Developing a Digital Library of Digitized Cultural Objects: Lessons Learned on Preliminary User Studies and 3D Scanning Process.

Miguel Garcia-Ruiz
Department of Mathematics and Computer Science
Algoma University
Canada
miguel.garcia@algomau.ca

Pedro C. Santana-Mancilla
School of Telematics
University of Colima
Mexico
psantana@ucol.mx

Laura S. Gaytan-Lugo
School of Mechanical and Electrical Engineering
University of Colima
Mexico
laura@ucol.mx

Institutional Background

Algoma University's Wishart Library is located in Sault Ste. Marie, Ontario, Canada. It serves more than 1600 undergraduate students and scholars from sciences, liberal arts, and professional degree programs, and other regional patrons. The library houses an important collection of cultural objects made by local indigenous people dating back from the 1800s, which belongs to The Engracia de Jesus Matias Archives and Special Collections. About a hundred of small objects have been catalogued online, shown in http://archives.algomau.ca/main/node/20967. However, just a very small sample of those objects have been on display at the library's main floor, mainly because of space constraints and fragility of some objects, among other reasons.

Project Description

We are conducting a research project related to developing a digital library of 3D models of cultural objects, to use it in libraries and classroom settings, supported by Algoma University Research Fund. The overarching aim of this project is to digitize local Canadian cultural objects and displaying them on an online digital library in an affordable and usable way, to see if the tools, methods and resulting 3D models are technically feasible for educational applications. One of our project objectives is to carry out user studies to test and analyze the usability (the ease of use based on efficiency, effectiveness and user

satisfaction components) of the scanned 3D models displayed on a digital library and using virtual reality (VR) technology. This in turn should improve and support the learning experience of Canadian culture (Virvou and Katsionis 2008).

We conduct this project not only for the sake of preserving cultural heritage, but also to make information from the object collection easily accessible and usable to scholars, researchers and the general public in the library and in classrooms, in particular to students that take courses on regional indigenous culture, taught at Algoma University.

Problems Found

At the beginning of the project, we tried some techniques such as of taking hundreds of pictures of a cultural object using a DSLR camera, with a resolution of up to 5184 x 3456 pixels, and automatically constructing a 3D model out of those pictures using a commercial software. This generated high-quality 3D models, but it was a time-consuming and difficult process.

Digitizing cultural objects is not trivial. Special care must be exercised when manipulating them, because of their fragility and surface degradation, among other issues. Some objects' surfaces are not smooth and shiny, which can be very difficult to capture accurately with a 3D scanner.

Tackling the 3D Scanning Process and Usability Testing Lenses

To achieve our project's aim, we are using a Matter and Form 3D scanner (https://matterandform.net/scanner) for scanning a sample of cultural objects from Algoma University's library. This is an easy-to-use scanner that provides high resolution textures of 3840 x 1920 pixels, capturing details of about 0.43 mm in color, shown in Figure 1.

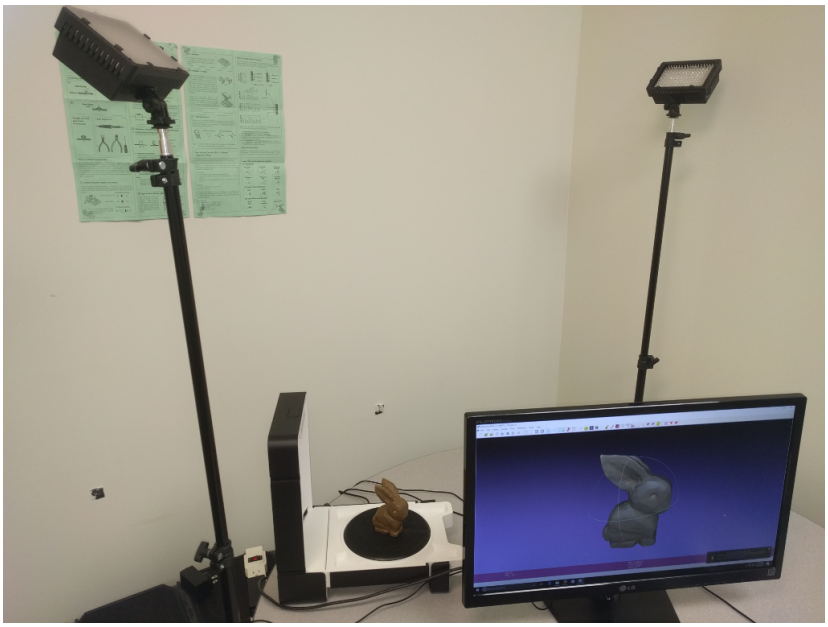

Figure 1. 3D scanner and lighting set up.

Once an object's 3D digital model is created, it is possible to show it on a web page using a desktop computer or a mobile device. This will allow researchers, students and interested people to inspect the 3D models from many angles interacting with the digitized object virtually. The 3D model can also be accompanied with a description of the digitized artifact and extra information such as pictures on how the object was used in the past.

Lessons Learned

We have learned a number of lessons regarding the 3D scanning process. For instance, scanning cultural objects that have a shiny surface is very challenging. The Matter and Form scanner developers suggest to coat the object to be scanned with talc powder or spraying the object using specialized sprays (https://matterandform.net/blog/tips-for-scanning-shiny-objects). However, we wanted to use a non-invasive technique. We tried different lighting techniques such as using LED lights placed at different positions in the room where the objects were scanned. This also helped scanning objects with rough surfaces. In the end, using regular office fluorescent lights and two low-dimmed LED lights (shown in Figure 1) helped producing a more scattered and uniform illumination and reduced unwanted shadows cast on the scanned object. This lighting setting and the 3D scanner cost less than $800 USD, making it an affordable and effective solution.

Another lesson that we learned was to use low-cost (or free) and easy-to-use software for visualizing the obtained 3D models, such as an open source software visualization tool called Meshlab (http://www.meshlab.net/). As a proof of concept for our future digital library, we uploaded a 3D model of one of our scanned objects to a free web site called Sketchfab, shown in: https://sketchfab.com/models/44ce7f1dfdd94aeaba8ffd5951275598
Sketchfab allows to visualize the 3D model on a smart phone's website in stereo. The phone can be inserted in an inexpensive virtual reality headset (Figure 2) such as the EVO Next VR ((https://merkuryinnovations.com/merkury/evo-next-bluetooth-controller/#black), costing about $40 USD. We conducted a preliminary usability testing session with six computer science students where they visualized and manipulated the 3D model using the VR headset (shown in Figure 3) and filling out the SUS Usability Questionnaire (Brooke 1996). Some test results indicated that the VR application was highly usable, with potential for its application in educational settings such as libraries and classrooms (Garcia-Ruiz, Santana-Mancilla and Gaytan-Lugo 2017).

Figure 2. Smart phone displaying the 3D model and inserted into the VR headset.

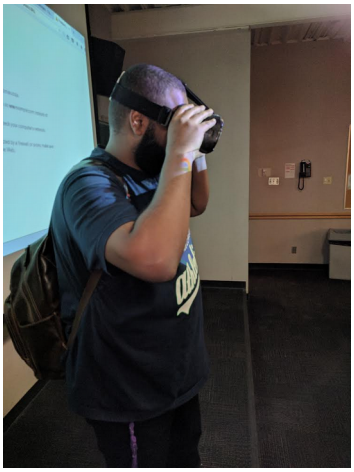

Figure 3. A student wearing the VR headset and watching the scanned 3D model.

References

Brooke, John. “SUS-A quick and dirty usability scale.” *Usability evaluation in industry* 189, no. 194 (1996): 4-7.

Garcia-Ruiz, Miguel, Santana-Mancilla, and Pedro, Gaytan-Lugo, Sanely. “A Usability study on low-cost virtual reality technology for visualizing digitized Canadian cultural objects: Implications in education.” Paper presented at Ed-Media conference, Washington, DC, June 20-23, 2017.

Virvou, Maria, and Katsionis, George. “On the usability and likeability of virtual reality games for education: The case of VR-ENGAGE.” *Computers & Education* 50(1) (2008): 154-178.