

# ViSMan-DHER: a Virtual Archaeology Application for Visualization and Management of Archaeological Data Related to ancient Herculaneum (NA), Italy

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## Abstract

*This work aims at presenting a case-study application of ViSMan (Visual Scenarios Manager), an open-source framework developed at Cineca for visualization and interaction with virtual scientific models connected to digital archives of data.*

*ViSMan has been used for the visualization of a digital model of a roman house, realized by the Università di Bologna within the DHER (Domus Herculaneensis Rationes) Project. The application allows navigation through several scenarios (the Campanian landscape, the archaeological areas of Pompeii and Herculaneum, some reconstructed houses) and a direct link between the models and a rich digital archive, consisting in old and new photographic documentation of insulae, houses, rooms and wall decoration details, former excavation and restoration reports, and more archaeological data about the reconstructed structures. Most data come from the Archive of the Soprintendenza archeologica of Pompeii and cover many houses in the two archaeological areas.*

*Reconstructed structures were used as a spatial interface for visualization and analysis of the collected data managed through a relational database.*

Categories and Subject Descriptors (according to ACM CCS): I.3.6 [Computer Graphics]: Methodology and Techniques I.3.7 [Computer Graphics]: Three-Dimensional Graphics and Realism—Virtual Reality

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## 1. Introduction: Virtual Archaeology for research and communication (A.C., A.G.)

The use of virtual reconstructions in archaeology, as well as in Cultural Heritage, is gaining increasing importance both in scientific research and in communication. While it is now possible to easily implement interactive virtual environments for communication of cultural sites (see e.g. <http://www.vhlab.itabc.cnr.it/>), we think that virtual reconstructions will prove to be valuable tools for scientific visualization, analysis and organization of data.

Today the scientific research in archaeology is characterized by a “dramatic growth of information”: the heuristic process, i.e. the evolution of not selected data (pre-knowledge) in selected information (knowledge), is becoming more and more difficult [Fri08] [For08]. Virtual Reality can be a valuable resource integrating the scientific research, not only as a useful, but unnecessary, communication tool, but also, and mainly, as a heuristic tool [For08]. In other words, with Virtual Reality applications, archaeological communication can fully develop the potential for understanding of the evidence.

Features of a scientific virtual model may include real-

time interaction, linking between elements and multimedia documentation about the research process, supporting of abstract data mapping, such as dimensions, morphology, spatial relation between elements, while allowing spatial simulation and testing about statics, visibility, lighting, capacity, use... and allowing interactive handling, display and check of data rather than simple movement [Bar00]. It may as well allow understanding of information and relationships otherwise not too clear, and preservation of contextual data [FB00].

Most Virtual Heritage applications and Research Programmes recently tend to focus on open-source resources, to meet their financial needs and cope with cooperation, flexibility, long-term preservation and interoperability issues (see for example the European Project EPOCH).

In the DHER (*Domus Herculaneensis Rationes*) Project we decided to create and optimize virtual models to be used as spatial interface providing access to complex archives of documentation at distinct levels.

## 2. ViSMan: a framework for visualization and

### management of scientific data (A.G.)

ViSMan (*Virtual Scenarios Manager*) is an open-source software developed at Cineca ([www.cineca.it](http://www.cineca.it)). It is a powerful tool, written in C++ and based on OpenGL, providing visualization and interaction with virtual scientific models connected to digital archives of data [BCD\*04]. ViSMan has been developed from the open source graphic libraries OpenGL Open Scenegraph, in C+++, a language that allows low-level operations that are sometimes necessary to handle 3d graphics. ViSMan is basically an advanced, open-source viewer for 3D data, providing a simple video-game like browsing experience and some advanced features, such as collision detection and switching between different virtual environments. Furthermore, 3d objects in the scene can be connected through a unique identifier to one or more records in relational databases, that means by clicking on object or part of it on the stage, you can have access to multimedia contents (HTML, text, images, videos, web-pages or anything else) associated with that element.

A key aspect of the software is its modular architecture: new information and new types of data can be included fast and easily even by non-experts, simply adding files in standard 3D formats (like OSG or IVE) or compiling and modifying a suitable database, that can be obtained from Microsoft Access or other commonly used softwares.

### 3. DHER Project: the needing of a data management system (A.C., D.S.)

This project is part of the Vesuviana program, started in 1997 at by the University of Bologna ([www.unibo.it](http://www.unibo.it)) in collaboration with the Soprintendenza of Pompeii and Naples [CorV07] [Cor09]. The main research projects developed within the program are Pompeii - Insula del Centenario (IX, 8) and DHER - *Domus Herculaneensis Rationes*. With the first project (1997-2005) a detailed and multidisciplinary analysis of the evidence from the Insula IX at Pompeii was carried out encompassing also an accurate archives survey, while the DHER project (2005-2010) focuses mainly on the study of the housing culture in Herculaneum. Some houses in Insula III (House of the Skeleton, House of the Bronze Herm, House of the Wooden Partition...) have been studied more in depth, and under different aspects.

Data acquisition was performed by archaeologists, specialized in archives research, in archaeometry and in the study of materials, topographers, geologists, conservators, structural engineers and multimedia technology specialists, including filmmakers. These activities, organized in an interdisciplinary and experimental way, with strong education and training purposes, resulted in a huge amount of data, both recorded on the site (e.g. measures and photogrammetry of standing structures) and recovered from archives that were taken into account for analysis and restoration (such as detached pictures, which attested the damages occurred over the decades). Dealing with such a vast and complex amount of evidence requires an approach

that allows to interconnect information, providing an easy, synoptic access to the interlinked external data and analyzed structures

### 4. DHER-ViSMan application (A.C., E.T.)

The purpose of the ViSMan-DHER application is to make visualization and query into the rich archive of data, collected throughout the DHER project, available not only to specialists involved in the project, but also to other researchers, students and specialists.

To meet these requirements, ViSMan-DHER was structured in two parts: a group of virtual models (OSG format was used) representing the archaeological contexts associated to the data, structured in Scenarios and containing Nodes; and a relational database containing reference to Nodes and to the corresponding items in an archive of images, texts and documents.

Two concepts need to be explained to understand how the application is structured:

1. The **Scenarios** represent a whole virtual environment that has been modeled; some Scenarios currently included in ViSMan-DHER are: the Campanian Landscape, the archaeological areas of Herculaneum; and Pompeii, the House of the Skeleton, the House of the Bronze Herm...;

2. The Node represents a virtual model or a portion of it (i.e. a group of geometries, a solid or a plane) inside a Scenario that has been associated and linked to one or more external data; for example the simplified reconstruction of Insula III (positioned in the "Archaeological area of Herculaneum" Scenario) is a Node, associated to historic photographic documentation as well as to graphical documentation items;

The following categories of data were included in the application:

- Decoration: Photomaps
- Decoration: Analytic description
- Excavation journals
- Findings: Analytic description
- Findings: Photographs
- Graphic documentation from the Archive of the Soprintendenza
  - Photographs from the Archive of the Soprintendenza: Foglia, 1992
  - Photographs from the Archive of the Soprintendenza: historic photographs
  - Restoration reports, 1996
  - Survey data: Masonry Stratigraphic Units (USM)
  - Survey data: Photomap

Types of data are JPEG images, TXT text files and

PDF documents, although further format are supported by ViSMan and might be included in the future.

Since the data encompassed are related to different contexts (from the territory to a single wall-painting) a hierarchy of Scenarios with growing level of detail has been devised for visualization. Every different context gives access to a dedicated portion of the database, with the possibility to vary information detail depending on the reconstructed level that the user is exploring. A standard navigation of the application could be the following: navigation of the territory DEM, choice of one archaeological area (Pompeii or Herculaneum), visualization of the representation of the city, including some Nodes (Insulae and houses), query to the database to know which data are available for a certain Node, visualization of the data (e.g. images), switch to a new Scenario (a reconstructed house), query and visualization of data associated with single walls or rooms. Switching between Scenarios is achieved by clicking elements (usually labels) inside the 3d model, while data associated to a node can be queried by clicking directly on it and selecting the type of data required from a list of choices.

#### 4.1 House of the Skeleton (A.C., D.S.)

The so-called House of the Skeleton presented a unique situation. Data generated from architectural survey and masonry analysis were particularly rich for this building, consisting of geo-referencing operations, surface and volumetric survey, monoscopic and stereoscopic photogrammetry of wall surfaces, mapping of Masonry Stratigraphic Units with their restorations and modern integrations.

In this case, however, pre-existing data included also a detailed and realistic 3D-model, realized from the combination of survey and photogrammetry. Consequently, the model was optimized (using 3D Studio Max and later Blender) for real-time visualization and integrated into the application, thus becoming at the same time the representation of the survey and photogrammetric data, and an intuitive spatially organized interface to other data.

Even in this case it was necessary to choose a “unit” for data visualization, therefore each wall surface was treated as a unit - that is, it was marked as a Node in the OSG file - and linked to the available types of data for that area of the building.

The ViSMan-DHER application allows free navigation into the House model, the creation of view-points, ground- and wall-collision detection, and of course queries and visualization of connected data.

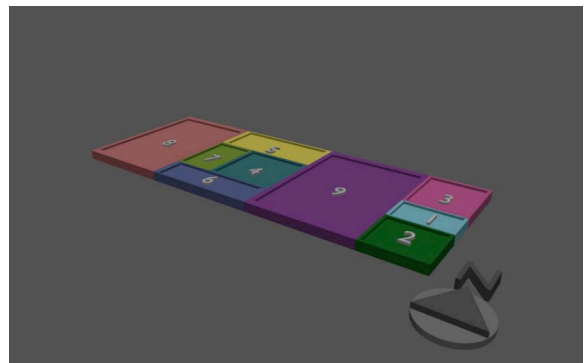


**Figure 1.** *Data visualization through the virtual model in the Scenario House of the Skeleton*

#### 4.2 House of the Bronze Herm (A.C., D.S.)

For the House of the Bronze Herm we had to deal with a different situation. A realistic 3D model did not exist, and it made little sense to undertake its realization only to display the data recorded. However, archive and field data were interesting, although less rich than in the above mentioned houses. In this case - a smaller and less complex building – it seemed that a single room would have been more significant as far as its level of detail about data organization and visualization than the single wall.

This is certainly the most common situation for the studied structures in Herculaneum and Pompeii, so the solution in this case had to be simple and flexible and allow future application to further case-studies.



**Figure 2.** *Scenario House of the bronze Herm*

Eventually we chose to model a simplified representation of the building, just extruding its plan, and keeping the division into rooms as different Nodes, since we believe that a virtual model should be first realistic and complete – in order to allow further research and that functionality and effectiveness as a representative model comes second, provided that spatial and context information and relationships are conserved.

### 5. Fruition and publishing opportunities (E.T.)

Initially a proposed solution for public display was a double frame, providing users with two monitors: one for interactive navigation of the three-dimensional models, the other to display and query the database. The whole system is multiplatform and is currently accessible from PC and also in immersive computer-graphic environments, such as the Virtual Theatre at Cineca.

Future development in distribution will include publication as a stand-alone application on CD-ROM, and experimentation of new channels for distribution. In particular, other projects realized with ViSMan have shown that on-line hosting of the 3D models, database and contents are an effective channel for communication, and allow great personalization of the interface, and also integration or linking to existing projects and institutions (see e.g. <http://muvi.cineca.it/>, <http://www.certosadibologna.it/>).

### 6. Conclusions (A.C., A.G.)

The successful implementation of ViSMan-DHER shows that Virtual Reality can indeed develop into an effective research tool for historians and archaeologists, since it allows visualization - in some cases simulation as well - of concepts and relationships that would otherwise be confined to the imaginary, while ensuring the scientific accuracy of historical reconstructions [ADD\*09].

Moreover, new technologies in data management and visualization are valuable resources for teaching and disseminating Cultural Heritage, provided that they are included in research projects, as in this case, from the beginning.

Next step could encompass a quantitative growth in content information, with the integration of data pertaining to new houses, as well as creation of new typologies of data, implementation of more complex queries in the database, or greater freedom for the researcher/user on data display. From a technical point of view, interface/interaction issues and portability over the Web seem to be the main aspects to focus on.

Finally, previous experiences carried out by VisIT Lab (Cineca) in the field of Virtual Reality applications took us to the conclusion that we should start evaluating educational effectiveness of these tools with the support of cognitive psychology methodologies. Also in this sense, a migration of the application to the Web would provide access to a much richer range of tools for user profiling and usage evaluation.

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