IJDC | *Peer-Reviewed Paper*

Complexities of Digital Preservation in a Virtual Reality Environment: The Case of Virtual Bethel

Angela P. Murillo
Indiana University – Purdue University

Lydia Spotts
Indiana University – Purdue University

Andrea Copeland
Indiana University – Purdue University

Ayoung Yoon
Indiana University – Purdue University

Zebulun M. Wood
Indiana University – Purdue University

Abstract

The complexity of preserving virtual reality environments combines the challenges of preserving singular digital objects, the relationships among those objects, and the processes involved in creating those relationships. A case study involving the preservation of the Virtual Bethel environment is presented. This case is active and ongoing. The paper provides a brief history of the Bethel AME Church of Indianapolis and its importance, then describes the unique preservation challenges of the Virtual Bethel project, and finally provides guidance and preservation recommendations for Virtual Bethel, using the National Digital Stewardship Alliance Levels of Preservation. Discussion of limitations of the guidance and recommendations follow.

Received 22 December 2017 ~ *Accepted* 20 February 2018

Correspondence should be addressed to Angela P. Murillo, 535 West Michigan Street, IT557, Indianapolis, Indiana, 46202, USA. Email: apmurill@iu.edu

An earlier version of this paper was presented at the 13th International Digital Curation Conference.

The *International Journal of Digital Curation* is an international journal committed to scholarly excellence and dedicated to the advancement of digital curation across a wide range of sectors. The IJDC is published by the University of Edinburgh on behalf of the Digital Curation Centre. ISSN: 1746-8256. URL: http://www.ijdc.net/

 doi:10.2218/ijdc.v13i1.631

Introduction

The digital preservation community has worked countless hours to create preservation strategies for digital objects within a variety of contexts and complexities. To date, this tremendous work has accounted for the preservation strategies, policies, tools, and techniques that can be utilized for many types of digital objects and contexts. With the growing amount of virtual reality environments being created, the digital preservation community needs to consider the types of data objects created in these virtual spaces. Additionally, strategies and techniques need to be created to ensure that these new, unique, and growing virtual worlds do not run the risk of being lost and can be preserved for long-term access and reuse.

One such virtual reality project is the Virtual Bethel project at the School of Informatics and Computing (SoIC) at Indiana University-Purdue University Indianapolis (IUPUI). The Virtual Bethel project is a collaboration between the SoIC Department of Library and Information Science (DLIS) and the Media Arts and Science Program (MAS) in the Department of Human-Centered Computing, the Bethel Church which is the oldest African American church in Indianapolis, and several other cultural heritage organizations in Indianapolis. Through this project, the partners have worked together to preserve and make accessible the church's rich history in a virtual reality environment with vignettes of the historical documentation available through the Bethel archive.

As virtual reality environments become more common, there is an increased need to consider the specific and unique preservation challenges of these environments. Virtual Bethel provides an apt case study. More specifically, the preservation challenges for this project revolve around how to ensure that the project files (input), process and production pipeline, and the virtual reality environment (output: dissemination and executable files) will be accessible and interpretable by machines (hardware/software) and viewers/researchers in the future. These significant issues include degradation, data decay and rot, and obsolescence of formats, software, and hardware. This paper will explore these preservations challenges to assist Virtual Bethel and other virtual reality projects, and help identify preservation concerns specific to virtual reality.

The paper begins with a review of the history of the Bethel AME Church of Indianapolis and its importance. Then the paper describes the unique preservation challenges of the Virtual Bethel project. Finally, it provides guidance and preservation recommendations for Virtual Bethel, using the National Digital Stewardship (NDSA) Levels of Digital Preservation (Phillips, Bailey, Goethals and Owens, 2013). This paper concludes with a discussion of limitations of the guidance and recommendations.

The Bethel History and Importance

The Bethel AME Church was founded in 1836, is the oldest African American church in the city of Indianapolis, and was a vital part of the African American community in the heart of the Indianapolis Jazz District. The Bethel Church played a vital role in the Underground Railroad, the founding of the NAACP in Indiana, the founding of the first formal School for Black Children, and the development of the African Methodist Episcopal Church in the United States. Additionally, it is the only remaining building in

Indianapolis that Madame C.J. Walker was actually in, it is the oldest building on the Indianapolis Central Canal, and is on the state and national historic registry.

The Bethel Church history is represented in an extensive archive that spans over 162 years and provides artifacts documenting the incredibly rich history of the Bethel Church and the African American community in Indianapolis. While the Bethel building still is in existence, it was recently sold for five million dollars to become a hotel. Therefore, the building will be repurposed, and the congregation of the Bethel Church has moved to a new location. Keeping the Bethel sanctuary alive in a virtual environment will allow the congregation – along with future community members, historians, and others interested in this community – to retain access to the original Bethel sanctuary, at least in some fashion, through the Bethel virtual reality environment developed at SoIC.

The importance of the Bethel community was summarized by the church historian, Olivia McGee Lockhart:

> 'The Bethel Church was a cornerstone of what took place here in the city of Indianapolis… in the social life, the political life, and the economic life, it was part of the complete story… In terms of longevity and historical landmarking, I don't think anyone can beat us' (Lewis, 2016).

Virtual Bethel Project

In the fall of 2013, this archive came to the attention of Andrea Copeland, department chair of DLIS, only because an alumnus (Rodney Freeman) was a member of the church and sought participation in the grassroots organization Project Backup, whose mission was to promote digital preservation in the African American communities in Indianapolis. Unfortunately, many community archives are similarly discovered by happenstance as there are no connections to bridge underrepresented groups to formal support structures (Copeland, 2015; Copeland, 2017).

In 2015, Freeman, Copeland, McGee Lockhart, and others submitted a proposal to the National Historical Publications and Records Commission to digitize and preserve the church's archival collection while engaging congregants in the project to capture the historical narrative. Their efforts were rejected as the reviewers questioned "how they will reach their intended audience that comes from an age group that is not necessarily comfortable in an online environment and may not have the willingness to engage in oral histories and discussions online where there may be sensitivities to privacy issues that are not as present in the younger generations." It is interesting to reflect on this review given how technologically sophisticated this project has become with community engagement.

In the spring of 2016, with the help of the IUPUI University Library and in partnership with the Indiana Historical Society (IHS), funds were obtained through the Indiana State Library to digitize the archive. At this time, the physical archive was moved to IHS as the church was being sold. When notified the church was to be sold in the fall of 2016, the idea was raised that if possible a 3D scan of the sanctuary should be arranged. Funds were raised from IUPUI's Office of Community Engagement to pay $1,500 to a private company to complete the 3D scan. In the fall of 2016, with the successful scanning of the sanctuary and hundreds of photographs documenting the interior of the sanctuary, MAS students created Virtual Bethel – the 3D virtual representation of the Bethel Church. In February of 2017, the team received funding

 doi:10.2218/ijdc.v13i1.631

from Indiana University's New Frontiers in the Humanities to combine the digitized archive with the virtual sanctuary to create a new learning space.

The team is working collaboratively to create vignettes to tell the story of the rich history of the Bethel Church. Vignette themes include: 'they built this in the shadow of slavery', 'the center of Indiana Avenue community', 'the realization of civic life through groups within the church', and 'the promotion of the welfare of African-Americans'. These vignettes use a mixture of photographs, documents, and news stories to tell the story of the Bethel community and provide a way to preserve the history of the community now and in the future.

Virtual Bethel Preservation Challenges and Evaluation

While the Virtual Bethel project has some of the well-known challenges of digital preservation, such as obsolescence of hardware and operating systems (Harvey, 2011), the project has several unique preservation challenges due to the nature of 3D data, the complexity of the data creation process, as well as the associated technology. Developed using the UNREAL game engine, Virtual Bethel project shares the challenges of game preservation, such as the diversity of platforms used to run the environment and render the content for user experiences (web VR, mobile VR, and full head mounted display [HMD] technology), the variety of media types, the multi-layered data structure, and the complexity of relationships among data.

There have been some efforts made in preserving interactive digital art and video games, such as Antonescue, Guttenbrunner and Rauber's case study to preserve Second Life (2009), Library of Congress' effort to preserve video game as a part of preserving American art (2007), McDonough et al., (2010), and Rhizome's ArtBase digital art archive (2018). However, an agreement on the standards and best practices have not yet been reached because the standards or models of preservation and the solutions devised do not reflect the current technology development and complexity (Kaltman, 2016).

Currently, the Virtual Bethel project has undergone an evaluation of the potential challenges for digital preservation as well as an evaluation of the status of the project files. Both library (classification, item-level description) and archival (arrangement, respect for original order, aggregate description) organizational and descriptive approaches were considered for the unique preservation challenges of the Virtual Bethel. The following section outlines the preservation challenges, preservation evaluation, and an argument for an archival approach.

Virtual Bethel Preservation Challenges

The Virtual Bethel project has several major preservation challenges. These preservation challenges start with defining the boundaries and phases of the collection. There are three distinct phases involved in the creation of the Virtual Bethel project: 1) pre-production, 2) production, and 3) post-production or executable. Additionally, there is a need to determine the relationships of the files both within and between the three phases of creation, as some files are reliant on each other for meaningful rendering by software, and thus human interpretation. Along with the challenges of defining the collection boundaries and understanding and preserving relationships amongst the files and phases, two major preservation issues exist for the Virtual Bethel project. These

challenges include data degradation and obsolescence of formats, software, and hardware. It is equally important to preserve the pre-production and production files or input files, as well as the processes, including the production pipeline and the VR environment. Before any of these challenges can be addressed, a preservation evaluation needs to be conducted to determine the most appropriate ways to deal with these challenges.

Preservation Evaluation

The Virtual Bethel project is assessing and planning preservation actions. However, no preservation actions have been taken, as there is no existing VR preservation workflow, policy, or infrastructure at SoIC or IUPUI University library. Furthermore, during the development of the Virtual Bethel project the amount of data grew from 40 to 60GB, as of Spring 2017.

Faculty at DLIS studied the preservation problem through the Digital Preservation course taught during the Spring Semester 2017. Throughout this course, library and information science students and faculty considered sources of acquisition, creators, context, and content of the Virtual Bethel project. From an archives perspective, the class considered appraisal, arrangement, description, and descriptive products. They explored preservation tools, access, and storage systems. Aspects impacting access and use such as rights, restriction, reproduction, and documentation of provenance and cultural heritage rights were also examined. The course took a multi-state approach and scope. The initial format parameters were limited to still images and 3D model files only. As the knowledge and resources were limited, preservation of hardware and software were considered out of scope for the initial evaluation.

During this evaluation, several organizational and descriptive methods were considered, including a digital library of catalogued objects, and an archival arrangement and descriptive approach. From the library perspective, a digital library of 30,000+ still images (jpeg), plus OBJ files and STL files was considered. An OBJ file is a 3D file format used in graphics applications, and an STL file is a 3D file used in scanning and 3D imaging. This approach would entail item-level description and re-grouping by subject or type. From the archival perspective, preserving all file formats in the original order, or the creators' folder hierarchy was considered. Intellectual access would be via a collection-level description, alongside contextual information documenting the creation process and software, hardware, and operating systems. Lastly, a comprehensive or multi-level approach was considered that questioned if we could preserve more. This would include preservation of project files, finished products and dissemination files. Additionally, this approach would consider if some production files could be preserved in standard or open source formats and if some products are interpretable by open source software. Keep in mind that all of these preservation approaches still excluded preservation of all commercial and proprietary software used in the project, as well as the hardware used.

Arguments for an Archival Approach

While both the library and archival approach have great potential for preservation of the Virtual Bethel data, the archival approach may be more effective and more likely to support future interpretation and use. Archival principles of particular usefulness for this environment include:

 doi:10.2218/ijdc.v13i1.631

- Provenance, which considers the origin and context of creation. Through provenance, records from the creator are kept together and there is a record regarding origins, custody, and ownership. Provenance preserves the existing relationships and evidential significance that can be inferred from the context of the records.

- Respect for original order, which preserves the existing relationships and evidential significance that can be inferred from the context of the records, and reflects the aggregation of records in relation to activity. This provides the best possibility for meaningful future use, as digital objects are meaningless unless interpreted by software and hardware, needed to mediate intellectual access to content (Rothenberg, 1995).

Additionally, given the overwhelming amount of individual digital objects in this collection, the archival approach would be more efficient and effective. In the current collection, individual files are a part of a larger collection, where little value can be derived from labor-intensive item-level description. Greater meaning is derived from their place in the larger context of the project. Context could be provided through questions such as 'what was the file used for?', 'how was it manipulated and with what tool?', and 'at which stage in the creation process or production pipeline is it used?'

In this way, the collection in its aggregate has value and meaning. For instance, the folder hierarchies for project coordination and administrative documents are just as important to preserve as the hierarchy enabling the rendering of compound objects which are interconnected through meaningful folder hierarchies. Figure 1 provides an example of the types of notes that need to be provided to users to understand the complexity of compound objects throughout the collection. Using administrative metadata such as this allows for future interpretation of the compound objects, and additionally describes the 'parts' that must be preserved and presented in context.

Bethel Project (Fall 2016)

Note to new user(s):

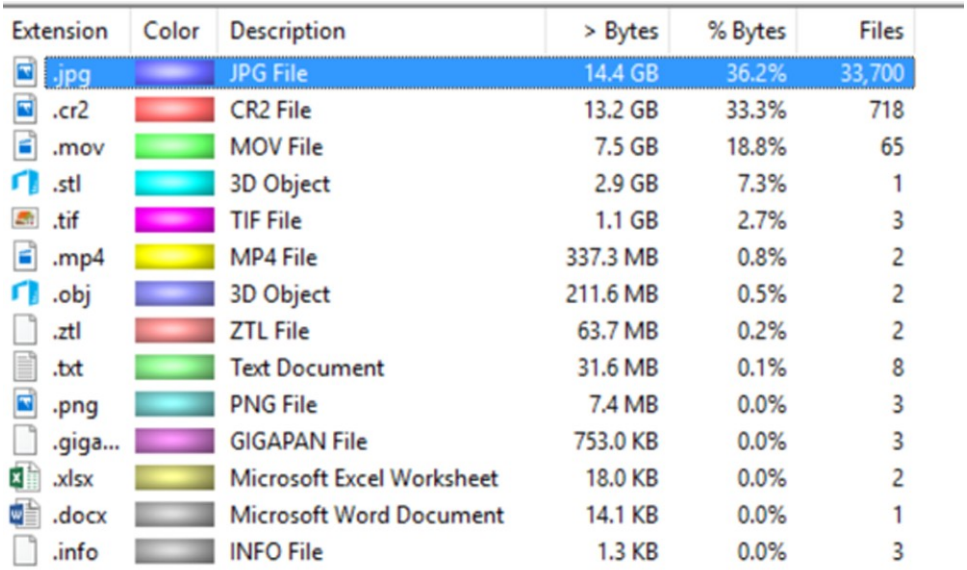
The project is broken into two parts. The Maya project folder, and the Game Engine (UE4) project folder.

The entire contents of the Bethel Project are located within the Maya project folder (possibly excluding reference images).

- All of the assets that are currently in the **'finalDeliverables.mb' file** are located in the **'Assets' folder**, within the Maya project. Each object has its own folder with textures if they have them.
- In the **'Data' folder**, is where the LIDAR scan data of the church is located (which is what was used as the template for modeling the scene), and also a folder that contains most of the texturing files from Substance and Quixel.
- Located in the **'Scripts' folder** are a couple of scripts for Maya plug-ins that were found to be useful during the production process.
- Within the **'Scenes' folder** there are both a **'finalDeliverables.mb'** and **'workingDoc.mb'**. The working doc is what was used for constructing the scene, and then once completed, imported into the final deliverables scene to be later imported into game engine.
  - Everything that is in the final deliverables mb file, has been both modeled and

Figure 1. Administrative metadata.

Additionally, to gain preliminary intellectual control of the collection, the project team have identified all file types, the size of each group, and its relation to the composition of the collection. As shown in Figure 2, currently there are 14 different file types associated with the project.



Extension	Color	Description	> Bytes	% Bytes	Files
.jpg		JPG File	14.4 GB	36.2%	33,700
.cr2		CR2 File	13.2 GB	33.3%	718
.mov		MOV File	7.5 GB	18.8%	65
.stl		3D Object	2.9 GB	7.3%	1
.tif		TIF File	1.1 GB	2.7%	3
.mp4		MP4 File	337.3 MB	0.8%	2
.obj		3D Object	211.6 MB	0.5%	2
.ztl		ZTL File	63.7 MB	0.2%	2
.txt		Text Document	31.6 MB	0.1%	8
.png		PNG File	7.4 MB	0.0%	3
.giga...		GIGAPAN File	753.0 KB	0.0%	3
.xlsx		Microsoft Excel Worksheet	18.0 KB	0.0%	2
.docx		Microsoft Word Document	14.1 KB	0.0%	1
.info		INFO File	1.3 KB	0.0%	3

Figure 2. File types and amounts.

As shown in Figure 2, files types range from tens of thousands to just a few. The project team is currently working on file format validation and analysis as the collection continues to grow.

Preservation Recommendations and Plans for Virtual Bethel

The National Digital Stewardship Alliance (NDSA) 'Levels of Digital Preservation' provides a tiered set of recommendations for digital preservation. This NDSA approach was considered promising for the Virtual Bethel project because the approach is both content and technology agnostic, and focuses on preservation actions (Phillips, Bailey, Goethals and Owens, 2013). The NSDA Level of Digital Preservation provides five functional areas of digital preservations systems, which include: storage and geographic location, file fixity and data integrity, information security, metadata, and file formats (Table 1).

Table 1 (over). The NSDA Levels of Digital Preservation (Phillips, Bailey, Goethals and Owens 2013).

 doi:10.2218/ijdc.v13i1.631

	Level 1 (Protect your data)	Level 2 (Know your data)	Level 3 (Monitor your data)	Level 4 (Repair your data)
Storage and Geographic Location	Two complete copies that are not collocated For data on heterogeneous media (optical discs, hard drives, etc) get the content off the medium and into your storage system	At least three complete copies At least one copy in a different geographic location Document your storage system(s) and storage media and what you need to use them	At least one copy in a geographic location with a different disaster threat Obsolescence monitoring process for your storage system(s) and media	At least three copies in geographic locations with different disaster threats Have a comprehensive plan in place that will keep files and metadata on currently accessible media systems
File Fixity and Data Integrity	Check file fixity on ingest if it has been provided with content Create fixity info if it wasn't provided with the content	Check fixity on all ingests Use write-blockers when working with original media Virus-check high risk content	Check fixity of content at fixed intervals Maintain logs of fixity info; supply audit on demand Ability to detect corrupt data Virus-check all content	Check fixity of all content in response to specific events or activities Ability to replace/repair corrupted data Ensure no one person has write access to all copies
Information Security	Identify who has read, write, move and delete authorization to individual files Restrict who has those authorizations to individual files	Document access restrictions for content	Maintain logs of who performed what actions on files, including deletions and preservation actions	Perform audit of logs
Metadata	Inventory of content and its storage locations Ensure backup and non-collocation of inventory	Store administrative metadata Store transformative metadata and log events	Store standard technical and descriptive metadata	Store standard preservation metadata

	Level 1 (Protect your data)	Level 2 (Know your data)	Level 3 (Monitor your data)	Level 4 (Repair your data)
File Formats	When you can give input into the creation of digital files, encourage use of a limited set of known open formats and codecs	Inventory of file formats in use	Monitor file format obsolescence issues	Perform format migrations, emulation and similar activities as needed

The remainder of this section examines the Virtual Bethel based on these functional areas and makes recommendations.

Recommendation and Plan for Storage and Geographic Location

Currently, the project is located in the Indiana University Box[1] system, which is a cloud storage environment provided by IUPUI for all students, faculty, and staff. A full copy is located in the MAS faculty project box folder (IUPUI, n.d.), an 'in process' surrogate was created for the Digital Preservation course, which is now out-dated. As of January 2018, multiple copies exist on box, as the creation team is adding vignettes, refining the curatorial experience for the audience, and creating documentation to port the experience to many mediums (web, mobile VR for iOS and Android, as well as Occulus and Vive full VR).

The preservation team has focused assessment and preservation efforts to the basic VR environment (without the vignettes), so the project iterations must be identified and a version of the finished environment isolated and duplicated for storage elsewhere, as Box is not a long-term storage or preservation system, nor does storage limited to one system follow the NDSA recommendations.

In accordance with the NDSA Preservation Standard, multiple copies of the collection in multiple geographic locations should be created. The copies prevent loss due to bit rot or failures in storage media or systems. The multiple geographic locations protect the copies from regional threats such as natural or manmade disasters. Additionally, documentation and monitoring of the storage system and media, and a plan for keeping content accessible is suggested.

The first recommendation is to immediately create at least three copies, which would satisfy all four levels regarding the number of copies. The second recommendation is to identify at least one additional geographic location to have a copy stored. Lastly, documentation and monitoring of the storage system and media needs to be put in place.

To achieve these recommendations, the project team is currently making a plan to copy the project files into a DSpace installation managed through SoIC. A project collection homepage has already been created and the project team is currently working on the documentation prior to ingest, which will occur by the end of the spring semester 2018. Eventually, the project will likely be copied into the DSpace installation managed by the University Library's Center for Digital Scholarship, which has two redundancies, one used as the access server and the other as the dark archive server.

1 IUPUI Box: https://box.iu.edu

 doi:10.2218/ijdc.v13i1.631

Recommendation and Plan for File Fixity and Data Integrity

In accordance with the NDSA Preservation Standard, it is recommended that fixity checks are performed on all ingests. Additionally, the guidance recommends that fixity is checked at regular intervals, a log should be put into place, it should be possible to replace/repair corrupt data, and no one person should have write access to all copies. Currently, the project does not have any checks for file fixity and data integrity, nor has there been any fixity information provided.

The project team is considering several options to satisfy these recommendations. First, to ensure that no one person has write access to all copies, additional copies will be created and placed into DSpace during Spring 2018. Additionally, prior to ingesting into DSpace fixity information will be created using tools such as Bagger or Bagit. This will generate a manifest for each group of files and include a MD5 checksum.

These actions will provide at least Level 1 fixity information for the data. From this point on, a routine schedule will be created, as well as a schedule for maintaining logs and checking for corrupt data using the DSpace implementation at SoIC. Furthermore, the project team is exploring the technical capabilities of the Center for Digital Scholarship to determine if these types of file fixity and data integrity checks are already included in their workflow.

Recommendation and Plan for Information Security

Regarding security, the project team needs to ensure restricted write access and generate logs of what preservation actions were performed on the files. No actions of this sort have been made on the current Virtual Bethel project data. In accordance with the NDSA Preservation Standard at the first level, identification and restriction of who has read, write, move, and delete authorization of individual files is recommended. Moving through the levels, additional recommendations include documenting access restrictions, maintaining a log of who performed what actions on the files, and performing audits of these logs.

There are several immediate items that could be performed to at the least achieve a Level 1 requirement. This would be to immediately identify those individuals who have authorization to the individual files and what type of authorization they have. The project team is currently in the process of interviewing the data creators to identify all individuals and types of authorizations. In doing this, documentation is being created for access restrictions to the content.

Additionally, since the data of this project continues to grow and the individuals working on this project continue to grow, identification of those individuals needs to be conducted, as well as maintaining a log of actions on the files including any preservation actions that are performed. Through the process of interviewing the data creators, the project team is creating documentation to maintain a log of actions on the files including the preservation actions that will be performing during the Spring 2018 semester.

Recommendation and Plan for Metadata

Regarding metadata, this project is particularly in need of certain types of metadata including descriptive metadata, administrative metadata, technical metadata, and preservation metadata, which provides information on what transformation or

preservation actions were performed. In accordance with the NDSA Preservation Standard each of these types of metadata needs to be stored.

From the definitions found in the NDSA Glossary (National Digital Stewardship Alliance, n.d.):

- Descriptive metadata identifies a resource and describes its intellectual content for purposes such as discovery and identification.
- Administrative metadata comprises both technical and preservation metadata and is generally used for internal management of digital resources.
- Technical metadata describes the technical state of and the process used to create a file. This is often closely related either to its file format or the original software used to create the file.
- Preservation metadata documents the technical processes associated with preservation, specifies rights management information, establishes the authenticity of digital content, and records the chain of custody and provenance for a digital object.

Decisions need to be made regarding which metadata fields will be utilized from each of the aforementioned schema and then each schema should be implemented systematically in phases to ensure consistency throughout the process. As context could be lost, it is recommended that metadata creation is given a high priority to ensure that context is documented as soon as possible.

There are several actions being performed to ensure adequate metadata. An inventory of what metadata has been created is being conducted to discover gaps. In the case of the Virtual Bethel project, some administrative metadata exists as shown in Figure 1, however, interviews with the data creators are being conducted to provide thorough documentation of administrative metadata. To provide technical metadata, the project team is in the process of reviewing the data creation workflow, which includes preproduction, production, and post-production phases. For each phase, the team is documenting the types of data created, the process, and which software is used to create the files. Regarding preservation metadata, the project team is exploring the ability to implement PREMIS through METS using DSpace with plans to have this completed by the end of the Spring Semester 2018. The project team is still developing a plan for descriptive metadata by first determining what categories will be used to organize the file folders. Most likely, we will use pre-production, production, and post-production.

Recommendation and Plan for File Formats

Regarding file formats, an inventory of formats has been created, as shown in Figure 2. While this inventory has been created at a high level, no assessment of obsolescence risk, or investigation of the suitability of normalization, emulation, or other approaches, as suggested by the NDSA Preservation Standard, has been completed.

There are several immediate actions that could adequately satisfy the NDSA Preservation Standard. During the process of interviewing the data creators the current inventory is being double checked to ensure accuracy. Additionally, file formats not included in the current list are being added, as well as the software specifications for the files. Once this list has been completed, the project team will conduct an analysis of the various file formats to evaluate for obsolescence concerns. The project team is currently

 doi:10.2218/ijdc.v13i1.631

anticipating inclusion of copies of software needed to execute the VR files will be kept alongside the files in DSpace to ensure users will be able to execute the VR files, since some of these file formats may be unique given the virtual reality environment. Additionally, evaluation of any potential format migration, emulation, or similar activities needs will be conducted.

Limitations and Conclusion

As shown from the analysis above, each preservation category needs attention. In many cases, creating what is needed for the data to pass a Level 1 status would not take an extreme amount of effort, so the preservation of these files could move forward without too much difficulty. Through interviewing the data creators and completing a thorough documentation of the pre-production, production, and post production phases of the Bethel project, the project team will be able to take the first steps in ensuring the Virtual Bethel is preserved. This documentation will allow the project team to determine where their efforts should be focused in the next phase of preservation. Additionally, by moving the files into DSpace, along with including METS/PREMIS metadata with the files, the team will ensure that the data is moved into a preservation environment.

However, there are limitations to the current analysis. These limitations include two major flaws in this analysis. First, the specific file types for virtual reality need to be given further consideration. As virtual reality is a newer technology the specific file formats for VR have not been explored as thoroughly as other more common file types. It is highly likely that file-specific issues may occur during the preservation process, which will require further investigation on how exactly to preserve these objects.

Second, as noted in Phillips, Bailey, Goethals and Owens (2013), the Levels of Preservation model does not take into consideration rights and/or policy as part of the evaluation. This would need to be considered, particularly if the project data were to be moved into a repository space, such as the DSpace at the Center for Digital Scholarship. Any rights or policy constraints from the Center would need to be examined to ensure that it works well with the Virtual Bethel project. On that same note, since the storage system and storage media are still unknown, it is difficult to determine any potential technical concerns that would arise from the storage system and storage media where the data would be stored.

While the NDSA Levels of Preservation does provide a solid foundation and a good start to consider the preservation actions that need to be considered for the Virtual Bethel project, there are still factors that will need to be considered once preservation actions begin.

Acknowledgements

This project was supported by Indiana University's New Frontiers in the Arts and Humanities Program. The authors would also like to sincerely thank Olivia McGee Lockhart, Pastor Louis Parham and others in the Bethel Community, without whom this project could have never occurred. Additionally, the authors would like to thank Rodney Freeman, Jenny Johson, Wilma Moore, Kisha Tandy, Albert William, and Zeb Wood, as well the Indiana Historical Society, Indiana State Library, the Indiana State Museum, and the IUPUI University Library.

References

Antonescu, M.-D., Guttenbrunner M. & Rauber A. (2009). Documenting a virtual world: A case study in preserving scenes from Second Life. In International Web Archiving Workshop (IWAW 2009). Corfu, Greece, pp. 5-9.

Copeland, A. (2015). Public library: A place for the digital community archive. *Preservation, Digital Technology & Culture, 44*(1), 12-21. Retrieved from https://scholarworks.iupui.edu/handle/1805/6117

Copeland, A. (2017). The Bethel AME Church Archive: Partners and participants. In H. Roued-Cunliffe and A. Copeland, Eds., Participatory Heritage (pp. 15-24). London: Facet. Retrieved from https://scholarworks.iupui.edu/handle/1805/12030

Harvey, R. (2011). Why there's a problem: Digital artifacts and digital objects. In Preserving digital materials (Ch. 3 pp. 39-55). Berlin, Boston: De Gruyter Saur.

Indiana University-Purdue University Indianapolis. (n.d.). Our story. RetIndiana University-Purdue University Indianapolis. Box @IU. Retrieved from https://comet.soic.iupui.edu/bethel/

Kaltman, E. (2016, June). Current game preservation is not enough. How They Got Game. Retrieved from https://web.stanford.edu/group/htgg/cgi-bin/drupal/?q=node/1211

Lewis, O. (2016, April). Indy's oldest African-American church sold for hotel space. The Indy Star. Retrieved from https://www.indystar.com/story/news/2016/04/08/indys-oldest-african-american-church-sold-hotel-space/82765744/

Library of Congress. (2007, August). Digital preservation program makes awards to preserve American creative works. Retrieved from https://www.loc.gov/item/prn-156/library-makes-awards-to-preserve-creative-america/2007-08-03/

McDonough, J., Olendorf, R., Kirschenbaum, M., Kraus, K., Reside, D., Donahue, R., Phelps, A., Egert, C., Lowood, H., & Rojo, S. (2010). Preserving virtual worlds - Final report.

National Digital Stewardship Alliance - Digital Library Federation. (n.d.) Glossary. Retrieved from http://ndsa.diglib.org//glossary/

Phillips, M., Bailey, J., Goethals, A., & Owens, T. (2013). The NDSA levels of digital preservation: An explanation and uses. In Proceedings of the Archiving (IS&T) Conference. Washington, DC. Retrieved from http://ndsa.org/documents/NDSA_Levels_Archiving_2013.pdf

Rhizome. (2018). ArtBase. Retrieved from http://rhizome.org/art/artbase/

 doi:10.2218/ijdc.v13i1.631

Rothenberg, J. (1995). Ensuring the longevity of digital documents. *Scientific American, 272*, 42–47.