Chapter 3

A User Study of Virtual Reality for Visualizing Digitized Canadian Cultural Objects

Miguel Angel Garcia-Ruiz
Algoma University, Canada

Pedro Cesar Santana-Mancilla
Universidad de Colima, Mexico

Laura Sanely Gaytan-Lugo
Universidad de Colima, Mexico

EXECUTIVE SUMMARY

Algoma University holds an important collection of Canadian objects from the Anishinaabe culture dating from 1880. Some of those objects have been on display in the university’s library, but most of them still remain stored in the university’s archive, limiting opportunities to use them in teaching and learning activities. This chapter describes a research project focusing on digitizing and visualizing cultural artifacts using virtual reality (VR) technology, with the aim of supporting learning of Canadian heritage in cross-cultural courses. The chapter shows technical aspects of the objects’ 3D digitization process and goes on to explain a user study with students watching a 3D model displayed on a low-cost VR headset. Results from the study show that visualization of the 3D model on the VR headset was effective, efficient, and satisfactory enough to use, motivating students to keep using it in further sessions. Technology integration of VR in educational settings is also analyzed and discussed.

INTRODUCTION

The digital preservation and dissemination of cultural heritage have been greatly improved over the past two decades, due to the development of technologies such as web pages, three-dimensional (3D) digitization devices, specialized 3D graphics modelling and visualization software, among other techniques (Bentkowska-Kafel & MacDonald, 2018). The web has allowed better ways of cataloging, documenting,
A User Study of Virtual Reality for Visualizing Digitized Canadian Cultural Objects

displaying and accessing cultural information. Using innovations in 3D digitization with accurate sensors allow for registering and capturing more accurate details of cultural objects, including their 3D imaging and modelling (Tsirliganis et al., 2004), and the resulting 3D graphical models can be easily displayed and consulted on websites. More recently, virtual reality (VR) technology has been proposed and researched for enhancing visualization and interaction with 3D graphical models of cultural objects (Ch’ng, Cai & Thwaites, 2018). The premise of VR is to support user’s immersion (the person’s perception of being physically present in a 3D virtual environment) and to use most of his/her human senses to manipulate virtual objects and perceive multisensory information from a virtual environment (Burdea & Coiffet, 2003). In VR, users generally don a VR headset that greatly facilitates visual immersion, and may use other technologies such as specialized controllers for interacting with the virtual environment (Sherman & Craig, 2002). Immersion in VR is very important for supporting engagement and motivation of users, which can also provide an enhanced learning experience (Gaitatzes, Christopoulos & Rousso, 2001). Other visualization technologies have been researched and applied in the presentation of cultural heritage such as augmented reality, where digital information such as computer graphics are superimposed on video recording from a real-world environment in real time (e.g., Pedersen et al., 2017). A detailed comparison of augmented and virtual reality technologies for cultural heritage is described by Bekele et al. (2018). However, this chapter deals with the use of VR for visualizing digitized cultural objects.

Motivations for conducting digital cultural heritage preservation include: supporting dissemination of digital media collections through websites and virtual museums, ensuring that appearance and shape of cultural objects are not damaged or lost due to natural or human-made causes or accidents, making replicas, identifying art forgery, helping analyze cultural objects (Gomes, Bellon & Silva, 2014), digital restoration and making digital archives of 3D models (Pieraccini et al., 2001) and using digitized cultural objects for learning and teaching purposes (Garcia-Ruiz, Santana-Mancilla & Gaytan-Lugo, 2017). In addition, digital heritage preservation has been used for promoting the inclusion of indigenous knowledge (Kapuire et al., 2017).

The objective of this book chapter is to describe the researchers’ process of 3D digitizing Canadian cultural objects belonging to a collection from Algoma University, as part of a research project funded by Algoma University Research Fund (AURF). The chapter also explains the application of the generated 3D models in educational settings, such as Algoma University’s library and in classrooms, for learning and teaching purposes. The chapter goes on to describe initial user studies, namely usability and technology acceptance studies with a 3D digital model digitized in our project, and played on a virtual reality headset in a classroom. The chapter also discusses lessons learned on the 3D digitization process and the use of virtual reality in the classroom for digital heritage learning.

BACKGROUND

The literature shows many examples and techniques for the digitization of objects, buildings and archaeological sites in 3D (Portales et al., 2017). There are a number of digital acquisition methods for capturing cultural heritage 3D data to carry out 3D reconstruction, which is the capturing of 3D digital information of a real object and constructing the object’s digital shape and appearance (Gomes, Bellon & Silva, 2014). 3D digitizing methods include: