Proceedings of the 38th Annual Conference on Computer Applications and Quantitative Methods in Archaeology, CAA2010
F. Contreras, M. Farjas and F.J. Melero (eds.)

Landscape and Virtual Archaeology: VisArq 1.0

Diarte, P.[1], Sebastián, M.[2], Guidazzoli, A.[3], Delli, F.[3], Diamanti, T.[3]

[1] Dpto. Ciencias de la Antigüedad. Grupo URBS, University of Zaragoza, Spain.
[2] Dpto. Ciencias de la Antigüedad. Grupo PPVE, University of Zaragoza, Spain.
[3] VIS.I.T Lab.CINECA.Casalecchio di Reno, Bologna.Italy.
diarte@unizar.es, msebas@unizar.es

VisArq.1.0. is an informatic application that links remote archaeological sites and dispersed throughout the area of the province of Zaragoza. The creation of a homogeneous and normalized database with its respective viewer is the ultimate aim of a project that was born to cover the needs of the academic-scientific world, but also of the less specialized public. The advantage of this application involving virtual reality is also that citizens can check on a "single window" all this archaeological heritage, an important issue for a discipline such as archaeology, where the display information is fundamental to archaeological theory and practice.

Keywords: 3D viewer, interactive information, digital elevation model, geodatabase, graphic reconstructions.

1. Introduction

Recent years have witnessed the increasing need to create a homogeneous and interactive system for the management and implementation of archaeological information in the province of Zaragoza (Spain). Faced with this situation, the Department of Antiquity Sciences of the University of Zaragoza decided to develop an application that would fill this gap. It was with this intention that 'Vis.Arq.1.0.' was created, a tool that is both a 3D viewer of the province's cultural heritage, as well as an exhaustive database, which facilitates a rapid overview of the archaeological landscape and the analysis of the sites' related documentation.

With a digital elevation model (DEM) we are able to geographically contextualize each municipality, turning them into the main information nodes. Information (images, written documents, three-dimensional models, etc.) from the archaeological sites found in the province is accessed through the three-dimensional data of the municipalities.

2. Aims

The creation of a protocol for the systematization and management of site information is an important step in the development and consolidation of archaeological research. It is well known that the contingency and heterogeneity of the data is a major problem for comprehensive and global analyses of archaeological areas. The possibility of contextualizing studied sites – geographically and archaeologically- will considerably ease the work of archaeologists. Furthermore, if the database promotes a more extensive dissemination of the archaeological information, then the fundamental objective will have been fulfilled.

The general aim of this project was to create a database of the archaeology in the province of Zaragoza that would be coherent in its form and content, and which could also be used as a 3D or 2D viewer (according to need) of the whole area under study. The end result is a geodatabase that displays the archaeological wealth of the province of Zaragoza in a visual and dynamic way (HERMON, 2008).

3. Methodology

Graphic reconstructions and Virtual Reality environments have been used with increasing emphasis in scientific projects of diverse nature. Their application to heritage sites has been very welcome in the last few years, since they facilitate the comprehension and inter-relation of heterogeneous data. The cultural and eco-nomic importance of what is here called ICT (Infor-mation and Communications Technology) has resulted in the rapid application of these systems to the field of archaeology, which *a priori* would not be included in the traditional humanistic formation of an archaeologist.

Hence, computer graphics presents itself as an excellent solution for the creation of a visual product able to offer the most reliable reconstruction of a monument or an archaeological object. Complex information and the archaeologist's interpretation (AVIS *et al.*, 2010)are combined in a graphic product that allows for the three-dimensional explora-tion of the model without altering

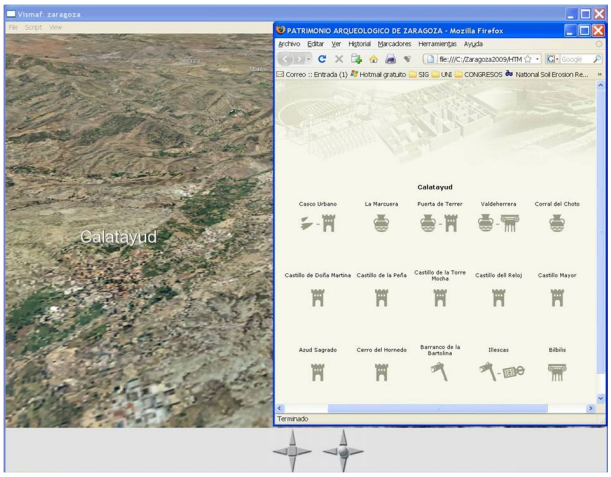

Figure 1: *Display of the digital elevation model and HTML of the municipality of Belmonte de Gracián and its associated archaeological sites. Observe the chrono-cultural icons used for the identification of each site.*

its shape. The digital model, must, and in fact does, make the archaeological data understandable, so that possible study scenarios become almost tangible. Our cognitive spectrum is widened, consolidated, aiding work with a visual basis.

This project therefore intends to function at different temporal and spatial scales (DIARTE y SEBASTIÁN, 2010), from the detailed analysis of archaeological materials to the general observation of the landscape, where the finds are located. Such a wide temporal and spatial spectrum is only undertakable by new technologies – thanks to the existence of a potent database, perfectly manageable by any computer-, with which we can gather ample historical information, both in detail and at more general scales.

As way of summary, there are four main courses of action or basic tasks we have completed:

3.1. Database design

The design of the database was done following the protocol of action for the introduction of information in a Geographic Information System (BURILLO, 1991). The data have been structured in: elements –simple units, defined according to our work scale- and attributes or properties –characteristics of the elements. The information available is organized so that each unit, unique and unmistakable, is defined in function of the values of its properties (attributes), its relations with other units (topology) and the mathematical procedures that describe the unit. Our elements –nodes- possess spatial characteristics, such as localization (*x, y, z* coordinates for each municipality), geometric and topological properties, as well as thematic (Fig. 2 and 4) ones (culture, function, type, bibliographic reference and photographic reference), which define them, combining both kinds of data in the analysis and display of the information.

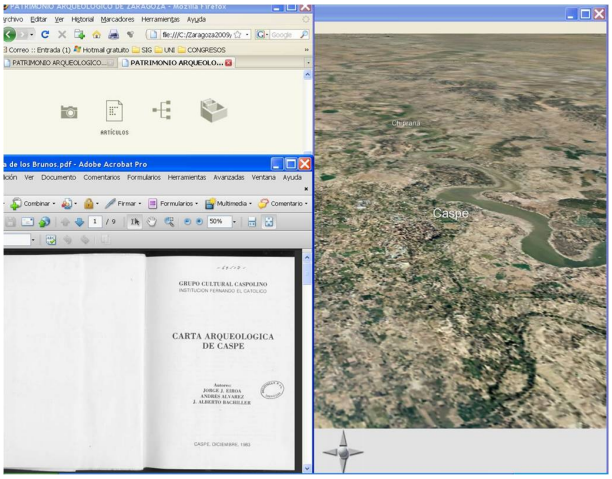

Figure 2: *Example of the documentary information linked to each site.*

3.2. Digital Elevation Model (DEM)

The DEM was created for a closer approximation to the reality of the analyzed territory. The basic unit of information in this model is an altitude value, z, accompanied by the corresponding values x and y, as shown in the geographic projection system UTM European Datum 30N for a precise spatial reference. The design of these interrelations configures the different options in the data structure, the choice of which is fundamental, because it completely conditions the future use of the information, transformed from heavy and illegible to a simplified and easily handled model. The main program used was ArcGis 9.3, specifically its extensions Spatial Analyst and 3D Analyst.

Once the Digital Elevation Model (Fig. 2) was created and corrected, we thought it necessary to superimpose the orthophotos of the PNOA (National Aerial Orthophotography Program), since we thought they would contribute more information to the landscape of the area, therefore bringing the reader closer to the analyzed reality.

3.3. Interactive information: HTML

For the connection of our database, which held filetypes -.pdf, .jpg, .xls and .avi, to the digital terrain model it was necessary to create a useful and intuitive interface (Fig.1) that would allow for an easy access to the whole information. The choice of the programming language HTML was justified in the first place by its lightness, and especially, because it enables to upload the final project to an Internet server, making it accessible to all interested users.

The information relating to the municipalities and their sites was programmed in an HTML language, excepting the images belonging to the chrono-cultural icons, which were created with a Java-Script image substitute. On the other hand, the image gallery (Fig.3) was configured with Java-Script and designed by CSS (Cascading Style

Sheets), which made it swifter and improved the viewing of the images.

3.4. Connection of the information (VISMAN)

Connection is not by any means an easy task. Besides there being no commercial software thought for applications dedicated to heritage sites, none of the existing software accommodated our needs. Fortunately, we had an open source software available, developed by the Vis. I. T. Lab. of the CINECA (Consortium of Universities, Bologna, Italy), created specifically for the management of heritage data. The software, named VISMan (Virtual Scenarios Manager), allows for the navigation of digital elevation models (DEM), as well as 3D models and GIS information (SEBASTIÁN *et al.*, 2010). By managing large amounts of data at the same time, it allows for the navigation of extensive landscapes at high resolution, while interacting with the database and thus offering a stereoscopic visualization.

VISMan was created from the open source graphic library OpenGl Scenegraph, available for Windows and Linux, and also used without any difficulty on other programs and diverse media. This factor is especially important, when considering that the final product will function both on a virtual support and on computers, like those installed in interpretation centres, or even at homes. VISMan therefore permits the navigation of the different levels that make up the application (from the area of the province of Zaragoza to the last level, i.e., the archaeological record sheet) (AVIS *et al.*, 2010; DIARTE, 2007; GUIDAZZOLI and DIARTE, 2009). The application also holds the database information, represented, queried, and shown in a straightforward manner, facilitating its use, much as if it were a videogame, although a videogame of high scientific content. An intuitive mode of navigation has been created, which considerably increases the efficiency and usefulness of the application, while always preserving the complexity and the scientific nature of the sources. The navigation and query interface is 'open' and also accepts data organized in preexistent structures.

4. VisArq.1.0: management and display

The direct interrelation of the four tasks exposed above led to the creation of an intuitive and precise application that perfectly combines the necessary tools for the management and display of archaeological data. The final result, VisArq. 1.0, is an optimal solution, both for science and the dissemination of knowledge, and in this specific case, of the archaeology of the province of Zaragoza. Furthermore, one of its main advantages lies in the use of open source software, which allows its application to any region or country.

In summary, VisArq. 1.0 acts like a 3D navigator over the province of Zaragoza, displaying the characteristics of its landscape, from which we access the archaeological information.

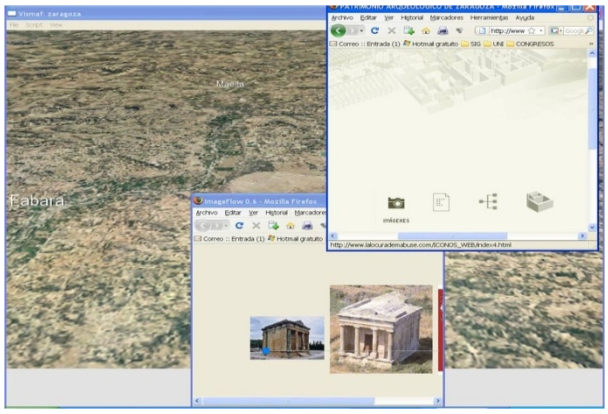

Figure 3: *Example of the fotographic archive linked to each site.*

5. Conclusions

Faced with an increasing volume of archaeological information and the use of new technologies, we have considered it necessary to create a protocol of action for the management and later use of such information. The creation of a homogeneous and normalized database with its respective viewer is the ultimate aim of a project that was born to cover the needs of the academic-scientific world, but also of the less specialized public. Benefiting from computer innovation and virtual reality, with increasingly 'real' and intuitive interfaces only improves the accessibility and comprehension of archaeological studies. Thus, interactive databases, used scientifically and for dissemination (FORTE, 2008; GAINI *et al.*, 2005), will promote the value of sites. VisArq. 1.0 offers precisely this, a visualization of archaeological information and a protocol of action, which in its first version attempts to be the beginning of a modus operandi, in which the standardization, unification, and display of data is the ultimate aim.

Cultural heritage projects tend to be undertaken by individuals or small work groups that have exclusive access to the information and dissemination of the obtained results –according to convenience-. This situation impoverishes analysis and knowledge transfer. What can be changed in culture research projects?, and, to what extent can virtual archaeology contribute towards this? The transfer of sources, the dissemination

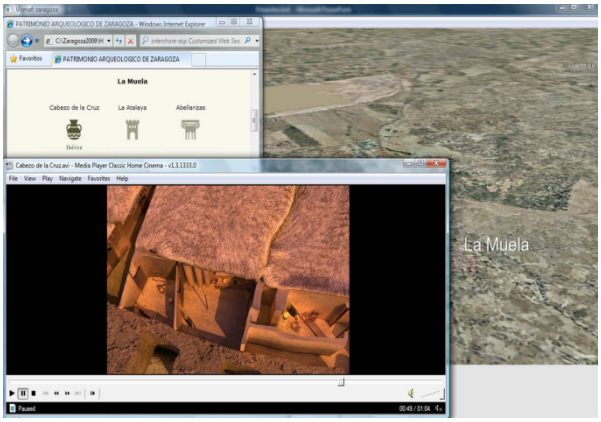

Figure 4: *Example of the 3D model view of Cabezo de La Cruz (La Muela, Zaragoza).*

of critical information and the compromise to work towards the standardization of data will be fundamental for the creation of a new state of affairs in the production of knowledge, through shared development processes and combined analysis.

Today, the dissemination of open source systems in the cultural sphere is contributing towards the renovation of research methodology. The preparation and introduction of data from the real to the digital world is a tedious and complicated job, because of the large amounts of data generated. These difficulties are softened by the progressive development of computer techniques, although there is still a long way to go. This process takes up to 90% of the total worktime of any research project, something which is not usually valued, even though results rely to a great extent on the precision and quality of the data. With the support of the Public Administration, similar initiatives could lead in the future to an increase in the standardization in the collection of data (PLENTICKX, 2004), which would in turn ease the documentation and analysis of archaeological sites, therefore also contributing to a much needed global picture of the archaeological wealth in the area. Nevertheless, we would also like to point out that unfortunately collaboration from other institutions, such as Town Councils, local Studies Centres, the Regional Council of Aragón, and the Provincial Museum of Zaragoza, has been quite scarce, hindering our work greatly. With a more active participation from these institutions, the project would have obtained a more complete database. We would like to finish by highlighting this point, since it is our firm belief that initiatives such as ours, which bear no commercial interest, will only benefit universities, scientific institutions, and public administration in general, and signify an important step forward in making archaeological resources accessible to the members of the public, and not less importantly, to the scientific community (BELLIDO,2001; COFÁN, 1994).

Acknowledgements

Our most sincere thanks to Professors Manuel Martín-Bueno and Pilar Utrilla Miranda for having believed in this project from the beginning and to Dr. Ángel Pueyo Campos for his time and advice. We of course would also like to thank Cuarto Espacio services of the Provincial Council of Zaragoza, since this paper is a part of the research project: 'Zaragoza y su patrimonio arqueológico: escenarios virtuales interactivos y datos tridimensionales', granted with the 2009 research awards of Zaragoza Provincia, Cuarto Espacio of the afore mentioned Council (Diputación Provincial de Zaragoza).

References

ALVISI, C., DIARTE, P., GUIDAZZOLI, A. y VENTURA, M., 2010. Sistemi integrati di visualizzazione e fruizione dei dati: verso il corpus degli apparati decorativi di Ercolano. In in I. BRAGANTINI (ed.), *Atti del X Congresso Internazionale dell'Aipma (Association Internationale pour la peinture murale antique)*, Naples, pp.899-902.

BELLIDO, M.L., 2001. Museos virtuales y digitales, *Revista de Museología nº21,* 2001., pp.41-47.

BURILLO, F., IBAÑEZ, E.J., 1991. Configuración de la Base de Datos y Ficha informatizada del Proyecto Carta Arqueológica de Aragón, 1990. *Cuadernos del Instituto Aragonés de Arqueología, I*. Teruel.

COFÁN, F., 1994. La revolución informática: cómo los avances tecnológicos están cambiando los Museos. *Revista de Museología, Nº 3,* 1994 , pp. 32-36.

DIARTE, P., 2007. The DHER project and Virtual Archeology. *Science and Supercomputing in Europe. Report 2007,* Bolonia, pp.728-731.

DIARTE, P., SEBASTIÁN, M., 2010. Hacia un nuevo concepto de gestión de datos arqueológicos: tratamiento de la información y visualización, *Salduie, nº 8, pp.113-120.*

FORTE, M., 2008. Virtual archaeology: communication in 3D and ecological thinking. *Beyond Illustration: 2D and 3D Digital Technologies as Tools for Discovery in Archaeology,* BAR International Series, Oxford: Archaeopress, pp.20-34.

GAIANI, M., MICOLI, L., 2005. A framework to build and visualize 3D models from real world data for historical archi-tecture and archaeology as a base for a 3D information system in FORTE, M. (Ed.), *Proceedings of the 2nd Italy-United States Workshop,* Berkeley, USA. BAR International series, 1379, pp.103-125.

GUIDAZZOLI, A., DIARTE BLASCO, P., 2009. Escenarios virtuales interactivos y su aplicación a la Arqueología. El Proyecto DHER: una propuesta de trabajo, *Salduie, nº 7,* pp.113-120.

HERMON, S., 2008. Reasoning in 3D: a critical appraisal of the role of 3D modelling and Virtual Reconstructuions in Archeology. *Beyond Illustration: 2D and 3D Digital Technologies as Tools for Discovery in Archaeology*, BAR International Series, Oxford: Archaeopress, pp.36-45.

PLETINCKX, D. et al., 2004. Telling the local story: an interactive cultural presentation system for community and regional settings. P*roceedings VAST 2004*. pp. 233-239.

SEBASTIÁN , M., URIARTE , M., ANGÁS, J., MARTÍNEZ-BEA, M., 2009. Documentación sistémica del arte rupestre mediante el análisis espectral del escaneado 3d de las estaciones pintadas en Aragón, España. el caso concreto del abrigo de la vacada y el Covacho del Plano del Pulido, *I Congreso Internacional de Arqueología e Informática Gráfica, Patrimonio e Innovación, Sevilla*, 17-20 de junio de 2009, Sevilla, pp.189-193.