Experimenting with Virtual Reality in a University Library

ABSTRACT

Virtual Reality (VR) has become increasingly relevant to academic environments thanks to the arrival of consumer grade and priced VR equipment. In 2015 the University of Adelaide Libraries were challenged to demonstrate innovative and relevant uses of this technology in a way which supported the University's mission while also demonstrating opportunities for the Library. This pilot project existed as part of a greater movement driven by the University's Technology Services division[1], and allowed an examination of how established groups could best exploit a technology on the very forefront of change.

To meet this goal a two phased project was proposed focusing on the rapid acquisition of VR production skills and the creation of a body of resources which could assist staff and students in the creation of content for this new media format. Using the freely available Unreal Engine (UE4) an experience was created which allowed users to view a fictional world which rendered the effects of Boolean searching on a range of objects.

Communications with academics, students and library staff throughout the project indicated that the University's community is excited about VR but has a low awareness of how to apply VR to the academic environment.

This project exists within, and due to, the current upheaval within the library industry. The direction of the project and the decision to produce documentation supporting an unreleased product came from the idea of the academic library as a place that creates opportunities for self-directed clients, easing the process of learning and research.

[1] Similar opportunities were presented to the Marketing & Communications and the Learning Innovation Studio.

The process highlighted the value of documentation designed to lower the initial barrier to entry for this rising technology. Following this pilot project the University Libraries will consider VR as a component of the 'Library of the Future' and determine how best it may be utilized to meet our client needs.

PAPER

The University of Adelaide is one of Australia's leading Group of Eight, research-intensive universities and is consistently ranked among the top one per cent of universities in the world. Established in 1874, it is Australia's third oldest university.

The University has four campuses in South Australia located at North Terrace, Adelaide; Roseworthy; Waite; and Thebarton. The primary campus on North Terrace, in the heart of Adelaide, is the main location for undergraduate teaching and a vast range of research activities. The University Libraries comprise five physical libraries in addition to Rare Books and Special Collections, and University Archives & Recordkeeping.

In 2015 a team in the University's Marketing and Communications department began investigating use of Virtual Reality (VR) to promote the University, through development of 'on campus' experiences such as 360-degree video that places the user inside Bonython Hall on the University's North Terrace Campus.

In support of this initial investigation of the applications of VR technology, the University's Technology Services department provided three University departments (the University Libraries, Marketing & Communications and Learning & Teaching) with VR equipment to pilot VR projects or services dedicated to each department's area of expertise.

What is Virtual Reality?

Over the last six months Virtual Reality (VR) has become a mainstream reality[2]; no longer the realm of fantasy this technology is now readily available on the consumer market. While VR has been utilized in research for decades[3], the impending arrival of consumer grade and priced equipment has seen VR become increasingly relevant to education and research environments.

VR is a technology that can allow a person to feel present in a completely digitally created world. This feeling of presence is produced by replacing a user's vision with a stereoscopic image updated in real time of an environment rendered by a computer, viewed by the user through a headset. With the addition of accompanying audio experienced through headphones, a well-crafted experience can immerse the user in the digital environment, overriding his or her sense of physical place.

Virtual Reality was originally popularised in the late 80's, early 90's, but the first headset was designed in 1968 by Ivan Sutherland[4]. The original popular push for VR fizzled out as the extremely large, and heavy headsets were expensive, clunky, and uncomfortable

[2] Hardawar, Devindra. 2016. "Oculus Rift Review: High-End VR Is Here -- If You Can Pay." *Engadget*. March 28.http://www.engadget.com/2016/03/28/oculus-rift-review/.

[3] "Virtual Reality, IEEE Annual International Symposium." 2016. Accessed May 21. http://ieeexplore.ieee.org/xpl/conhome.jsp?punumber=1000791.

[4] Sutherland, Ivan E. 1968. "A Head-Mounted Three Dimensional Display." In *Proceedings of the December 9-11, 1968, Fall Joint Computer Conference, Part I*, 757–64. AFIPS '68 (Fall, Part I). New York, NY, USA: ACM. doi:10.1145/1476589.1476686.

while providing a less than wonderful user experience. This failing was widely seen as proof that VR was not viable. Over the next two decades VR faded from popular culture[5].

In 2010, purely as an attempt to raise money for a small VR kit for enthusiasts, Palmer Luckey began a Kickstarter to raise funds for what would come to be known at the Oculus Rift Development Kit (DK1). With the aid of video game industry heavyweight John Carmack, Palmer's Kickstarter would go on to raise over 2.4 million dollars[6]. With the successful Kickstarter, Palmer established Oculus to design and develop VR headsets. After successfully supplying the DK1 headsets, Oculus went on to collaborate with Valve, a company which later joined HTC to develop a competing product, the HTC Vive; Oculus was then acquired by Facebook. The acquisition aided Oculus in partnering with Samsung for the supply of parts for the Development Kit 2, and for the development of custom screens for use within the Oculus Consumer Version[7].

As of 2016, all the initial major contenders for VR have released the consumer version of their products. HTC, Oculus, and Sony have all released consumer headsets this year. It has been inferred that all three are already at work designing the second generation of their respective headsets, seeking to smooth any roughness consumers

[5] Betters, Elyse. 2013. "Virtual Reality: Lessons from the Past for Oculus Rift." BBC News. August 30.http://www.bbc.com/news/technology-23877695.
[6] "Oculus Rift: Step Into the Game." 2016. Kickstarter. Accessed May 19.https://www.kickstarter.com/projects/1523379957/oculus-rift-step-into-the-game.
[7] Robertson, Adi. 2014. "Why Oculus Needs Samsung's Help with Virtual Reality." The Verge. September 3.http://www.theverge.com/2014/9/3/6102547/why-oculus-needs-samsung-gear-vr-headset.

discover and to improve the technology, making use of the technologies each of their competitors have pioneered to ensure their headset is not left behind. Oculus is suggesting VR may follow a release cycle that is "less than the console lifecycles of five plus years, and closer to the smartphone iteration time of one year."[8] These are not the only players within the industry, however; many smaller companies and start-ups have their own headsets which they are seeking to bring to market[9], and the organisation most likely to have a large impact on this fledgling industry, Apple, has already begun establishing patents which suggests they will also make a move into VR[10].

The increasing availability of this technology is seeing VR applied to a wide number of areas. Games are an obvious solution; already a number of high profile pieces have been released to consumers touching multiple gaming demographics. For example, *Eve Valkyrie*, a space flight simulator game where the player is placed in the cockpit and engages in multiplayer combats set in space; and *The Climb*, a game making use of motion controls to allow the user to virtually rock climb in extreme locations.

[8] "Oculus Already Working on the Second Consumer Version of the Rift, Says Palmer Luckey." 2015. UploadVR. July 7. http://uploadvr.com/oculus-rift-cv2-palmer/.
[9] "The Best VR Headsets: The Virtual Reality Race Is on." 2016. Wareable. Accessed May 19. http://www.wareable.com/headgear/the-best-ar-and-vr-headsets.
[10] Painter, Lewis. 2016. "Apple Sending Employees to Top VR Lab at Stanford, Suggests Apple Is Working on VR Headset." Macworld UK. Accessed May 19. http://www.macworld.co.uk/feature/apple/apple-virtual-reality-release-date-rumours-features-leaks-patents-2016-tim-cook-flyby-media-vr-lab-stanford-3601447/.

Gaming, however, is just one application of this technology. In the corporate sector, architecture firms[11] have begun using VR as a tool to provide tours of house and building designs without the need to construct a physical display home. In this application, VR design tools can be used to adapt lighting, materials used within the home, and even present a range of furnishing solutions to best meet the expectations of the prospective buyer[12]. Major automotive companies are using VR to allow their designers immediate access to their interior designs to ensure they are practical, comfortable and aesthetically pleasing in person[13]. In the armed forces, the United States Army has been using the technology for years in high-risk training (paratroopers), but also in rehabilitation, such as aiding those who have suffered PTSD[14].

VR and libraries

The next 12 to 24 month present a great opportunity for libraries to investigate VR technology, to listen for client interest and start a conversation around the content. Some libraries have already embraced the technology: the Bibliothèque et Archives

[11]"SA Virtual Reality Tech Could Spell End for Display Homes." 2015. InDaily. November 30. http://indaily.com.au/real-estate/2015/11/30/sa-virtual-reality-tech-could-spell-end-for-display-homes/.
[12] CGCloud.pro. 2016. Loft in London - Walkthrough. CGCloud. Accessed May 19.https://www.youtube.com/watch?v=xNG-Jcciejc.
[13] Buss, Dale. 2015. "Virtual Reality Sweeps Auto Industry, From Designing Cars to Driving Them." Brandchannel: June 23.http://brandchannel.com/2015/06/23/auto-virtual-reality-062315/.
[14] Pomerleau, Mark. 2015. "How Virtual Reality Helps Treat Soldiers with PTSD -." Defense Systems. March 13.https://defensesystems.com/articles/2015/03/13/army-virtual-reality-ptsd-treatment.aspx.

nationales du Québec[15], for example, are staging *The Library at Night* exhibition, providing a virtual experience of 10 different libraries from around the world.

For public libraries, providing access to VR is a clear service space. Due to the initial financial cost to acquire the equipment, this is a technology which is hard for an individual to purchase, but represents a far lesser cost for a library. With VR's ability to present 360 video of any location around the world; it is possible for clients to view places they could never normally visit, something which is of great value to those who lack funds or mobility. Being able to visit completely virtual spaces allows users to explore other worlds, learn new technologies or operate in virtual collaborative spaces. As the technology spreads, much like internet access, access to virtual reality may become a highly sought out utility.

Academic libraries have an opportunity to engage with Virtual Reality in ways that serve the education and research interests of our organisations. As mainstream application of Virtual Reality is in its infancy, the academic library represents a central unit within the university to act as a gateway to this technology. Libraries are open to all faculties, are experienced at providing services to students and academics alike, and are experienced at working with and learning new technologies. Brokering VR services or projects from within the library allows academics to trial concepts, gives students the

[15] Bibliothèque et Archives nationales du Québec. 2016. "The Library at Night - Ex Machina / Robert Lepage, Alberto Manguel." Accessed May 19.http://www.banq.qc.ca/activites/expositions/bibliotheque_la_nuit.html?language_id=1.

chance to work with, and create for, the technology and demonstrates yet again that libraries are a hub of collaboration.

Our Project

In the context of our project, the challenge for the University of Adelaide Libraries was to demonstrate innovative and relevant use of VR technology in a way that supports the University's mission (https://www.adelaide.edu.au/about/mission/) and demonstrates opportunities for the University Libraries.

In April 2015, the University Libraries received notification that Technology Services would provide the University Libraries with a Samsung Gear VR headset, and a Samsung Galaxy Note 4 phone. A project was proposed that would pilot different approaches to VR services from a University Libraries' perspective. A six month timeline was identified to coincide with the conclusion of the Library of the Future (LOTF) project at the end of 2015. As a small pilot project, the team comprised of three staff: Ben Weatherall (Digital Services Officer), Steve Thomas (Library Systems Manager) and Cathy Miller (eResearch Librarian).The project was broken into two phases to allow delivery of multiple approaches to VR services. Phase one incorporated the delivery of 360° film-based experiences based in and around the North Terrace Campus' Barr Smith Library, using equipment and digitisation services provided by Technology Services. In keeping with the Marketing and Communications Department's approach of using VR to promote the University, these experiences aimed to profile and publicise

the Barr Smith Library as a space, with focus on the Library's historic Reading Room. The resulting videos were made publicly accessible via the project's webpage[16]. The videos are viewable from a 360°, two-dimensional point of view via YouTube with the user navigating with a mouse. The full three-dimensional VR experience is complete when the user views the videos with a VR headset or via the YouTube mobile application with the aid of Google Cardboard, an easily constructed cardboard viewer that converts the user's mobile phone to a VR headset.[17]

The initial phase one project was a highly collaborative effort between the Library and the University's Technology Services (TS) division. The Library's collaborators within TS, Aaron Dean and Rob Lee, provided a large amount of support and expertise in the initial filming process. Filming was completed within a single day and touched on three locations around the University. Filming was a simple process once explained, the 360heros unit being a simple housing for multiple GoPro cameras, controlled by a single remote. Once the cameras were synchronised with the remote, it was a direct process of pressing record to capture the scene. Once recording was complete, the process became more difficult. Due to the nature of the camera, the final scene required the footage from each GoPro to be collated into folders, and then stitched together by an editing package. This process relies upon templates (which are not always perfect) and requires many hours to process. Upon completion a single warped film can be viewed on a normal computer. At this point the views were prepared via a metadata tagging

[16] Weatherall, Ben, Cathy Miller, and Stephen Thomas. 2015. "Virtual Reality Project - University Libraries."https://www.adelaide.edu.au/library/about/projects/vr/.
[17] YouTube. 2016. "Upload 360-degree videos." Accessed 22 May. https://support.google.com/youtube/answer/6178631?hl=en

application, and then uploaded into YouTube. Notwithstanding the fact that the creation of the videos would not have been possible without input from collaborators in TS, this phase provided the Library with a quick and highly visible pathway into VR.

Phase two commenced at the end of July. The intent was to craft a simple output demonstrating the experience of developing within Unreal Engine 4[18] for GearVR, then provide a document explaining the process and hurdles. The document was intended to provide a resource for others interested in VR development, and to lower the barrier to entry for future developers in and outside of the Library. A demonstration of simple Boolean searching (a basic skill within libraries) was chosen to reference the library's role in the project.

The initial stage of this phase of the project was dedicated to skills acquisition; acting as developer on the project, Ben Weatherall went through a process of self-education on the development environment, Unreal Engine 4. Due to the recent opening of game development tools to the public, this proved to be a straightforward process with hundreds of introductory tutorials available on all aspects of the software environment[19], including introductions to creation of objects, textures, scenes and gameplay elements. During this initial training the project aims and goals were discussed, with a view to creating a VR experience that would best serve the Library as a promotional tool for both the Library's services as well as the scope of VR. It was decided that a tool to

[18] "What Is Unreal Engine 4." 2016. Accessed May 20.https://www.unrealengine.com/what-is-unreal-engine-4.
[19] "Unreal Engine Downloads - Development Presentations and Tips." 2016. Accessed May 20. https://www.unrealengine.com/resources.

highlight the value of understanding Boolean logic, a critical skill for use in search engines, would be desirable. To keep the presentation simple, the team decided on a stylised presentation theme around bubbles of knowledge represented in the experience as beach balls, which move in and out of the experience as a result of the Boolean logic controlled by the user. To keep the project to time, due to the project's nature as a learning exercise, it was deemed that the demonstration would represent a minimal viable product: the simplest form in which the idea could be expressed while being functional.

From this initial concept the design began to take shape. Initially all development was based on a single first person perspective to minimise complexity and ensure that the delay which would come from porting the project onto the GearVR headset would be kept at a minimum. Half way through development a feedback meeting was scheduled with the Library Learning and Research Support (LaRS) team to gather additional feedback about the product and ensure the base product would meet the needs of their clients, while also acting as a sanity check for the product. The final demonstration was created a full month earlier than originally anticipated, and was quickly ported to android for use in the GearVR.

Prior to the project, no staff member in the Library had the skillset to develop for VR. The extent of development work within VR which had occurred prior to the project was solely the domain of the University's Technology Services division. This was not an

accident; to appropriately judge the learning curve students and staff would encounter, the project team needed to approach the task from entry level, and find methods and resources to ease content creation and understanding of the technology. These lessons and resources were then recorded within the project documentation to assist future projects.

It was clear that there would be shortcomings with the software, equipment, and methodologies behind developing content for VR, as there is with any technology. Instead of seeking to avoid these problems, the project actively sought to discover, explore, resolve and document each of them. This methodology allowed a knowledge base to be developed regarding the limitations of the technology) which will be built upon and made available via future projects.

The core result of the project was a pair of documents recording the technologies used, the process of creating the outputs for the two phases of the project and the experiences of working with the technology. These documents are intended to be supplied to those undertaking future projects[20,21] to ease the first steps of creation.

[20] "Virtual Reality Project: The 360° Filming Process." 2016. Accessed May 22. https://www.adelaide.edu.au/library/about/projects/vr/phase1/filming.html.
[21] "Virtual Reality Project: The Development Process." 2016. Accessed May 22. https://www.adelaide.edu.au/library/about/projects/vr/phase2/Phase_2_Developing_VR_experiences_with_GearVR.pdf.

While this project saw Library staff creating VR content, the goal was never to position the Library as a content creation studio. Instead the intent was to show that it is possible for anyone to create content for virtual reality. The documentation and recording of the limitations discovered in the technology are intended to aid decision making regarding implementing the technology within the Library, and to build student and academic engagement with the technology. It is via the Library's clients that the most interesting and engaging content within VR will be built.

At the lowest level, this project aimed to build awareness of VR within the University. By working within the space, meeting with academics and departments, and then presenting the findings, it was hoped that a basic understanding of the technology would be planted. This exposure to VR will provide a future frame of reference for the technology.

This project was run in the vein of a skunkworks, a style of development which has fallen to the wayside in recent years. A skunkworks project operates separate to the operational objective of the organisation as a whole, they are given a defined goal and then left to determine the best course of action without guidance from the institution at large. Throughout the project advice and input was sought from members of the library, but the relationship between the project and the library members was that of presentation to an external client. The team was in complete control over the exact output of the project, the method with which to complete the objectives set before them.

This method ensured minimal downtime throughout the project; the small team could set goals, come together occasionally to ensure the project was still on track, and to determine the next best step for the project as a whole. This method paid large dividends for an exploratory project such as this; the design of the project was quickly determined (a single meeting to brainstorm ideas, and then a second to confirm mock-ups met the design goals), development proceeded unabated (concluding a month earlier than originally expected) and allowed the team convert external task allocation into learning experiences.

What's next?

As with any emerging technology which fundamentally shifts how existing processes are performed, it is hard to pin-point VR's possible relevance to modern society. While VR already has value in the education and research sector, primarily in data visualisation (such as in the University of Adelaide's VR centre within the Australian School of Petroleum[22]), its relevance and value is not yet perceived by society as a whole. There are signs however that it will become critical to a large number of businesses in short order. The rapid uptake of the technology within marketing, for example HBO Series Game of Thrones *'Ascend the Wall'* experience[23], film, the Adelaide symphony orchestra VR concert held in early 2015 at the Santos foyer[24] and Cirque du Soleil 'Kurios' experience on the GearVR, and architecture, IVRNation.com, Irisvr.com,

[22] Australian School of Petroluem. 2014. "South Australian Virtual Reality Centre." Accessed 22 May. http://www.asp.adelaide.edu.au/about/facilities/savrc/

[23] "Game of Thrones." 2016. *Framestore VR Studio*. Accessed May 22.http://framestorevr.com/game-of-thrones/.

[24] "Adelaide Symphony Orchestra." 2016. Accessed May 22.https://www.aso.com.au/news-media/latest-news?article=883239.

archvirtual.com, shows that the technology is not a simple gimmick. Traditionally VR devices and installations were low resolution, bulky and cost a large amount per device[3]. This meant that the devices would only be purchased for specific projects which needed custom solutions coded specifically for the device. If the current interest were to vanish immediately, there would already be an abundance of cheap headsets, offering acceptable resolutions, with a range of development software with a low barrier to entry. VR does not appear to be disappearing anytime soon however, with the consumer version being set to be released in early 2016.

For researchers the technology poses great opportunities for behavioural research, visualisation of data and the ability to present research in immediate and impactful ways via spherical video and virtual environments. Regardless of the commercial success of the technology, the availability of cheap consumer level VR equipment already represents a great boon to research institutes.

Following this project, a VR Community of Practice was formed within the University of Adelaide. This group has been established with the goal of promoting VR as a technology to support academics and students throughout the University. This community is spearheaded by the University Libraries, as they are uniquely placed to ensure access to the equipment for all the faculties within the University.

The community is already assisting the University's School of Health Science in a VR presentation designed to induct first year students into the operating theatre. A

permanent installation is currently being arranged to allow student and academic access to consumer version of the HTC Vive and Oculus rift within the University, which once completed will be promoted to each faculty along with a call for participants to build the Community of Practice. Attempts are also underway to build industry relations with the local VR and game development communities in order to build a culture of cross collaboration. Within such a culture, career pathways for students seeking to work in these fields will grow, while also giving the University an obvious list of collaboration partners for future projects.

As a pilot project, this initial investigation into VR within libraries proved successful in generating interest and engagement across the University, leading to the formation of a community of practice. The Library's future role in brokering and providing access to VR technology and services remains to be seen. However, as the University's community explores VR and applies the technology to different approaches in education and research, the University Libraries is poised to engage and collaborate in new opportunities emerging as a result of this technology.

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