
HoloMuse: Enhancing engagement with Archaeological Artifacts through Gesture-Based Interaction with Holograms

Christina Pollalis

Wellesley College
Wellesley, MA 02148, USA
cpollali@wellesley.edu

Whitney Fahnbuehl

Wellesley College
Wellesley, MA 02148, USA
wfahnbuehl@wellesley.edu

Jordan Tynes

Wellesley College
Wellesley, MA 02148, USA
jtynes@wellesley.edu

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the Owner/Author.

Copyright is held by the owner/author(s).
TEI '17, March 20-23, 2017, Yokohama, Japan
ACM 978-1-4503-4676-4/17/03.
<http://dx.doi.org/10.1145/3024969.3025094>

Orit Shaer

Wellesley College
Wellesley, MA 02148, USA
oshaer@wellesley.edu

Abstract

We present HoloMuse, an AR application for the HoloLens wearable device, which allows users to actively engage with archaeological artifacts from a museum collection in ways that are otherwise not possible. We designed HoloLens to facilitate learning and engagement with museum collections without taking away from the experience of viewing an original artifact within the context of an exhibit. HoloMuse can be used inside the gallery or in the classroom. It enables users to pick up, rotate, scale, and alter a hologram of an original archeological artifact using in-air gestures. Users can also curate their own exhibit or customize an existing one by selecting artifacts from a virtual gallery and placing them within the physical world so that they are viewable only using the device. We intend to study the impact of HoloMuse on learning and engagement with college-level art history and archeology students.

Author Keywords

Augmented Reality; museums; gesture-based interaction; education.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

Introduction

Augmented reality (AR) technology poses unique opportunities for museums to bring exhibits “to life” and to allow visitors to experience and engage with original artifacts in new ways. Indeed, many museums are experimenting with the use of AR for increasing visitor engagement. Examples of AR applications for museums include the “Skin and Bones” application in the National Museum of Natural History, the “Ultimate Dinosaurs” exhibit at the Cincinnati Museum Center, and the “ROM Ultimate Dinosaurs” at the Royal Ontario Museum.



Figure 1: A user rotating an artifact.



Figure 2: A user customizing an exhibit by placing an artifact in the physical world.

However, current AR applications, which utilize tablets and phones, often divert visitor attention from the original artifact and from the context within which it is presented to the screen. Such applications provide only limited interactions with the original artifact, which typically include viewing a virtual layer superimposed on the artifact or manipulating a superimposed object using on-screen touch gestures. Therefore, an important open question is how can AR enhance a visitor’s engagement and understanding of authentic artifacts without taking away from viewing them within an exhibit context?

The increasing availability of wearable AR devices, such as the Microsoft Hololens [11], provides opportunities to develop AR experiences in which users can see the world and other people around them without holding an additional mediating device (e.g. phone) but also interact through mid-air gestures and movement with

3D holograms that are superimposed on the physical world. Users can add, remove, and place holograms within their physical environment and interact with them in ways similar to interacting with physical objects in the real non-digital world – e.g. walking around an artifact to view it from different perspectives, rotating an object, picking it up, and placing it within the physical space. In addition, users can engage with holograms in ways not always possible in the real physical world such as scaling and altering (e.g. by removing a layer of paint).

In this abstract, we present our first prototype of HoloMuse, an AR application for engaging with archaeological artifacts using the HoloLens device. HoloMuse allows users to actively engage with holograms of archeological artifacts presented in the Anonymous Museum – an academic fine-arts museum on the Anonymous College campus. These holograms are constructed from 3D scans of artifacts from Ancient Greece ranging from the 500 B.C.E period to the late 6th century B.C.E period.

Using HoloMuse, users can interact with these artifacts in ways otherwise not possible, including picking up, rotating, scaling, and removing a paint layer (see Figure 1). Users can also curate their own exhibit, or add artifacts to an existing exhibit, by selecting artifacts from a virtual gallery and placing them within the physical world (see Figure 2). HoloMuse can be used inside the gallery or in the classroom. Through active interaction and careful examination of the properties of an individual artifact and of the relations between artifacts, we expect to enhance the learning and understanding of archeological artifacts. We believe that allowing people to actively interact with original

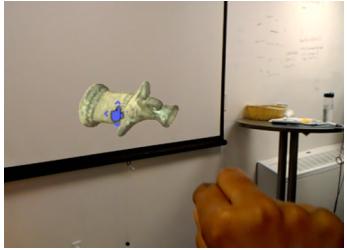


Figure 3: A user using an air gesture to select an artifact.

artifacts will lead to new pedagogical approaches to archaeology and art history. This paper also includes photos taken with the HoloLens camera that demonstrate what the user sees through the device.

Related Work

Studies have found that engagement with objects is vital for enhancing visitor understanding and overall enjoyment in a museum space [1]. Actively engaging with artifacts has been proven to enhance visitor experience as it allows them to expand their visual and verbal vocabulary and makes them feel more comfortable around the art [9, 13]. Advances in mobile technology and augmented reality have been extensively incorporated into museum applications and guides [12]. Here we discuss applications that were designed with the goal of increasing user engagement with objects in museums. For example, ArteMuse [14] is a mobile application that enhances the experience of beginner users when engaging with works of art. Its evaluation indicated that when using the application visitors spent more time viewing works of art, were more engaged when interacting with them, and had a subjectively better experience in the museum. Participatory mobile applications, such as ArtLinks [4, 5], and Imprints [2], allow for personalization of exhibits and interaction with other visitors by sharing personalized tags created for objects in the museum. Repentir [8], is an AR application that allows a user to digitally explore under an oil painting's surface by removing a layer of paint. Another example of a novel interface for engaging with artifacts and self-curating is the Pen in the Cooper Hewitt Smithsonian Design Museum. The Pen is given to visitors with their admission ticket and allows visitors to "collect" and "save" objects from the museum exhibits [3]. These

objects can be explored further by transferring them to large interactive tables or can be used in the Immersion Room, where visitors can use their pens to select wallpapers from the permanent museum collection, see them projected on the walls, and manipulate them. The pen also allows for extended interaction since a visitor can view or share the collected artifacts through a web browser and more objects can be added during a later visit to the museum.

Several AR guides have been developed for museums. For example, GuidiGo [10], ARCO [15], The AR Guide [7], and ARtSense [6] have been developed for research purposes. Museums also offer AR apps as supplementary gadget to their exhibits, such as the "ARTours" application at the Stedelijk Museum in Amsterdam that uses AR to place artifacts in a public park, and the "Get Surreal" application at the San Francisco Exploratorium that turned its After Dark event at the museum into an AR experience. However, to date there is a lack of substantial research on how AR applications impact users' engagement, understanding and enjoyment in an art exhibit. There is also little work about how AR applications can be used for customizing and curating.

HoloMuse

HoloMuse is an AR application that utilizes the HoloLens device to allow users to directly interact with holograms of archaeological artifacts from the Anonymous Museum's collection.

In the current prototype, users can select a hologram from a virtual gallery, by focusing their gaze on a particular hologram and selecting it using a voice



Figure 4: A user placed multiple holograms to curate their own exhibit space.



Figure 5: The directional arrow that allows other users to locate the exhibit space.



Figure 8: A user removed the material of an artifact.

command or an in-air gesture (see Figure 3). Users can rotate and scale the hologram using in-air gestures, and then place it within their field of view with an air-gesture tap so that the hologram remains on the selected position unless moved again. Users can place multiple holograms in various positions, thereby customizing the exhibit space and curating their own collection (see Figure 4).

Users can invite others to visit the customized space they created by sharing their exhibit (currently by handing the HoloLens to another person), we are currently implementing a visiting mode – where virtual arrows will appear when the user turn their head in the general direction of a hologram to help the user locate the added holograms in the space (see Figure 5).

To encourage users to learn more about an individual artifact and to study it carefully, as well as to consider the relations between artifacts, we are currently implementing features that will allow users to request and present additional information (text and voice) about an artifact (see Figure 7), and to select an artifact from an inventory (see Figure 6).

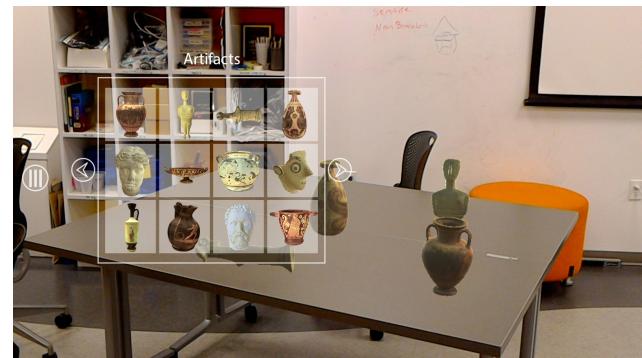


Figure 6: A user opening a virtual gallery to select an object to place in the space.

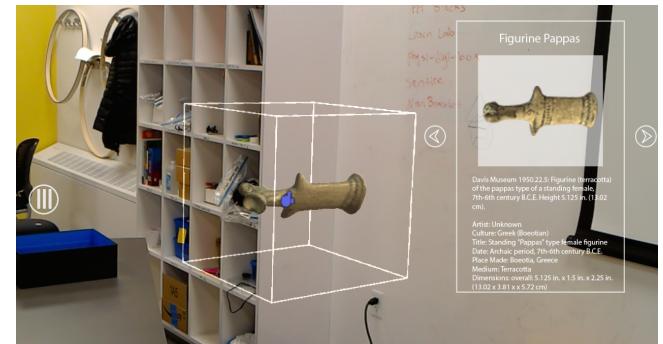


Figure 7: A user requested more information about an artifact.

Design Process

Our design process follows a human-centered approach. We work closely with users – on-campus museum visitors and students, as well as museum curators and faculty with expertise in art history and archaeology, to explore the potential of wearable AR in promoting meaningful engagement and learning with archeological artifacts in and outside the museum. We are planning to employ both qualitative and quantitative research methods to refine and validate our design, and then to evaluate the impact of the system on learning and engagement.

Preliminary Evaluation

We conducted a preliminary evaluation of HoloMuse, presenting it as an interactive demo in the library where about 20 users interacted with the application (see Figure 9). Most users enjoyed the application and were able to select and manipulate a hologram using gestures without significant problems. However, some

had difficulties making HoloLens specific gestures and required practice. This issue could be resolved through a brief tutorial on the use of the HoloLens platform.



Figure 9: A user interacting with the HoloMuse demo in the library.

Implementation

HoloMuse is implemented using HoloLens for Unity 5.4.0f3-HTP (Unity HoloLens Technical Preview), Visual Studio 2015 (Update 3) with Tools (1.4), and Windows 10 SDK (10.0.10586) installed. Archeological artifacts

References

1. Bell, C. The Museum as 'Cultural Ecolgy.' 2002. Retrieved October 25, 2016 from http://echo.iat.sfu.ca/library/bell_02_museum_ecology.pdf.

were scanned using Artec Spider and modeled using Artec Studio 10 and 11.

Conclusion and Future Work

We present HoloMuse, an AR application that utilizes the HoloLens device to allow users to actively engage with archaeological artifacts from a museum collection using gaze, in-air gestures, and whole body interaction (e.g. walking). We designed HoloMuse to facilitate learning and engagement with museum collections without taking away from the experience of viewing an original artifact within the context of an exhibit. HoloMuse can be used inside the gallery or in the classroom. It enables users to manipulate and relate archaeological artifacts in ways otherwise not possible.

We are currently iterating on the design and implementation of HoloMuse, focusing on the development of sharing a curated exhibit through a 'visiting mode'. We are also planning to create an interface for museum curators and faculty to upload content to the application. We plan to study the impact of HoloMuse on learning and engagement by deploying it in the on-campus Anonymous Museum, making it available for college-level art history and archeology students.

2. Boehner, K., J. Thom-Santelli, A. Zoss, G. Gay, J.S. Hall, and T. Barrett. Imprints of place: creative expressions of the museum experience. 2005. Retrieved on November 3, 2016. CHI '05 Extended abstracts on Human factors in computing systems.
3. Cooper Hewitt. The New Cooper Hewitt Experience. 2016. Retrieved November 3, 2016 from <http://www.cooperhewitt.org/new-experience/>.

4. Cosley, D., J. Baxter, S. Lee, B. Alson, S. Nomura, P. Adams, C. Sarabu, and G. Gay. A tag in the hand: supporting semantic, social, and spatial navigation in museums. 2009. Retrieved on November 3, 2016. In Proceedings of the 27th international conference on Human factors in computing systems.
5. Cosley, D., J. Lewenstein, A. Herman, J. Holloway, J. Baxter, S. Nomura, K. Boehner, G. Gay. ArtLinks: Fostering social awareness and reflection in museums. 2008. Retrieved on November 3, 2016. In Proceeding of the 26th annual SIGCHI conference on Human factors in computing systems.
6. Damala, A. and P. Cuband. Bridging the Gap between the Digital and the Physical: Design and Evaluation of a Mobile Augmented Reality Guide for the Museum Visit. 2008. Retrieved November 1, 2016 from <http://dl.acm.org/citation.cfm?id=1413660>.
7. Damala, A., N. Stojanovic, T. Schuchert, J. Moragues, A. Cabrera, and K. Gillette. Adaptive Augmented Reality for Cultural Heritage: ARTSENSE Project. 2012. Retrieved November 3, 2016 from http://www.academia.edu/2296517/Adaptive_Augmented_Reality_for_Cultural_Heritage_The_ARTNSE_project.
8. Hook, J., J. Briggs, M. Blythe, N. Walsh, P. Olivier. Repentir: a digital exploration beneath the surface of an oil painting. 2013. Retrieved on January 1 2017. CHI '13 Extended abstracts on Human factors in computing systems.
9. Leder, H., B. Belke, A. Oeberst, and D. Augustin. A model of aesthetic appreciation and aesthetic judgments. British Journal of Psychology95, 4, 489-508. 2004. Retrieved November 2, 2016 from http://echo.iat.sfu.ca/library/bell_02_museum_ecology.pdf.
10. Mason, M. The MIT Museum Glassware Prototype: Visitor Experience Exploration for Designing Smart Glasses. 2016. Retrieved November 3, 2016 from <http://dl.acm.org/citation.cfm?id=2872278>.
11. Microsoft. Microsoft HoloLens. 2016. Retrieved November 1, 2016 from <https://www.microsoft.com/microsoft-hololens/en-us>.
12. Museum ID. British Museum – Augmented Reality: Beyond the Hype. Retrieved November 2, 2016 from <http://www.museum-id.com/idea-detail.asp?id=336>.
13. Rothstein, E. From Picassos to Sarcophagi, Guided by Phone Apps. 2010. Retrieved November 1, 2016 from <http://www.nytimes.com/2010/10/02/arts/design/02apps.html>.
14. Shaer O., J. Olsen, M. Edwards, C. Valdes. Art Appreciation: Fostering Engagement and Reflection in Museums through a Social-Mobile Application. 2011. Retrieved November 1, 2016 from http://www.museumsandtheweb.com/mw2011/papers/art_app_reciation_fostering_engagement_and_ref.html.
15. Wojciechnowski, R., K. Walczak, M. White, and W. Cellary. Building Virtual and Augmented Reality Museum Exhibitions. 2004. Retrieved November 1, 2016 from <http://dl.acm.org/citation.cfm?id=985060>.