Museums of the Future: Heritage Experiences in the Reality-Virtuality Continuum

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In this paper we reflect on the interplay and the disconnects between real and virtual heritage experiences, and the fragmented nature of digital experiences. We consider the important engagement potential that virtual interactions bring to small less visible artefacts, like clay cuneiform tablets, and, with case study examples, we imagine museums of the future where engagements unite, blend and reinforce rich heritage experiences.

Cultural heritage; Virtual reality; Augmented Reality; User experience; Digital heritage

1. INTRODUCTION

There is much potential for digital experiences to supplement, augment and simulate physical heritage engagements (Flynn, 2019). We consider here the nature and connectedness of these experiences.

As shown in Table 1, many aspects of physical heritage experiences have virtual digital counterparts that, at least in part, incorporate semblances of the physical reality. For example, virtual tours of museum galleries enable visitors to virtually navigate the physical exhibition spaces, preview display cabinets, and observe larger-scale objects. These virtual tour visitors probably cannot get close enough to display cases to see small objects or read display cards but, like a movie trailer, this is a preview and not a substitute for the real experience.

Virtual museum visitors may also be able to acquire artefact information from museum webpages and linked resources, and they may be able to download 3D models of selected artefacts. In counterpart, physical museum visitors can usually purchase guidebooks that provide details about collections and artefacts, and they can often also purchase selected artefact replicas in museum shops.

Digital experiences can also supplement and augment in-situ experiences. For example, physical museum visitors can access website information and media, and, perhaps, narrated tour guide recordings in a language of their choice. Similarly, Augmented Reality (AR) apps and Virtual Reality (VR) experiences can, at least potentially, supplement physical experiences.

Table 1: Heritage experiences with physical and digital counterpart examples

Heritage Experience	Physical Example	Digital Example
Museum, Heritage Site Experience	*Visit to museum exhibition*	*Online virtual gallery tours*
Exhibition displays	*Viewing artefacts in display cabinets*	*Web-based gallery tour.*
Location and Artefact Information	*Museum guides, exhibition catalogue*	*Online archives artefact database*
All around 3D Object Views	*Hands-on displays and demonstrations*	*Online 3D artefact viewers*
Takeaway 3D Models	*Replicas in museum gift shop*	*Download and printable models.*
Collecting and Sharing Artefacts	*Photographs or postcards*	*Instagram or Facebook*
Augmented / Mixed Reality (AR/MR)	*AR museum app*	*AR museum app*
Cultural Context	*Physical installation, costumed actors*	*VR historical environment*

Of course, digital experiences are often the only achievable means of accessing artefacts and heritage sites. Museums, like other public places, have been unavailable to the public during the COVID-19 pandemic and, when they are open and within reach, the majority of artefacts, typically 95-99% of large museum holdings worldwide, are held in storage with little or no opportunity of ever being displayed in the limited exhibition spaces. Similarly, the access to heritage sites is often limited because of physical constraints or preservation concerns.

2. DIGITAL LIVES FOR SMALL ARTEFACTS

In all quarters, those which are small, uncolourful and less visible are often neglected. The wildlife conservationist, Gerald Durrell, famously championed the cause of overlooked but critically endangered "little brown" non-crowd-pleasers and created the Jersey Wildlife Park, a unique preservation zoo without elephants, giraffes or tigers. Similarly, in cultural heritage, the small and less visually dramatic artefacts and sites struggle to attract attention from the magnificence and scale of the likes of Egyptian sarcophagi and the Acropolis. We consider small artefacts in the following sections and how digital presence and virtual interactions might improve their visibility.

2.1 Staffordshire Hoard

Discovered in 2009, the Staffordshire Hoard, comprises thousands of small, intricate Anglo-Saxon gold, silver and cloisonné artefacts as shown in Figure 1.
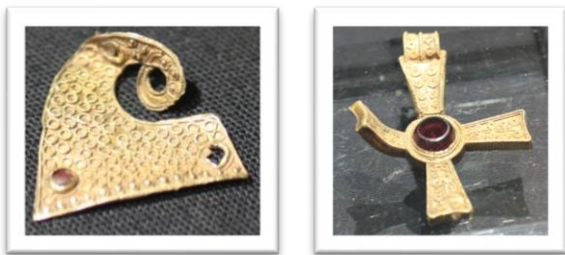

Figure 1: *Small form-factor Staffordshire Hoard items*

Most of the items are so small that magnifying glasses are provided to visitors but, like so many physically displayed artefacts, only the front-facing surfaces can be viewed by visitors. Interactive touchscreen views of all around photographically textured virtual 3D models would enable visitors (both virtual and physical) to interact with small exhibits like these, experience their intricate detail and explore interesting cultural contexts via connected media links.

2.2 Cuneiform tablets

Palm-sized Mesopotamian clay tablets inscribed with cuneiform script are the earliest human writings. Whilst not visually striking these clay records provide fascinating insights into humankind's first civilizations. Figure 2 shows a 4,000-year-old cuneiform tablet in the 3D viewer interface of The Virtual Cuneiform Tablet Reconstruction Project (VCTR): *virtualcuneiform.org* (Woolley et al., 2017). The viewer enables all around interactive views of tablets (Collins et al. 2017; 2019) and provides a digital opportunity to connect information, context and experiences to artefacts that have limited visibility and availability to museum visitors.

Figure 2: *A 3D cuneiform tablet interaction. The writing tells us that the King is going to Sumer. His large party need lentils, milk, cumin, figs, beer and more (Cripps 2010; 2021).*

3. CONNECTED EXPERIENCES

Ideally, digital experiences would blend and connect with each other and with physical experiences, and still support the social engagement and experience-sharing opportunities that traditional museum and heritage site visits have always afforded.

3.1 Digital practicalities

Although there is much potential for innovative digital heritage experiences, it is important to recognise the enormity of resource limitations across the heritage sector. The 'Great Archaeological Sites' website: *archeologie.culture.fr* represents a remarkable and unusual level of investment (in this case from the French Ministry of Culture). The website is a vast collection of interactive heritage imagery, video and 3D graphics that, although difficult to navigate, demonstrates the potential for achievement that colocation of media can enable, even when the experiences themselves are not very connected. But, of course, added to the problem of resourcing, designing and developing these resources is the difficulty of maintaining them. All too often excellent digital initiatives have limited availability beyond their short project lifespans.
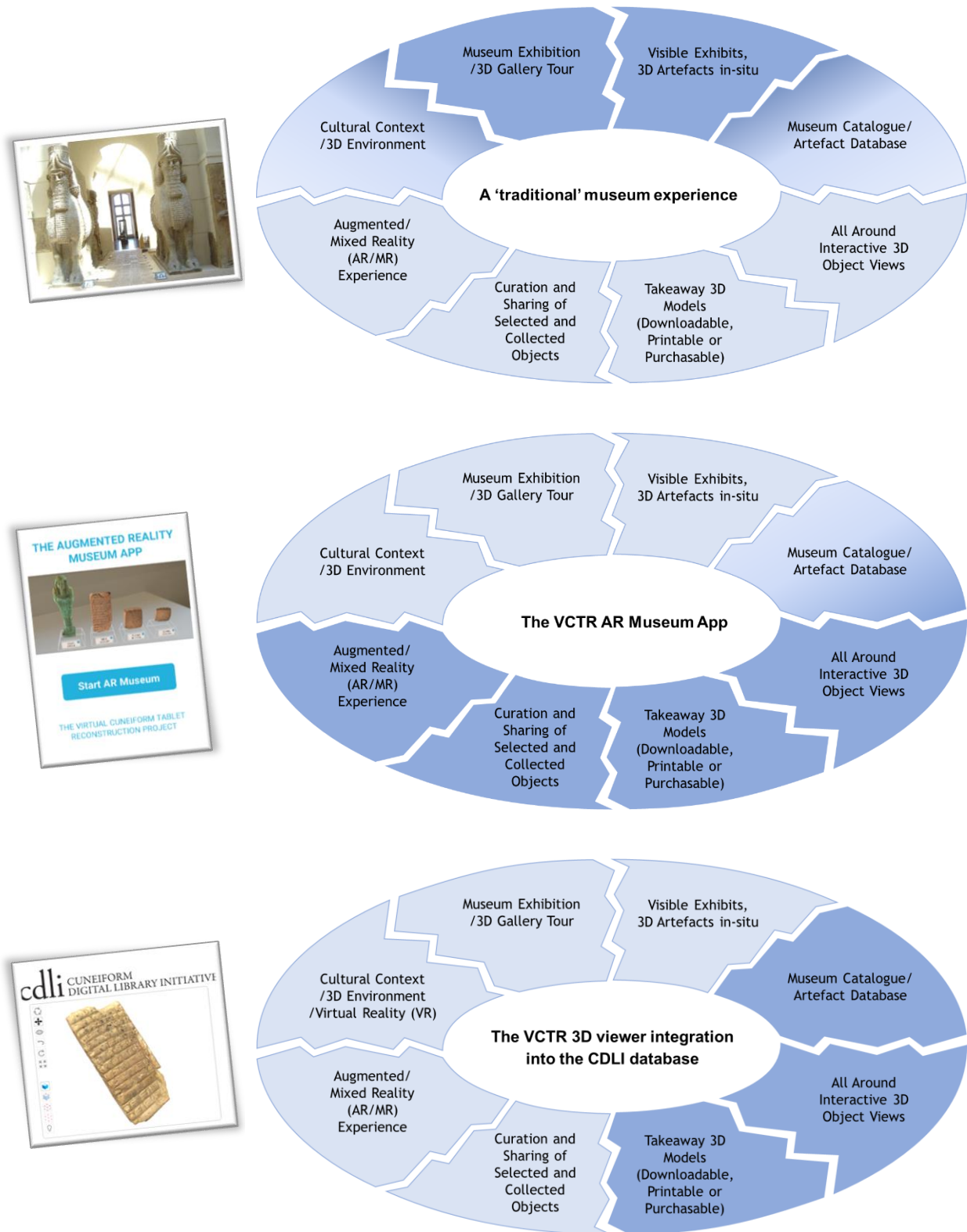
Figure 3: The Fragmented Virtuality-Physicality Continuum: Top – the traditional physical museum experience; Middle – the VCTR AR Museum App, and Bottom – the VCTR 3D viewer integration project

3.2 Connected experiences

Preferences for heritage experiences are increasingly more visually oriented, with virtual reality considered as an engaging medium for heritage learning (Ch'ng et al., 2020). However, stepping into connected contextual 'other world' experiences can be afforded by a variety of digital experiences. Perhaps the greater challenge is connecting these experiences.

As shown in the shaded elements of Figure 3 (top), 'traditional' physical museum visits enable some connected heritage experiences. For example, visitors can explore exhibition spaces, see visible artefacts, access physical information sources and, observe available installations for cultural context. There are often, of course, supplementary digital experiences, but these are not generally connected. For example, a virtual 3D gallery tour and a virtual 3D environment experience may not connect with each other, nor with the physical experience.

3.2.1 The VCTR AR museum
Figure 3 (middle) summarises the connected virtual experiences prototyped by the VCTR AR Museum apps (Woolley et al., 2020). As shown in the Android AR app screenshot in Figure 4, the app demonstrates the enablement of museum visitors (virtual and physical) to acquire, curate, exhibit, share and interact with eclectic 'takeaway' 3D artefact models.

Figure 4. *The AR Museum app*

3.2.2 VCTR 3D viewer integration
Figure 3 (bottom) demonstrates a further connected digital experience project currently in progress in which photo-realistic 3D models of cuneiform tablets are being integrated into the international cuneiform database (CDLI) with the VCTR 3D viewer via a Google Summer of Code CDLI integration project.

4. TOWARD INTERWOVEN EMBODIMENT

Beyond the connected exemplars summarised here, we are exploring connected virtual-physical experiences in new research where, for example, virtual environment visitors can explore a Mesopotamian experience using the Valve Index VR system, such as learning how to make a cuneiform tablet, then 3D print their creations on 'return' to the physical world.

Further still, there is a need to make virtual heritage experiences available to physical heritage visitors and, as much as possible, enable individuals to share and collect memories and artefacts. For example, enabling physical visitors to access *and share* digital experiences to accessible and engaging virtual contexts such as 3D recreations of ancient environments, virtual video gallery samples of archaeological digs and expert curator accounts, and we should enable visitors to collect, curate and share artefacts and memories from these experiences.

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