Exploring Virtual History at The National Museum of American History

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Abstract

At VSMM 2000 and 2001, we described the design and implementation of, and public response to, an immersive interactive museum exhibit called "This Old Digital City" (TODC). TODC uses real-time virtual environment technology to immerse museum visitors in a 3D reconstruction of Cedar Rapids, Iowa during two time periods, the 1900s and the 1920s. The exhibit has been a successful demonstration of the use of immersive virtual environment technology as an engaging communication medium to present museum archival material. Through partnership with the Smithsonian Institution's National Museum of American History (NMAH), Digital Artefacts and the University of Iowa have embarked on a multiphase research project to evaluate the usability and potential applications for virtual environments in a museum setting. In this paper we describe the NMAH process of assessing and customizing the TODC model, our initial findings on usability and user response, and the goals for the next phase of research.

1. Introduction

Although computer technology can provide simulation environments and other forms of educational immersion, investigation into the application and utility of these experiences in a museum environment have been quite limited. Museums are not "early adopters" of cutting edge technology and lack the resources to sustain long-term research projects to determine the effic acy of adopting cutting-edge techniques such as virtual reality. However, as younger learners begin to display preferences toward multi-tasking, self-directed exploration and vastly different visual requirements from prior generations of learners, museums begin to consider how to fulfill the learning needs of young audiences. Ideally, educational techniques will be developed that blend the best of a traditional museum experience with the best of cutting-edge immersive technology. This blended experience would fulfill a variety of learning-style needs and would appeal to both adults and children.

An important step in that direction, "This Old Digital City" (TODC) [1, 2] is an example of using high-end virtual environment technology as an interface to historical archives. Historic content accessed within the virtual environment of Cedar Rapids, Iowa, was found to motivate student "explorers" at the city's History Center. Curious about the potential of a virtual environment to capture and hold the attention of museum visitors at the Smithsonian Institution, staff at the National Museum of American History's (NMAH) Division of Information

Technology and Society sought the opportunity to collaborate with the developers of the TODC experience. This paper describes the initial experiences and results of that collaboration.

2. Background: NMAH Perspective

Traditional history museums collect, display and interpret material culture. Learning and exploration are typically focused upon objects and their interpretation. The physical display environment could be as contextually rich as a detailed recreation of a historic site, or as simple as a glass case with brief labels. Videos and interactive opportunities can augment static displays, and concepts are crafted to attract a wide range of visitors. But while physical exhibitions can provide the desired "experience" for many people, museum staff note less success at attracting and engaging pre-teen and teenage visitors. The initial aim of this research is to assess the attracting and holding power of a virtual environment upon a target audience of pre-teen and teen visitors in the museum. Another aim of this research is to begin to explore the impact of linking physical objects and virtual space. Implicit in this notion is our recognition that virtual space offers a dynamic, flexible visual landscape that beckons to be explored in conjunction with physical collections and other museum materials.

The work described here grew out of success of the original TODC exhibits [1,2] at The History Center in Cedar Rapids, Iowa. TODC uses real-time virtual environment technology to immerse visitors in a 3D reconstruction of Cedar Rapids during two time periods, the 1900s and the 1920s. Museum patrons sit in and operate a "time machine" to freely explore the city, modeled in high-resolution 3D graphics. As visitors tour the city, they are able to access multimedia content associated with buildings and other historically significant sites. Triggered by experience with and observations of TODC, the current project was initiated following several discussions between NMAH, Digital Artefacts (DA), and The University of Iowa on how to expand on the ideas in TODC to further explore the potential for virtual environments in museums.

Section 3 describes the development and execution of Phase I of our project, which took place during Summer 2002. Section 4 presents outcomes and discussion of the work, and Section 5 presents some of our ideas and plans for Phase II of this research.

3. Project Phase I: Summer 2002

Setting: The research was conducted in a theater space within the Information Age exhibition at the NMAH. The Information Age exhibition displays icons of the museums communication technology collection, and provides an appropriate backdrop for this initiative.

Display and computing hardware: The TODC experience at the Cedar Rapids History Center uses four networked synchronized PC computers and a multi-screen projection system to give museum visitors a large immersive180-degree field of view. For Phase I at NMAH, a single 10-by-8 foot screen and single computer (Athlon XP 2100+, nForce motherboard, GeForce4 graphics card) were used instead.

Visitor "selection" and feedback: Exhibit visitors were primarily "self-selecting" in the sense that they freely entered the theater space upon seeing other people engaged in activity. Children and adults were invited to try out the experience. Seating in the theater makes it possible for families to relax and watch while others participated in the research. School groups visiting the museum also participated, and typically several members of the group would try out the experience before a group leader signaled that it was time to leave. Museum interns and staff were also invited to try the experience. Exhibit experience feedback was obtained through verbal and written surveys of participants. Several in-depth discussions occurred with interns who offered focused, critical assessment.

3.1 Initial Assessment

To initiate the research, a two-week assessment was conducted using the TODC software and visual database in essentially its original form. The TODC virtual environment includes 64 square blocks of downtown Cedar Rapids, with animated trains and trolleys, ambient sounds consisting of period music, and a flowing river. Museum staff wanted to observe how visitors would navigate the virtual space, and how they responded to the existing content. During this period, visitors navigated the environment using only a standard computer gaming joystick.

Figure 1. A scene from the TODC virtual environment

3.2 ModifyingTODC to Meet NMAH Research Goals

Based on observations, discussions and review of questionnaires from the initial NMAH assessment, museum staff were confident that visitors were enjoying the experience, and that work could advance to the next stage. Modifications were made to TODC, and content nodes were built showcasing objects from the museum's collections. The objects include a 1939 RCA television and a console radio. Because of TODC's expansive geographic area we needed to either develop methods for guiding users to the content or simply place them near the content. We decided to start users near the one of the content nodes. A triggered audio file directs their interest to a Kresge's department store window with the television. Hand-colored human sprites were placed near the store window; another triggered audio file lets visitors hear the sprites' conversation about the television in the window. The 3D virtual television in the store window plays a video clip from the Smithsonian archives. In the original TODC, video narrative or content was not provided directly within the 3D environment, but instead was presented on a media player window overlaying the 3D scene. The approach was effective for presenting content, but it lessened the immersive experience by abruptly removing users from "inside" the environment to present such content. For the NMAH exhibit, we chose to embed the video content directly in the virtual environment to provide a consistent sense of presence for the user.

Figure 2. Custom input device created for NMAH exhibit

Another change to the virtual environment was the addition of a period house the user could enter and explore. Feedback from our initial visitor observations indicated that people wanted more interior spaces to explore and, so, a two-story house and two additional sprites were placed within the environment. The interior was designed to match wallpaper and furnishings from a diorama of a 1930s living room scene within NMAH's Information Age Exhibit Hall. We hope to build synergy and educational opportunities by learning how to effectively link physical spaces inside the Information Age exhibition and virtual spaces.

Two sprites, Margie and Joan, stand outside the period house and talking about Margie's new house and radio. The conversation suggests that there are radio programs to be heard inside the house, but it was too long and most people did not listen to the entire thing. Rather, they headed directly into the house. Unfortunately, the conversation of the two women mixed with the radio sounds and the ambient sound of a train whistle from the street outside. The resulting cacophony was confusing and discouraged visitors from staying in the house to listen to the radio program. It is worth noting that people behaved differently while experiencing the radio and the TV. The radio audio seemed to hold less attention, but we did not specifically inquire about interest levels on the questionnaire. Likewise, the TV seemed to attract more attention but that could be because of its location on the street, the ease of finding it in the world, or something about the graphic style or color of the rendering. Phase II research will include a more thorough assessment of cueing, and the efficacy of using sound, video or animation files.

Digital Artefacts designed and built a custom portable user-interaction panel (see Figure 2) to enhance the user's experience in the virtual environment. The commodity joystick used in the two-week initial assessment proved somewhat difficult to use and provided no navigational assistance to users. The new device includes a joystick for free navigation, and buttons allowing users to look up or down to see details of the environment that aren't at eye level, to take an automated guided tour of the environment (a "sit back and relax" mode), and to reset to the initial position in the environment. All are labeled to assist the visitors. The reset functionality allows users unfamiliar with the exhibit to start over and see or hear any intro content we would like to provide. Furthermore, a map of the environment was provided, with location of the start point, key content, and other special points of interest labeled.

Figure 3. In the virtual environment, a 1939 television is displayed in a store window. Video plays on the virtual TV screen. The actual physical TV is present is also present in the theater space (in the glass case on the right side of the image).

3.3 Integration of Physical Historic Objects with the Environment

After several weeks of use of the modified TODC environment, Smithsonian staff added an additional layer of content to the exhibit. As a beginning step toward blending physical objects and virtual space, the actual 1939 historic television (corresponding to the one in the virtual environment) was placed in the exhibit space, near the large display screen and in view of the virtual environment users (see Figure 3). It plays the same video loop as the one in the virtual department store window.

Its inclusion in the experience did not arouse questions or cause a noticeable change in how users navigated the virtual space. In future research, we hope to forge a closer connection between physical objects and virtual space with the goal of focusing the attention of pre-teen and teen visitors back onto objects, and to enhance their educational experiences within exhibitions. We feel there is untapped potential to create fun, engaging and memorable experiences by blending physical objects within virtual environments.

4. Discussion

Phase I work demonstrated to NMAH staff that a large single screen virtual environment presentation is both engaging and entertaining to a broad demographic of visitors. It is worth noting that families have been willing to alter their planned museum agendas upon encountering this exhibit, and to spend a substantial portion of their planned museum visit time waiting for a chance to experience the activity. Typically, summertime visitors to the NMAH will spend 1-3 hours exploring the entire museum, which contains 100,000 square feet of exhibition space. It is therefore a sizable allocation of time to spend even 20 minutes with the TODC exhibit. It could be concluded that, even from a distance, this experience signals something worthwhile to visitors, and that parents are willing to alter their plans in order to experience this different form of engagement with their children. While it is premature to speculate that this pattern would be sustained across groups of visitors that did not include children, it is an initial indication of success at reaching the target audience. Perhaps the preliminary research outcomes are best summarized in the words of project assistant Sonny Heston, "the kids have lined up like it is a pony ride… parents and children patiently watched others use it and explore the environment and ask when they will be able to have a turn."

Researchers noted that parents preferred their children to "drive", and in cases where boys and girls were in the same family unit, boys were more eager to "go first" than girls. In cases where girls were visiting as a group without boys, then girls willingly volunteered to "drive" first. It was not uncommon for parents to ask that brothers "give their sister a turn" or make other attempts to equalize the experience.

Overall, visitors demonstrated varying navigational skill but each was able to remain "on-task" until he or she passed control to another person. No one was observed to leave in frustration, complain exceedingly about getting lost or stuck, or show signs of "defeat". Of the children and adults who experienced mild frustration about getting lost or confused, humor was expressed in conjunction with trying to figure things out. About half of the visitors who were part of the initial test group wrote on their exit survey forms that they felt like they got lost while navigating in the world. But in discussion and during observation, it was not apparent who these people were because they did not express that feeling verbally. This suggests the value of observation, discussion and a written questionnaire because children and adults are frequently more comfortable expressing a negative sentiment privately.

At the project's outset, exhibit maintenance and software upgrades were major concerns for NMAH, especially in light of the museum's large daily visitor numbers. It was decided to limit the number of users per day, and to conduct the research in a facilitated situation, with museum staff always present. Because the software was being developed remotely, in Iowa, museum staff would also have to learn to load new files and make needed modifications to the physical configuration. Digital Artefacts traveled to NMAH to provide initial installation and an overview of the exhibit interface, computing system and software. Procedures were developed for upgrading the software and visual database. After installation, museum staff successfully installed two updates to the visual database and software. The apprehension of museum staff to be able to maintain a highly technical installation is common across all museums and can foster reluctance to engage in research of this kind.

From the perspective of NMAH, Phase I successfully demonstrated to museum staff that: virtual historical environments represent an effective and engaging medium that interest museum visitors; PC-based hardware and cutting-edge virtual environment software can be robust enough for heavy daily use by the public; and further research is warranted, especially to explore linking physical artifacts with the virtual spaces, and to further develop techniques for embedding and accessing content and navigating.

Figure 4. Visitors using the exhibit in the theater space within NMAH's Information Age exhibition.

5. Future goals

Can virtual environments serve as portals to a new form of museum experience whereby a blended form of physical and virtual immersion is provided? Static displays, which are viewed "at a glance", instantly telegraph a message about what they contain. Within seconds, museum visitors of any age, make decisions about where to focus their attention and whether to move to the next display. Perhaps teen visitors are compelled to explore virtual space more extensively than they typically explore physical space because surprises are revealed in conjunction with exploration. Discussions with teens during their exploration of the NMAH exhibit suggest that they are highly motivated to discover the content nodes present in the world, and that they seek more opportunities to go inside buildings, meet people and explore everyday life. The challenge of the next phase of research is to fulfill this expectation while maximizing the museum mission to teach through objects, material culture and the history of real people in everyday life.

Based on our Phase I experiences, plans are underway for Phase II of our project. Some of the objectives are to:

- Create interest in and support for ongoing virtual environment research at NMAH. This unique venue has a broad demographic of users and can provide an extraordinary opportunity to employ user centered design principles to design engaging experiences for education and communication through large screen virtual environments. It is exciting to provide unique, fun and memorable learning experiences for kids that speak to them through a medium they love, video games. The scale of presentation of a virtual environment in a museum is also unique. The large screen projection places the visitor in a virtual world where the objects can be scaled to the size they are in real life.

- Continue to explore virtual environments as a medium for communicating intellectual content. This will include development of a touch screen, dynamic interface that allows users to access digital narrative content associated with the objects within the virtual environment. The specific content and extension of the virtual environment may be to create a highly detailed virtual house or school in which visitors experience many museum objects in the virtual environment context. As they explore the interior space the digital interface updates with the appropriate screens associated with the location and content. Users are free to explore the environment or they can use the dynamic personal interface to access detailed information and narrative.

- Explore new and evolving user interfaces that direct interaction away from a computer monitor or other typical "programmed" surface and toward large-scale interfaces. A museum visitor could explore surfaces, images, landscapes using their arm, finger, hand as the "pointer". Eliminate buttons, joysticks, clicks and strive to make the interface truly seamless, truly immersive, and full-scale. Reveal layers of experience so that visitors with specialized interests have more content to explore.

- Link content development to specific exhibition elements so that synergy is established between the virtual and physical world and work to create a stronger "sense of presence" in the virtual world based on the character, personality and ambience of the physical exhibition - add style, work to establish "personality" via visual elements, sprites, sound files, and other elements that build sense of presence.

- Explore the many questions that arise. How can historic immersion enhance the understanding of what it means to have lived in America? How can historic immersion aid in the acquisition of new knowledge for pre-teen and teens visitors to museums? How can historic immersion strengthen the experience all visitors may have with objects and the physical displays presented in the museum?

6. Related Work

Research and general interest in "virtual history" has grown dramatically in recent years, and much of it is documented the VSMM conferences. Many projects and papers, including [3-17] share some of the perspectives, goals, and challenges present in our work. The Virtual Harlem [18, 19] project and the Herodian Temple Mount exhibit [20] in the Davidson Center at The Jerusalem Archeological Park are probably the two most closely related projects.

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