



CHAPTER 11

Virtual Bethel: Preservation of Indianapolis's Oldest Black Church

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This chapter will offer a basic introduction to the principles behind three dimensional (3D) imaging, modeling and representation of spaces and objects, and how these can be used in research, and teaching and learning. We will present a local heritage community-based research project. The class project involves students' hands-on learning to produce complete 3D models and visualizations at the Media Arts & Science Program in School of Informatics and Computing (SoIC) at Indiana

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University—Purdue University Indianapolis (IUPUI). Our experience has been overwhelmingly positive in terms of the knowledge gained by the team and the goodwill generated in our community. Our intention is to help Digital Humanities researchers embark on 3D modeling and virtual reality recreations of physical spaces.

The Virtual Bethel experience presented several challenges to our team from which we will share lessons that are likely to be useful to other virtual recreation projects. The following lessons will be unpacked throughout the chapter: first, working on a community-based heritage project takes a considerable investment of time regarding relationship and trust building. Second, individuals cannot accomplish a project of this magnitude working alone, rather, a large team of diverse highly skilled individuals is required. Third, partnerships are essential to meet the range of skills needed and to share the considerable technology costs. Lastly, and most importantly, respect for the **intangible cultural heritage** of the people involved needs to be reflected in the virtual recreation. Above all else, we want our community partners to feel respected by the rendering of their cultural heritage when they and others experience Virtual Bethel.

BETHEL AME CHURCH OF INDIANAPOLIS

Bethel is the oldest African American church in the city of Indianapolis and was once a vital part of a thriving African American community in the heart of the Indiana Avenue Jazz District. The Church was founded in Indianapolis in 1836, and its archive documents a shared heritage and a living community. Over its 180 years of existence, the Bethel AME Church has played a vital role in the Underground Railroad, the founding of the National Association for the Advancement of Colored People (NAACP) in Indiana, the founding of the first formal School for Black Children in Indianapolis, and the development of the African Methodist Episcopal Church in the United States. In the 1960s and the 1970s, the development of the Federal interstate highway system and of IUPUI displaced many members of the community over the course of just a few decades. Where the church was once surrounded by the homes and businesses of its members, high-end condominiums now encroach on the tiny parcel upon which the crumbling brick building stands and IUPUI's five-story School of Informatics and Computing, where the authors work, looms across the street.

For the past three years, Andrea Copeland worked closely with Olivia McGee-Lockhart, the Bethel AME Church of Indianapolis' **Keeper of History**, church archivist and historian. Their common goal is to preserve and make accessible the church's archive dating back to the 1850s. The oldest items in the archive include handwritten journals, letters, and other evidence that the church was a station on the underground railroad. This archive came to Copeland's attention only because one of the School's alumni was a member of the church and sought her help. Unfortunately, many community archives are similarly discovered by happenstance as there are no connections to bridge marginalized groups to formal support structures. To lessen the role of chance in whose history is preserved, methods for creating connections between resource-rich institutions and history's underrepresented groups are desperately needed. These connections can help to realize more inclusive historical representations. Virtual reality projects such as the one described here produce excitement, as evidenced by the local TV news station's interest in the project.¹ That excitement can be used to focus needed attention on the diverse preservation needs within a community.

Given the social and economic influences in downtown Indianapolis, Bethel's membership has dwindled, and the majority of its parishioners are now elderly. Over time, the church building suffered physically and, with increasingly limited resources, repairs became unlikely. Selling the building and relocating the church became the best option for sustaining the 180-year-old congregation. The church was sold for several million dollars in fall 2016 and will become a hotel in spring 2017. Moving forward, the congregation is already building a new church in another part of the city. The 3D virtual representation of the church's sanctuary is now a significant part of local history documentation. Perhaps more importantly, it allows the cultural heritage of this community to remain accessible in a "tangible" form to be celebrated, learned from, connected to, shared with others, and passed on to future generations.

Local heritage institutions have played an important role in this project, which will continue going forward. The church's archive now resides at the Indiana Historical Society and through a partnership with the IUPUI library, the archive has been digitized. The images created in

¹Nick McGill, "Indy's Oldest Black Church Get 'Digital Restoration'," last modified February 23, 2017, <http://fox59.com/2017/02/23/indys-oldest-black-church-gets-digital-restoration/>.

support of Virtual Bethel constitute a digital archive of over 60,000 files. Now that considerable documentation of this church's history is accessible, our next challenge is to bring the digitized archive into the virtual space. By representing the church's sanctuary we will create new opportunities for learning and research.

As the development of this project has taken an organic path that has evolved over several years, we have gained valuable insight that can be applied to similar cultural heritage challenges. The displacement of this congregation brought about through **gentrification** is a phenomenon facing communities all over the United States. Projects such as this one can not only provide historical preservation, but also raise awareness about what is being lost from our collective cultural heritage experience due to gentrification.

CREATING VIRTUAL SPACES—IT TAKES A VILLAGE

Virtual reality utilizes 3D content, the creation of images, spaces, and animations to implement fully digital-virtual recreations of historical artifacts and spaces. Experiencing spaces in virtual and mixed realities provides an impactful, contextual, and immersive environment for learning history and conducting research with digital artifacts. Use of virtual reality (usually built on **game engines**) is expanding in Digital Humanities as a research and education tool. Entire spaces can be replicated to allow users to immerse themselves in places that no longer exist due to time, historical events, or inaccessibility. Taking an interdisciplinary and technological approach allows for new experiences and research questions to be asked of those historical materials and experiences. The threats to artifacts, documents, and buildings representing diverse cultural pasts are ever-present and our work here begins to look at ways to preserve the experiential aspects inherent in static representations of the past.

A Media Arts & Science team-based course in 3D production/visualization served as the production lab for this project. The course is designed to include work with community partners to provide students with real-world, context-driven, hands-on learning opportunities. The course focuses on the creation of high-end, broadcast-quality animations through team-based learning. Students develop skills in areas related to production in a 3D project. These include preproduction skills such as story concept and development, script writing, research, conceptual drawing, storyboarding, animatics, and project management. Production

skills are explored in 3D asset creation, time management, file management, sound, and title sequences. Post-production processes include final rendering issues, movie creation, and formatting for various playback devices.

Our experience working with students and community partners provides methods for developing 3D technology-based Digital Humanities projects while developing interdisciplinary research collaborations and capacity for community engagement. Students and faculty work with archival documents and physical artifacts/spaces to learn methods to represent that history using new media technology. Further, they worked with heritage professionals, historians, and community experts. The Media Arts faculty, Zebulun Wood and Albert William, work in conjunction with Ayoung Yoon and Andrea Copeland, faculty from the Department of Library and Information Science which is also in SoIC, as well as faculty in the History, Geography and Anthropology departments in the School of Liberal Arts. This project illustrates the need for cross-campus department collaborations to develop Digital Humanities projects of magnitude. The well-documented Virtual Harlem project provides another example of how important interdisciplinary collaborations are for historical virtual recreations.²

Copeland and Yoon are leading the local cultural heritage project involving the Bethel AME Church of Indianapolis. They partnered with Wood and William, who teach courses in 3D/visualization, for the purposes of extending research and curriculum initiatives. This project provides the opportunity for students to use digital arts technology to preserve and represent physical objects and spaces as well as to engage audiences in the exploration of history through new media. 3D virtual technology is used to preserve an important historic space that will no longer exist owing to gentrification, redevelopment, and changes in the city's use of its landscape. The virtual representation of the church's sanctuary now provides a vessel to engage audiences in the history of the Bethel church as well as the history of African Americans in Indianapolis. Like other virtual history projects, we want to replicate or translate a historic experience for modern audiences in a way that engages them bodily

²James J. Sosnoski, Patricia Harkin, and Bryan Carter, *Configuring History: Teaching the Harlem Renaissance Through Virtual Reality Cityscapes* (New York: Peter Lang, 2006).

and emotionally.³ We believe this sanctuary is worthy of our efforts because of its historical significance, but also because of the injustice to the community brought about by gentrification. We are hoping that others will take an interest and think differently about the changes they see around them.

COMPETENCIES FOR RESTORING 3D SCANNED STRUCTURES

The technology, skills, and human resources needed to build virtual environments are considerable. Without the contributions of students in a Media Arts and Science program and a lab dedicated to these types of projects, the digital preservation would not have been possible. The discussion that follows regarding the course and the competencies illustrates the depth of knowledge needed for Digital Humanities projects of this magnitude. Given that you might not be fortunate enough to have numerous talented media arts students available to you, this section will help you determine what skills are needed for your own project and who, exactly, you need to partner with.

Our 3D team production class allows students to work as a group and emulates the collaborative efforts found in the media and animation industry. Students should have a number of prerequisites completed, including intermediate courses in **3D modeling, texturing and lighting, and animation**. The goal of the course is to bring students together to work on a common project. Students are encouraged to bring their existing knowledge and specialty (modeling, unwrapping, shading, lighting, game engines, or development) to the table, and also to investigate new skill sets they may be interested in or that are needed to facilitate the success of the production.

Through teaching this course for several years, we have found that students are drawn to this class for a number of reasons. It allows them to work together on a single project synergistically. Students can apply their existing skills and also find ways to pursue other interests they may not have yet explored. It teaches them team dynamics and helps foster group activity. It explains goals that are essential to the success of group

³Alison Landsberg, "Digital Translations of the Past: Virtual History Exhibits," in *Engaging the Past: Mass Culture and the Production of Historical Memory* (New York: Columbia University Press, 2015): 147–176.

work: communication, leadership, organization, and accountability. Past class assessments have provided us with feedback that the experiences students receive in this class are different to their regular class work, that they relish this experience, and that the overall result is a very satisfying academic exercise. You will need to identify project partners that have technical skills as well as “soft skills,” e.g., communication, time management, and team-based problem-solving.

At the beginning of class, we assess student skills and strengths, and build the team according to this assessment and the project goals. We carefully look at the abilities needed and often recruit students that we feel can benefit from the class and can contribute to specific portions of the project as it develops. We encourage and expect leadership from within the group. Based on our course design, we encourage you to assemble a team that focuses on the strengths of each individual and structure the project so that all team members can easily interact with one another. We encourage you to create a communication system that is easiest for them to use; many times students have opted to use Facebook. A cloud-based file sharing and storage system called IU Box is utilized for file sharing, reference, and communication between the team and stakeholders.

Knowledge of the subject matter is, of course, critical to the success of the project. We challenge the students to research any new topics on their own. We also provide supplementary material on the course’s online course management software, CANVAS. Knowing the history of the subject, or the background of the story gives you a more vested interest in the success of the program. Fostering relationships with community members and working to develop an understanding of their history facilitates more respectful and valuable intangible cultural heritage projects.

DIGITAL PRESERVATION PIPELINE

In the fall semester of 2016, our class was presented with the opportunity to recreate the historic Bethel AME Church in Indianapolis. We felt that a virtual reality experience that utilized 3D models and textures would be a powerful way to tell the story of this church. We also felt this opportunity for community engagement was a perfect fit for the class. Any chance for our students to interact with the community is a positive experience on all accounts. We presented them with this possibility in the first class meeting and it was met with great excitement. Students

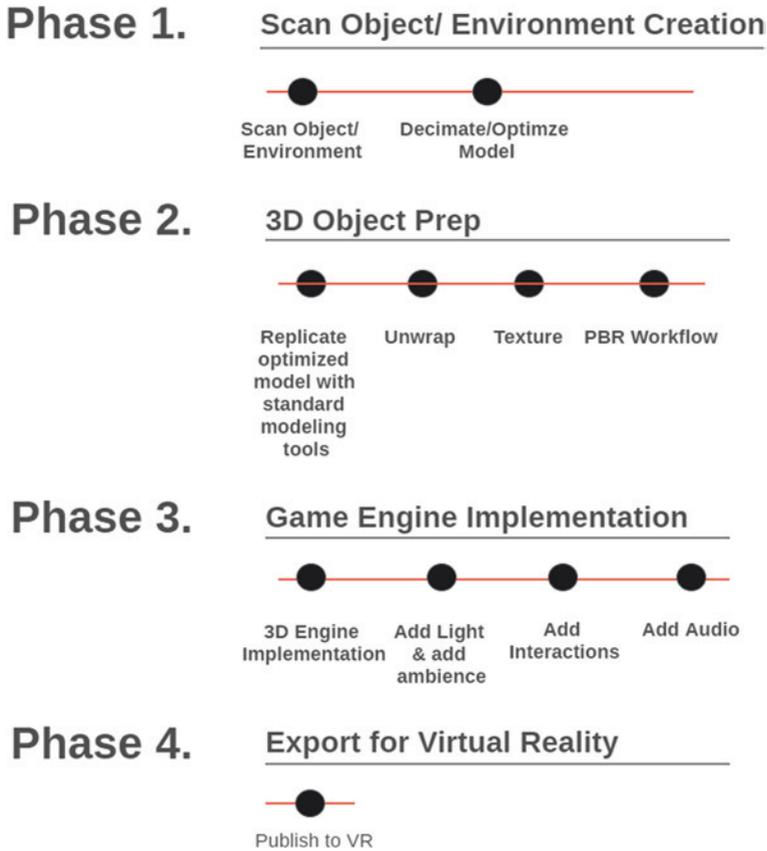


Fig. 11.1 Scan to VR data pipeline

felt this was a meaningful use of their skills and time, and were excited that they were working to give back to the community. Figure 11.1 provides an overview of the technical processes associated with each phase of development.

During our second class meeting, all students and faculty visited the church to take **reference photographs** and to experience the space we would recreate. On a warm, late afternoon with sunlight streaming through the stained glass windows, we spent over two hours exploring every corner of the church. We took approximately 2000 high-quality photographs to use as reference models and textures that would go into

the VR. Additionally, we utilized a GigaPan robotic camera system to capture images that were stitched together to form highly detailed panoramas of the interior, ensuring there was not an inch of the space missed; a Ricoh Theta camera was also used to capture low-resolution 360° images. All of these photographs were cataloged, archived, and used to help recreate the digital space. Measurements of some structures were also taken for use as a scale reference.

Before the start of the semester, laser scans of the interior of the Bethel AME church were created by Online Resources, a local 3D scanning company, and the data were given to us to use in our project. 3D scanning can be utilized for many applications and is not limited to room-scaled objects. It is becoming a common tool to preserve the likeness of objects both large and small. This data set of 8 scans was approximately 10 GB and contained 39 million polygons. To review the data, we decimated the scan with Pixologic's Zbrush 4r7 plugin to reduce the polygon count to approximately 800,000 polygons. Tests were done to see what the scanned data looked like using the Unreal 4 game engine outputting to an HTC Vive VR system. Based on these tests, it was apparent that the students would need to rebuild the interior of the church digitally because the scanned data contained many holes, the polygon mesh was not clean, and the high polygon count made it impractical for real-time VR. While these data were to scale and detailed, it was incomplete and unsuitable to use without considerable modifications. We recognized it as an excellent reference resource to speed up our modeling workflow. One of the first steps we took to develop the church interior involved exporting the scanned data into Unreal and scaling it correctly. This allowed us to compare the experience of the digital space and the real Bethel sanctuary. We noted heights of objects (like a pew during reference photography) and then compared them to measurements of the same object in the VR template. The team agreed on a realistic scale for the pews, organ, piano, and second floor early in the project.

Students used Autodesk Maya 2016 as the software to model all the assets. The scanned data was brought into Maya and scaled to its proper dimensions for use as a template. Objects that had been measured by students were used as references. Then, the scanned model was brought to its proper relative scale based on unit settings in Maya. This data set was used as a reference to build all the components for the interior of the church.

To give an example of this workflow, we can look at the creation of the church's pews. For the most part, the pews were all the same design but differed in size and orientation. By using the scanned data and the reference photographs, our modeler was able to determine the basic shapes of each part of the pew to scale and build a simple base model. We needed to be cognizant of the number of polygons that this model contained so that it would show enough detail, but not be so high as to hinder the Unreal 4 engine when it was brought to VR. Once this model was completed satisfactorily, with necessary technical considerations of polygon count and overall topology, it was used to populate the environment by duplicating and adjusting the scale and position of each pew to match the scanned church model.

Similar processes were completed to construct all elements of the environment. The church's primary structure of the walls, floor, and ceiling was built. The stairs, balcony, the pulpit, choir lofts, and the pipe organ was among the many pieces that were created. All assets were built to adhere to technical standards that would allow them to function optimally in VR.

The team reviewed, critiqued, and assessed each asset as it was created. Production meetings were held at the beginning of each week's class in a conference room, instead of our usual classroom to focus on each asset and consider the broader context of the project as a team. Each student's work was reviewed weekly by the team; concerns were addressed as needed, then tasks were allocated to move forward. Students sign weekly contracts so that everyone knows expectations and deadlines. We stress that others are relying on their progress and adherence to mandatory deadlines. Production meetings were followed by visits to the IU Advanced Visualization Lab to view the advances in the VR environment with the tools we are designing. Then, there was time for all members to interact, work, and receive instructions on techniques that were necessary to further progress. As we neared completion, several Bethel congregants and the church's pastor visited to see our progress. This was an inspiring visit for all involved, as the students saw the impact of their work on the visitors and understand the project's cultural significance.

As students completed assets, a spreadsheet was updated with progress. As digital models were completed students began unwrapping the 3D objects, so they could be textured using Allegorithmic's Substance Painter. This process applied materials and colors to the 3D models to



Fig. 11.2 A photo of the original church

impart a sense of realism. A pipeline was developed to simplify the identification of particular materials and a library was created for students to access materials. As models were painted, texture maps were exported for use in the Unreal 4 VR.

After all models had materials applied to them and had been added to Unreal, various processes were used to optimize the scene; these included critically testing the textures to see if there were errors, adding lighting to the scene to simulate light coming through the windows, optimizing navigation controls, and creating teleportation to navigate in the environment.⁴

Figures 11.2 through 11.3a–c, visually illustrate the development process. Figure 11.2 is a photograph of the church’s sanctuary. Figure 11.3a is a screen capture showing the original 3D LIDAR scan inside of Epic’s Unreal game development engine. In Fig. 11.3b, the 3D model has been recreated by students using a 3D modeling technique known as retopology (simplifying and creating efficient geometry for real-time rendering and animation). Lastly, in Fig. 11.3c the sanctuary appears fully textured, shaded, and rendered dynamically ready for virtual reality.

⁴Rachel Davidson and Tyler Jackson, “Project Progress Video,” last modified February 2017, <https://vimeo.com/209509528>.

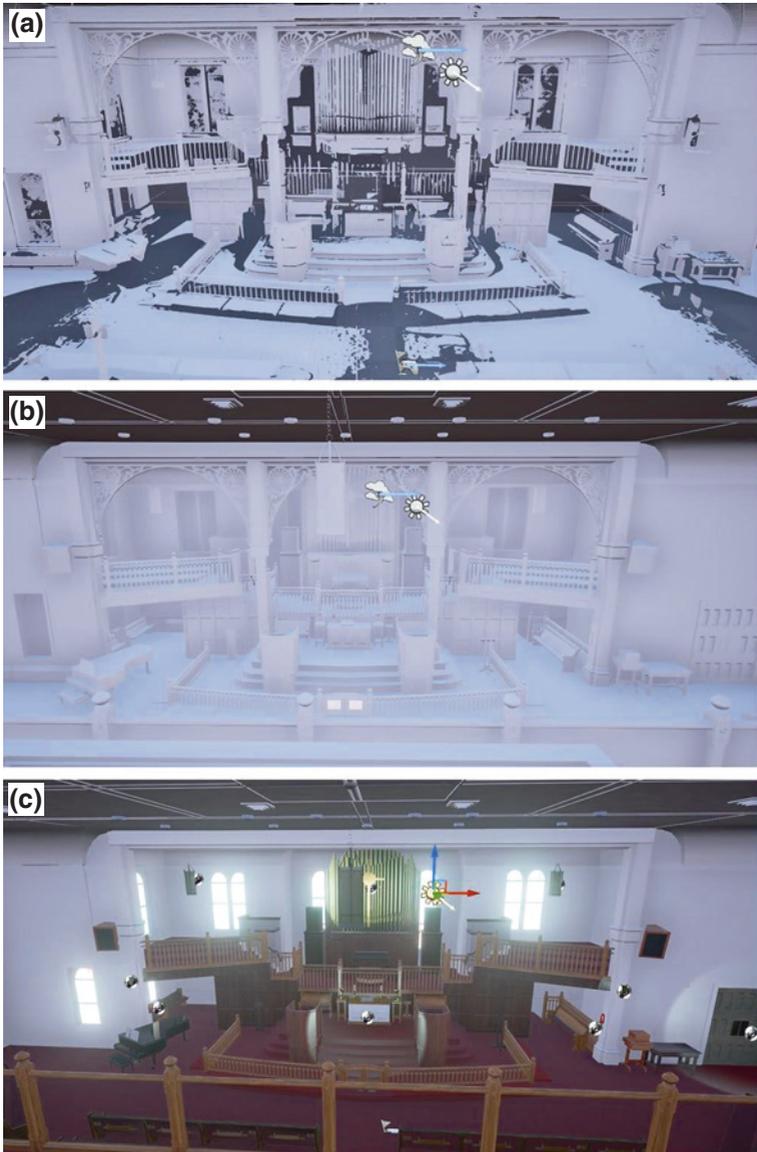


Fig. 11.3 The digital modeling process. **a** Laser scan model provided by Online Resources, Inc., **b** Recreated 3D model of Bethel AMC from 3D laser scan, and **c** A fully lit and textured Virtual Bethel shown in Epic's Unreal game development engine

IMPLICATIONS FOR TEACHING AND LEARNING IN DIGITAL HUMANITIES

Team learning is the key to the design of the project. Students hold themselves and their peers equally accountable in their respective roles, for meeting deadlines, responsibilities, and reassigning tasks. Week contracts commit them to achieving goals on behalf of the team/project. Furthermore, when working in a team in which all members contribute separate files into the same project requires the diligent management of file dependencies and naming conventions, because it is easy to save over, replace, or misplace someone else's work. Cloud-based project folders and structures have helped this class considerably when dealing with versioning issues. Communication skills are developed that span from interpersonal collaboration to formal project documentation.

Service learning is the element which connects the team to communities outside of the university. The community partner becomes the students' client and their payment is the chance to make a difference. At IUPUI, an important goal is to connect our students' expertise to unique applications of knowledge through service and engagement, which can benefit the community. The Virtual Bethel project exemplifies this IUPUI staple and demonstrates the value of our students' skillsets beyond video game and film entertainment.

IMPLICATIONS FOR RESEARCH IN DIGITAL HUMANITIES

In March of 2017, we received a New Frontiers in the Humanities Grant from IUPUI to create the Virtual Bethel Learning Sanctuary and to build an image archive.⁵ At its core, Virtual Bethel Learning Sanctuary exemplifies a new, multifaceted approach to preserving and experiencing cultural digital heritage. This project will bring diverse historical evidence (documents, photos, oral histories, video, etc.) together in one place, thereby transcending the walls of the institutions that contain each of the component parts. The combination of archival artifacts and documents with virtual reality, which is inherently participatory, extends the functionality and impact of online exhibits of cultural materials which are overwhelmingly static in nature. Interaction and immersion within virtual environments

⁵Zebulun Wood, "New Frontiers Proposal Video," last modified October 2016, <https://vimeo.com/187085145>.

and archives enable innovative research and learning with primary sources. However, this will present further challenges and pose new questions about what narrative is told, who tells it, how it is told, and how those decisions impact the experience of participants in the virtual learning space. Public history digital collections and sites have been criticized for their lack of critical evaluation in terms of how the projects are experienced by their users.⁶ This next phase will allow us to explore research questions related to public perceptions of value in digital historical experiences and what kinds of learning take place in virtual spaces.

Further, this project contributes to research in digital preservation. The combination of 3D modeling with virtual reality technology for historic preservation is a recent innovation.⁷ As such, the project will contribute to the development of standards and best practices for the management and preservation of virtual reality data. Learning from game and software preservation research, this project addresses core preservation concerns when developing the Virtual Bethel Learning Sanctuary that can be suitable for long-term preservation and use. Future research will continue to explore methods for preserving complex interactive, multilayered digital object virtual reality data, and technological requirements for rendering.

Given the diversity and sophistication of the equipment used to generate images for the Virtual Bethel project, the research advances knowledge in image archiving **data curation**. Making the Virtual Bethel “construction documents” archive (60,000+ files) open access might well be unprecedented, and certainly is not the norm. This will allow others, without the vast technological resources of SoIC to explore 3D modeling and virtual reality. The archive will also document virtual reality technology and development in the years 2016–2017 to support future research in this area.

Our experience illustrates that local community-based Digital Humanities projects are resource and time intensive. The level of coordination

⁶Fien Danniau, “Public History in a Digital Context: Back to the Future or Back to Basics?” *BMGN: Low Countries Historical Review* 128, no. 4 (2013).

⁷Kyriacos Themistocleous, “Model Reconstruction for 3D Visualization of Cultural Heritage Sites Using Open Data from Social Media: The Case Study of Soli, Cyprus,” *Journal of Archaeological Science: Reports* 14 (2017); Belen Jiménez Fernández-Palacios, Daniele Morabito, and Fabio Remondino, “Access to Complex Reality-Based 3D Models Using Virtual Reality Solutions,” *Journal of Cultural Heritage* 23 (2017).

needed among faculty, community members, and students is considerable. The relationships that underpin this project were developed over years. The course was team taught and enrolled 12 students resulting in an instructor to student ratio of 2:6. The technology investment is significant given the lab space, equipment, and software needed to teach, create, and research in this area. The costs are high, but hopefully we have illustrated that the benefits are significant as well. In addition to creating a powerful learning environment for our students, this project has benefitted the research agendas of several faculty, preserved an important part of Indiana history, and provided a framework from which to approach future projects.

Acknowledgements Special thanks to **Online Resources, Inc. for 3D scan of Bethel's sanctuary**: Without the Scan of Bethel Sanctuary we would not have had an ideal reference of the space to rebuild for VR. JD Schaumburg of Online resources recalls the amount the day of scanning: "5 hours of scanning and it took about 3 hours of computer crunching time to merge the High Res files to the low res files. Yes we can upload the High Res scans to the IU box. They are about 1 GB to 1.5 GB for each scan, and we have 8 total scans." Online Resources can be found at <http://www.onlineresourcesinc.com/>. We'd also like to thank **Advanced Visualization Lab (AVL), UITS, IUPUI**. Without the AVL team we could not have compared Unreal and Unity Game engines. In the end, both engines are entirely capable of Digital Preservation of spaces for Virtual Reality. Thanks for your wisdom and advice Mike, Jeff, Chauncey. Tyler you are at the heart of this project's success. Advanced Visualization Lab can be found at <https://rt.uits.iu.edu/visualization/avl/>.

APPENDIX: HARDWARE AND SOFTWARE

Hardware:

HTC Vive Virtual Reality Kit
 Compatible PCs
 Surphaser—3D Scanner (property of Online Resources, Inc.)

Software:

Retopologizing of the Scan
 Pixologic Zbrush
3D Modeling Software Used

Autodesk Maya

3D Unwrapping Software Used

Autodesk Maya & Headus UV Layout Pro

3D Texturing Software Used

Adobe Photoshop

Physically Based Rendering Texturing Software Used

Allegorithmic Substance Painter & Designer

Game Engines Used

Epic Unreal Engine

Unity Game Engine for comparison

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