Virtually Real or Really Virtual: Towards a Heritage Metaverse?

JEREMY HUGGETT, University of Glasgow, UK

The hype surrounding the impending mainstreaming of Virtual Reality can seem to prioritize the digital above the critical. With the development of VR said to be at a pivotal point, there is an important opportunity to consider the emergence of virtual heritage and its potential futures. This paper argues that there is a disjunction between the present reality of virtual heritage and virtual reality and discusses the twin challenges of presence and realism within virtual reality. In particular, it highlights a paradox inherent in virtual heritage and virtual reality and proposes the use of 'loose-realism' as a solution. Ultimately, the challenge is to address the claims that virtual reality represents a new class of information system, or metaverse, in order that virtual heritage fully engages with inquiry about the past.

Key words:
Virtual Reality, Virtual Heritage, Virtual Presence, Virtual Realism, Virtual Immersion, Archaeogaming.

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1. VIRTUAL DEVICES AND VIRTUAL WORLDS

Virtual Reality (VR) has been a long time in coming. In the 1950s the film industry was actively pursuing the creation of sensory experiences alongside developments in wide-screen pictures, stereophonic sound, and 3D images. One system that made it to the prototype stage in 1962 was Morton Heilig's Sensorama Simulator – an arcade-like device which featured a vibrating seat, handles, viewing holes, and a set of vents providing breezes and chemical scents [Turi 2014]. Perhaps closer to what we now perceive as VR was Ivan Sutherland's development of the head-mounted three-dimensional display, nicknamed the 'Sword of Damocles' because it was suspended from the ceiling above the user's head. The headset presented a pair of miniature cathode ray tube screens providing stereo vision, and the computer-generated perspective wire frame environments responded to head movements [Sutherland 1968]. In the 1970s and 1980s, the US Air Force and NASA continued to explore the development of VR, and in 1985 NASA developed the Virtual Environment Workstation which incorporated a head-mounted display, head tracker, speech recognition, data glove and 3D audio [Fisher et al. 1987]. However, technological limitations and cost meant that VR

Author's address: Jeremy Huggett, Archaeology, School of Humanities, University of Glasgow, Glasgow, G12 8QQ, UK; email: jeremy.huggett@glasgow.ac.uk

was largely reserved for areas such as medical simulation, flight simulators, and industrial design, and few people could experience it.

Attempts to bring VR to the wider public during the 1990s, such as Nintendo's Virtual Boy and Sega's VR, were commercial failures. However, the rapid development of accessible and relatively affordable mobile and wearable technologies during recent years has brought us to what some have argued is a pivotal moment for virtual reality [e.g. Day 2015]. Devices such as the Oculus Rift and the Valve HTC Vive launched in early 2016 with Sony's Playstation VR and Microsoft's Hololens following soon after. These and devices like them were anticipated to see the rise of consumer-VR [e.g. Johnson 2015] although its uptake has been slower than anticipated [e.g. Bajarin 2018].

At the same time, increasingly compelling historical worlds were being created as the basis for mainstream gaming. For instance, Ubisoft's historical reconstructions in recent editions of their Assassin's Creed games are visually striking and have a considerable degree of historical accuracy while including some modifications to support the gameplay [Reinhard 2018a: 188-89]. In the reconstruction of revolutionary Paris in 1798 that underpins Assassin's Creed Unity, for example, rooflines were altered to facilitate the parkour movement traditionally associated with the protagonist [Webster 2014], while the highly detailed 1:1 internal and external reconstruction of Notre Dame cathedral includes modifications creating pathways through the structure as well as different internal artwork required for copyright reasons [Makedonski 2014]. Released in 2015, Assassin's Creed Syndicate did much the same for Victorian London of 1868 although with perhaps greater license in favor of the gameplay, including the shrinking of distance and omission of some areas of London [Kerr 2015] as well as a range of other historical shortcuts [Nielson 2015]. Archaeological reconstruction came to the fore in Assassin's Creed Origins, released in 2017, with an open-world recreation of ancient Egyptian cities and their surroundings [Nielson 2017] produced in collaboration with a number of archaeologists and including an educational mode with over 70 guided tours covering aspects of Egyptian life and ritual [MacDonald 2018; Webster 2018]. This was followed up by the release of Assassin's Creed Odyssey in 2018 with its recreation of Ancient Greece [Nielson 2018; Garst 2018]. Ubisoft also released Far Cry Primal in 2016, a game which sought to recreate a Mesolithic world incorporating hunting, gathering, and crafting [see Brouwers 2016; Morgan 2016; Riris 2016a,b,c,d]. Not surprisingly, Ubisoft also moved into virtual reality gaming in order to capitalize on the anticipated mainstreaming of VR headsets, but such games do not as yet incorporate their historical environments (although it is likely that Ubisoft's Eagle Flight VR uses simplified assets from Assassin's Creed Unity to create a deserted and overgrown version of Paris [e.g. Hartup 2016; Takahashi 2015]).

2. VIRTUALLY REAL HERITAGE?

As a consequence of all this creative activity, it is not unreasonable to suggest that Virtual Reality is at a transformative time. Where does that leave virtual heritage? In most cases, authors are agreed that virtual heritage sits at the intersection between VR and cultural heritage, although interestingly most definitions focus on imagery and three-dimensionality and make little reference to virtual reality itself, something that has previously been observed [Pujol Tost 2008: 106-7].

Although the scope of definitions of virtual heritage (like that of cultural heritage itself) is broad, ranging in scale from portable artefacts to buildings, settlements, and landscapes [e.g. Koller et al. 2009: 2], it remains the case that – as observed over twenty years ago [Miller and Richards 1995: 20] – the focus of much virtual heritage is architectural [e.g. Bogdanovych et al. 2011: 140]. Perhaps because many of the early models were associated with museum displays, the question of appearance not surprisingly comes to the fore and there is a strong focus on creating the virtual models – collecting the data, building the models, and, to a lesser extent, archiving the products of virtual heritage. Particular interlinked concerns are authenticity and accuracy: for example, Roussou and Drettakis [2003: 47] argue that the general perception in virtual heritage is that realism directly maps onto the degree of authenticity, and similarly, the level of accuracy, legitimacy and realism of content is seen to be analogous to the level of perceived authenticity [Affleck and Kvan 2005: 170]. This presents a number of somewhat awkward circular relationships.

At the same time, there is frequently expressed concern about the authority of the resulting model. For example,

"Virtual reconstructions allow us to experience, amongst other things, heritage that is inaccessible and sometimes no longer existing. The manner in which they are produced however, is full of ambiguities … It is important that the process of interpretation is discussed and highlighted, and the results not presented as absolute truth." [Affleck and Kvan 2005: 172].

It is commonplace that the power of the digital visual is to assign a misplaced confidence in the viewer's mind of the truth of what is displayed, not least when what is modelled is incomplete and/or not available for comparison. The processes behind a successful visual are normally disguised, so that the manner in which it has been produced, the variety of sources, multiple datasets, multiple scales, and the intellectual processes behind them remain invisible to the viewer and are reserved, if at all, for any accompanying process metadata or paradata.

To accuracy, authenticity, and authority might be added accessibility since the reality of many examples of virtual heritage is that the often complex and elaborate models are reduced to selected 2D views for presentational purposes, which in some respects makes it little different to the classic visualizations of cultural heritage by artists such as Alan Sorrell and without many of the advantages of such traditional representations. Furthermore, software used in the creation of such models can be proprietary, expensive, and demanding high computer specifications. Consequently, models are frequently presented as a series of selected stills, or alternatively as a walk/fly-through in which the experience is tightly controlled and interaction highly constrained. As a result, a series of all-too familiar criticisms of virtual heritage arise: that it is static and lifeless, lacks meaningful context, employs confusing interface designs, has a range of orientation and navigation difficulties, lacks useful feedback mechanisms, lacks dynamic elements (virtual humans/animals, weather, temporal, typological, material, and historic aspects), lacks user engagement and focuses on the guided tour of a largely passive observer, and lacks a sense of place [Tan and Rahaman 2009: 146-9].

3. LOOKING VIRTUALLY FORWARD

Pujol and Champion have proposed six major aims for virtual heritage:

"First, it should aim to carefully capture objects and processes of scientific, social or spiritual value. Second, it should present this information as accurately, authentically, and engagingly as possible. Third, it should attempt to distribute the project in a sensitive, safe and durable manner to as wide and long-term an audience as possible. Fourth, it should aim to provide an effective and inspirational learning environment that best communicates the intended pedagogical aims. Fifth, it should allow the possibility of participating in its construction. Finally, it should attempt to carefully evaluate its effectiveness with regard to the above five aims in order to improve both the project and virtual heritage in general." [Pujol and Champion 2012: 86].

In different ways, each of these aims is challenging. For instance, the capture of objects is a largely technical issue but how can processes be most effectively captured and subsequently used? Accuracy and authenticity are certainly not straightforward issues, but what is meant by 'engaging'? For whom? And how? The distribution of virtual heritage projects is not simple – archiving is beginning to be addressed, but it remains the case that the distribution of the outcomes is frequently limited by the two-dimensionality of the page or screen. The pedagogical emphasis is interesting: why is this given pre-eminence over analysis and research? The idea of participatory virtual heritage remains largely undeveloped despite a number of projects such as ACCORD [Jeffrey et al. 2015], and the focus of these is largely on data collection with questions such as levels of expertise, specialization, and professional ownership frequently coming into play. The last of Pujol and Champion's aims remains largely unrealized – there is no detailed evaluation of the effectiveness of virtual heritage as yet.

Furthermore, if virtual heritage is said to exist at the intersection between Virtual Reality and cultural heritage, these aims – like the definitions before them – largely omit any reference to virtual reality. Indeed, they are essentially generic – replace 'virtual heritage' with 'GIS' or 'databases', for example, and much the same aims might equally apply. This is perhaps underlined by Champion's more recent definition of virtual heritage which he defines as:

"… the attempt to convey not just the appearance but also the meaning and significance of cultural artefacts and the associated social agency that designed and used them through the use of interactive and immersive digital media." [Champion 2015: 95].

Here Champion extends the definition beyond the visual – virtual heritage is about more than the eye can see, incorporating the intangible as well as the tangible – and emphasizes the place of interaction and immersion as key aspects of virtual heritage. From this, two particular challenges can be identified: presence and realism, key factors in defining virtual reality in terms of human experience.

4. VIRTUAL PRESENCE

Immersive and non-immersive VR are frequently distinguished from each other in terms of the mode of interaction [e.g. Elsaesser 2014: 296]: immersive VR employs wearable devices that are capable of

isolating the senses such that the user feels transported into the virtual world; non-immersive VR uses external manually operated input devices such as joysticks, mice etc. which remind the user that they are operating a device.

It is this interaction and immersion that is seen to generate the illusion of 'presence', creating a space in which the user appears to dwell rather than presenting an object or experience unfolding in front of their eyes. This might raise the specter of the "flawed pseudo-phenomenology" identified by Lock [2003: 261] and also associated with some applications of GIS. However, there may be value in the creation of such a dynamic experience. For example, it may be argued that

"… having walked, smelt and heard a landscape as it is, thinking of how it might have been, how can we not take the opportunity to walk in it as we have imagined and built it to be? Forested, landscaped, denuded of roads and pylons – or are our own landscape archaeologies to be constrained to the apparently, environmentally pristine? And if the bodies exploring these landscapes cannot be the bodies of the past why not explore virtual landscapes more freely, in bodies not wholly our own?" [Cripps et al. 2006: 30].

A key question here, though, is whether a dynamic experience actually enhances understanding, especially given that most of our virtual heritage experiences are essentially passive – either still images or walk/fly-throughs. Evidence to date suggests that if our objectives in creating these virtual worlds is to provide a means of understanding structure and layout, to experience the feel of a place and a sense of the environment, then the ability to actively navigate and explore the world rather than passively observe it provides a better appreciation [e.g. Laing et al. 2007; Morgan 2009: 479-81].

However, presence goes beyond the individual's sense of 'being there' within the virtual environment. It can also relate to the presence of social others (real or virtual agents), and the responsiveness of the environment to the individual (their ability to act in and on the environment) [e.g. Schuemie et al. 2001: 184]. How the virtual world responds to the presence of the viewer and reacts to their actions within it is key to immersive experience.

Both are particular characteristics of successful gaming worlds – the success of an open world environment such as provided in Ubisoft's Assassin's Creed series or Witcher 3 by CD Projekt RED, for instance, is in part reliant on the experience of non-player characters, associates and enemies reacting dynamically with the player and with each other (see Bostan's discussion of Oblivion [Bostan 2009], or Reinhard's encounter with an 'archaeologist' in Assassin's Creed Odyssey [Reinhard 2018b], for example). More elaborately, the Nemesis system introduced in Monolith's Middle Earth: Shadow of Mordor/Shadow of War series provided a set of enemies who gain experience and skill, and, rather than responding to elaborate branching scripts, remember events: whether or not the player had beaten them, wounded them, or ran away, and use this knowledge the next time the player encountered them. This makes the experience of each player and of each play-through unique [e.g. Parkin 2015].

This kind of presence is not yet a feature of virtual heritage, and yet the growth of agent-based modelling in archaeology would suggest that the potential is certainly there to translate these into the immersive virtual worlds from the typically 2D or 2.5D worlds they currently inhabit. Rare examples of this approach include work by Ch'ng and Gaffney who have used VR in conjunction with artificial life to model a Mesolithic landscape with agents representing foraging hunter-gatherers

[Ch'ng and Gaffney 2013; Ch'ng et al. 2016]. There have also been attempts to integrate 3D virtual worlds with artificial intelligence using Second Life – for example, to recreate the daily life of the citizens of Uruk around 3000BC [Bogdanovych et al. 2011; Bogdanovych et al. 2015]. Elsewhere, simulations may use 3D representations as a means of communicating their results, rather than as an integral part of the simulation [e.g. Murgatroyd et al. 2012: 492]. In other instances, virtual heritage agents are simply used as guides, storytellers, or route-planners for the virtual viewer [e.g. Champion 2015: 173], with little agency of their own. In all cases, the appearance of the virtual heritage agents and their worlds is considerably poorer than that available in gaming worlds, and hence may not meet the visual expectations of the general user. Currently, therefore, virtual heritage agents fall well short of what is possible.

Of course, one of the challenges of modelling human agents in virtual worlds is the believability of the results – both in terms of the behavior of the agents [e.g. Bogdanovych et al. 2015] and their appearance: the disruption of the sense of immersion – the so-called uncanny valley – that we experience when something moves or looks almost, but not quite, like a living creature. Indeed, realism, along with interactivity, are the two technological dimensions of VR that support the sense of being in an environment, whether natural or mediated, and more sophisticated simulations (higher immersion) can result in increased presence [Diemer et al. 2015: 6].

5. VIRTUAL REALISM

There is a paradox here. The value and utility of a virtual model is commonly linked to its realism and accuracy/authenticity – indeed, this realism is seen as a key factor in successful immersion in a virtual world. The problem is that the use of so-called photo-realistic or hyper-real imagery is often associated with falsely increasing the authority of a visualization. In other words, realism in conjunction with authority/authenticity is seen as necessary for a successful model, yet simultaneously the same realism may actually undermine its authority. For example, Frankland [2012] demonstrated that audiences perceive the same information differently when presented with photorealistic and non-photorealistic representations. This is compounded when the cultural heritage either no longer exists or only exists in a partial form, hence:

"Minus the existence of a real subject with which to authenticate the truth of the image, hyper-realistic visualizations assume a position of authority over the viewer that is primed for exploitation." [Kullman 2014: 22].

Gillings describes a cycle of suspicion that results: the realism of a model is tested through a search for clues as to its authenticity which in turn heightens a sense that the virtual representation is increasingly sophisticated in order to disguise and, perhaps, deceive the viewer [Gillings 1999: 251]. Additionally, as Kullman has observed, the deception goes beyond the physical elements and typically incorporates an idealized temporal model whereby each element is depicted in its most attractive, identifiable, or knowable moment in time, creating a series of temporal disjunctions [Kullman 2014: 22].

Watterson has perhaps pointed one way forward, reminding us that we already suspend disbelief in situations which do not necessarily employ photo-realistic imagery, such as two-dimensional

theatre stage sets [Watterson 2015: 128]. Indeed, Jeffrey commented that he found the less realistic examples of 3D visualizations more attractive:

"False color, dense point clouds, cut planes through structures giving impossible views and especially representations where details and shapes have to be mentally reconstructed from the fragments represented - all these have their own particular beauty." [Jeffrey 2015: 149].

Jeffrey suggested that these characteristics seem to be largely accidental or incidental, rather than deliberate, and both he and Watterson seem to agree that such aspects might usefully be incorporated and developed.

Watterson's own approach to visualization, incorporating a variety of data sources in a more explicitly artistic manner, is somewhat akin to what – in the context of landscape design – Kullman has defined as 'loose-realism' which "infers an 'incomplete, but not false image' of the landscape" [Kullman 2014: 24], contrasting with the deceptive character of hyperrealism.

Effectively, therefore, the proposal here is that we should seek to embrace a degree of 'unrealism' which might be approached in a number of more playful ways.

For instance, we might consider a traditional approach to the illustration of archaeological reconstructions. The visualizations of archaeological artists such as Alan Sorrell and Victor Ambrus are something that virtual representations have moved away from, but pencil or ink analog images convey a useful combination of reality and uncertainty with which the viewer must engage. This approach might usefully be translated into a virtual environment, taking the typical digital data derived from photogrammetry, laser scanning etc. and using it as the basis for re-presentation in an analog-style visualization, somewhat similar to the rotoscope animation technique as seen in Richard Linklater's 2006 film A Scanner Darkly or the 1985 pop videos by the Norwegian band A-Ha, for instance.

A more recent example is the work of Rose Ferraby who has used artistic techniques such as screen printing to provide new perspectives on the representation of archaeological geophysics results [Ferraby 2017], and semi-abstract watercolor paintings of archaeological plans, sections and wider landscapes as a means of providing alternative interpretive lenses for viewing archaeological field evidence [Ferraby and St John 2019]. As a development of these approaches, we might consider a "collage" methodology in which different sources are incorporated to create a model world. Since a typical virtual heritage model often uses data from different sources, a collage approach is in some respects already implicit. However, the focus is frequently on disguising the fact that different datasets are being brought together, whereas a true collage does not seek to minimize the boundaries or differences between the different datasets but uses them as an integral part of the visualization. For instance, Watterson's visualization of Skara Brae [Watterson et al. 2014] employs mixed media including kite photography, laser scans, and live action, and various lighting effects. One of the technical achievements of the resulting film is the way in which the different media seamlessly blend into a combined whole: kite photography merging into live video merging into a model derived from 3D scan data, for instance, with the viewer unable to detect the transitions. Alternatively, in a virtual world in which the viewer is encouraged to develop their own narrative, the boundaries between the different techniques might usefully clarify where the real versus the surveyed versus the interpreted begin and end. So a mix of techniques and representations within the same model

may be a valuable approach, whereas in the pursuit of realism point clouds, wireframes, and other modes of representation are more commonly considered to be work in progress rather than the finished item. The application of loose-realism might thereby help to address the expectations of truth that Watterson's film and numerous other examples of virtual heritage imagery have encountered [Watterson 2015: 126-7]. The challenge is to create a loosely realistic environment that still manages to support immersion and maintain a sense of presence while allowing the users to understand the relationships that exist within it. As Vanderbilt [2016] suggests, "realism will be one of the first qualities to be discarded as we make virtual space more realistic".

6. A VIRTUAL HERITAGE METAVERSE?

Some believe that virtual worlds will comprise a metaverse, combining immersive VR with physical actors, objects, interfaces and networks in a future form of Internet [e.g. Smart et al. 2007]: a social, virtual world that parallels – and in some respects, replaces – the real world [Mason 2015]. Again, the gaming industry leads the way with its development of Massively Multiplayer Online Gaming with their large, persistent worlds populated by large numbers of human players. Key characteristics of a metaverse include immersive realism, ubiquity (in the sense that it is universal, available, accessible, interoperable), and scalable (in terms of number of users, scene complexity, and range of interactions) [Dionisio et al. 2013: 8ff]. These give rise to a series of affordances, including the development of enhanced spatial knowledge representation, the ability to undertake experiential tasks that would be impractical or impossible in the real world, a sense of presence, co-presence and identity construction, and improved transfer of knowledge and skills into real world situations, for example [e.g. Dalgarno and Lee 2010: 18-23; Fowler 2015: 413-414]. Proponents of the metaverse argue that the challenge is therefore to move from the independent, isolated virtual worlds currently experienced to an integrated network environment providing for human interaction and culture [Dionisio et al. 2013: 28].

A variant of the metaverse can be perceived in terms of virtual worlds representing a new class of information system, combining traditional approaches to modelling and simulation with what Chaturvedi et al. [2011: 673] describe as emergent user dynamics supporting emergent knowledge processes. In this case, virtual worlds are seen as a means of visualizing the complexity and multidimensionality of 'big data' through combining human pattern recognition skills with immersive visualization in virtual reality [e.g. Donalek et al. 2014; Marks et al. 2014]. Virtual tools can provide varied means of accessing, viewing and analyzing data within a domain which offers spatiality, immersion and interaction [e.g. Moran et al. 2015]. Although this concept of a new kind of information system would seem to have potential value here, virtual heritage reconstructions instead often seem to be primarily an alternative form of archaeological illustration and presentation rather than something that is or should be capable of driving forward archaeological inquiry which the existence of a metaverse or new class of information system might imply. Crucially, the experience does not stop with viewing – action results, and in this regard, the virtual environment parallels the gaming experience, in which the user is required to make choices that affect the outcome in significant ways, and where the experience may differ between users.

The development of a digital excavation monograph employing a 3D interface [Opitz and Johnson 2016; Opitz 2018] can be seen as an early example of this kind of information system although it presently is primarily an isolated world with internal links. The ARtefactKit virtual lab [Eve 2017; Heritage Jam 2017] potentially demonstrates the value of linking between virtual environments. As a proof of concept, it enables 3D virtual models of bones and real-world examples to be handled and compared side by side and provides links to remote online datasets for comparative and identification purposes. On a small scale, therefore, this represents a virtual information metaverse based on a combination of the virtual and physical worlds mediated through augmented reality.

In some senses, the development of virtual heritage mirrors the development of the web. The virtual heritage equivalent of Web 1.0 is where most people are users and consumers of content which is generated and circulated by a few specialists and there is very limited interaction available. Arguably we have yet to move consistently from this Virtual Heritage 1.0 towards the equivalent of Web 2.0, in which there is increased interaction, mashups (or collages) which combine different content in novel forms, and a more democratic approach to content creation. Whether we can usefully move from Virtual Heritage 2.0 to the equivalent of Web 3.0 with its semantic structures, automated processing and re-presentation of content employing intelligent agents remains to be explored.

In a typically perceptive paper on VR presented in 1997, Gillings asked what are models for?

"… we often find that far from embracing the Virtual-models as a new means of exploring ideas, we have exhausted ourselves in addressing and maintaining this cycle of suspicion. As a result the models are left as little more than ingenious images to be viewed and consumed … They become a closed, end-product, something passive to be gazed at, whether from without, within, a fixed viewing point or a flexible one. In effect, they become the passive images rather than objects of analysis." [Gillings 1999: 253].

Although we have made tremendous strides forward in the intervening twenty-two years in terms of data capture, modelling, and presentation, I would suggest that we are more often than not still at the stage of generating ingenious, largely passive imagery designed to be viewed and consumed – and this is equally as true of current consumer virtual reality headsets as it is of more traditional three-dimensional heritage representations. We have yet to fully rise to the challenge and potential offered by virtual reality, and consequently virtual heritage has yet to realize its potential for engaging with and understanding the past.

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