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**3D Documentation and Visualization Techniques for Cultural Resources
and Museum Collections,
Grand Teton National Park, Intermountain Region**

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Executive Summary (400 words)

National parks are often touted as physical laboratories for discovery and research, but they are also rich troves of cultural heritage and historical landscape change that shape national park system policies and management strategies across the United States. This project meets national needs in historic preservation by undertaking research that adapts existing 3D technologies in innovative ways to preserve, document, and visualize cultural resources and museum collections in national parks. These activities advance ideas about how National Park Service (NPS) units can preserve museum collections and historic landscapes using digital technologies. Specifically, this trans-disciplinary project combined the expertise of cultural geographers, geospatial visualization technicians and scholars, and museum collections staff of the National Park Service to document and help preserve rare and/or fragile ethnographic objects in a national park museum collection. We used low cost but cutting edge 3D scanning technology to create high resolution images of ethnographic objects in the David T. Vernon Collection of Native American social and cultural objects, held in the museum collections of Grand Teton National Park, Wyoming. The collection represents tribes from across the United States and objects collected between 1830 to 1940, including clothing, jewelry, weapons, and tools. Through a process of photography, combined with 3D visualization software (AgriSoft) and Sketchfab, we created approximately 45 high resolution 3D images of objects ranging from moccasins to leather shirts to beaded pouches. Before 3D scanning, all objects were vetted first by the tribes with affiliation to the objects through a series of meetings between NPS museum staff and tribal liaisons to select objects best suited to this scanning process. Over a series of several trips to Grand Teton National Park's headquarters and main collections site in Wyoming and the WAAC (Western Archaeological and Anthropological Center) collections conservation site in Arizona, and in collaboration with NPS project partners and collaborators, we photographed objects using a digital camera. Each object required between 150 to 400 photographs that were then processed into 3D composite images through the software AgriSoft. After that process, geovisualization trained graduate students and faculty reviewed and finalized the 3D images and uploaded them to a free, public access website (Sketchfab). In addition, we created a training video and uploaded it to YouTube for free, public access viewing and easy sharing/linking to NPS websites. The results of this project underwent scholarly review at various stages of work through several academic conference presentations.

Introduction

National parks are often touted as physical laboratories for discovery and research, but they are also rich troves of cultural heritage and historical landscape change that shape national park system policies and management strategies across the United States. This project meets national needs in historic preservation by undertaking research that adapts existing 3D technologies in innovative ways to preserve, document, and visualize cultural resources and museum collections in national parks. These activities advance ideas about how National Park Service (NPS) units can preserve museum collections and historic landscapes using digital technologies.

This project relates to the National Park Service's Cultural Resources Programs and some aspects of the Director's Call to Action. Specifically, this project provides an opportunity to create new ways of updating digital preservation methods and technologies, create collaborative partnerships to reach preservation and documentation goals for cultural resources, and prepare exhibits and activities that reinforce the themes of the 100th anniversary of the National Park Service in 2016.

The work that we completed uses low-cost cutting-edge digital technology in innovative ways that are rarely combined together to create digital preservation and documentation products. We explored new ways of interpreting cultural data for national parks that is easily applicable across the United States. By utilizing off-the-shelf technology in innovative ways, such as digital cameras and inexpensive but powerful software such as AgriSoft, we can demonstrate to park personnel how to use this technology as affordable tools to scan or digitize cultural artifacts in 3D for display on websites or in digital catalogues (Draelos, Deshpande, & Grant, 2012; Henry, Krainin, Herbst, Ren, & Fox, 2012). We are building on the work of earth scientists, archaeologists and other scientists that have been using affordable 3D technologies for high resolution data collection (Mankoff & Russo, 2013; Richards-Rissetto, 2012).

This project meets national needs in historic preservation by undertaking research that adapts existing 3D technologies in innovative ways to preserve, document, and visualize cultural resources and museum collections in national parks. These activities enhance and create new and innovative interpretive displays and tools that can advance ideas about how National Park Service (NPS) units can preserve museum collections and historic landscapes using digital technologies. We explore this approach through a case study at Grand Teton National Park (GRTE) in western Wyoming, Intermountain Region of the NPS.

Methods

Our methods include several steps to select suitable objects for this project, collect initial photographs of the objects, process the photographs into 3D visualizations, and then post these 3D images and training videos to create these images to free, public access websites. In the first goals of this project, we created a series of high-resolution 3D scans of museum objects from a wide range of historic cultural and archeological collections from the David T. Vernon Collection of social and cultural objects used by Native American Tribes from 1830 to 1940 across the United States. These 3D scans included a sampling of objects from a wide range of historic cultural and

archeological collections from this diverse Indian Arts Collection. Several hundred of the most vulnerable objects have been sent to the Western Archaeological Conservation Center (WACC), a National Park Service conservation and curatorial facility in Tucson, AZ. Objects include representations of social and cultural objects used by tribes across America from 1830 to 1940 such as clothing, jewelry, weapons, and tools. Some of the objects can be traced by to individuals—a rare feature among collections of this type. By creating 3D scans of some of these vulnerable objects, we are contributing to the preservation of these objects and documentation of their contexts. To complete the 3D scans we will use a couple of technologies that include using Sketchfab software and a "structure from motion" approach by taking a series of overlapping stereo photographs of each item. These images are post-processed into 3D images with a scale reference. The models can be exported into several formats that can be displayed on websites.

These digital products provide greater public access to rare and valuable pieces of cultural and landscape history in our national parks. This collaborative and interdisciplinary project combined national park service museum and cultural resource specialists with university scholars to create digital content for preservation and documentation, train NPS staff to use this technology for a range of objects in museum collections, complete a technical report so that other researchers may build upon this research, and contribute digital content that may be used in a range of online public interpretation and exhibits showcasing the cultural resources and dynamic human history of national parks. This project offers an exceptional opportunity to meet national need in preservation technology by harnessing relatively inexpensive, easily accessed, and portable 3D scanning technology that will create digital content that can provide greater public access to and appreciation for cultural and historical resources in national park sites.

This project provide national level public access to fragile National Park Service museum collections, create innovate and engaging cultural resources digital interpretation, and engage the public both at the park unit site and remote historic landscapes by the public (due to the collections' fragile state and the relative remoteness of the historic dude ranches). For example, there are very few interpretive digital displays that have a home online (website) and in a physical museum (for example, in Grand Teton NP's Colter Bay Museum and the Craig Thomas Discovery and Visitor Center) that focus on cultural and historical themes and use the 3D scanning technology we will use. Our scans provide the ability for audiences of national park users both in the park and at distant locations to see and explore (by rotating on a digital screen) high resolution scans of Native American artifacts that are rarely accessible to the public due to the artifacts' vulnerable and fragile conditions. In addition, the collection of museum objects that we scanned is gathered from tribes around the United States, providing an interest and national need to access these important cultural artifacts.

We utilized low-cost software to process photographs taken by a consumer grade digital camera to generate output files that are compatible for display on websites or with other 3D modeling software packages (for example: .obj, 3ds, and .dxf). These formats are also suitable for 3D printing or augmented reality. Larger objects for scanning, landscapes or historical aerial imagery can be stitched together with Structure from Motion software such as Sketchfab. We utilized this approach for larger and smaller objects.

Results and Discussion

Results of this work included 3D images, metadata, and training tools. This trans-disciplinary project combined the expertise of cultural geographers, geospatial visualization technicians and scholars, and museum collections staff of the National Park Service to document and help preserve rare and/or fragile ethnographic objects in a national park museum collection. We used low cost but cutting edge 3D scanning technology to create high resolution images of ethnographic objects in the David T. Vernon Collection of Native American social and cultural objects, held in the museum collections of Grand Teton National Park, Wyoming. The collection represents tribes from across the United States and objects collected between 1830 to 1940, including clothing, jewelry, weapons, and tools. Through a process of photography, combined with 3D visualization software (AgriSoft) and Sketchfab, we created approximately 45 high resolution 3D images of objects ranging from moccasins to leather shirts to beaded pouches. Before 3D scanning, all objects were vetted first by the tribes with affiliation to the objects through a series of meetings between NPS museum staff and tribal liaisons to select objects best suited to this scanning process. Over a series of several trips to Grand Teton National Park's headquarters and main collections site in Wyoming and the WAAC (Western Archaeological and Anthropological Center) collections conservation site in Arizona, and in collaboration with NPS project partners and collaborators, we photographed objects using a digital camera. Each object required between 150 to 400 photographs that were then processed into 3D composite images through the software AgriSoft. After that process, geovisualization trained graduate students and faculty reviewed and finalized the 3D images and uploaded them to a free, public access website (Sketchfab). Our university project team transferred all 3D images, metadata, and training videos to an external hard drive and delivered that to our project collaborators at Grand Teton National Park's headquarters in Wyoming (to Bridgette Guild, GRTE Museum Director). We explored and discussed with our collaborators at the NPS ways to incorporate the 3D scans of the Vernon Collection museum objects in digital exhibits at Grand Teton National Park (on-site at visitor's centers) and also available to a broad public audience through the GTNP NPS website. In addition, we created a training video and uploaded it to YouTube for free, public access viewing and easy sharing/linking to NPS websites. The training videos show a step-by-step guide to photographing and creating the 3D images for other scholars and museum staff to use. The results of this project underwent scholarly review at various stages of work through several academic conference presentations at national scientific and geographic and international geomeia (geography and visual media) conferences.

Conclusions

This project provides an innovative way to visualize historic and ethnographic objects in 3D and in ways that are low cost. This provides new opportunities for documenting and preserving museum objects and providing public access to these objects through imagery and potential new museum displays.

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