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Combining image and model based rendering of an archaeological site

M. Vergauwen[a,*], G. Willems[a], F. Verbiest[a], L. Van Gool[a,b], D. Pletinckx[c]

[a] *K.U. Leuven ESAT-PSI, Kasteelpark Arenberg 10, B-3001 Leuven, Belgium*
[b] *ETH Zürich D-ITET-BIWI, Gloriastrasse 35, CH-8092 Zürich, Switzerland*
[c] *Ename Center for Public Archaeology and Heritage Presentation, Abdijstraat 13-15, B-9700 Oudenaarde, Belgium*

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Abstract

Preservation of cultural heritage through digital technology can only be successful if people can experience sites and reconstructions in an intuitive, yet convincingly realistic manner. A way to get people interested in the past is highlighting the link of the past with the present.

In this paper, an entire pipeline is discussed that augments an existing Quicktime VR object movie of the virtual reconstruction of an archaeological site with images of the site as it exists today. The new images are generated using an image-based rendering approach.

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Keywords: Image-based rendering; Cultural heritage; Landscape reconstruction

1. Introduction

Preservation of cultural heritage through digital technology can only be successful if people can experience sites and reconstructions in an intuitive, yet convincingly real way. It also requires ways to get people interested in the past. A possible strategy to do so is highlighting the link of the past with the present. For example, when visitors to an archaeological site can see the link between the archaeological remains and the historical buildings that were standing on that spot, they will be more inclined to explore the story of that site in more detail.

This paper extends this methodology to landscapes, and proves that it is possible to show the evolution of a landscape until the present day, without making a virtual model of that present

*Corresponding author.
E-mail address: maarten.vergauwen@esat.kuleuven.be (M. Vergauwen).

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day situation. In this paper, we discuss a way to create interactive applications to explore the evolution of a landscape and register a visualization of the current landscape with existing virtual reconstructions. In this way, we obtain an optimal combination of real and virtual images that shows the evolution and history of the site. This paper outlines the pipeline from data acquisition by oblique aerial photography, over camera calibration and registration of the virtual with the real landscape, to image-based rendering techniques to create the appropriate views.

Many applications make use of the QuickTime technology provided by Apple, especially to create interactive applications through the QTVR suite [1]. One element of this technology are QTVR object movies that allow interactive access to a two-dimensional (2D) matrix of images. One of the ways to use this is to show an object from several different angles.

A more sophisticated use of the QTVR object technology is to build interactive 4D objects, by rotating the object through a horizontal cursor movement, and evolving the object through time through a vertical cursor movement. Since 1999, the Provincial Archaeological Museum of Ename has used 4D QTVR objects to show the evolution of the entire village over the last 10 centuries [16]. In this interactive TimeLine application, virtual models of 12 consecutive periods are visualized. In the TimeLine application a virtual camera spins at a fixed height around a fixed point, yielding 36 regularly spaced views on the geo-referenced virtual model, and this for all 12 historical periods. In this way, the columns of the 36×12 matrix of views show the evolution of the landscape from 1020 to 1780 AD from a specific point of view, with the columns evenly spaced on a predefined circle with a height of 150 m and a diameter of 260 m. The circle where the virtual camera was positioned is shown in Fig. 1. This figure also shows the Ename site.

To extend this matrix to the present, as illustrated in Fig. 3, we need to take images from exactly the same 36 viewpoints, and this at a height of 150 m. This is virtually impossible with straightforward photography however, and the paper proposes an alternative way, based on

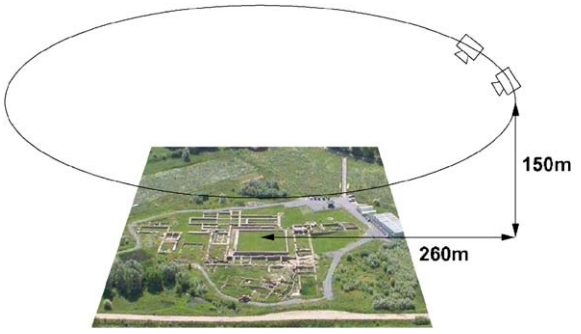

Fig. 1. The setup of the virtual cameras. They are distributed every 10° on a circle with a radius of 260 m at 150 m altitude.

image-based rendering. The result is rewarding. In more than one way, this most recent, modern row of the TimeLine matrix (see the 4th row in Fig. 3) is the most intriguing one, as it links the present—experienced by the visitor—to the past. Every element in the current landscape gets a meaning, a story, a reason why it is the way it is. By linking the past to the present, a general audience can be addressed by telling the story of how a place in time came to be.

2. Overview of the pipeline

A processing pipeline has been devised to create modern views that are aligned with those already in the TimeLine matrix, as shown in Fig. 2.

First step: In essence, this pipeline produces interpolated views, starting from a series of photographs of the site. Therefore, a first step consists of acquiring the latter. Since the virtual TimeLine images show the archaeological site from above, a helicopter was used to shoot the photographs. Section 3 explains this in more detail. The use of a helicopter is only part of the solution. Even when combined with state-of-the art technology such as DGPS or steadycams, it is highly unlikely that one would manage to let any of the images coincide perfectly with one of the 36 target viewpoints as used in the TimeLine views. We have used image-based rendering (IBR) for that purpose. IBR takes a series of close photographs taken from known directions and a 3D