Special Issue on Virtual Heritage: Cultural Agents, Environments, and Objects

Guest Editor's Introduction

1 Virtual Heritage

Virtual heritage—the use of digital technology and virtual environments for researching, conserving, and conveying our cultural heritage—offers exciting new ways to learn and experience the cultural treasures of the world, both past and present.

Virtual heritage has its origin at the formation of the Virtual Systems and Multimedia (VSMM) Society conference at Gifu, Japan in 1995, and can be attributed to many of the champions (Addison, 2000; Refsland, Ojika, Addison, & Stone, 2000; Stone & Ojika, 2000) of this particular strand of work. Since then, the heritage community has witnessed considerable investment from various institutions for heritage works that involve or are related to the use of digital technology, particularly with one of the larger funding bodies in Europe.

Two notable projects totaling 10 million euros that have garnered wide media attention for their discoveries, including being selected as exhibits for the 2012 and 2015 Royal Society Summer Science Exhibition, bear witness to the importance of digital- and technology-oriented heritage projects. These two complex archaeological heritage projects with large spatial-temporal scales—Europe's Lost World and the Stonehenge Hidden Landscapes project—are pushing technological boundaries beyond what contemporary techniques can afford (see Ch'ng et al., 2011; Gaffney, Fitch, & Smith, 2009; Gaffney, Thomson, & Fitch, 2007). These are specimen works that have demonstrated that heritage could contribute to pioneering geophysics instrumentation, and digital and computational approaches.

Many other funded projects worldwide, involving cutting-edge technologies overseen by a consortium of academic and heritage institutions, are pioneers to the many digital heritage innovations today, the list of which is too numerous to be offered here. The support for heritage research has important meaning, as stated in the European Commission's website: "Cultural heritage enriches the individual lives of citizens, is a driving force for the cultural and creative sectors, and plays a role in creating and enhancing Europe's social capital. It is also an important resource for economic growth, employment and social cohesion, offering the potential to revitalize urban and rural areas and promote sustainable tourism" (European Commission, 2015).

It is undeniable that heritage has significant value, and is an economic asset to many fortunate countries rich in culture. For example, the estimated total economic impacts of the heritage-based tourism economy measured £13.95 billion, excluding natural heritage, and £26.37 billion, including natural heritage in GDP. This has direct relevance to employment, estimated at 392,812 jobs for cultural heritage, and 742,419 including natural heritage. While the UK and European economy have been underperforming relative to other parts of the world since the financial crisis ended, the total impact of the heritage tourism industry has still risen (El Beyrouty & Tessler, 2013). Spillover benefits suggest a link between the visitor economy and other areas of economy, such as retail, manufacturing, health and life sciences, and estimates have shown that the tourism economy will have grown by 2.6% a year from 2009 to 2018 (Deloitte, 2008).

In observing the present trend of development in digital technologies, one cannot help but be in awe of the speed of innovation that has brought us to where we are today. From Immersive Virtual Environments to 3D printing, and the suite of usable mixed reality and ubiquitous computing that arrays the spectrum of opportunities, the benefits that cultural institutions and heritage sites could gain from these developments for engaging newer, younger audiences must be sought.

Opportunities in better heritage technologies are due to the digital revolution. Yet, any researchers in the more technical disciplines aiming to make use of digital technologies for heritage must be careful so as not to be overly focused on technology itself, lest the cultural heritage content that technology is meant to convey becomes secondary. Digital technology must support

the research, conservation, and communication of cultural heritage, and reciprocally, heritage data used for developing better technologies for supporting heritage research is encouraged. The value of using a range of technology for heritage, including scenarios of use, has been discussed (Ch'ng, 2013).

This special issue has brought together a collection of important papers, deliberately introduced in section four of this editorial. The subsequent sections discuss important observations and strategic issues for virtual heritage. Finally, this introduction concludes with future directions.

2 Issues of Sustainability

It is important to note that the traditional formats of access to authentic cultural objects are unsustainable. The current modes of access are challenging environmentally and are probably unsustainable over the longer run. Take, for example, a European heritage site. In the early 1900s, visitors to Stonehenge were handed chisels to take home souvenirs. Each year, about a million people visited the 5,000 year old monument, and it was eventually fenced up to prevent the monument from being destroyed completely. As a further example, multiple visits to the Mona Lisa painting is a costly activity; queuing up for a precious few minutes of viewing pleasure measured against the cost of travel is not sustainable; perhaps the Mona Lisa might have to go to the people. This benefits cultural learning for people, the majority of whom, due to various reasons, are unable to visit. The digital revolution can potentially solve accessibility as well as sustainability issues discussed above.

Cultural institutions, and museums in particular, are experiencing a decline in audiences, with remaining visitors belonging to the older, and whiter generation, according to a 2008 American census by the National Endowment for the Arts (Iyengar, Bradshaw, & Nichols, 2009). In this report, a general trend of decline is observed, with the Art Museum/Gallery category decreasing in attendance by 14.3% since 2002. The majority of audiences seemed to have turned to other sources of entertainment. We may interpret the report in this way, that the online generations expect much more than what contemporary cultural institutions can offer; it seems that cultural objects encased within glass boxes labelled with a formal caption in the museums do not provide as much stimuli as other forms of entertainment.

Yet, despite the trend in the report, there is hope that could allow us a way to carry out mitigation strategies to remedy the situation. Data in the 2008 census demonstrate that arts education is the most powerful influence on arts participation in later years. The report found "a likely relationship between individuals' experiences with arts education and their adult behavior with regard to arts participation," with data correlating adult arts participation and other variables such as general education, socioeconomic status, race, gender, family background, and geographical location. The National Endowment for the Arts 2012 survey delved deeper and revealed that "adults who attended performing arts or visited museums as children were three to four times as likely to see shows or visit museums as adults" (Iyengar, Grantham, Nichols, Menzer, & Shingler, 2012). Top reasons Americans attend the arts (performances and exhibits) include socializing with friends or family members (73%), learning new things (64%), and supporting the community (51%) (Iyengar, Menzer, & Chidester, 2012).

There are ample opportunities for researchers in virtual heritage and digital technology to contribute here in bringing out the meaning and value of heritage objects and environments to these audiences.

3 Benefits and Pitfalls of Digital Technologies in Heritage Work

Technological progression, particularly in the information and computational sciences, is creating new research opportunities for virtual heritage. A small community of researchers in these disciplines are discovering new tools and ways of interpreting virtual representations of objects, monuments and environments, using agent-based models, evolvable and responsive virtual environments dwelt by avatars and agents, as well as high-definition imaging, interactive cinema and 3D printing technologies. These new ways of discovering, seeing and manipulating intangible information looks to become the next stage of virtual heritage research, with two main communities of potential users. For the public, the integration of living and adaptive virtual agents and responsive environments could give virtual heritage

applications a richer, more evolvable content, and a higher level of interactivity and immersive experience. For researchers, particularly in recent trends in computational archaeology, the potential for the use of simulation approaches for filling gaps in the information space looks to be very prospective indeed (see Ch'ng & Gaffney, 2013; Craenen, Murgatroyd, Theodoropoulos, Gaffney, & Suryanarayanan, 2012; Murgatroyd, 2013). Lake's "Trends in Archaeological Simulation" has provided a thorough review of the past 20 to 25 years of development of the field (Lake, 2014).

At this point, it is perhaps appropriate to diverge slightly, and discuss a very interesting sub-cultural phenomenon. We know that the entertainment industry draws ideas and bases their stories on societal behavior, experience, culture and environments. In the past decade, there has been an observed phenomenon where increasingly, characters and stories within entertainment media seem to influence societal cultures. Media contents seem to "spill out" into the real world, particularly with Cosplays (Winge, 2006). A particular case is at the Yuwaku Onsen Hot Spring in Kanazawa, Ishikawa in Japan, a real-life setting where a Japanese anime "Hanasaku Iroha" is based. The imaginary Bonbori Matsuri festival in the anime was adopted by the local community as a real event around 2012. As a result, the tourism of the town flourished, with thousands of fans visiting the site, and tens of thousands watching the festival online. This reciprocal effect of mutual influence between the imaginary and the physical is becoming common, and is a positive opportunity. The blurring of the line between the real and the virtual, particularly with augmented and mixed reality, together with 3D printing and embedded electronic sensors that connect physical objects to their virtual copies can open up ample opportunities for heritage.

The availability of digital technology can have very positive contribution to heritage; however, the danger of possessing a multiplicity of technology is that technology itself, and not the heritage content it is supposed to augment, becomes the priority. There is the risk that audiences are more intrigued by the interface technology itself than the actual heritage contents. There is, therefore, the mandatory need for balance within virtual heritage research for a consortium of equally involved multidisciplinary subject-matter experts.

The digital revolution can potentially solve the accessibility as well as the sustainability issues discussed in this article, but will it undermine the value of the heritage or cultural objects, particularly when the simulacra (Baudrillard, 1983, 1994) in the form of the digital are easily reproducible, copied, and disseminated within the 21st century sharing culture? Whilst digital technology has great advantages for heritage, it is also this very nature of the digital that may be a real threat to the value of the original object. By being copied and reproduced, the value of the original may be undermined, its authenticity and aura lost in the widely communicated simulacrum.

The original purpose of virtual heritage is the "conservation, preservation and interpretation of our cultural and natural history," with "nondestructive public access" to heritage sites (Refsland et al., 2000). It is observed that while the purpose has not changed, digital technology, used in heritage as a whole, have become more established and sophisticated, so much so that the heritage content that technology is supposed to augment may have become secondary. In virtual heritage research, we must continually restate, and refocus the purpose of virtual environments and the associated digital technologies used in heritage works, so as not to detract from it.

4 The Scope of the Special Issue

Virtual heritage research in past decades has focused mainly on the visual aspect of heritage information processing. However, visualization has, in recent trend, become a process *in* research rather than a product *of* research (Ch'ng, Gaffney, & Chapman, 2014) in an investigation, such as analysis and interpretation as the articles in this special issue demonstrate.

The purpose of this special issue is to explore the state of work of present virtual heritage research. This special issue consists of six papers—two on cultural agents, two on cultural environments, and the remaining two on cultural objects and 3D printing.

In "Defining Cultural Agents for Virtual Heritage Environments," Champion explores why heritage projects incorporating agents may not have fulfilled their aims, and how virtual heritage environments have special needs that create more criteria than in mainstream virtual environments research.

Wolf and Badler's article, "The Distribution of Carried Items in Urban Environments," conducts an ethnographic observational study of items carried by a large sample of people in two urban community environments so as to inform virtual environments designers in better, more accurate representation of non-player characters and agents.

In "An Immersive Virtual Sailing on the 18th-Century Ship *Le Boullongne*," the multidisciplinary team of Barreau and colleagues creates, with the aim of understanding onboard living conditions, a highly accurate virtual environment of an eighteenth-century ship with visual, aural, and physical simulation and interaction.

Ranaweera, Cohen, and Frishkopf present a novel application for users to find and listen to world music inside a virtual environment in "Narrowcasting and Multipresence for Music Auditioning and Conferencing in Social Cyberworlds," supporting two kinds of sound sources—musical selections and avatar conversation.

Di Franco and colleagues' article, "3D Printing and Immersive Visualization for Improved Perception of Ancient Artifacts," explores how 3D printing of cultural heritage objects affects perception of our past, comparing interactions using immersive environments and 3D printed objects with traditional museum displays.

Nicolas and colleagues describe a mixed reality interface with 3D printing technology for the purposes of analyzing, understanding and restoring artifacts in "Touching and Interacting with Inaccessible Cultural Heritage."

5 Conclusion

Optical scanning technology, remote sensing, sophisticated 3D modeling tools, and developments in efficient computer graphics rendering pipelines have fuelled worldwide virtual reconstructions of tangible heritage. Such needs prompted funding councils and agencies to reserve and distribute resources in order to support the development of technologies and methodologies that made high-impact research possible. The visualization and real-time interactive aspects of such developments have since provided great opportunities for tangible heritage to be analyzed, interpreted and experienced via their virtual representations (Ch'ng, Gaffney, & Chapman, 2013), with an observed shift toward new paradigms of investigation that inform academic research, such as complex systems science and agent-based modeling (Ch'ng, Gaffney, & Chapman, 2013).

However, in reviewing the present state of virtual heritage research, we realize that there remains a gap in the discipline. Most heritage applications lacked a sense of immersion in terms of *livingness*, life, behavior and cultural agents in the virtual environments, and there has not been any progression in such developments since a decade ago. Reconstructions of heritage as elaborate virtual manifestations of materiality are without life, if they are without representations of life and behavior as intangible heritage representations in the virtual environment. Perhaps it is time for the heritage community to lead, by defining genuine problems within their domains, working with the science and engineering disciplines so that the real value of heritage can be realized in the present day.

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