
Shared AR Experiences in a Museum Installation

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ABSTRACT

Augmented Reality (AR) is quickly gaining popularity thanks to more capable smartphones and applications. Although the critical mass of AR is mostly on hand-held AR, head-worn devices are slowly gaining popularity. Therefore, researchers need to address the interaction nuances between hand-held and head-worn AR. One clear difference is the ability of headset user to share his/her experience with others that don't have access to the augmentation since there is no screen to be shared. Museums and cultural heritage sites are great for different kinds of VR and AR experiences, and in fact, several museums already have digital components in their exhibits. When using head-worn AR, however, it is essential for experience designers to understand how to create shared AR experiences since most people do not visit a museum alone. In this work, we share our initial notes on three sharing techniques for AR content which we tested in two different venues throughout five months and with roughly 400 people.

CHI'19 Extended Abstracts, May 4-9, 2019, Glasgow, Scotland UK

Proceedings of the 1st Workshop on Challenges Using Head-Mounted Displays in Shared and Social Spaces. This is the author's version of the work. It is posted here for your personal use. Not for redistribution. The definitive Version of Record was published in *Proceedings of (CHI'19 Extended Abstracts)*.

Psychogeography is defined by *Guy Debord* as "the study of the specific effects of the geographical environment, consciously organized or not, on the emotions and behaviour of individuals"[1]. The exhibit is coined "The Psychogeographer's Table" as it juxtaposes a series of maps, buildings, imagery, and artifacts that together tell the complex story of how the 1917 harbour explosion shaped Halifax's past and present.

CCS CONCEPTS

• **Human-centered computing** → **Field studies; Empirical studies in HCI**; Human computer interaction (HCI).

KEYWORDS

augmented reality; digital heritage; museum; interactivity

INTRODUCTION

Augmented Reality (AR) is at the cusp of becoming an ubiquitous tool in modern smartphones. Applications such as Yelp, IKEA Place, Pokèmon Go and the augmented Google Maps street navigation enable everyday users to explore AR content in ways that were previously only found in research labs and specialized installations. Similar to Virtual Reality (VR), AR can also be experienced using headsets which add virtual content without blocking the user's view of the real world. However, head-worn AR is still far from being widely adopted.

Museums and cultural heritage sites are constantly seeking to evolve their exhibits in order to keep visitors interested and motivated while exploring the curated spaces. Many are exploring how digital tools can be used to either enhance visitors' experiences or to motivate younger generations to visit. [3] reviewed 87 AR public installations in museums and heritage sites, from 2004 to 2017, of which almost half used hand-held AR. In a similar review, [2] explored 53 publications from 2012 to 2016 on empirical evaluations of digital cultural heritage systems that focused on visitor experience; only six papers explored hand held AR and only one work explored head-worn AR.

SHARING AR EXPERIENCES

We believe that an important part of a museum experience is one's ability to explore with other people while being able to communicate and share individual ideas and feelings. While hand-held AR solutions allow for easy sharing, either by using multiple devices such as smartphones or by people sharing the same screen, head-worn AR generally does not.

The Psychogeographer's Table

We introduce the Psychogeographer's Table (Figure 1), a mixed reality exhibit used to explore three techniques for sharing of head-worn AR in museum spaces. The table juxtaposes a series of maps, buildings, imagery, and artifacts that together tell the complex story of how the 1917 Halifax Explosion shaped the city's past and present. The table is comprised of 4 elements: a machine cut wooden model of the Halifax harbour, a top-down projector with projection mapped content, one head-worn headset (HoloLens) and one large television that is used as the sharing medium.



Figure 1: The Psychogeographer's Table exhibit installed at the Maritime Museum of the Atlantic in Halifax, Canada.

Visitors can interact with the virtual AR buildings on the table by pointing (with gaze) and pressing a handheld button. When a building is selected, it gets enlarged in the center of the table and information about it is displayed as another hologram on the wall across from the table. The same information is provided to other visitors using the sharing techniques on the large television.

The three explored techniques are as follows: *Virtual Reality Companion (VRC)*, which displays a real-time rendering of the augmented reality scene from the view point of the HoloLens user (Figure 2a); *Semantic Linking (SL)*, which shows relevant information (same information present in AR) on the TV but without positional information (Figure 2b); and *Indicator Rings (IR)*, which does not use the TV but rather projects rings on the table indicating the current focus of the AR user (Figure 2c).

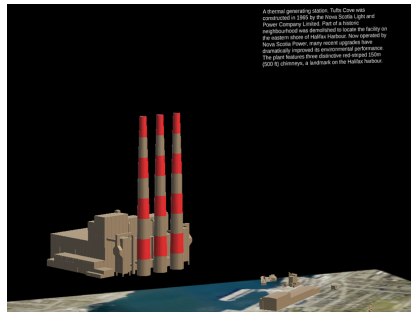
DISCUSSION AND CONCLUSION

The exhibit was installed in the Dalhousie University Art Gallery for one month, after which it was moved to the Maritime Museum of the Atlantic where it remained for a further four months. In total, approximately 400 people experienced our exhibit in both locations combined with the AR component; many more experienced the table and projection mapping alone. During this time, we also conducted two user studies in both locations with a total of 107 participants (47 pairs and 13 singles). Formal data analysis of the studies is still underway, however, we would like to use this opportunity to informally expose some of our on-site notes and observations.

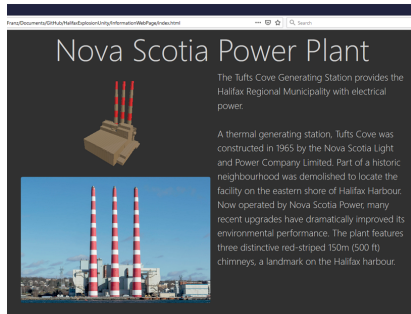
Our participants enjoyed their experience with the AR content and, for the most part, had no difficulties interacting with the exhibit. This is particularly interesting when we consider not only that most visitors had never used AR or VR before, but also factor in the average age of our participants: around 50 years old (most participants were in the (43, 58] bracket).

Some visitors who had experience with VR (but not AR), had an initial fear of feeling nauseated and, despite their curiosity, did not wish to try the AR headset. However, when informed about the differences between AR and VR regarding induced nausea, most decided to try our exhibit and had no problem with nausea. Therefore, we postulate that digital heritage content creators and museum curators should be explicit about VR sickness when using AR headsets in order to reduce the access barrier for users with previous *bad* VR experiences.

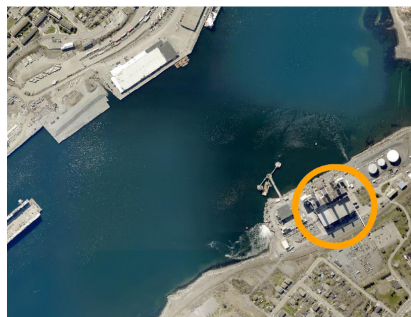
We conducted both studies while the art gallery and the museum were in normal operation. In fact, we were at the museum for four months during the peak tourist season of the city. We were initially not sure on how people would feel regarding their personal space (including the sharing medium) while using the AR headset, as other studies revealed concerns regarding participants reporting being shy or awkward while using AR in public. We observed that our users felt as if they were not using a headset at all (aside from general complaints about the weight), as they were naturally talking to their group and other visitors around the table. We also noted that the headset users did not seem to



(a)



(b)



(c)

Figure 2: Three different techniques for sharing information between AR and non-AR: a) Virtual Reality Companion; b) Semantic Linking; c) Indicator Rings.

feel concerned about other people seeing their current view of the augmented world and, in fact, they naturally used the TV to facilitate conversation when approached by other visitors.

When designing a shared experience such as a museum exhibit or even a collaborative work station, it is important to take into account that not everyone might have access to the augmentation device. If the exhibit is poorly designed it can lead to a communication gap between individuals using AR and those without, thus fragmenting the group due to the non-AR visitors being *locked out* of the experience. With the Psychogeographers' table we tried to reduce separation using our sharing techniques. Our initial video analysis shows different behaviour when using *VRC* and *SL* for the non-AR participant. All of our techniques showed improvement regarding participant communication and engagement with the exhibit when compared to the baseline without external sharing techniques.

Non-AR participants exposed to *VRC* tended to talk and move less around the exhibit when compared to *SL*, probably because of the live component of this sharing method. Since the non-AR content in *VRC* was a representation of the AR participant's view, non-AR participants had to be mainly focused on the TV. *VRC* non-AR participants also seemed to have a better grasp of what was being presented in AR according to one of our post-session questions. When planning for a shared AR exhibit it is important to consider this trade-off between continuous communication and comprehension of virtual content. We believe that a solution that integrates both techniques could be used but further research is required to explore this scenario.

We also observed an interesting emergent behaviour in *VRC* but not on *SL*: after a initial exploration and discovery phase with the AR participant acting as a guide to the virtual aspects of the exhibit, some pairs of participants demonstrated something similar to an inversion-of-control behaviour. Non-AR participants became the guide directing the headset wearer to look at specific locations and to select specific buildings on the table while using the TV as their 'window' to the virtual content.

It is also interesting to note the effect of *VRC* and *SL* on other visitors who were not part of the study. We observed that bystanders were attracted to the TV in both conditions, however, more so when using *VRC* probably due to its dynamic element.

Virtual and Augmented Reality are rapidly expanding in popularity and accessibility, with a plethora of new devices and applications every month. It is vital to consider usability aspects of such devices, especially when designing for public use which is traditionally the case with museums and heritage sites. Our current work explores some aspects of shared AR experiences using head-worn AR and attempts to address concerns regarding communication and isolation of both headset and non-headset users. We believe that even without a fully complete data analysis this work can provide meaningful discussion opportunities in the workshop.

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