The Virtual Egyptian Temple

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Abstract: At the center of every flourishing ancient Egyptian community, there was a sacred temple, the House of the Divinity. This Establishment (Sacred Corporation) was a model for the Egyptian world, containing all the knowledge, images and materials necessary for Harmony between Heaven and Earth. The Virtual Egyptian Temple embodies the key elements of a New Kingdom temple, useful for curricula in history, archeology, religion and culture. We are currently adding a lifelike companion agent, an Egyptian priest, who will follow the user, answer questions and make suggestions. The temple and all supporting materials are open-source and free to the public for any use (http://PublicVR.org/egypt/). Two versions are available: the VRML version (no priest) is lightweight and eloquent, while the *Unreal Engine* version is rich in detail and the focus of our current efforts. The latter is available in the *Virtual Theater*, a panoramic projection-based display based on the *CaveUT* software.

Introduction

We present the Virtual Egyptian Temple, a three-dimensional model which embodies the identifying and functional elements of a temple from the New Kingdom period. (Fig. 1) Like most other religious architecture, it is information rich, with complex spatial relationships that organize the symbolism and even the activities in the space. The temple exists in a small virtual world, which the user "visit" from a desktop (using VRML or the game, Unreal Tournament) or through an immersive display like the Virtual Theater (Fig. 2). Either interface allows the student to explore the temple, viewing it from the inside, allowing him to see relationships not otherwise emphasized or even shown. However, immersive displays are particularly effective, because the student can see the temple in life-size, with approximately the same view as if the temple were real. Immersion also conveys a sense of *presence* or "being there" in the virtual environment. Handled properly, this can be used to focus students' attention on the subject matter.

The temple is an example of *Virtual Heritage* (VH) which is the use *virtual reality* (VR) to create models or animations which represent, recreate and interpret cultural artifacts, such as the temple. This is an active area of research and development, with the same general advantages mentioned above. Limitations with VH include it low ability to represent uncertainty in virtual recreations of ancient artifacts and the question of how to represent an artifact with a long and dynamic history. Finally, a class of artifacts may be best described by an example, but any one member of that group will also unique features particular to it. The virtual temple avoids this problem by (theoretically) having no unique features, because it does not represent any real temple.

The temple is based on Unreal Tournament, a partially open-source graphics-intensive computer game. It has considerable support for content creation and can be extensively reprogrammed. Students could modify the temple itself or add objects and animations to it or in it. Unreal Tournament also provides shared "play" over the internet, allowing users to occupy the same virtual world, seeing each other as animated humans or whatever they choose to represent themselves. This makes collaborative learning and distance learning designs possible. For example, we are working on an automated Egyptian "priest" (Fig. 1) a companion for the user who will answer questions and make suggestions.

The temple can be an important and useful tool in a curriculum which features ancient Egypt. Every ancient Egyptian community had a temple which housed a great deal of social, political and economic activity. It was the center of life, and a model for the Egyptian world, containing all the knowledge, images and materials necessary for Harmony between Heaven and Earth. It is a good starting point for understanding the material.

The temple and its supporting material are available to the public at (http://PublicVR/egypt/). Educators are welcome to use it directly or incorporate into their own applications.

Figure One: The Virtual Egyptian Temple and its priest.

Virtual Heritage

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 and the means used to display it range from still photos to immersive virtual reality. This is a very active area of research and development, (Michell 2000)(Champion 2004b)(Champion 2004c)(Addison 2000)(Roehl 1997)(Stone 2002)(Levy 2004) and most of it is intended for some kind of educational use. The majority of VH applications are architectural reconstructions, centered on a reconstructed building or monument, and most of them use VRML technology. A handful of VH applications illustrate topics on ancient Egypt (Kufu 2004)(Economou et al. 2001)(Lehner 2003)(Michell & Economou 2000)(TutTomb 2001).

To the educator, a VR model can be an efficient means of communicating a large amount of information because it 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.

Technologies available for VH applications afford additional possibilities. Autonomous agents can represent ancient peoples conducting their business or interacting with the user (Ulicny 2002). Networked multi-user environments allow distant students and educators to "meet" in a shared virtual environments (Raalte, 2003)(Santos, 2002), creating opportunities for collaborative and distance learning. Pedagogical agents in the environment can guide and facilitate learning (Economou 2001). Generally, interaction and activity dominate engagement and are central to learning (Winn 2003). Goal-seeking activities are especially effective, and can be cast in the form of a game (Champion 2004b)(DeLeon, 2000).

Additionally, the VR interface can be *immersive*, meaning that it engages the senses broadly enough to make the user feel like s/he is *in* the virtual world. Examples of this are the Virtual Theater (Fig. 3) and the SAS-Cube (Cavazza 2004). By engaging vision more broadly and even the other senses (e.g. sound, touch, etc.) immersion can convey more information, provide a more complete simulation, create a stronger sense of realism (of the object) and

presence (of the user in the virtual space). Properly handled, the sense of presence will increase student engagement with the material and improve learning (Dede 1999)(Winn 2001). However, immersion is only an advantage for learning when an egocentric view of some visualized information is advantageous. We believe this is the case with the Virtual Egyptian Temple, when the (visually) immersed student is better able to see the deliberate juxtaposition of the elements on the temple and more readily understand it as a whole.

Limitations of Virtual Heritage

An archaeological reconstruction is necessarily pieced together from existing evidence which requires many judgments during construction. Depending on the level of conjecture tolerated by the reconstruction project, the creators 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 (Champion 2004a)(Frischer 2003). 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.

Also, archaeological evidence of any site reflects its entire history, not some snapshot in time. For example, ancient monuments with a long history may have features from more than one time period. Deciding what to put into the virtual reconstruction requires considerable judgment and sensitivity from the authors. The Venice Charter (VeniceCharter 2004) on physical restorations and reconstructions recommends that all time periods represented in an artifact should be respected.

A related problem develops when we try to convey information about a class of artifacts using a single exemplar. Even the most well-chosen individual of that group will have unique features not shared by the others, and identifying them as non-representative only emphasizes them more, Accordingly, we structured the virtual temple not to match any one physical example, but from the basic features which identify a New Kingdom Temple. For details, we used elements from the Temple of Horus at Edfu (Arnold, 1999), Medient Habu (Chicago, 1930), and a few other sources.

If properly handled, these limitations are manageable. Ultimately, it is the instructional design of any learning activity which will determine its success, not the technology it employs *per se*.

Advantages of the Virtual Temple and Unreal Technology

The temple is particularly valuable for studies of ancient Egypt, because temples were the center of life in every Egyptian community. They were sacred models for the Egyptian world, containing all the knowledge, images and materials necessary for maintaining harmony between Heaven and Earth. The Egyptians believed that the activities within the sacred precinct of the temple preserved the agricultural cycles of Nature, maintained the connection and interaction with the Ancestor Spirits, provided a local focus for the cult of the Divine Kingship and functioned as the home of the local family of Divinities. Understanding the temple is an excellent first step in understanding ancient Egyptian culture.

By the New Kingdom, the form of the temple had become traditional, with five essential spaces-the area outside the temple, the space within the Enclosure Wall, the First Pylon, the Hypostyle Hall, and the innermost “holy of holies”. These and many other themes and others were constant across all temples. Used as an exemplar, the temple makes these ideas accessible to the student in a way that is simple and compelling. For example, the hieroglyphics are larger than life, especially in the VRML version, so the students can read them.

The most recent version of the temple requires a copy of the game, *Unreal Tournament*, which is based on the Unreal Engine (EpicGames 2004). The engine supports a high level of visual detail, advanced lighting effects (Fig. 1), animation, networking, high speed and built in physics (i.e. Gravity works.) Unreal Tournament supports multiplayer games networked over the internet, where each player drives a humanoid avatar. Player/students can speak to each other through a built-in voice-over-ip protocol and each can command his or her avatar to perform the actions it is capable of. This creates many opportunities for collaborative instructional design. For example, the virtual Egyptian priest in figure two could be used by an instructor or tour guide to teach distant students something about the temple. In addition, students could be given team-based assignments to explore parts of the temple, perhaps engaging in an information “treasure-hunt.”

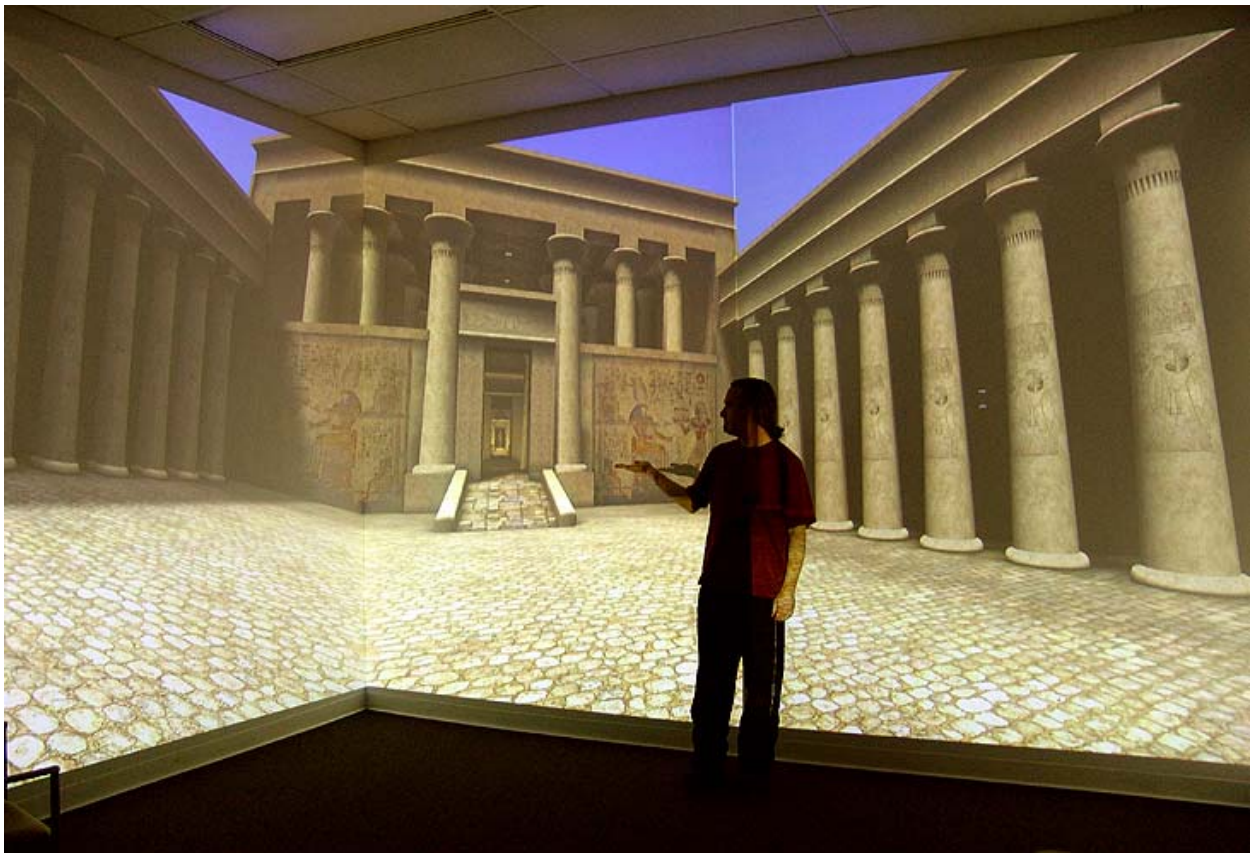

Figure Two: The temple in the Virtual Theater.

The game also comes with extensive authoring support for users to create their own worlds, objects and animations. Also, all of the code for the game which is not part of the Unreal Engine, is open-sourced, which allows extensive reprogramming. Students or educators may change the temple itself or add other objects or actors, perhaps an artist or a musician or a visiting aristocrat. This creates opportunities for constructionist (project-based) learning curricula or custom instructor-made modifications. Finally, the game has a large community of users/developers who are constantly producing content (virtual worlds, people, objects, etc.) most of which is freely available and easily reusable.

Basing our temple on Unreal Tournament also allows us to take advantage of CaveUT (Jacobson & Lewis 2005) a freeware modification to the game which adapts it to immersive displays, like the Virtual Theater, shown in figure three. Displays of this kind can be built for approximately $2500 per screen, or less if borrow equipment is used (Jacobson 2005a).

Our Current Work

we are now developing an interactive narrative for the temple which will allow the student in the temple to elicit verbal descriptions and other statements by using the controller to select the objects or areas of interest. The narrative will adapt to what the student has seen and done by adjusting descriptions accordingly, and it will make suggestions on what s/he might want to see next.

Moreno (2002) and Mayer (2001) have shown that when the student is working with a visual model or image, relaying additional information in the form of sound or narrative is much better than displaying it as text. The text competes with the graphics for the student's attentional resources, while sound does not, being an entirely separate sensory channel.

When we attach the narrative to the temple, we will "embody" it by making an automated version of the priest (Fig 1.). The priest will follow the student as s/he explores the temple and point to things that the narrative is explaining. Through these actions and through other social motion of the priest, the narrative will appear to be his voice.

We look forward to conducting a series of learning experiments with the temple in the Virtual Theater. Our short-term goal is better understand how the conduct of the priest can facilitate learning.

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