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Making Cultural Heritage Artifacts into 3D Digital Objects Using Photogrammetry : Final Report

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Making Cultural Heritage Artifacts into 3D Digital Objects Using Photogrammetry: Final Report

Overview & Acknowledgements

The project *Making Cultural Heritage Artifacts into 3D Digital Objects Using Photogrammetry* aimed to demonstrate that the conversion of analog materials into 3D digital objects is possible with the use of affordable equipment and the use of open source platforms for processing and editing. Our gratitude is with the Private Academic Library Network of Indiana (PALNI), who supported our project with the necessary funding through the 2019 PALNI Innovation Grant. With the generosity and support of PALNI this project was able to succeed and Butler University Libraries and the Center for Academic Technology is happy to report on our success, challenges, and lessons learned.

Key Personnel

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The project began with just the key personnel, Kristen Allen and Olivia MacIsaac. However, once the grant was awarded the team expanded and in the summer of 2019, Tatum Turner was hired as the inaugural 3D Digital Imaging Specialist for both Butler University Libraries and the Center for Academic Technology. Turner was pivotal in the progress and accomplishments of this project and developed the necessary skills to be successful in this newly created role.

Key Strategic Partners

Carly Dannenmueller, Metadata Associate/Private Academic Library Network of Indiana (PALNI) Support, was a key strategic partner on this project. Dannenmueller served as the Co-Chair of Butler University Art Collection Committee. It was in this role that she provided documentation, images, and information on the Art Collection at Butler University. Dannenmueller helped with identifying parts of the collection that could be captured using Photogrammetry. Unfortunately, Dannenmueller left Butler University in April 2019. Before her departure she handed over her responsibilities as Co-Chair of the Butler University Art Collection Committee to Digital Scholarship Associate, Olivia MacIsaac. Dannenmueller's role in the project shifted onto MacIsaac, which meant that MacIsaac handled identifying the collection and items to scan, providing access to items within the collection, and evaluating the quality of the final 3D objects before they were uploaded and displayed online.

As the new Co-Chair of the Butler University Art Committee, MacIsaac worked closely with James Cramer, former Community Relations Manager for Clowes Memorial Hall. Cramer served as the other Co-Chair of the Butler University Art Committee. Cramer provided historical knowledge about the Butler University Art Committee, helped with the access of items in the collections, and provided a level of support that allowed for this project to move forward during the time the grant was awarded. Overall, Cramer became a key strategic partner and our team is grateful for the help he was able to provide on this project.

Janice Gustafarro, Metadata Librarian for Butler University Libraries, was also identified as a key strategic partner on this project. Gustafarro assisted with the creation of compliant metadata (XML, DC) to describe the 3D digitized materials. Gustafarro reached out to other librarians working with 3D data and was able to fabricate a metadata template that the 3D Digital Imaging Specialist could fill out as they started creating 3D digital data. This metadata template was useful in that it required the collection of both descriptive and technical metadata. It was also Gustafarro that aided in the display of the final 3D objects in the digital collection management platform, CONTENTdm. The inclusion of the 3D objects in CONTENTdm allows for the 3D items to be displayed alongside the other digital collections showcased by Butler University Libraries.

Item Description	
Title	Duck Vessel
Creator	Chimu Artist
Time Period	900 B. C.E.-1470 C.E.
Description	In terms of artistic decoration of ceramics, the Chimú worked solely with monochromatic colors, such as this blackware pitcher. The shiny gray-black finish of this object was achieved by firing the pottery at a very high temperature in a closed kiln, which prevented oxygen from reacting with the clay. The shapes of the vessels made by Chimú artists were often varied. Animal-, food-, and human-shaped vessels were fashioned from molds made by the Chimú artists. Decorative incising was added to give the vessels additional character, such as the eyes and feathers that appear on this duck. In Chimú culture, the duck is a highly revered bird, and often appears as decoration on vessels and on human figurines wearing duck masks and feathers.
Materials of which the object is composed	Terracotta
Object Dimensions	7" x 9.5" W
Object Condition	Minimal Wear
Subjects	terracottas (sculptural works) vessels (containers)
Keywords	Terracotta, Ceramic, Pottery
Place where object was created	Peru
Object Type	Pottery
Name of repository where object is located	Butler University
Location of the Repository	Indianapolis, Indiana
Location of the object within the repository	Diversity Center Hallway Display Cases, Atherton Union
Type of digital resource	InteractiveResource
Link to the digital resource in 3D viewer	https://sketchfab.com/3d-models/duck-vessel-b2526a37fa0d4f798b574f31abcd2965
Rights associated with the digital resource	No Known Copyright
Standardized rights statement for the digital resource	http://rightsstatements.org/vocab/NKC/1.0/
Name of Digital Collection	Butler University - University Art Collection
Publisher of the digital collection	Butler University
Language of metadata	English

Figure 1. Descriptive metadata for [“Duck Vessel” by Chimu Artist displayed on CONTENTdm](#).

Tassie Gniady, Cyberinfrastructure Coordinator Research Technologies at Indiana University-Bloomington (IUB), Tyler Jackson, Advanced Visualization Lab - User Support, and Jeff Rogers, Advanced Visualization Lab at Indiana University-Purdue University Indianapolis (IUPUI) were all identified as strategic partners on this project. Gniady, Jackson, and Rogers generously listened to our interest in finding a low-cost solution to capture 3D data and agreed to meet with us before we pursued the grant. They provided expertise, documentation, and support during the beginning of our project by answering our questions and aiding us in problem solving. The 3D Digital Imaging Specialist sought guidance in the “Photogrammetry Workflow Guide” produced by the Indiana University - Advanced Visualization Lab in Fall 2018. This guide on photogrammetry allowed for the team to understand the basics of 3D scanning using the method of Photogrammetry. Our team is humbled to have worked with and received documentation and the counsel from staff members from both Indiana University - Bloomington (IUB) and Indiana University-Purdue University Indianapolis (IUPUI).

Although not identified as key strategic partners, additional staff members at Butler University supported our project and our team would also like to acknowledge the work and dedication of these individuals. Megan Grady-Rutledge, Academic Technologist Specialist for the Center for Academic Technology, worked closely with faculty member, Lynne A. Kvapil, Associate Professor of Classics in the Department of Philosophy, Religion and Classics in the College of Liberal Arts and Sciences to investigate other 3D imaging technologies to capture cultural heritage materials. Grady-Rutledge then worked with 3D Digital Imaging Specialist, Turner, to

explore [Reflectance Transformation Imaging \(RTI\)](#). RTI uses similar equipment to Photogrammetry and it was through Grady-Rutledge's, Kvapil's, and Turner's exploration in RTI that the department invested in a DSLR camera. This DSLR, when not in use for RTI projects, was used for the capturing of images for our project and improved the quality of our photosets. Lastly, staff members Nate Partenheimer and Nick Northcutt in Butler University's Information Technology (IT) department helped our team determine computer specifications and technology options that aided in the success of our project. As a team we cannot thank them enough for all their help, support, and dedication to this grant project.

Goals & Outcomes Measures

Summary of Project Outcomes

The project outcomes that we identified in our grant proposal were the following:

- Identify a low-cost solution to digitizing 3D objects;
- Digitize 10 or more art pieces from the Butler Art Collections of differing textures including wood, fabric, and metal to document best practices for each texture;
- Increase website page views of the Butler University Libraries Omeka exhibit highlighting artwork on the campus of Butler University, created by Carly Dannemueller, by 10%;
- Evaluate online platforms to host and share 3D objects;
- Investigate, evaluate, and recommend a model for collaboration between PALNI institutions, including team collaboration similar to PALSave and fee-for-service model.

Goal 1: Identifying a Low-Cost Solution

To identify a low-cost solution to digitizing 3D objects, our team sought out the expertise from other institutions undertaking similar projects. Through our investigations and inquiries, our team was able to identify low-cost solutions to 3D digitization. After various discussions with staff members from IUPUI, IUB, and Butler University IT, we made decisions on software, equipment, and technology based on the recommendations of these key strategic partners.

Our team moved forward with the decision to use the photogrammetry equipment list shared with us by Tassie Gniady (IUB) and Jeff Rogers (IUPUI). This equipment list aided in the decision making process when it came to purchasing the following items: [light kit](#), [light tent kit](#), [turntable](#), and other miscellaneous items such as the [5" x 7" color chart](#) and [kneaded eraser](#).

Since this project was investigating a low-cost solution for other PALNI institutions and schools, we moved forward with computer recommendations from Butler University IT staff members, Nick Northcutt and Nate Partenheimer. Nick and Nate met with our team before the submission of the grant proposal to discuss options when it came to rendering 3D objects using

a computer and rendering 3D objects on Butler's cluster supercomputer, Big Dawg. More details on the computer specifications are listed in the budget section of this report.

Next, we researched photogrammetry software to perform the necessary function to render a 3D object. Initially, experimenting with [AliceVision Meshroom](#), a free open-source software, did not yield positive results of a successful 3D model. After consultation with both Jeff Rogers and Tassie Gnady, we then moved forward and purchased an education license for [Agisoft Metashape](#) and had quick successes. After developing a deeper understanding of our equipment, best pre-processing practices, and the photogrammetry process using Metashape, we were able to obtain better results with Meshroom and develop a second workflow. This breakthrough was exciting as we could recommend a sustainable, low-cost (free) software solution to other universities.

Through using Meshroom, we estimate the cost to be around \$2,000 for essential equipment and tools; however, to further mitigate this cost, Butler has proposed a multi-tier collaboration model for PALNI institutions (see [Collaboration Model for PALNI Institutions](#) below). For institutions who opt to use Metashape and invest in the essential as well as nice-to-have equipment, we estimate the total cost to be around \$4,500.

Goal 2: Digitize Art of Different Textures

Our team was very interested in the outcomes of digitizing art with different or unique textures using photogrammetry. Based on research completed prior to our grant proposal submission, we assumed our team might run into trouble when capturing physical objects that were plastic, see-through, and made of dark metal when using photogrammetry. Workarounds exist for capturing objects made from these materials; for example, many photogrammetry practitioners usually alter hard-to-capture surfaces with dust, markers, and other materials to create texture on smooth surfaces. However, these practices were not practical for our project since we were working with cultural heritage materials; we were fully aware we could not alter the surface of the objects without causing harm or irreversible damage. Therefore, we chose to focus some of our efforts on digitizing different textures such as wood, metal, and fabric. For the duration of the grant, we were able to successfully digitize art materials that were made of metal and fabric, and we were unable to successfully source a wooden object from the collection to digitize.

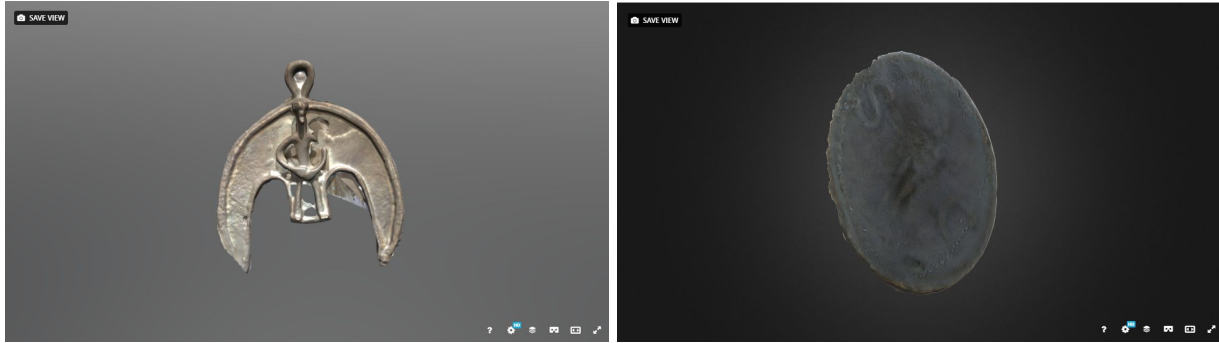


Figure 2. 3D models of Pendant of a Human Figure and an Unidentified Ancient Roman Coin. Both objects were dark, smooth metal objects that we completed tests on before capturing a bulk of the objects for the grant.

Before our team made headway with our grant project, we worked together to identify a number of objects that might prove hard to capture and render in the photogrammetry software. Two objects that proved difficult for our team to capture were dark, smooth metal objects: a Pendant of a Human Figure that was found in the African and Indigenous Art Collection at Butler University and an Unidentified Ancient Roman Coin borrowed from Lynne Kyavil for RTI. Because of the flat and smooth surfaces, capturing all the surface details proved difficult. We tried a variety of methods to capture this type of material, but in the end, we did not find a viable solution at the time of reporting.

Since the Butler University Art Collection is full artwork made from a vast amount of different materials, the second material type we identified with which to experiment was cloth and fabric. The Ballet Russe collection contains various costumes designed for the Ballet Russe de Monte Carlo; these assets were donated to Butler University in the 1970s and have been a fine representation of classical ballet history. Since the time of donation, these objects have not been properly displayed and have mostly spent their time in storage. However, five costumes from the Ballet Russe collection are currently displayed in the Schrott Center for the Arts. These costumes underwent recent conservation and were already being displayed on mannequins, making our access to the costumes less of a concern to our team and to the university. Therefore, these costumes were selected for digitization.

Our team scanned the costumes from the Ballet Russe collection in two ways: by removing the costume from the display case and by shooting through the display case. The first method employed was tested on the Chief Eunuch costume (Fig. 3) by pulling the costume out of its display case in order for photographs to be captured. About 144 photographs were taken of the front and back of the costume using the DSLR camera mounted on a tripod. Although this attempt did not result in a clean and polish model, our team was surprised at the outcome. The model was filled with holes and was imperfect but, as the first attempt to capture an object made of fabric, it was taken as a success.

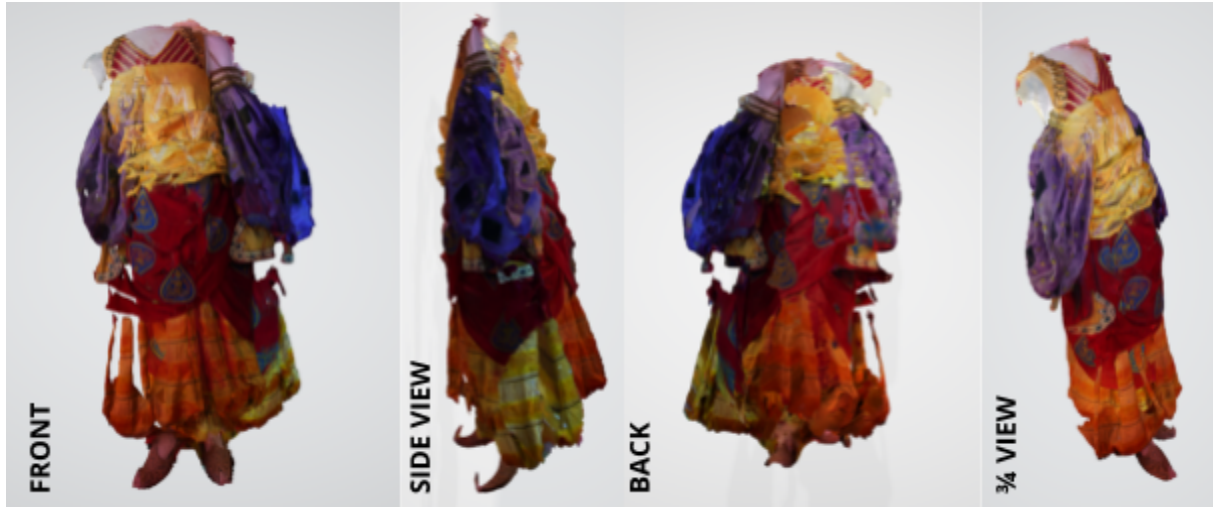


Figure 3. 3D model of Chief Eunuch costume

There was a fear from the stewards of this collection that lifting the display cases over the more delicate costumes could cause them harm. Taking their concerns into account, the second method had to be employed: capturing the costumes from behind the glass display cases. Relying on information gathered from forum discussions, we found that taking photos through the glass would be possible and these photos could be processed in the photogrammetric software to create a 3D model. The DSLR camera was handled manually and around 31-61 images were captured for the costumes behind the display glass (Fig. 4.).



Figure 4. Tatum Turner, 3D Digital Imaging Specialist, captures the Yellow Garden Party Dress and Classical Ballet Tutu behind the display case glass.

Our expectations for capturing the costumes behind the glass display cases were low. In photogrammetry, it is important to capture an object from every angle, and this proved difficult for the fragile costumes due to the restriction of the glass display cases. The resulting number of photographs taken and used in the photogrammetric software to construct a 3D model were relatively low; most photographs captured the costumes straight on or from above the case. However, some close-up images of small details were also captured since both the Garden Party Dress and Classical Ballet Tutu had fine details like bows and beading. The results of this experimentation proved surprising with results comparable to the 3D model of the Chief Eunuch costume (Fig. 5). Even with a smaller set of photos (and photos captured behind glass), the photogrammetric software was able to construct 3D models of the costumes.



Figure 5. 3D models of the Ballet Tutu and Garden Party Dress.

Goal 3: Evaluate Online Platforms to Host & Share 3D Models

When investigating options to host and share 3D models, we looked at what was currently on the market. Knowing that other schools like IUB and IUPUI use Sketchfab to host and share their 3D models, this was the platform that our team initially investigated to use. We also looked at other options such as the Smithsonian 3D viewer. The Smithsonian 3D viewer has allowed for annotations to be placed on 3D objects (see [Killer Whale Hat from the National Museum of Natural History](#)). However, currently there is no option to download and use the Smithsonian viewer for collections and content outside Smithsonian institutions, so we again came back to SketchFab. Through conversations with Gniady and Rogers, we found out that SketchFab offers free Pro accounts to non-profit institutions that collect, store, and care for cultural heritage materials. At no cost ([normally \\$180 per year](#)), the Pro account gave us access to:

- 30 uploads per month;
- unlimited downloadable and store uploads;
- 200 MB max file size (our model sizes range from under 5 MB to over 33 MB);
- 20 annotations per model;
- and private uploads.

Goal 4: Increase Omeka Website Views

With the departure of one of our key strategic partners, Carly Dannenmueller, who served as Co-Chair of Butler University Art Collection Committee, there was no longer a force to update the Omeka website containing information and a map of the Butler University Art Collection. Therefore, we shifted from using Omeka to another website to measure our project’s use and impact.

Instead we identified data from both SketchFab and CONTENTdm reliable to determine the use and impact of our project’s 3D models. Since the 3D models were hosted and viewed on SketchFab, we could pull page views for each 3D model. Below you’ll find Sketchfab data pulled on the views of our publicly available 3D models:

Sketchfab views from May 1, 2019 - February 21, 2019

Overall Views from All Models	981 Views
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Three Most Viewed 3D models from May 1, 2019 - February 21, 2019

Terracotta Pot by Chorotega artist	222 Views
Tripod Vessel by Huetar artist	100 Views
Duck Vessel by Chimu artist	96 Views

It should be noted that our model, [Large Male Effigy](#) by Quimbaya artist, was [highlighted as one of the week’s top 10](#) Cultural Heritage & History models for the week of August 19.

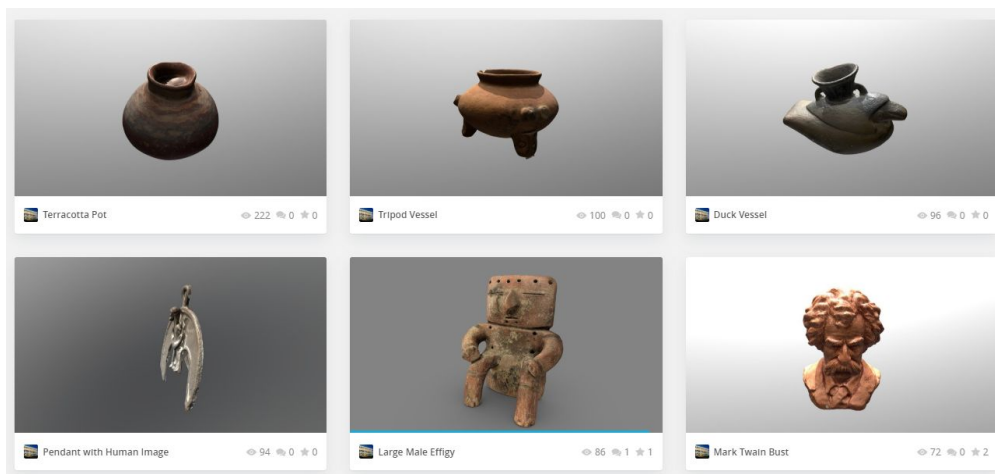


Figure 6. Most viewed artifacts, sorted by views, on [Butler’s Sketchfab profile](#).

Besides being in SketchFab, the 3D models were also included in the Butler University Digital Collections on PALNI's shared instance of ContentDM. A new collection was created titled [Butler University-University Art Collection](#), which will continue to expand and grow; the art collection at Butler University includes over 100 fine art and ethnographic objects. Currently the 3D objects digitized using photogrammetry are the only items in this digital collection on CONTENTdm. One benefit of CONTENTdm is that richer descriptive information is displayed alongside each item, giving users an idea of the objects origins, artist information, rights information, and more.

Our team was inspired to include our 3D objects on CONTENTdm because of work completed by the Center for Digital Scholarship at IUPUI. The Center for Digital Scholarship at IUPUI embeds the Sketchfab viewer into CONTENTdm to allow users to access the models alongside the other digital collections in the library's holdings. In the future, with the development of CONTENTdm's International Image Interoperability Framework (IIIF), there is a hope that users will upload 3D content directly into CONTENTdm, eliminating the need to upload the 3D models into Sketchfab. The [IIIF 3D Community Group](#) is working towards a set of goals to make this possible. Our team looks forward to when our content will exist within one platform.

Below you'll find the data that we pulled from CONTENTdm for pageviews, users, and city of users.

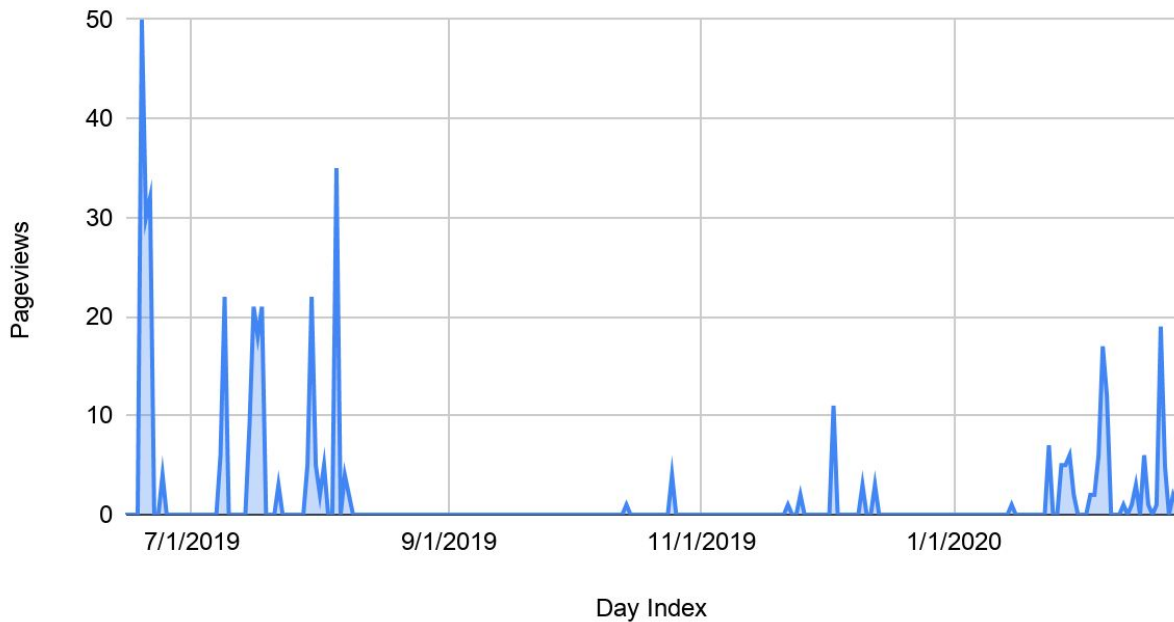


Figure 7. CONTENTdm page views for the [Butler University-University Art Collection](#).

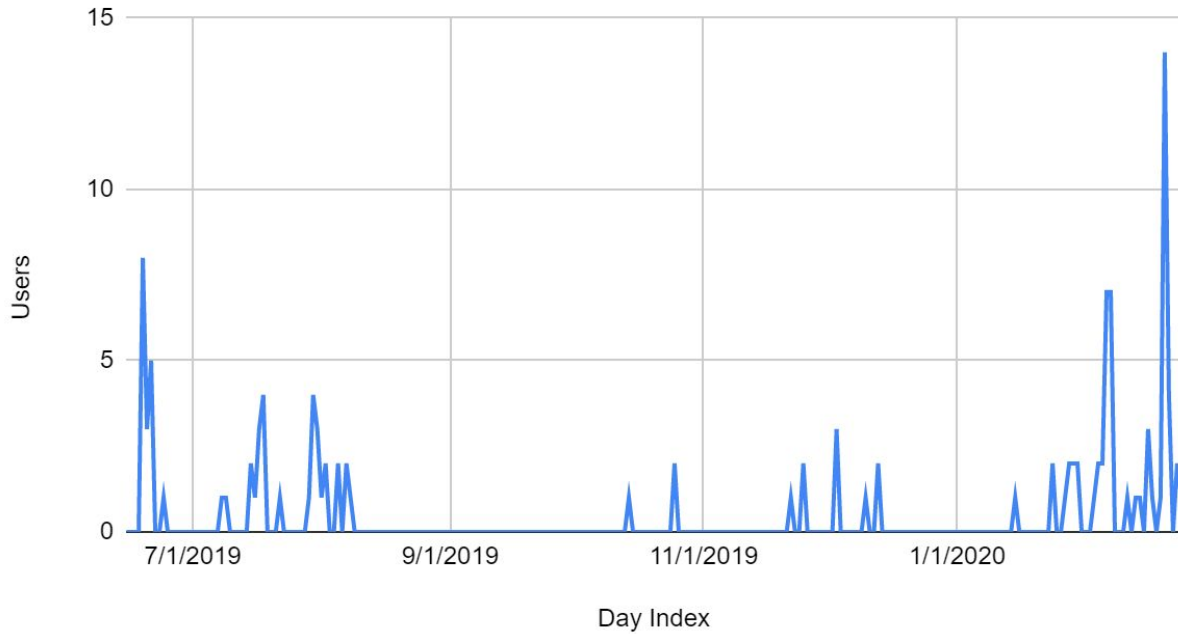


Figure 8. Number of CONTENTdm users accessing the [Butler University-University Art Collection](#).

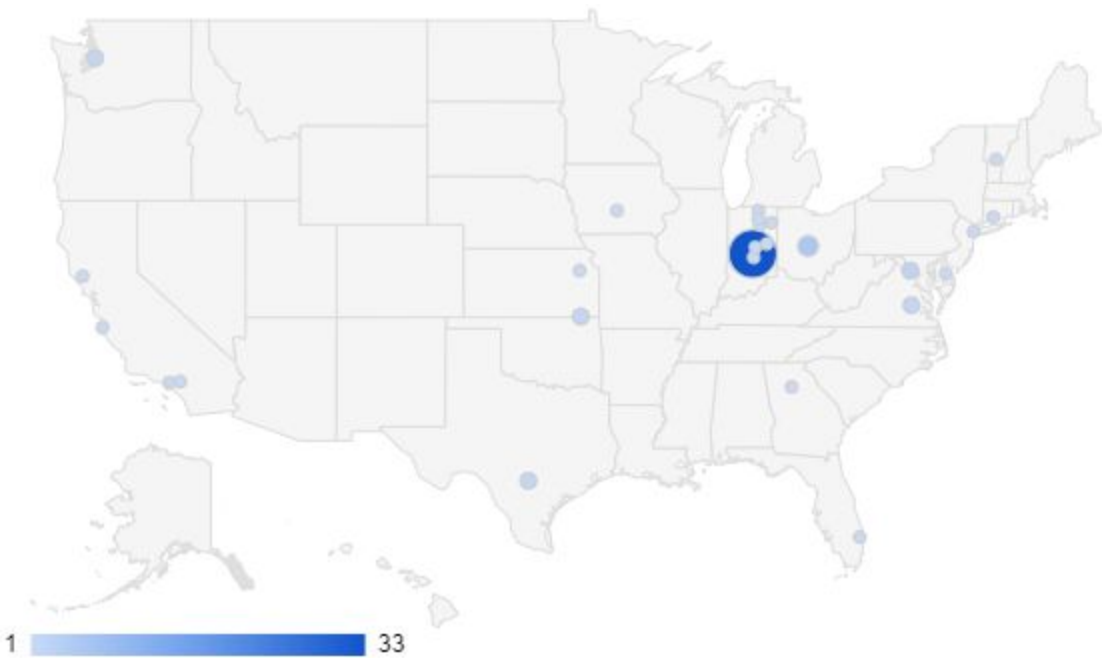


Figure 9. Locations of CONTENTdm users accessing the [Butler University-University Art Collection](#).

Note that the data we pulled from both SketchFab and CONTENTdm might not show accurate results in terms of total views. The way in which users interacted with these models is also unclear and cannot be assessed.

Goal 5: Canvas Training Course

The Photogrammetry Training course walks through our recommended workflow: learners begin with an introduction to photogrammetry, navigate through the process of taking, organizing and editing images, learn to use photogrammetry software, apply post-processing skills, and how to make objects available online with appropriate metadata.

In our initial conversations about course design, we discussed the benefits of an asynchronous, self-paced course compared to a synchronous, cohort model. Because the process of photogrammetry is somewhat complex and rendering 3D models can be time consuming, we decided to build the course for learners to complete asynchronously while still receiving timely feedback from facilitators. In each module, learners will complete a short quiz to check for understanding and an assignment where they will apply one skill needed in the photogrammetry workflow. At the completion of each module, a badge will be awarded to the learner indicating competency has been reached for that particular photogrammetry skill. A final badge is awarded at the conclusion of the course.



Figure 10. Images of the badges awarded in the training course.

To access the Canvas course, PALNI members can navigate to butler.instructure.com/register and use the following join code: H6ADCX.

Goal 6: Collaboration Model for PALNI Institutions

In order to collaborate with other PALNI institutions, the Butler Libraries and Center for Academic Technology proposed the following three tier model to PALNI institutions. Based on survey results, PALNI institutions are most interested in the Tier 1 (Butler digitizes objects and sends files to back to owning institution) and the Tier 3 (institution digitizes objects through access to Butler's virtual computer) models for deep collaboration.

Tier 1

After consultation, PALNI institutions will be responsible for transporting objects to and from Butler University to be digitized. Butler will complete the full photogrammetry process, including uploading the object to Butler's SketchFab account. The files will then be transferred back to the PALNI institution and the institution will be responsible for file storage and management. If necessary, Butler will take on file management and storage and assist with metadata needs for an additional fee.

Estimated cost:
\$40-75 per item

Tier 2

After consultation, PALNI institutions will be responsible for taking their own photo sets of objects to digitize. They will then submit their photo sets to Butler University. All photo editing and rendering processes will be completed by Butler University. Additionally, Butler will upload the final object to Butler's SketchFab account. The files will then be transferred back to the PALNI institution and the institution will be responsible for file storage and management. If necessary, Butler will take on file management and storage and assist with metadata needs for an additional fee.

Estimated cost:
\$30-60* per item

* Price may be reduced if PALNI institution chooses to complete photo editing prior to submission

Tier 3

After going through a Canvas course and completing a certificate, PALNI institutions will be responsible for taking and editing their own photo sets of objects to digitize. They will then upload photo sets on Butler's virtual machine which will then automate the photogrammetry process. This process will not let users change software settings, so

objects may not be rendered correctly the first time. The institution will be responsible for file storage and uploading the final object to their own SketchFab account.

Estimated cost:

Flat fee dependent on object number and priority, \$25-50 annually

In terms of sustainability, Butler is committed to continued deep collaboration with PALNI institutions. One weakness of specialized knowledge or projects is that the knowledge is often concentrated to one individual and if that individual leaves an organization, the project may not be carried on. However, we have transferred knowledge of this process to our shared Canvas course, which can be used as for professional development training should any turnover happen. Further, the Butler Libraries and Center for Academic Technology will open the Photogrammetry training course as a professional development opportunity for student employees who express interest in assisting with the upcoming photogrammetry projects. Finally, we have incorporated a feedback component into each module, so should any technology update or process no longer work, we have a feedback mechanism to catch these changes and make updates to our course.

We believe these tiers offer other PALNI institutions the best opportunity to replicate the 3D digitization undertaken by Butler. The low-cost solutions presented make 3D digitization more feasible for smaller institutions while simultaneously offering support through the process. Further, while our preference is for the training course to remain under the Butler instance of Canvas in order to provide timely feedback, help with troubleshooting, and access accurate analytics, we recognize that there may be cases where an institution may want to incorporate all or some of this training course into an academic course. Should another institution wish to host the training course in their institution's LMS, after a short consultation Butler will draft a MOU with particular interest on information sharing (e.g. number of learners, type of use, etc.).

Financial Statement

Anticipated vs. Actual Budget with Budget Notes

Budget Categories	Projected Budget	Actual Spending
STUDENT LABOR & BENEFITS		
Student Wages (\$10/hr, 20 hrs/wk, 11.5 wks)	\$2,300	\$2,251.79
Summer Housing Stipend	\$1,000	\$1,000.00
TOTAL LABOR & BENEFITS	\$3,300	\$3,251.79
EQUIPMENT & SUPPLIES		
Gaming Desktop & Graphics Card	\$1,700	\$1,616.25
Lighting	\$290	\$259.84
Turntables	\$20	\$39.95
Agisoft Software	-	\$63.13
Miscellaneous	\$100	\$3.99
TOTAL EQUIPMENT & SUPPLIES EXPENSES	\$2,110	\$1,983.16
TOTAL FUNDING		
	\$5,410	\$5,234.95

Budget Notes

The following items did not need to be purchased as the Butler Library and/or Center for Academic Technology already owns the following: Smartphone Camera, DSLR, iPad Camera, Tripod.

Gaming Desktop and Graphics Card

After consulting with Butler IT staff, it was determined the standard workstations provided by the University did not have the graphics cards needed to render 3D objects nor the specs to add one. Therefore, IT recommended a gaming desktop for our photogrammetry process. The 3D rendering software, Metashape and Meshroom, are compatible with GPU's with CUDA cores.

- [HP EliteDesk 800 with GeForce GTX 1080 Ti Graphics Card](#) (\$1,700)

Turntable

In order to keep the objects stable and in one position throughout the capturing process, we had to purchase a turntable. We originally believed that we need more than one turntable in order to capture objects of various sizes. However, below is the turntable we purchased based on the recommended equipment list from IUB:

- [Turntable](#) (LapWorks 12" Heavy Duty Swivel - for Big Screen TV's & Large Flat Panel Monitors with Steel Ball Bearings for Indoor/Outdoor Use, \$11.50)

Lighting

In order to capture photos a small portable light tent kit was needed when working with small objects and a large light kit was needed for working with larger objects. We purchased the two light kits below after consulting with colleagues from the Cyber DH Team at IUB and the Advanced Visualization Lab at IUPUI:

- [Light Kit](#) (Fovitec - 3x 20"x28" Softbox Continuous Lighting Kit w/ 2500W Equivalent Total Output - [Includes Boom, Stands, Softboxes, Bag, 11x 45W Bulbs], \$189.95)
- [Light Tent Kit](#) (Polaroid Photo Studio Light Tent Kit, Includes 1 Tent, 2 Lights, 1 Tripod Stand, 1 Carrying Case, 4 Backdrops (Black, Blue, White, Red), \$89.99)
 - The lights that came with this kit were not adequate. We ended up purchasing another set of lights in order to capture better photographs.

Miscellaneous

We purchased the following based on recommendations from our colleagues from the Cyber DH Team at IUB and the Advanced Visualization Lab at IUPUI. The color chart was used to ensure the photographs were color corrected. We used the kneaded eraser to prop up objects when needed:

- [5" x 7" color chart](#) (DGK Color Tools DKK 5" x 7" Set of 2 White Balance and Color Calibration Charts with 12% and 18% Gray - Includes Frame Stand and User Guide, \$12.95)
- [Kneaded Eraser](#) (PRISMACOLOR Design Eraser, 1224 Kneaded Rubber Eraser, Grey (70531) (3 Pack), \$4.46)

At the beginning of our project we purchased an education license of Agisoft Metashape. This allow us to test out different photosets in a different photogrammetric software than Meshroom:

- [Agisoft Metashape Standard Edition](#) (Educational license – rehostable node-locked, \$59)

Conclusion

Thanks to the insight from IUB and IUPUI along with the hard work and interest of our student employee, Tatum Turner, this project was a huge success. Because of the interest and excitement resulting from this project, Butler Libraries extended the employment of Turner and, in addition to the Butler Art Collection, our team digitized objects in the Eliza Blaker collection. The interest of this project also spurred interest in virtual reality (VR), and the Butler Center for Academic Technology invested in VR equipment and a 3D printer in the hopes of making the collections even more interactive in the future. Our forward looking expectations also include deepened partnerships with other PALNI institutions who are looking to begin their own 3D digitizing journeys.