÍRIA, SPAIN)

UNA NUEVA METODOLOGÍA PARA LA RECONSTRUCCIÓN VIRTUAL 3D FOTORREALISTA DEL YACIMIENTO ARQUEOLÓGICO "CASTELLET DE BERNABÉ" (LLIRIA, ESPAÑA)

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Abstract:

In recent decades, the 3D virtual reconstructions and visualizations of archaeological sites have been commonly used by scientists to better understand the missing structures. They have also been considered as an interesting communication tool for addressing the presentation of these assets to the audiences because virtual immersive environments presentations are an easy and meaningful way to understand the archaeological remains. However, the 3D reconstruction of archaeological sites is challenging, because some of most of the parts of the assets do not exist nowadays. This paper presents a methodology for the the 3D photorealistic virtual reconstruction of the Iberian settlement Castellet de Bernabé (Llíria, Spain).

Key words: virtual archaeology, digital archaeology, cultural heritage, documentation, 3D reconstruction

Resumen:

En las últimas décadas, la comunidad científica utiliza las reconstrucciones visuales en 3D y las visualizaciones de los yacimientos arqueológicos para comprender mejor las estructuras que han desaparecido. Estas técnicas también se han considerado una herramienta de comunicación interesante para abordar la presentación de estos bienes a las audiencias, pues las presentaciones en ambientes virtuales inmersivos son una forma fácil y significativa de entender los yacimientos arqueológicos. Sin embargo, la reconstrucción 3D de los yacimientos arqueológicos puede suponer un reto, ya que alguna o la mayor parte del yacimiento puede no existir en la actualidad. Este trabajo presenta una metodología para la reconstrucción virtual 3D fotorrealística del yacimiento íbero Castellet de Bernabé (Llíria, España).

Palabras clave: arqueología virtual, arqueología digital, patrimonio cultural, documentación, reconstrucción 3D

1. Introduction

Cultural Heritage (CH) is a fundamental expression of the richness and diversity of our culture and therefore, its conservation, documentation and dissemination is thus considered of the utmost importance. The 3D virtual reconstruction of cultural heritage buildings and archaeological sites is of high interest for different reasons, namely the accurate documentation of our tangible cultural legacy, the determination of mechanical alteration on the assets, or the mere shape acquisition prior to restoration and/or reconstruction works, etc.

Reconstructing and understanding the past allows local people to reinforce their identity and permits the general public to access to history (Viñals *et al.* 2013).

Different technologies exists nowadays to deal with the 3D reconstruction of assets, mainly stereo-photogrammetry, laser scanning or structured light-based techniques (Groves *et al.* 2014; Zhang *et al.* 2012; Zlot *et al.* 2013).

The visual appearance or photometric properties is also of utmost importance. These aspects can be acquired from the use of conventional cameras, mobile phones, or cameras (Pires and Cruz 2007; Navarro *et al.* 2009; Lerma *et al.* 2011; Remondino *et al.* 2011). However,

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when dealing with archaeological sites, the 3D reconstruction and visualization is usually not fully possible with the use of acquisition devices, because most or part of the assets do not exist nowadays. In this sense, alternative approaches have to be used such as e.g. the vitual reconstruction and visualization with augmented reality approaches (Portalés *et al.* 2009).

In this work, we will deal with the reconstruction and visualization of the archaeological site "Castellet de Bernabé" by means of the virtual reality technology, following a customized mixed methodology that includes on site observation, comparative research and archaeological interpretation, among others. We aim at enhancing heritage values by allowing the intellectual and emotional engagement to CH of the visitors.

2. The Archaeological Site

The archaeological site of Castellet de Bernabé was first excavated in 1984, and it was restored in 1988. It is located in LLíria, in the inland of Valencian Region (Spain). It is an Iberian settlement that flourished from the 5th to the 3rd century BC (Pla 1945; Guérin 2003), and was a village in territory of Edeta (actually Llíria), that spread from the Mediterranean mountain range of Calderona to the Túria river. The Iberians were a diverse western Mediterranean civilization group that shared common cultural characteristics, including urban and trade networks.

3. 3D Photorealistic Virtual Reconstruction and Visaulization

The virtual reconstruction of the Castellet de Bernabé is challenging, as most of the site is nowadays not present. In this regards, the site was reconstructed by using a customized methodology in order to determine its original size, materials or colours. The methodology involves the following approaches:

- **Bibliographic research** including: an aerial image of the site, a map of contour lines, drawings of the original shape of the houses, detailed written description of artifacts made by historians, etc.
- **Case study**: review of other archaeological Iberian sites, including Bastida de les Alcusses (Moixent, València), Puntal dels Llops (Olocau) or Tossal de Sant Miquel (Llíria), among others.
- **In-depth interview**: the archaeologist expert in Castellet de Bernabé excavation and study, Pièrre Guérin, was the referee along all the process.
- **On site observation**: there were gathered, analysed and incorporated to the reconstruction many detailed images regarding colours and textures.
- **Comparative research**: it was also developed a field study in the area of Middle Atlas, as many areas of Moroccan Middle Atlas had still very similar housing to those constructed by Iberians in Lliria.

From the map with contour lines, a digital terrain model (DTM) was generated by using Geographic Information Systems (GIS) tools, and then exported to 3D Studio Max to serve as a basis for the virtual reconstruction of the site. The aerial image of the site served to draw the plant of the site. From the written texts and drawings, other issues such as the height of the houses was derived.

Once the site was virtually reconstructed in its shape, different materials and textures were added in order to give it a photorealistic appearance. To that end, several information and images of other similar archaeological sites presenting nowadays a better conservation stage were gathered. The result of the 3D and photorealistic reconstruction is presented in Figure 1, where in Figure 1a, an overall view of the generated digital terrain model together with the reconstructed site is depicted. In Figure 1b, a view of the interior of the site is given, where the textures and materials (of the walls, doors, etc.) can be better appreciated.
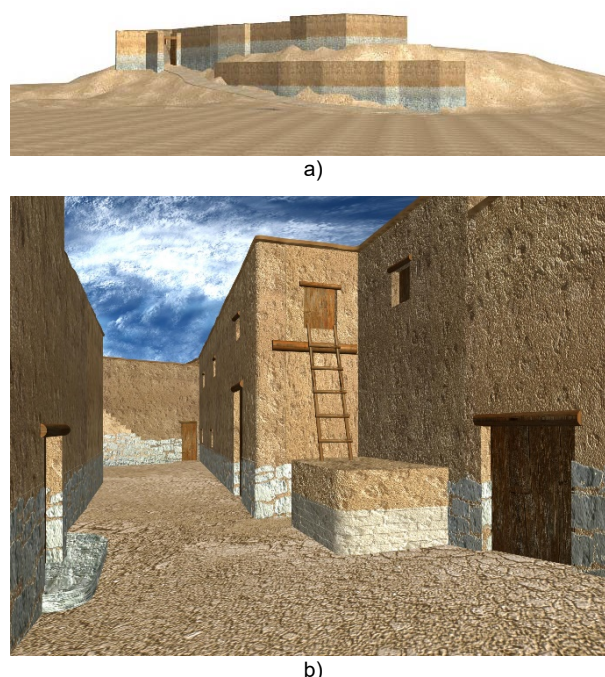

a)

b)

Figure 1: Virtual reconstruction of the Castellet de Bernabé, where: a) Overall view of the digital terrain model and the 3D reconstructed site; b) Detailed view of the interior of the site.

After the 3D reconstruction of the Castellet de Bernabé archaeological site, there were developed different kinds of visual materials, which were part of the different interpretation materials designed for the settlement communication. A total of the four different visual materials were prepared from the 3D reconstruction: a past and present book (Viñals *et al.* 2008a; Wikipedia 2014); a virtual flight (YouTube 2016); a multi-use trail (Alonso-Monasterio 2014); and an explorer diary (Viñals *et al.* 2008b).

4. Conclusion

Heritage interpretation is a powerful tool that enhances heritage values and allows the intellectual and emotional access to heritage of the visitors. This process is developed from original objects, using both personal and non-personal resources. 3D reconstruction of archaeological sites allows an easy and rapid intellectual access to heritage, so visitors have time and energy to emotionally engage with the site, what leads to deeper connections that allow mindfulness and understanding.

Thanks to the 3D and photorealistic reconstruction of the Castellet de Bernabé, its visitors can develop pro-conservation behaviours and sense of place.

These virtual reality based techniques arise as highly efficient tools to support interpretation, especially in cultural heritage interpretation of archaeological sites, where it is necessary to describe and create mental images of the sites to boost the deep understanding of the heritage and of the civilizations that created them. They provide a synoptic image upon which the interpretation discourse can be constructed.

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