

Dome Displays for Educational Games and Activities in the Museum and on the Road

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Abstract. The immersive Earth Theater at Carnegie Museum of Natural History (CMNH) uses CaveUT and the Unreal Engine for real time virtual tours as part of public and educational programming. Research conducted comparing the theater with desktop displays shows immersion is a powerful tool, helping people create more connections. Content builds on the museum's strengths and includes dinosaurs, an Egyptian temple and a Seneca village. CMNH has tremendous expertise in traditional tours, combining skills of storytelling, communication, leading group dynamics, timing and humor to convey and contextualize the topics. This background is just as critical to great virtual tours as the beautiful, complex and natural graphics.

Keywords: CaveUT, DomeUT, Earth Theater, Educational Games, Informal Education, Dome, Portable, Egypt, Oviraptor, Dinosaur, Virtual Reality, Mixed Reality, Unreal Tournament, Unreal Engine, Immersive, Tour, Constructivist.

1 Introduction

The Earth Theater at Carnegie Museum of Natural History is a partial dome display, 210 degrees wide by 30 degrees high. It seats sixty people within the curve of its screen and is equipped with surround sound. Interactive content for the Earth Theater is based on the CaveUT freeware and the Unreal Engine v2.5 [1]. The software employs a small network of computers driving five projectors which project onto the main screen to provide a single contiguous view of the virtual environment. Prospective effects and spherical warping are accomplished by the VRGL freeware [1], a modified OpenGL graphics library.

While making a presentation in the Earth Theater, the tour guide interacts with the audience while navigating through virtual space using a wireless control device. Just as with a physical exhibit, the tour guide is able to order the presentation and focus on

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individual features according to the needs of the moment—essentially an exercise in storytelling. Unlike a single flat screen, the curve of the Earth Theater provides an immersive space enabling the viewers to be “in the world”. It also allows the tour guide to explain more and navigate less while using the full sweep of the view to juxtapose related elements.

Our interactive shows will also display on standard desktop computers, traveling Discovery Dome and a Vision Station™. We will present additional display devices and our most developed applications.

2 The Virtual Egyptian Temple

The Virtual Egyptian Temple [2] has no real-world analog, although it contains elements from existing temples. It correctly embodies the key features of the typical New Kingdom period Egyptian temple in a way that is accessible for an untrained audience. Some differences are made for the sake of presentation. For example, 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; the temple has the minimum required areas (e.g. one Courtyard); the hieroglyphics make the appropriate statements; murals and statuary are in appropriate locations; and so on. The temple is thematically integrated with the museum’s Walton Hall of Ancient Egypt collection, with virtual duplicates of some of the artifacts there.



Fig. 1. The Virtual Egyptian Temple as it appears in the Earth Theater

3 OvirapTour

The museum developed *OvirapTour* to accompany the opening of a new exhibit, *Dinosaurs in Their Time*. This three room, virtual mini-museum houses all of the fossils necessary to lead audiences through the evolution of dinosaurs to birds. A fossil and a fleshed-out recreation of *Ovirator philocerotops* begin the story. It continues with the earliest known feathered dinosaurs and earliest known birds. The highlight is a highly detailed model of CMNH’s unnamed oviraptorosaurus and an ostrich, a very similar modern bird. Part of the challenge for this model was to design it in a



Fig. 2 and 3. Line up of ostrich, ostrich skeleton, *Oviraptor* skeleton and *Oviraptor* in *Oviraptor-Tour* playing at CMNH

pipeline for a real time engine despite the complexity required for scientific accuracy. Additionally, it is rigged for animation for use in functional morphology research.

4 Gates of Horus

Gates of Horus is an interactive learning game based on the Virtual Egyptian Temple. The player uses a cordless mouse and a special on-screen(s) cursor to click on individual features of the temple. This prompts the priest in that particular area to explain that feature's meaning. To progress from one area of the temple to the next, the student must answer all of the priest's questions for that area. When the student correctly answers all of these questions, the gateway to the next area of the temple opens, and the student explores and learns in the same way. The student wins the game when s/he

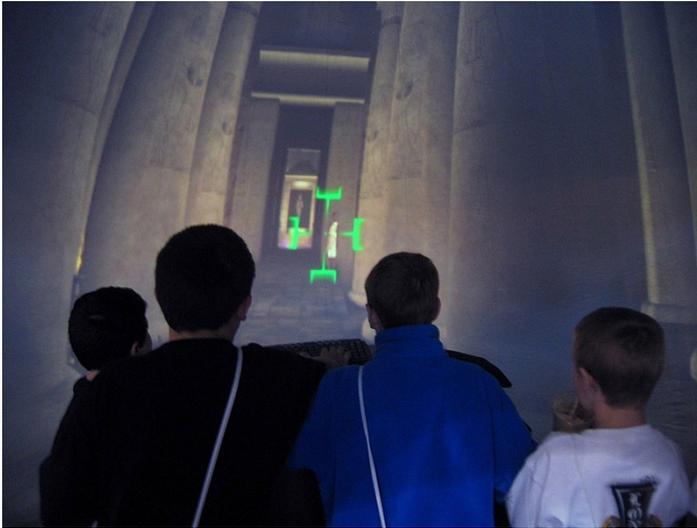


Fig. 4. Children play the learning game, *Gates of Horus*, in the inflatable dome. Image courtesy of Elumenati [3].

answers all of the questions from the priest in the inner sanctuary. Metaphorically, this makes the divine image of the god speak and bring the blessings of heaven to the land of Egypt.

We used *Gates of Horus* for a learning experiment [4], where some students played the game on a desktop computer while others got to (individually) use the entire Earth Theater as their personal display. Those who used the Earth Theater demonstrated more and better knowledge of the temple when asked to *give* a guided tour of the temple. This is one of the very few experiments to actually demonstrate that visual immersion can convey a learning advantage. We believe that the key is to provide a learning activity which truly benefits from the visual immersion and a topic where an inside view of something is informative.

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