A 3D Model for Detecting and Communicating the Archaeological Risk

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3D technologies have become a very effective way of exploring and interacting with a wide range of different environments. In a Virtual Reality system, the visualized model should increase the provided informative level by means of datasets of information to be integrated in real-time navigation, in order to make the final user able to interact with the Virtual Environment and increase his knowledge about the landscape being explored. With this aim, a 3D predictive model for the Pisa coastal plain has been created. This area is nowadays affected by a strong building programme which compromises the preservation of a potentially wide and still unexplored archaeological heritage. In order to monitor and detect the areas where a higher probability level of finding new sites is expected, a predictive model has been conceived, starting from GIS collected data, and subsequently implemented in a Virtual Reality system.

What we finally obtained is a 3D immersive, navigable landscape representing the Pisa coastal plain, in which is possible to look at the distribution of the known sites and have an immediate, intuitive perception of the areas which might have a significant archaeological interest.

The user can navigate in, and interact with, the environment, finding out different kinds of information related to the archaeological record and, most of all, realizing which areas are likely to contain archaeological finds. One of the key points in this research is the use of web3D technologies, enabling a wide range of users to get a clear and intuitive visualization of complex three-dimensional models, which become very handy even for advanced off-line applications.

Moreover, another important aim to be reached by such a research is to create a communication tool for making a broader range of people get interested in cultural contents.

Keywords: Landscape Archaeology, Predictive Modeling, Virtual Archaeology, Virtual Reality.

1. Introduction

The present paper aims to discuss several issues related to the use of an innovative 3D Web-oriented technology in an archaeological context. In fact, such a work is meant to demonstrate the contribution given by Web3D to the study of GIS-based datasets. In particular, attention has been focused on the setup of a 3D predictive model for managing and presenting archaeological data coming from a study area located in North-Western Tuscany.

2. General Overview

Basically, the study area consists of an alluvial coastal plain, made up of Holocene sands, where a complex system of lagoons and channels, approximately up to the end of XV century AD was extended all over the region (MAZZANTI, 1993).

In the last thirty years, a multi-disciplinary research carried out by the University of Pisa, led to the discovery of over one hundred archaeological sites, dating from prehistory (middle/late-Paleolithic) to the modern Age (PASQUINUCCI, 2000).

Despite the great amount of archaeological evidence brought to light, just a reduced portion of territory has been explored, resulting in a lack of information about the remaining part, which is, on top of that, severely threatened by increasing development works. In this sense, a predictive model has been thought in order to better monitor and preserve those portions of land in which the "archaeological risk" of finding new, unexplored sites, is higher.

3. System Outline

Our predictive model is based on an inductive approach, which provides the final outcome starting from the analysis of an existing sample of known sites, and assessing the influence which a certain number of environmental variables, supposed to affect sites location, have exerted on the sample itself (WHEATLEY and GILLINGS, 2002). Then, all of these variables, also known as *predictors*, are processed through a weighted overlay algorithm, producing a final outcome, keeping into consideration the different weights and scores expressed by each one of them. Subsequently, two different 'training' and 'testing' risk maps are obtained, both expressing three different levels of probability/risk of finding new archaeological sites, from level 1 (low risk), to level 3 (high risk) (Figure 1). Finally, the models have been compared and tested in order to assess their overall reliability (LANDESCHI, 2009).

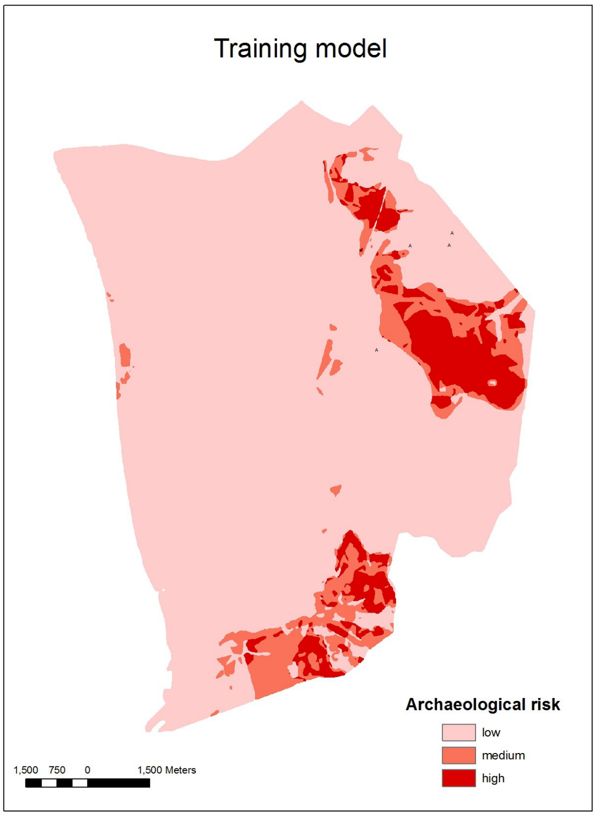

Figure 1: *Map of the archaeological risk.*

The predictive model, as well as the other thematic maps (land use, lithology), has been thus exported from GIS as VRML file and processed in order to be better managed by using XVR technology (CARROZZINO *et al*., 2005). Basically, this consists of a complete toolkit, which is meant to make users deal with different multimedia contents (3D, picture, audio files) in order to get a complete development environment where we can manage and integrate all of these data together. By the way, XVR users are provided with a tiny active-X control which enables them to easily upload on a web page their own contents, with the chance of making visitors navigate and interact with the Web3D environment. As for the Pisa coastal plain project, the archaeological record has been represented by using several 3D icons, each one of them standing for a specific site. Based on several shapes, each icon was meant to represent the original function of the archaeological site, whereas different colours were used to illustrate the chronological location (Figure 2).

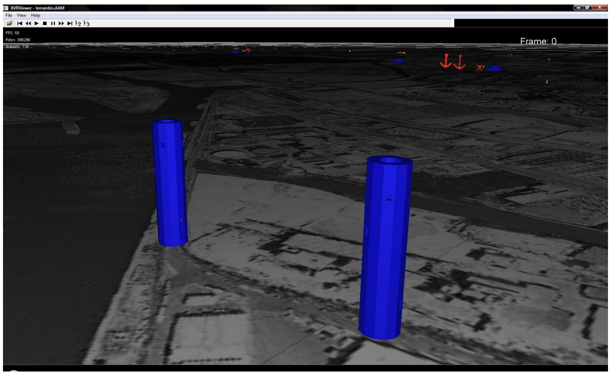

Figure 2: *Tower-shaped icons standing for medieval sites.*

Basically, the model obtained is an interactive-3D space where the final user can experience, just by opening a web page, a real-time navigation across the study area, where seeking and finding information about the archaeological record; furthermore, an integrated set of layers helps, on the one hand, the final user to improve his knowledge about the real space in which the sites are located, and on the other hand, the scholars to better address the historical questions related to the archaeological landscape in order to try to make predictions about the most risk-affected portions of land in the territory (Figure 3).

Conclusions

The widespread of Web technologies, has deeply affected also the way in which cultural contents can be accessed. The setup of an interactive, real-time tool for a more effective communication of archaeological information to a broader audience is something that is worth being analyzed, especially when it is based on the use of an innovative set of tools for enhancing the deployment of 3D contents on the Web. Moreover, such a technology could be a good means also for testing the real effectiveness of a predictive model, as it would be available for a lot of bodies, such as archaeological superintendences, urban planners, and anyone who is dealing with the management of archaeological risk in a specific territory. In fact, this tool lets the final user to intuitively observe, question, analyze the territory and know in advance which areas require a greater and more careful control, or in which portions of the land future archaeological investigations are more likely to guarantee success, or which are the most appropriate areas for planning new infrastructure works.

Figure 3: *Web-based model of the Portus Pisanus area.*

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