

Virtual Heritage: Living in the Past

Jeffrey Jacobsen and Lynn Holden
University of Pittsburgh

Abstract

Virtual Heritage (VH) is the use of electronic media to recreate or interpret culture and cultural artifacts as they are today or as they might have been in the past (Moltenbrey, 2001; Roehl, 1997). By definition, VH applications employ some kind of three dimensional representation; the means used to display it range from still photos to immersive Virtual Reality. Virtual Heritage is a very active area of research and development in both the academic and the commercial realms. (Roehl, 1997; Mitchell and Economou, 2000; Addison, 2000; Stone and Ojika, 2002; Champion, 2004b; Champion and Sekiguichi, 2004; Levy, 2004). Most VH applications are intended for some kind of educational use. While the main activity of virtual heritage is to create ancient artifacts, the real goal is to understand ancient cultures.

Most VH applications are architectural reconstructions, centered on a reconstructed building or monument. However, in the same way that archaeologists and historians study the artifacts because they are the primary cultural evidence we have, VH uses architecture as a frame for recreating ancient cultures. The larger goal of VH is to recreate ancient cultures, not as dead simulations, but as living museums where students/users can enter and understand a culture that is different from their own. The closest analog is the real-world living museums, where actors in period dress occupy a life-size historical setting and interact with the visitors. Ultimately, we would like to see the users themselves creating activities in the virtual space as a way of exploring different cultural viewpoints. For example, students who know about the Virtual Egyptian Temple (Jacobson and Holden, 2005) and the supporting material may attempt to recreate activities there. In doing so, they would learn about what is and is not possible in the architectural and cultural space.

In this paper we will begin by reviewing the issues and tradeoffs around building the architectural models for VH applications. These models are crucial in themselves and many of the issues involved in designing and creating them also apply to the dynamic and interactive aspects of VR. Then, we will touch on issues of how to bring culture to life in VR, the strengths and limitations for VR technology for VH applications. Finally, we will present the Virtual Egyptian Temple, our current project, as a working example.

Keywords: Virtual heritage, digital reconstructions, virtual reality, digital archeology, Egyptian archaeology, temple of Horus

Building the Models

For the researcher, high-quality 3D renderings of existing artifacts can make them accessible to a wider audience while preserving the often fragile originals, (e.g. a Neolithic cave painting). Three dimensional renderings are also an efficient tool for collaborative work, because archaeologists around the world can share them easily. If the artifact itself no longer exists, the act of reconstructing it forces the archaeologist to confront gaps in the evidence and contradictions or

weaknesses in existing theories (Champion, 2001; Frischer, 2003; Levy, 2004). Building a model is also an efficient way to store information on what the original looked like and a good model make a sound basis for scholarly discussions of the artifact. The value of 3D modeling is so well recognized that architects have been constructing 3D models of planned buildings since ancient times and CAD software is now a required tool in most architectural projects.

For educators, a spatial model can be an efficient means of communicating a large amount of visual information. One detailed 3D model can contain as much visual information as a large number of still images. Also, a model leverages the user's natural spatial perception abilities. This is especially important with architectural spaces that are "well-integrated" in the sense that information is encoded in the way the space looks to an observer.

An Egyptian Temple is an extreme example of this, because the hieroglyphics, the larger painted images and the conduct of ceremonies are all tightly integrated with the physical space itself being the main semantic organizing principle. Such an artifact is best viewed with the space intact, from the vantage points from which it was meant to be seen. In addition, users find 3D renderings compelling and a good rendering of a beautiful monument is also beautiful. This helps users accept the technology and engage in the experience. If a 3D model appears to beautiful, it is likely to posses an added degree of perceptual coherence, which in turn can make it a more effective vehicle for information.

However, an archaeological reconstruction is necessarily pieced together from existing evidence which requires many judgments. Depending on the level of conjecture tolerated by the reconstruction project, the builders may produce a reconstruction based on one of several competing theories of what the artifact really looked like. However, the final appearance of a static model is emphatic in the way it presents the model as the way the artifact looked. Uninformed viewers are likely to accept the model as authoritative (Frischer, 2003; Champion, 2004a). A static visual solution, like coding features with colors or with opacity would seriously degrade the appearance and the effectiveness of the model. Temporal solutions, like toggling certain features on and off, are probably best, but they complicate interaction design and are more difficult to implement.

Reconstruction as a Bridge Between Minds

One possible use of VH is by an archeologist is working on a site, so that s/he can use VR to convey his or her mental images of some fragmentary site or object. On a superficial level, this is certainly possible; the Archeologist can simply create a virtual model of the space or object for others to look at. In this way, VR can be a bridge between the expert and the novice, so knowledge can be conveyed to the student. In addition, VR can also be used to assist two-way communication-allowing the students to interact with each other, constructing mutually understood knowledge under the instructor's guidance (Fallman, 1999; Mayer, 2001; Dalgarno, 2001, 2002, Dalgarno et al 2002, Winn, 2003; Moreno, 2002).

However, the novice most needs to understand the meaning of what s/he sees and that is much more difficult to convey. It is possible to add some features to the VR experience which conveys some of the meaning of an archeological site or objects. For example, the student could see a (virtual) person actually using some artifact for its intended purpose, rather than seeing the object along with an explanation. The virtual person could be a simple agent or an avatar controlled by the expert or by another student. Other senses can be used as well. For example, Dr. Karabiber

and his team developed a Virtual Mosque and peopled it with virtual singers. As the agents perform their devotions, singing, the space reverberates as a real Mosque would; doing its part to create the unified sound.

One of the best uses of a virtual model is that it is mental tool to help the student organize the things s/he is learning about the site or artifact. This is an example of *external cognition*, (Hutchins, 1995; Norman, 1998) a term for the way people use the environment itself to think. A simple example is to imagine making soup, where the cook lays out all the ingredients on the cutting board in the same order that s/he will put them into the soup. In this way, the physical space of the cutting board is effectively part of the cook's brain. This fits within J.J. Gibson's idea that the mind/person and his/her environment cannot be defined independently (Gibson, 1979). In this way, the virtual environment is an extension of the user's environment and therefore an extension of the user as an embodied human being.

However, VR alone is not adequate or appropriate for many kinds of lessons the student may need. Like any other media, VR is best used in combination with other media and methods for an integrated learning approach. Nevertheless VR brings unique advantages such as allowing the student to explore places and things that long longer exist or that might be too dangerous or too expensive to visit. It allows the students and instructor interact in a new way, opening many possibilities for collaboration. Most importantly, VR can also bring things to life, especially allowing the user to explore ancient cultures.

Recreating Culture

By recreating or simulating something about an ancient culture, virtual heritage applications are a bridge between the people of the ancient culture and the modern user. The communication is one-way in the sense that the ancients are dead and cannot ask or answer questions, but we can learn about them by interacting with simulations of them and their environs. This leads to a question which is parallel to the expert-novice communication discussed above (Champion, 2006). How can we see a place as the original inhabitants saw it? For example, though the ancient Greek temples are impressive to us, to the ancient Greeks themselves, who actually lived in material poverty and were constantly at war, the temples were even more impressive. They could see the human sacrifice in the stone. Is there a way we can share the local perspective using VR technology?

One way to approach this is to deliberately vary the emphasis on elements. For example, a virtual Parthenon might be made to look preternaturally new and clean, while its surroundings and maybe the (virtual) Greeks in it make to look shabby or impoverished by comparison. One could go a step further and put artificial signposts in the virtual environment like a text message pointing to the Parthenon saying "Very expensive!" This approach is probably not advisable in most cases, because the exaggerations may not work, they definitely obscure or overshadow other information and may have unintended consequences.

A better way is to educate the user in the ancient culture, so s/he learns how to see the (virtual) recreation as the people who created them did. VR can be part of that process. For example, the instructor who employs some virtual ancient Greece application might make sure students see some things which demonstrate the poverty (by our standards) of the ancient Greeks and then helps the student understand the contrast between that and the wealth of the Parthenon. Perhaps a virtual Greek could simply say it in conversation, something like, "We are very proud of our

Parthenon which is made from the finest stone and richer than any mortal's house. We suffered gladly to build it..." and so on. This approach takes time, but students will invest the time if there is a payoff.

One very effective way to use VR to teach students about ancient culture is to have them enter the virtual environment as a shared social space and have them role-play members of that society. Under the guidance of an instructor, they could steadily refine their interactions, learning how to live "in" the ancient culture. Automated (or intelligent) agents could also be part of the community, performing simple tasks or even important roles. The accuracy and richness of the environment will have an important influence on the students' efforts.

The Temple

We present the Virtual Egyptian Temple, which we developed, as our primary example of understanding an ancient culture through recreating the cultural space.



Figure 14: The Virtual Egyptian Temple and the High Priest

The temple has no real-world analog, although it is constructed mostly from elements of the Temples of Horus at Edfu (Arnold, 1999) and at Medinet Habu (Oriental Institute Publications, 1930). Its purpose is to embody the key features of the typical New Kingdom period Egyptian temple in a way that is accessible to students. The temple consists of four major areas, the exterior (Pylon), the Courtyard, the Hypostyle Hall and the inner Sanctuary, arranged in that order and separated by gateways. Compared to a real temple, the model is simple, having only enough detail to represent the key features required. For example, there is only one of each of the four types of areas, while an actual temple might have had several Courtyards and Hypostyle Halls. Similarly, the hieroglyphics are larger than they would be in an actual temple to make them more legible. Nevertheless, the scale and proportions of the spaces are correct, hieroglyphics make the appropriate statements, the images are in proper locations and so on. In this way, the physical form and dimensions of the temple symbolize the archetypal elements of the ancient Egyptian culture, which evolved over many millennia.

The Egyptians built temples like this to be "read" at three levels of understanding. The first level was for the common people, who were illiterate, but who could understand the ideas depicted on the walls and the symbolism of the temple's overall structure and general grandeur. For literate Egyptians, the hieroglyphics on the temple itself and on objects within it provided a second level of knowledge. Finally, to the priests and royal family, highly educated people who studied theology intensively, the temple revealed a further meta-level of meaning and symbolism. This meta-level brought together all the elements and dimensions of knowledge and intelligence in a direct form which could be passed from one generation to the next.

Temples of this type are some of the best examples of such a knowledge scheme to survive from the ancient world. They worked extremely well as long as there was an educational system to make the keys available. In fact, many of the endeavors of the Western Hermeticists and Alchemists who inspired our Renaissance and Enlightenment were attempts to discover the lost "higher" meanings hidden in these ancient ruins. The key to much of this meta-knowledge turns out to be embodied in a simple but very high-level, multi-meaning system, based on a very sophisticated form of playfulness. In this scheme, images and pictorial words are much more than they seem and the complex relationships between picture-words, the images near them and the rituals and other activities being performed nearby, inspire a form of kinesthesia that offer higher insights to the performer.

The temple and applications of its type illustrate an interesting symmetry. Using the Virtual Reality as part of a human and humane learning process is a thoroughly modern techné. And yet, we are using VR to simulate a temple, which is the technology for an ancient techné', so that students can study it as the ancients did. We do this to understand the deeper truths about ourselves that motivate us. In this way the ancient and modern contain each other perfectly.

Future Challenges

The great challenge facing VR authors is to provide the conditions whereby users have experiences which are both intellectually and emotionally engaging. In terms of choosing the themes or topics for the application, this is much the same challenge faced by authors in other media. How to bring to the audience something that is both new, but recognizable in human terms and make it something they can care about. For example, a good fiction writer can make a story come alive by presenting a dilemma that is all too familiar in human condition (e.g. Romeo and Juliet). The VR author can do much the same. The difference being that the users themselves can be the characters in the drama.

Furthermore, users should learn something in the VR that they can use in real life. Educators call this *learning transfer* (Bloom, 1956) and it is the ultimate test of the usefulness for any educational activity. The student could learn something impersonal (e.g. how to fly a jet), or social (e.g. how to get along with the other users), or explore a potential aspect of their own personal identity. This last point is very important and often overlooked; a critical part of personal growth is playtesting personal responses to external stimuli. Virtual reality can potentially afford children and adults a safe place to have experiences that would not otherwise be possible or practical.

This leads us to the question of whether and how computer technology, often inhumane and inorganic, can support comfortable and naturalistic interactions for people, between each other

and this brave new world around them. VR provides an opportunity for this, but as with other media, it can be trivialized and made to carry empty messages, or, it can be a new way to meaningfully broaden the human experience. Perhaps it would be better to think of VR as providing a virtual space with unique properties into which we, the real people, can extend our lives and society--not to replace the real world but to enlarge it and discover it anew.

References

- Addison, A.C. 2000. "Emerging Trends in Virtual Heritage." *IEEE Multimedia* 7(2): 22-25.
- Arnold, D. 1999. *Temples of the Last Pharaohs*. Oxford: Oxford Press.
- Bloom, B.S. 1956. *Taxonomy of Educational Objectives; Book I Cognitive Domain*. New York: Longman Inc.
- Champion, E. 2001. *Travels through the imagination: Future visions of VR and related technologies*. YVR2001, December, 2001, Kaist Korea. Online paper at <http://www.itee.uq.edu.au/~erikc/papers/>
- . 2004a. "The Limits of Realism in Architectural Visualization." In *XXIst annual conference of the Society of Architectural Historians Australia and New Zealand*, Melbourne, Australia, 88-98. Online paper at <http://www.itee.uq.edu.au/~erikc/papers/>
- . 2004b. "Heritage Role Playing-History as an Interactive Digital Game." In *Proceedings of IE2004 Australian Workshop on Interactive Entertainment*, Sydney, Australia: Creativity and Cognition Studios Press: 47-65. Online paper at <http://itee.uq.edu.au/~erikc/papers/>
- . 2006. Personal Communication
- Champion, E. and S. Sekiguchi. 2004. "Cultural Learning in Virtual Environments." *VSMM2004 Hybrid Realities: Digital Partners*, Ogaki City, Gifu, Japan, 17-19 November 2004: 364-373. Online paper at <http://www.itee.uq.edu.au/~erikc/papers/>
- Dalgarno, B. 2001. "Interpretations of Constructivism and Consequences for Computer Assisted Learning." *British Journal of Educational Technology* 32(2).
- Dalgarno, B. 2002. "The Potential of 3D Virtual Learning Environments: A Constructivist Analysis." *E-Journal of Instructional Science and Technology* 5(2).
- Dalgarno, B., J. Hedberg, B. Harper. 2002. "The Contribution of 3D Environments to Conceptual Understanding." European Conference on AI in Education.
- Fallman, D. 1999. "VR in Education: An Introduction to Multisensory Constructivist Learning Environments." Conference on University Pedagogy, Umea University, Sweden. Online paper at http://daniel.fallman.org/resources/papers/Fallman_VRIE.pdf
- Frischer, B. 2003. "Mission and Recent Projects of the UCLA Cultural Virtual Reality Laboratory." *Virtual Retrospect 2003 or Virtual Concept 2003*, November, 5-7 <http://www.cvrlab.org>

- Gibson, J. J. 1979. *The Ecological Approach to Visual Perception*. Boston: Houghton Mifflin.
- Hutchins, E. 1995. *Cognition in the Wild*. Cambridge, Massachusetts: MIT Press.
- Jacobson, J. and L. Holden. 2005. "The Virtual Egyptian Temple." World Conference on Educational Media, Hypermedia & Telecommunications (ED-MEDIA), Montreal, Canada.
- Levy, R.M., P.C. Dawson, C. Arnold. 2004. "Reconstructing traditional Inuit house forms using Three-dimensional interactive computer modeling." *Visual Studies* 19(1).
- Moltenbrey, K. 2001. September. "Preserving the Past." *Computer Graphics World*.
- Oriental Institute Publications. 1930. *Medinet Habu*. Chicago: The University of Chicago.
- Roehl, D. B. 1997. "Virtual archeology. Bring new life to ancient worlds." *Innovation* 28 – 35.
- Mayer, R. E. 2001. *Multimedia Learning*. Cambridge University Press.
- Mitchell, W.L., D. Economou. 2000. "The Internet and Virtual Environments in Heritage Education: more than just a technical problem." In J.A. Barceló, Forte, M. and Sanders, D. H. eds., *Virtual Reality in Archeology*. Oxford: Archeo Press, 149-154.
- Moreno, R. 2002. "Pedagogical Agents in Virtual Reality Environments: Do Multimedia Principles Still Apply?" World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA), Charlottesville, Virginia.
- Norman, D. A. 1988. *The Design of Everyday Things*. New York: Basic Books.
- Stone, R. and Ojika, T. 2002. "Virtual Heritage: What Next?" *IEEE Multimedia* 73-74.
- Winn, W. 2003. "Learning in Artificial Environments: Embodiment, Embeddedness and Dynamic Adaptation." *Technology, Instruction, Cognition and Learning* 1: 87-114.