The Shaker Project:
First Steps towards a Collaborative Network for Virtual Heritage Production

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Abstract

The first digital reconstruction of the White Water Shaker Village focused on a minor portion of the structures built and occupied by members of the United Society of Believers in Christ's Second Appearing, known as Shakers, originally established in Ohio in the early 19th century. This paper revisits the project, now encompassing the full extent of the historical buildings on the site, and shifting from a high-polygon modeling approach to a low-polygon solution intended for real-time online visualization. In this phase we explore connections of the 3D models with web-based applications. We use Google Earth as the primary interface for visualizing the reconstruction of extant and demolished structures, and Google's 3D Warehouse as a key model repository. We aim at highlighting currently possible associations of web interfaces with digital models of historical sites developed for real-time visualization, fostering the integration of archaeological data with content originating from multiple online sources. The process benefits from utilizing consolidated web-services to facilitate content development and implementation, while minimizing costs associated with production and maintenance of content for the web. This initiative expects to: 1) increase public awareness of the historical Shaker site, with positive impact in preservation support; 2) demonstrate the extended function of the digital models as iconic agents, generators of web-traffic and key nodes for online explorations; 3) disseminate the adoption of innovative web services for sharing information about historical sites; 4) define the basic components of a collaborative network for digitally recreating historical Shaker sites across the United States. The project emphasizes the association of diversified cultural themes with the three-dimensional representation of historical sites. Aware of the technical and economic challenges of developing content for the web, we seek to formulate a sustainable approach, centered on an open attitude towards distributed content creation and application of emerging web-based technologies to virtual heritage production.

Keywords: *Google Earth, 3D Warehouse, Shakers, virtual heritage, architecture, digital reconstruction*

1 INTRODUCTION

In recent years a growing number of web applications—programs developed to work within a web browser over the Internet—have become available, introducing alternative methods for accomplishing daily tasks, facilitating social interaction, revisiting conventional media outputs, and above all bringing to the forefront of the web scene the end user as an active content producer. Ease in accessing the web facilitated the consolidation of a "web society,"[1] where the opportunities for developing new functions in browser-based applications have expanded, and learning opportunities and communication have been disseminated on a global scale. This development has been propelled by Web 2.0—a term describing the current state of the online experience with webpages offering interactive and participatory functions to users.

In this context, a new breed of online applications aiming at immersive three-dimensional experiences on the web is giving birth to new possibilities for online visualization of virtual reconstructions of historical sites. The applications are expanding the boundaries set by conventional pre-rendered outputs traditionally formatted as still images, animations, and Quicktime Virtual Reality Objects (QTVRs). Among recent technologies, Google Earth's 3D interface with its geo-reference capabilities and broad base of users has been the application of choice for projects using novel interfaces to explore digital recreations of historical sites in real-time, while allowing connections with educational content through links to external databases.[2]

Our project builds upon these approaches, highlighting the association of three-dimensional models built for real-time online visualization with a diverse set of web applications and media outputs. Google Earth's interface is our core application for navigating through the re-creation of the historical buildings. Our focus lies on a specific topic in American history: the architectural production of the Shakers in White Water Village, Ohio, and extending to all the Shaker villages, from New England to the Midwest, over a period of 150 years. As the project involves multiple locations, we have

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[1] Ken Brodlie and Nuha El-Khalili, "Web-based Virtual Environments," in *Virtual Reality in Geography* (New York: Taylor and Francis Inc., 2002) 35–46.

[2] Recent initiatives utilizing Google Earth's interface include these projects: "Rome Reborn," "Digital Karnak," and "Sanctuary Timber and Stone Circle at Avebury."

consolidated an online collaborative network for research, development of the models, and dissemination of associated educational content. A key aspect in our process is permitting users to learn about important cultural themes through interactive 3D online interfaces, which are connected to datasets spread over multiple websites in a networked system centered on the digital reconstructions. Project aims include: 1) online access to 3D models portraying the current state of the Shaker buildings; 2) digital reconstructions showcasing the probable original configuration of demolished and altered structures; and 3) development and dissemination of relevant themes related to the historical sites through diverse web services.

2   HISTORICAL BACKGROUND

The Shakers are considered one of the most successful American utopian groups. The history of the society, including its religious, cultural, and social aspects, affected and reflected 19th Century American life, and its design influences continue today. The society established more than 19 communities; at present, several restored villages offer on-site experiences within the Shaker built environment and simulated daily communal life. Today, the Shaker sites may be divided into the following groups: 1) those open to the public with buildings owned by a local organization, such as the Hancock Shaker Village in Massachusetts; 2) those closed to public visitation, with some publicly owned buildings and land, such as the White Water Shaker Village in Ohio; 3) remaining buildings and lands privately owned, such as in the Sodus Shaker Village in upstate New York; and 4) completely vanished settlements, such as the West Union Village in Indiana. The current physical conditions of the locations allied with independent ownerships form a diversified scenario of cases, but a common characteristic of all Shaker sites is the collapse or demolition of structures over time. The complete visualization of the full set of known buildings in the original villages is now only feasible through digital reconstructions.

3   CASE STUDY

The White Water Shaker Village in southwest Ohio is our case study for developing a prototype digital reconstruction and for evaluating methods for further application to other Shaker sites. The village, established by the Shakers in 1824, consists today of a few extant buildings with mixed levels of maintenance. From the original structures built on the site only a small number remains, and even these have been altered and used in diverse ways since the Shakers left in the early 1900s. Several parcels of the original White Water Shaker Village lands were sold to private owners, although much of the village now belongs to the Hamilton County Parks District. The overall condition of the location suggests the need for action to support the restoration and preservation of the remaining

buildings and land. Here is an opportunity to showcase a digital visualization, which, by comparing the probable original configurations of the buildings with their current states, unequivocally demonstrates the positive results that protection and continuous maintenance could bring to this historical landmark.

4   3D MODEL TYPOLOGY

In 2005, we developed a digital reconstruction of the northernmost portion of the White Water Shaker Village, creating a photo-realistic visualization based on mid-19th century photographs, an archaeological survey, and historical reports. The digital models were used to produce sets of animations and still images for a short documentary narrating aspects of the site development and current conditions.[1] Two years later we started a new phase in the digital re-creation of the site during a graduate seminar at the School of Architecture and Interior Design of the University of Cincinnati.[2] The course work produced a comprehensive virtual reconstruction of the village, including all extant and demolished structures outlined in the 1990s archaeological survey.[3] For the existing buildings, the students developed low-polygon models based on photographs and a few strategic measurements that allowed offsite determination of building dimensions through digital rectification of the images. The production flow employed the following software: Autocad for laying out footprints and elevations, Photoplan for rectifying the images, SketchUp for 3D modeling and exporting to Google Earth, and Photoshop for editing the photographs and producing highly compressed textures for facades and roofs (fig. 1).

Whenever historical photographs were available, a similar approach was applied to non-extant buildings. Data for building footprints of demolished structures portrayed in historical photographs were obtained from historical documents and the above mentioned archaeological survey. Building heights were derived from photo rectifications, using known dimensions of windows and doors in comparable buildings as the basic parameters for the photogrammetric process. The small

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[1]The project outcomes included a DVD and a CD-ROM. The video is available at the Cincinnati Public Television (CET) website: www.cetconnect.org/MediaPlayer.aspx?vid=1717.

[2]The course reviewed the current state of worldwide research and production of digital models of partially or completely vanished heritage sites, introducing the terminology and basic concepts employed by the multidisciplinary community involved with digital reconstructions. These ranged from applications in archaeology, architectural preservation, documentaries, and museum exhibits. The topic was addressed through readings and a practical exercise, providing the students with a theoretical framework that allowed them to understand the process for digitally recreating a historical site.

[3]A total of 53 digital models were developed, including 22 existing and 31 demolished buildings.

set of remaining historical images did limit the amount of data that could be extracted for the vanished structures. In most cases, only one or two facades were visible in the photographs, while in some situations only portions of the buildings showed (fig. 2).

The segmented nature of the pictorial data is represented in the 3D models of the demolished buildings, with textures relying exclusively on the historical imagery. In these instances only the parts of the vanished buildings appearing in the photographs received texture, and the resultant model uses a flat color in areas without known photographic records. For demolished buildings with no photographs available, we adopted a simplified representation, with a 3D model showing a basic volumetric configuration of the structure according to known dimensions and comparative studies with other Shaker buildings on and offsite.

Figure 1. *Archaeological survey map overlaid on Google Earth, showing the digital reconstruction of the existing and demolished buildings in the northernmost portion of White Water Shaker Village.*

It will be a task for the next phases of the project to further research and interpolate data to produce more detailed three-dimensional representations. Part of the process of digitally recreating the demolished buildings will follow the method applied to a Shaker dwelling house. In this case, we submitted portions of historical photographs to digital rectification, producing orthographic images that allowed us to retrieve probable dimensions and coordinates for positioning external elements in the building's facade (fig. 3). A summary of the different types of 3D models developed for extant and vanished structures is presented in figure 4. The role of recent and historical photographs in the digital reconstruction process was twofold, providing dimensional data through photo rectifications, and contributing graphic information to be used in creating textures applied to the models. The 'texture on-off' approach demonstrates the amount of currently known information on the architectural features of all buildings

on the site. This visualization method reflects the state of knowledge about extant and non-extant structures, enabling an interactive three-dimensional interpretation of the two-dimensional archaeological survey (fig. 5).[1]
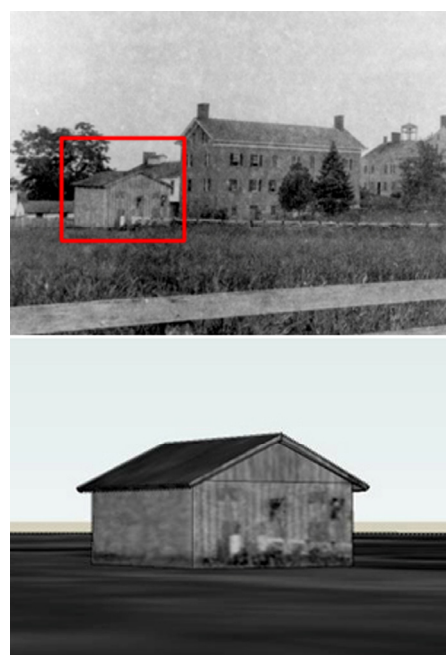

Figure 2. Top*: historical photograph.* Bottom*: digital model of a Shaker Dye House with textures originating from a single historical photograph.*
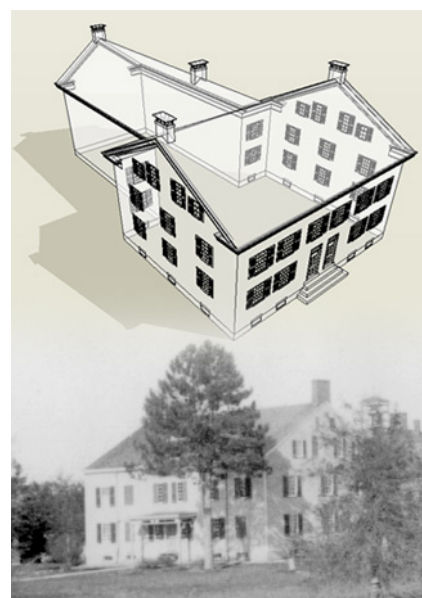

Figure 3. Top*: Digital reconstruction of a Shaker dwelling house based on dimensions obtained from rectified images.* Bottom*: Historical photograph.*

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[1]See Jose Kozan and Iara Beduschi Kozan, "White Water Shaker Village: Exploring Historical Images as Data Sources for Digital Reconstructions," in *Proceedings of the 34th Computer Applications and Quantitative Methods in Archaeology Conference* (Budapest: Archaeolingua, 2007) 437–442.

5 PUBLIC 3D MODELS REPOSITORY

The low-polygon models of the White Water Shaker Village were uploaded to Google's 3D Warehouse database of digital models into two separate collections, one containing existing buildings and another including some of the demolished structures identified in the archaeological survey.[1] During the last twelve months, Google registered 8,683 unique views and 2,710 downloads of the models, with a total number of hits to the pages containing the Shaker buildings reaching 11,393 for the same period of time.
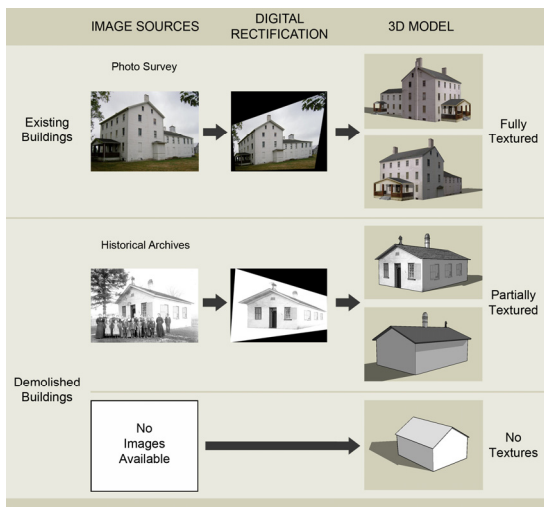

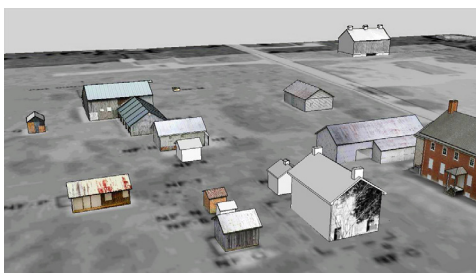**Figure 4.** *Summary of 3D model types.*

Figure 5. *Textures applied to the models demonstrate the current state of knowledge about architectural features of the historical buildings of the Shaker site.*

Preliminary viewing, comments left by users, and tagging reveals the level of interest in the publicly accessible digital models. For example, users of Google's 3D Warehouse incorporated the model of the Meeting House to three distinct collections: places of worship, building design, and new urbanism. Another Shaker structure was included in the "kinarukinari"

collection, which contains models related to nature, tradition and environmental harmony—values connected to Shaker culture. Although it is unclear how the models are being used by the public, the number of views, downloads and references to the 3D models confirm that once the digital files become available through widely-known databases, online visits and unsolicited user actions contribute to increased visibility of the historical buildings and sites (fig. 6).

Most of the models of the remaining structures in White Water were integrated into Google Earth, in a process that depends on Google's revision and approval for 3D models of existing buildings to be uploaded to the 3D Warehouse (fig. 7).[2] Incorporating Google's 3D Warehouse and Google Earth in the toolset for sharing virtual heritage outcomes seems to augment the visibility of reconstruction initiatives, translating into more "buzz," more widespread and far-flung education, and other practical opportunities associated with these interfaces. These may include connections with geo-referenced media as photographs through Panoramio, videos with YouTube, ultra-high resolution panoramas from Gigapan, and informative webpages from Wikipedia. Initial observations indicate that the use of popular online three-dimensional platforms to create exploratory experiences mediated by digital reconstructions have the potential to tie content segments to a sense of place-location, as well as offering opportunities for increased user participation and development of significant themes aggregated to the three-dimensional digital models.

Figure 6. *One of the models as shown in Google's 3D Warehouse, with the cumulative number of views and downloads highlighted.*

[1]The two sets of digital models of the White Water Shaker Village—existing and demolished structures—are available in Google's 3D Warehouse. A search for the term "Shakers" under collections leads to both sets.

[2]In late 2007, it took Google 10–12 weeks to publish the 3D models of the Shaker buildings into Google Earth's 3D Buildings layer. Google reviews the models for accuracy, and the basic prerequisites to approval are related with a small file size (low-polygon count and highly compressed textures), resemblance with the existing building, and correct geo-positioning.

6 EXPANDED ROLE OF THE DIGITAL MODELS

Architecture is not an isolated expression within a society, but shelters in its shapes key identifiers for a wide range of concrete actions and intangible values present at a particular place and time. The Shaker production is no exception, and other themes naturally flourish in conjunction with the creation of the digital models. These include the Shakers' use of the landscape in agriculture, industry, and waterworks, as well as the community, everyday life ways, crafts, religion, ritual, and beliefs. Some of the core humanities themes with potential for development include architectural histories, theories, principles, and characteristics of Shaker building; how design, construction, detailing, and craftsmanship reflect the group's values and ideals; and how their building practices were situated within American history at the time.

Figure 7. *Low-polygon models of existing White Water Shaker buildings available in Google Earth.*

The association of these topics with the digital models using 3D web-interfaces like Google Earth expands the possibilities for creating learning opportunities on thematic issues, in a process where the 3D models act as entry points for further exploration of historical topics. Forte addresses the importance of virtual heritage in embracing available technologies to ensure that the project outcomes enhance the educational experience.[1] We do not aim at developing additional associated content, but we hope to facilitate the process for connecting conventional and innovative media formats to the digital representation of the sites. Several web services are being tested for hosting the thematic material. The list includes obvious approaches such as blogs, wikis, image and video sharing services (Flickr, Panoramio, YouTube), collaborative maps (Google

Maps), as well less well-known options such as interactive timelines (Timerime), synths (Microsoft's Photosynth), and web-based applications for creating illustrated storytelling (Pixton). These established online applications minimize costs and ease implementation of content with relatively low technical requirements, which according to Refsland et al.[2] are crucial factors for promoting knowledge with "new layers of storytelling" in collaborative efforts directed at consolidating historical data. When associated with geo-referenced digital reconstructions, these web applications exponentially increase information related to the topic. They facilitate the formation of a collaborative network among scholars, students, and enthusiasts that may help develop new content and to connect layers of information originating from sources as diverse as archaeological research and personal photo albums, aggregating user-generated content with scholarly production.

It is evident that the process of adopting 3D online interfaces with geographic positioning capabilities in virtual heritage projects has expanded the role of digital models; these have evolved from a secluded element in archives, inaccessible to the public, to become an 'iconic agent' on the 3D web, defining the existence of our subject in space and time, and now serve as the primary link for directing traffic onto nodes in a distributed database connecting multiple websites.

7 CONCLUSION

Recent developments in web-based 3D interfaces have brought fresh prospects for virtual reconstructions of historical sites, expanding the boundaries set by conventional methods for dissemination of outcomes. However, along with the extraordinary growth of technologies for the web, the community of scholars involved with digitally recreating our heritage confronts new sets of challenges. How can they best take advantage of innovative web applications that are pushing the web from the conventional 2D browsing style to a three-dimensional navigation mode? It is uncertain how much web activity will incorporate 3D components in the future, but the educational potential for such virtual environments is unquestionable. The trend toward immersive experiences is rising and presents itself as an opportunity for bringing to this open and dynamic web territory initiatives for interpreting and preserving historical sites.

Standard approaches for showcasing virtual heritage have generally limited the function of 3D models to the role of generating images and animations. These are

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[1] Maurizio Forte, "Ecological Cybernetics, Virtual Reality, and Virtual Heritage," in *Theorizing Digital Cultural Heritage: A Critical Discourse* (Cambridge: MIT Press, 2007) 389–407.

[2] Scot Refsland et al., "Geo-Storytelling: A Living Archive of Spatial Culture," in *Theorizing Digital Cultural Heritage: A Critical Discourse* (Cambridge: MIT Press, 2007) 409–416.

presented to scholars and the public in non-interactive formats, and disconnected from immediate geographic references. The 3D model is thus used for a very limited time, and after imagery is produced, it remains inaccessible in private archives, isolated from potential connections with online knowledge gathering tools, in spite of existing web technologies permitting such integration. The development of digital reconstructions of heritage sites for Google Earth's geo-referenced 3D interface is a promising approach to maximizing user interaction with virtual heritage outcomes. The incorporation in the digital reconstruction toolset of established web services permits improved visibility of the results, translating into increased public and scholarly opportunities for participating and collaborating in content development through online communities of knowledge. In this process, the role of the digital models expands beyond simply allowing the visualization of the site to representing portals for exploration of a full range of associated themes—3D icons in a virtual landscape, connecting to numerous possibilities.

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