Original article

Proposal for the improvement and modification in the scale of evidence for virtual reconstruction of the cultural heritage: A first approach in the mosque-cathedral and the fluvial landscape of Cordoba

Rafael Ortiz-Cordero [a,*], Enrique León Pastor [b,1], Rafael Enrique Hidalgo Fernández [a,2]

[a] Dpto. de Ingeniería Gráfica y Geomática, Escuela Politécnica Superior, Universidad de Córdoba, Campus de Rabanales, 14071 Córdoba, Spain
[b] Dpto. Arqueología de Córdoba, Arqueólogo, ArqueoBetica, S.L., C/Plateros, nº 15, Bloque 1–1° B, 14006 Córdoba, Spain

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ABSTRACT

This article intends to improve and modify the scale of evidence in the virtual reconstructions created by Tayfun Oner for the Byzantium 1200 project team. In the article the scale has been analysed, reducing its number of levels and modifying its chromatic gradation to improve its perception. For this purpose, the original scale and the modified scale have been compared in three different three-dimensional models, the minaret of 'Abd al-Rahman III', Cordoba, Spain. A sector of the mosque of 'Abd al-Rahman I', Cordoba, Spain, and the Roman Port of Colonia Patricia, Cordoba, Spain. The modified scale complies with the London Charter and the Seville Principles for the Virtual Reconstruction of Cultural Heritage and it is aimed at been established as a common scale within the scientific community.

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1. Introduction

This paper aims to modify and improve the existing scale of evidence to illustrate the level of knowledge in virtual reconstructions. At the present, when the researcher or tourist observes a virtual reconstruction carried out by some technician, they obtain a hypothetical vision of the monument or archaeological site giving that they are observing a 3D reconstruction based on the studies of the author; and not taking into consideration the graduation of the evidence or certainty of what it is represented (http://www.cordobaromana.com) [1].

All reconstructions carried out through the use of videos, infographics or three-dimensional models are intended to show an illusion, which may be more or less accurate but that in no case will become real.

A first solution to this problem in the reconstruction of the Mosque Cathedral of Cordoba was carried out in the 2D reconstruction of the minaret of 'Abd al-Rahman III' by the architect Félix Hernández [2]. He established clear distinctions between the supposed, the results of his own investigations and the original remains of the minaret. This system, although valid in a 2D reconstruction, is not useful in a 3D reconstruction in which there are zones with different levels of illumination and greater complexity.

The scale of evidence or knowledge was created to clarify, improve and provide a scientific basis for virtual reconstructions. In 1994, the Byzantium 1200 project was founded by Tayfun Oner [3]. In 2011, the Portus Theodosiacus was published online (http://www.byzantium1200.com/port_t.html) with a scale showing the current level of knowledge of the reconstruction carried out. This scale shows to the person observing which zones actually exist, which ones are based on archaeological excavations and which ones have been recreated by the author from different data.

The scale used by the Byzantium 1200 project (Fig. 1) has ten levels of knowledge: (1) Imagination, refers to those objects or elements invented by the 3D modeler. (2) Based on similar structures, reconstructions based on similar structures from the same period. (3) Textual evidence, the element appears briefly in textual references. (4) Textual and comparative evidence, the element is widely described in textual references. (5) Simple graphical evidence, the reconstructed element is represented in coins, stamps or other simple representations. (6) Detailed graphical evidence, the reconstructed item is represented in prints, oil paintings, or other

* Corresponding author. Tel.: +34696579777.
E-mail addresses: rafaelortizcor@gmail.com (R. Ortiz-Cordero), eleonpastor@hotmail.com (E. León Pastor), ig1hifer@uco.es (R.E. Hidalgo Fernández).
[1] Tel.: +34646804172.
[2] Tel.: +34957218335.

BYZANTIUM 1200 - LEVEL OF KNOWLEDGE

- EXIST IN ITS ORIGINAL FORM
- PARTIALLY OR WITH MODIFICACIONS
- PHOTOGRAPHS OR PLANS AVAILABLE
- ARCHAEOLOGICAL INFORMATION
- DETAILED GRAPHICAL EVIDENCE
- SIMPLE GRAPHICAL EVIDENCE
- TEXTUAL AND COMPARATIVE EVIDENCE
- TEXTUAL EVIDENCE
- BASED ON SIMILAR STRUCTURES
- IMAGINATION

Fig. 1. Byzantium 1200 scale of knowledge for virtual reconstructions.

detailed format. (7) Archaeological information, the reconstruction is based on archaeological hypotheses, based on the information collected after a study of the building or an excavation. (8) Photographs or plans available, the element is recorded on architectural plans or photographs. (9) Partially or with modifications, the element is partially or has been modified with respect to its original form. (10) Exist in its original form, the element is in its original form without having undergone modifications.

Recently, in Spain, the archaeologist Pablo Aparicio Resco in collaboration with the Portuguese archaeologist César Figueiredo is carrying out a chart that represents the degree of historical/archaeological evidence based on the scale created for the Byzantium 1200 project. In reality, the scale is the same, except for some modifications in the scale division [4,5].

According to Aparicio, the scale is defined by a gradient of warm to cold colours, and with a colour coding so that the different tones are always the same (http://www.mediafire.com/view/vcl26cuwc66b5m3/Escala_Evidencias.pdf). Aparicio conducts a virtual reconstruction of a Roman Watchtower with his modified scale [6].

Dell'Unto has explored the same problem [7]. He generated a series of levels, (levels of consistency) to differentiate the archaeological evidence from other sources. Dell'Unto created a 6-level scale; Reconstruction by "objectivity", "testimony", "deduction", "comparisons", "analogy or styles" and "hypothesis". In this case, although Dell'Unto presents a scale of certainty, it does not incorporate any chromatic gradation.

The goal of the scale of evidence is to cover the aspects recommended by the London Letters [8] and the Seville Principles of Virtual Archaeology [9,10].

The objectives set out in the Charters are meant to promote intellectual and technical rigor and to ensure that processes and results are adequately understood and evaluated by users. The Charters emphasize that each community of experts must develop the guidelines of implementation of the Letters in a coherent manner with its own pretensions, objectives and methods. In addition to the Letters, we have at our disposal the Technical Recommendation for the Geometric Documentation of Patrimonial Entities [11], which insists on the obligation of technicians to present virtual reconstructions with scientific rigor and with clear levels of certainty (section 4.4. "Anastilosis processes or virtual recreation").

The existing scale has the advantage of showing the accuracy of the reconstructions carried out. Nonetheless, it has a colour variation that is too colourful as well as an excessive number of phases, which can be reduced. This chromatic gradation leads to a problem in those reconstructions in which much of the model is in its original state or it has more evidence of its existence, the scale saturates the image obtained due to the strong presence of red, pink

and orange colours of its first three phases. A colour system is considered multicolour if most of the shades are characterized by a high intensity; consequently, this colour system is more difficult to identify [12].

Jacques Bertin defends that one of the most common mistakes consists on representing the order of the scale by means of non-ordered sequences, producing in that way mistaken information. The colours with equal intensity are not ordered visually, ergo, they cannot present organized information [13].

2. Research aim

The objective of this paper is to improve the current scale reducing the number of phases and changing its colour gradation to avoid problems of colour saturation. In addition, it also aims at generating a definitive scale for the use inside the scientific community within the virtual reconstructions of the cultural heritage. As a result, the work is rigorous and the existing knowledge about reconstruction can be shared with the scientific community.

As an example of the scale proposed in this paper we are looking at the reconstruction of the 'Abd al-Rahman III' minaret and part of the prayer hall of the 'Abd al-Rahman I' Mosque, comparing the Byzantium 1200 scale and our proposed scale. Likewise, studies of the port and fluvial area of Corduba will be used to verify its versatility in exclusively archaeological areas.

3. Material and methods

The Byzantium 1200 scale of evidence has two limitations. The first and most important is its chromatic gradation. In virtual reconstructions of monuments in which much of the model is in its original state or with some slight modifications, the scale causes a saturation of the image obtained. To demonstrate this, two three-dimensional models have been developed to work with the current scale of evidence and the new scale proposal that we will label as "Cor_16".

The Byzantium 1200 scale of evidence [3] is valid for reconstructions in which only a small part of the monument or archaeological site is original. Otherwise, the image becomes saturated and instead of focusing the researcher's attention to the reconstructed areas, we obtain the opposite effect.

The reason behind that statement is that the human brain is attracted to warm colours like red, pink and orange as they are colours associated with danger and alertness [12]. The colours red and orange represent blood and fire, being for many people the red colour linked to life [14]. Red is the symbol of martyrdom and sacrifice because of its association with blood [15]. In addition, red colour is the one that most attracts our attention to being the colour associated with dynamism and activity [16]. According to Wong, red is the most outstanding colour in the visual spectrum; He also defends that socio-cultural contexts are factors that affect the way in which colours are perceived and interpreted [12].

Bertin states that shades of blue and red with the same value are perceived as equal by human's eyes before being distinguished as different colours [13]. For these reasons, red focuses the attention of the viewer on the wrong place of the image, which is precisely the part that exists in the monument, which can generate uncertainty in the researcher.

We intend to generate a new scale of evidence by providing corrective measures to the problem. The first option would be to invert the scale, placing the purple or dark blue at level ten of evidence and the red colour at level one; in that way, we would prevent the viewer from focusing on the wrong place. But this solution does not avoid the overload due to the great variation of colours used, nor the excessive number of existing levels.