

# Virtual Archaeology: Yesterday, Today, and Tomorrow

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**Abstract.** This is the position paper for the session entitled “Virtual Reconstructions in Archaeology.” The paper offers a brief overview of the current status of the field of Virtual Archaeology both as a summary of where we are and as a lead-in to the new trends and approaches evident in this session’s presentations. The paper also reviews the unique new organization, the Institute for the Visualization of History, formed to address some perceived deficiencies in the acceptance and expansion of Virtual Heritage projects.

Understanding the distant past is not easy. We weren’t there. With apologies to Tommy Lee Jones and MIB (the movie Men in Black), 500 years ago we could only muse about how surviving texts from the past might connect with the few known relics from the past. One hundred years ago, we had only photography and hand-drawn sketches to record new finds and make sense of our interpretations.



**Fig. 1a.** Drawing of the Nike Temple, Acropolis, Athens, as seen by ... in the 19th century.



**Fig. 1b.** Photography of the Nike Temple, Acropolis, Athens, as taken by ... in the 19th century.



**Fig. 2a.** Rendering from the virtual world of the ancient Fortress at Buhen, Egypt; built in 1993 by Bill Riseman and Donald H. Sanders.



**Fig. 2b.** Rendering from the virtual world of ancient stone circle of Stonehenge, England; built under the direction of Robert Stone, English Heritage, with Intel Corp. and Intergraph corp. in 1995.



**Fig. 3.** Merging site photography with site plans as the basis for an interactive re-creation of excavation progress; image from the Learning Sites digital excavation report of Tsoungiza, ancient Nemea, Greece.



Fig. 4. Rendering from the Learning Sites virtual world of the West House, Tsoungiza, ancient Nemea, Greece.

Ten years ago, we had 3D computer graphics, but at a steep price Today, we have 3D laser scanners, GPS, GIS, and numerous real-time visualization techniques. Given this pace of change, just imagine what we will have tomorrow. Understanding the past using technologies of the past makes things only a little bit clearer.

However, we now have new abilities to look through the mists of time and try to see things not possible just a decade or so ago The talks in this session exemplify various current issues in the field of Virtual Archaeology (VA) and its parent discipline, Virtual Heritage (VH). Many of these trends and issues find their roots in papers and discussions offered six years ago when, at the Barcelona CAA meetings, the first coordinated sessions devoted to Virtual Heritage were held Coincidentally, I chaired those sessions, as well. I have been involved in Virtual Archaeology for over ten years, and yet that Barcelona conference was in many ways the beginning of international recognition of the importance and potential benefits of applying the, then new, virtual reality (VR) technologies to the specific problems of archaeology. Some of those problems include: the difficulties of accurate data gathering, the subjective nature of data interpretation, the constraints of publishing images, the exasperating time lag between excavation and publication, and the problem of how to envision the past in more than just two dimensions, accurately, precisely, and in sufficient detail to arouse interest

in students and to permit colleagues to truly understand the complex issues of culture change.

Since the Barcelona CAA conference, Learning Sites, Inc.'s founding and hosting of the Virtual Worlds in Archaeology Initiative, and the subsequent book of papers from those pioneering Virtual Heritage sessions, there has been a dramatic rise in the number of projects actively synthesizing VR and related 3D graphics techniques into archaeological excavation, reporting, and teaching (from about a dozen worldwide VH projects then to over 100 today). A vast majority of these new projects emerge from active university departments and laboratories with the tools, the field projects, and the staff to continually question the directions, methods, goals, and effectiveness of the Virtual Heritage discipline. Other projects arise from companies, such as Learning Sites, and large multinational corporations with leading-edge programming departments, such as IBM and Intel.



Fig. 6. Composite image from the Learning Sites virtual world of the Northwest Palace, Nimrud, Assyria (Iraq), showing image databases that are linked to objects in the virtual world, and how wall reliefs in the virtual world are created directly from the surviving remains.

There has also been noticeable progress in the application of diverse new technologies to VH since Barcelona, especially in the wider use of augmented reality, laser scanning, image-base modeling, and GIS-based datasets.

These techniques have broadened the ways in which Virtual Heritage can integrate data from existing remains directly into virtual re-creations. VRML continues to be the output format of choice by practitioners, despite problems in the availability of interoperable VRML viewers (some do not have any Java support, some do not have any versions for Apple computers, some do not load well into the newest Web browsers, and there is still no consistent adherence to the VRML 2.0 specifications among the viewers). VRML prevalence is interesting given the supposed potential of X3D, Java3D, and numerous proprietary corporate interactive 3D visualization tools (such as those from Kaon, Adobe, MindAvenue, Demicon, Macromedia, and some that come integrated with higher-end CAD packages). Advances over the past few years has, thus, also led to fragmentation and the unfortunate lack of standards among the technologies available to VH developers. However, despite the gains in Virtual Heritage, there are still some bothersome aspects. I have talked about some of these

**Computer Applications in Archaeology**  
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In Barcelona we are going to begin a new cycle, and consequently we propose to all possible contributors to send papers on new techniques and new problems. Archaeology must become a mature science, and it needs new theories, new techniques, and new technologies to have success.

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  - Heritage Management and Discussion
  - Learning and Training

**SPECIAL SESSION**

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Virtual Reality for Archaeology

Virtual Reality is much more than a "fashion" in archaeology. Everything in archaeology is an "image", therefore image processing is one of the main tasks necessary in archaeology.

In last years a great deal of work has been spent trying to produce reliable reconstructions of ancient towns and landscapes using computer methods such as 3D modelling and animations. Although they are very interesting some of these "reconstruction projects" are not well known by general audiences.

A salient session of CAA98 at Barcelona will be the

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Here, all interested audiences will see archaeological reconstructions and animations from very different sites from all times and regions.

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CAA'98

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FOR MORE INFORMATION ABOUT ANY ASPECT OF THE CONFERENCE, PLEASE, CONTACT

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Fig. 5. One page of the brochure announcing the Barcelona CAA virtual archaeology sessions.

at other CAA (Sanders 1999), VAST (Sanders 2002), and VSMM (Sanders 2001) conferences, but they bear summarizing as the basis for continuing discussions and as the foundation for future project goals.

These irksome points are:

- the lack of archival standards and globally accessible databases of past virtual worlds and the lack of plans to secure current models for the certainty of upcoming changes in display software and hardware;
- the paucity of museum and visitor center exhibits that make use of interactive 3D reconstructions;
- the continued poor quality of digital re-creations of the past used on television and in movies, especially in view of all the work done around the world by VH experts; and
- the lack of truly fully digital excavation reports that use virtual worlds as the index to information in order to create a completely new kind of research resource recognizing the distinct value and advantages of interactive media over traditional static, codex-based publications and teaching tools.

The staff at Learning Sites have a solution to offer that addresses these deficiencies in the acceptance and wider application of Virtual Heritage.

We have formed a nonprofit organization called the Institute for the Visualization of History, Inc. ([www.vizin.org](http://www.vizin.org)).

This unique educational endeavor has been created to address many of the current issues in the field. For example, we address the data preservation issue through our Digital

Archive, which will allow for the long-term storage and retrieval of all types of VH data. The Archive will also house legacy computer systems to ensure that virtual worlds created years ago can once again be viewed and experienced and will offer a data migration service to upgrade worlds on demand.

We address the lack of integration of interactive content into schools curricula and museum exhibits through our VIZIN® Gallery, a public facility with high-end immersive display systems providing near first-hand experiences of historic places and events for school field-trips, for linking our digital exhibits to regional museum shows, and to allow the public to experience virtual reality and step into history.

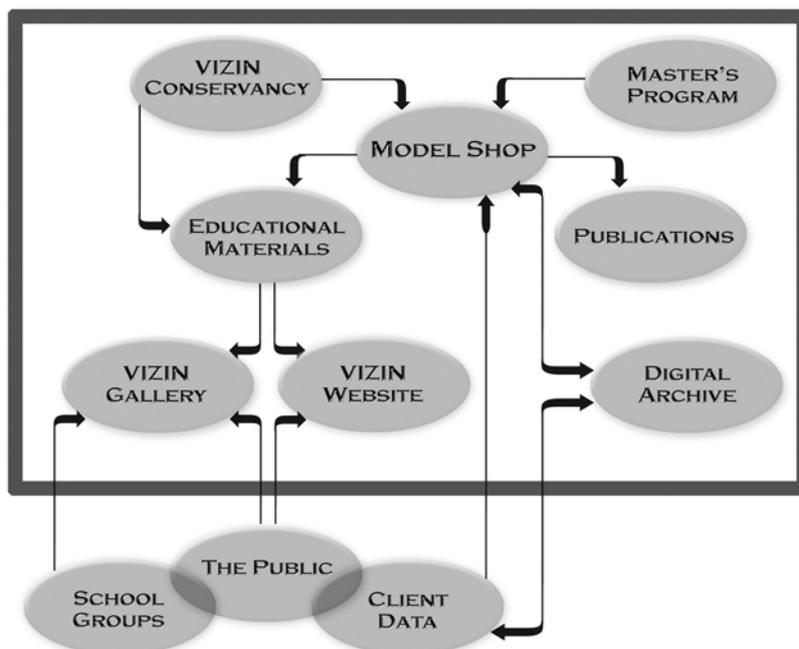
We address the waves of poor-quality graphics about the ancient world by forming alliances with global public television companies to provide scholarly, accurate, and highly detailed re-creations of the past.

We address the lack of innovation in scholarly publications by developing and distributing our own VR-based excavation reports through our ongoing collaborations with field archaeologists and their analyses of their excavated remains.

We address the issue of educating the new generation of content providers by offering the first comprehensive Masters Degree program in Virtual Heritage taught by the professional staff at the Institute as well as guest lecturers. The MVH is a one-year degree program with intensive courses, labs, and seminars on all aspects of virtual heritage, including computer graphics and programming, archaeological and historical data interpretation, visualization and perception, and documentation and preservation.

### THE INSTITUTE FOR THE VISUALIZATION OF HISTORY

Organizational chart showing how data and contacts flow within and beyond the Institute.



**Fig. 7.** The Institute for the Visualization of History, Inc., organizational chart.

Other VIZIN departments were developed to form a unifying approach toward the use of interactive 3D graphics for the study, teaching, publication, and experiencing of history, of all periods and locales.

By expanding the scope of our work beyond traditional Virtual Archaeology issues, the Institute has been able to push Virtual Heritage into new applications.

For example, some of the current Institute project themes include:

- Providing new tools to underwater archaeologists for the visualization, interpretation, and publication of their data. Underwater archaeologists have different excavation circumstances that present problems quite distinct from dirt archaeology, such as inability to go back to the site at will later, difficulty obtaining good color photographs due to the water, particles in the water, and absence of natural light, and difficulty appreciating the entire site from a distance.



Fig. 8. Screen grab from the virtual world of the Tantara Shipwreck, Tel Dor, Israel, digital publication project by the Institute.

- For the publication of the Tantara, Israel, shipwrecks, the Institute is developing a unique combination of virtual recreations of the wreck site, links from wrecks to a database of images and text, and a cross-platform interactive format.
- Trying to help determine the precise manner in which ancient sailors stacked cargo in their ships. The original embarkation configuration methods are unknown, but amphora wrecks throughout the Mediterranean are

common, as pottery survives, but the wooden ships carrying it often do not. However, we can use interactive technologies to seek solutions. We can work from the existing remains and from full vessel and artifact reconstructions and both sink and wreck the reconstruction and also “clamshell” back together existing ship hull and cargo remains and test various scenarios until we find configurations in which cargo patterns match. The solutions will allow underwater archaeologists determine vessel type and size from assessments of sea bottom amphora scatters.

- Working with deep submergence exploration teams to help them visualize geologic processes by integrating information from new and diverse datasets, as from autonomous underwater vehicle sonar, high-definition underwater video, and geophysical probes. We are currently in collaboration with a nationally known research laboratory on efficient data conversion techniques.
- Developing new online educational materials through integration of a wide array of Internet-capable programming and visualization techniques.

The goal is to include as much data (text, images, and interactives) about the history of the city of Jerusalem as practical to inform students about local, regional, and worldwide events, places, people, and artifacts. The online package will include an excavation simulation game, interactive timelines, and dozens of 3D artifacts and architectural reconstructions

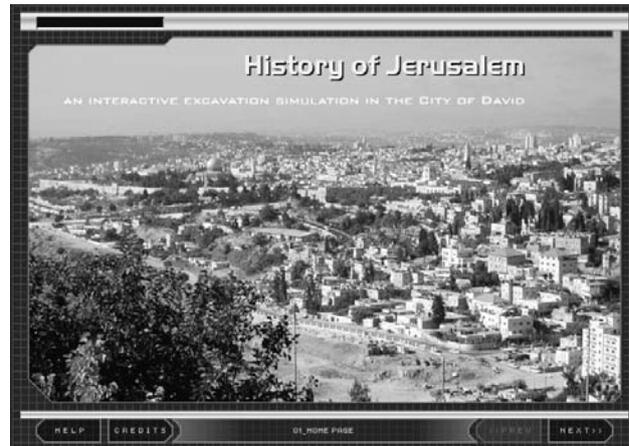


Fig. 10. Screen grab from the History of Jerusalem online educational package being designed by the Institute.

- Creating new tools for dealing with some vexing issues in VH, such as: (a) showing scale in virtual worlds; (b) providing users with means for distinguishing between what parts of virtual worlds are based on excavated evidence and what has been digitally reconstructed; and (c) providing access to external databases for personalized interactive research without having to leave the virtual world.

The other presentations in this session cover an even wider array of sites, issues, and technologies. The subjects of the talks offer a microcosm of the VH field as a whole, and the presenters offer alternative solutions to some of the issues that haunt the discipline.

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**CAAP 98**

Fig. 9. Images from the Kyrenia shipwreck (4th c. BCE) found off the coast of Cyprus; images copyright the Kyrenia Shipwreck Project.

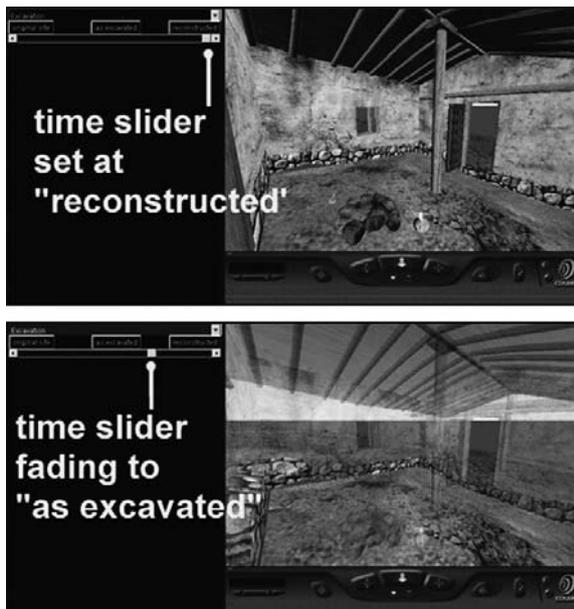


Fig. 11. Screen grab from an Institute project with a Java- and VRML-coded panel showing how a virtual world can be ghosted to compare as-excavated remains with as-reconstructed models.

Several recurring themes run through this set of papers, for example:

- several speakers focus on acquiring and transferring data directly from field remains to the 3D model as an important first step in the creation of an accurate and precise virtual environment;
- several speakers emphasize the usefulness of near photorealistic virtual worlds or renderings, either with or without the application of textures derived directly from surviving remains;
- several speakers discuss trends in the blending of GIS with VR techniques, generating a broader interdisciplinary approach toward more complete and archaeologically interesting virtual worlds, and
- several speakers suggest that the goal virtual archaeological world-building is conditioned by the needs of the end-user, whether at visitor centers, museums, or over the Internet and that the technological and intellectual needs of the end-user must be considered when preparing our models, textures, linked datasets, and presentation methods.

Given these repeating themes, the following questions about the efficacy of Virtual Heritage remain to be addressed:

- Is photo-realism a worthy goal, can it be achieved, and if so at what cost?
- How can knowledge about the end-user (whether other archaeologists, the general public, or students) influence our creation of virtual models and our development of adjunct materials with the virtual worlds? Should this be our concern, as archaeologists and historians, to presume to know how to develop these materials (or is their development best left to educators, with our support)?
- How can end-users most effectively evaluate and critique our virtual worlds, given all the data, software adjustments, visualization types, and interpretations that go into creating

and viewing the worlds, or even renderings generated from them? How do we train end-users to be critical, yet not judgmental when using our visualizations for their research, teaching, display, or publication?

- What are some of the more interesting digital tools that the VH community can create and then provide to archaeologists to help them interpret their evidence and thus the past (such as, pattern recognition capabilities to help re-assemble pottery or decorative elements from fragments, or automated aerial photo--GIS--virtual world interpretation tools; or artificial intelligence-driven worlds)? Can the VH community alone develop such tools for field archaeologists (or is this the purview of engineering labs)?
- When will VR software and game engines finally merge so that we can have the best of both approaches? Does the use of lower polygon, lower resolution game environments contradict the presumed move toward increased realism in our worlds? Can the rapid progress toward increased realism in both navigation and character interaction typical of today's games help guide tomorrow's heritage reconstructions and educational packages?
- Why is there still such resistance to the use of virtual ancient worlds for teaching, for publishing, and for public display? How can we change the situation? Or, to put it in the vernacular: if we build them, will they come; and if they come, will they pay?

Virtual Heritage has progressed far since the Barcelona CAA conference, but clearly there are many issues that remain to be satisfactorily addressed before the discipline can claim a coherent and comprehensive approach to documentation, preservation, education, or publication, and thus to acceptance by a wider audience beyond an insider group of practitioners. And we must strive for greater acceptance for the good of the world's rapidly vanishing heritage. Virtual Heritage should no longer be seen as a fringe approach to the understanding and visualization of history. Yet, for all its potential, the discipline remains somewhat fragmented and parochial in its application of the technologies available to it.

The answers to our persistent questions about the past will not emerge from reliance on methods of the past. The complexities of history will unfold only to sophisticated solutions, and the public will flock only to relevant and informative views of the past. Current work demonstrates that we are well on our way toward meeting those goals.

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