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Is Your Library Ready for the Reality of Virtual Reality? What You Need to Know and Why It Belongs in Your Library

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Is Your Library Ready for the Reality of Virtual Reality? What You Need to Know and Why It Belongs in Your Library

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Abstract

Virtual reality (VR) is no longer just gaming. It's increasingly being deployed across academic campuses and is becoming indispensable in fields ranging from the humanities to engineering to anthropology. A recent survey indicated that 100% of ARL campuses were using VR, with 40% of libraries actively supporting it. This paper discusses practical examples of how libraries are helping their institutions build out virtual reality utilizing 3D objects and explains why the library is the best place to do so. It provides a basic grounding in VR and related areas, showing what it is and why it's important to libraries. Specific attention is paid to VR deployments of AR/VR by the library across the campus.

Introduction

Virtual reality (VR) is increasingly available and important in academic libraries. Yet as many librarians consider the option they ask us: Why should the university library be the place to introduce this technology to the campus? Why not campus IT or the Computer Science Department? The answer resides in the role of librarianship as well as the role of the academic library on the campus.

Libraries have always been about collecting, archiving, and making accessible information for the purpose of creating knowledge. Today's emerging technologies are underscoring that the recordings of information continue to evolve. We'll all agree that printed matter and sound recordings have long been our stock in trade, but our charge has always been to handle information in all formats created. Three-dimensional (3D) is just the latest format and VR/AR/MR/3D printing are just the latest tools for interacting with those 3D objects.

What Do We Mean by the Term Virtual Reality?

Virtual reality, augmented reality (AR), mixed reality (MR), and 3D models are a group of technologies that aim to supplement "the real world" with increasingly immersive computer-generated content. Although they're more accurately referred to as Extended Reality, for the purposes of this paper we'll refer to them as VR.

VR isn't new. It's an extension of technologies we're already familiar with, like images, audio, and video recordings. Its beginnings are to be found in early attempts to replicate a 3D world—in Victorian panoramas and stereopticons. As early as 1929 mechanical flight simulators were providing a "VR experience." As hardware and software have improved, so has the quality of that experience, until today it's entering the mainstream.

VR sits on a spectrum, one that begins with the real world and gradually changes into a world that's wholly generated by computer (Figure 1).

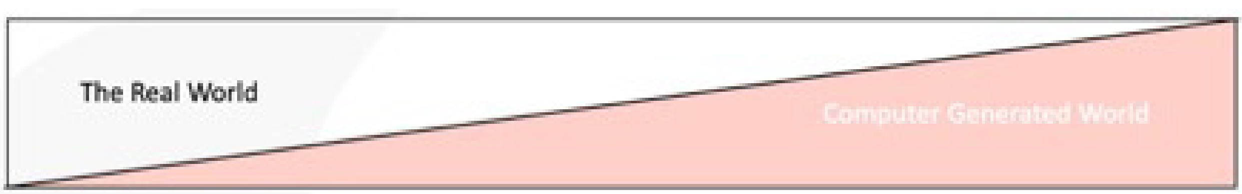

Figure 1. Representation of "real" and "virtual" worlds.

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The most common types of VR are:

- **Augmented Reality:** Computer graphics are overlaid on the real world. Examples of this include navigation systems that overlay directions on your car windscreen, or a Pokémon mobile game where you see characters superimposed on the real world.
- **Mixed Reality:** Mixes digital content with the real world but also reacts and responds to the real space; for example, when a digitally generated object appears to sit behind a table.
- **Virtual Reality:** An immersive, digitally generated world occludes your vision entirely and places the user within it.

The common elements in these technologies are virtual three-dimensional objects and scenes and how one interacts with them. 3D objects and scenes are like the images in a film—they're the building blocks that enable the experience. Interaction is like movement in film—it's how one drives the experience. And immersion in VR is like the projection and cinema in film—the location of the experience (Figure 2).

This is important, because just as images form the basic building blocks of film, so 3D objects and scenes form the basic building blocks of VR. You cannot have one without the other. It also helps us understand that VR content exists independently of the devices used to view it. A film doesn't cease to be a film when viewed on a phone, just as VR content remains the same whether it's viewed "inside the machine" or externally on a 2D monitor.

As one invests more in VR, so experiences become more comprehensive, both to create and to consume.

As Figure 3 shows, the simplest and lowest cost VR experience is 360-degree video. As of late 2018 a high-definition Ricoh Theta 360-degree camera cost less than $400. Its output can be viewed on a standard PC in two dimensions just as a regular video can be, but with the ability to change the view as it plays. It can also be viewed immersively using a mobile phone–based headset for under $100, or a dedicated head-mounted device can be used to deliver increasingly realistic experiences. This low cost has led to an explosion of content - as of late 2018 YouTube had more than 750,000 360-degree videos available.

Software like Unity, Unreal, and Blender allow one to create, manipulate, and deploy 3D objects and VR experiences. The scale and sophistication of the experiences one is able to create depends largely on the level to which one is able to invest.

High-quality VR hardware and software are also becoming increasingly affordable and standardized. In 2017 the launch of Oculus Go delivered a high-quality headset that can be deployed for less than $200. Blender is an open source tool for creating 3D objects. Unity, the world's most popular VR creation suite, is free to qualifying educational institutions.

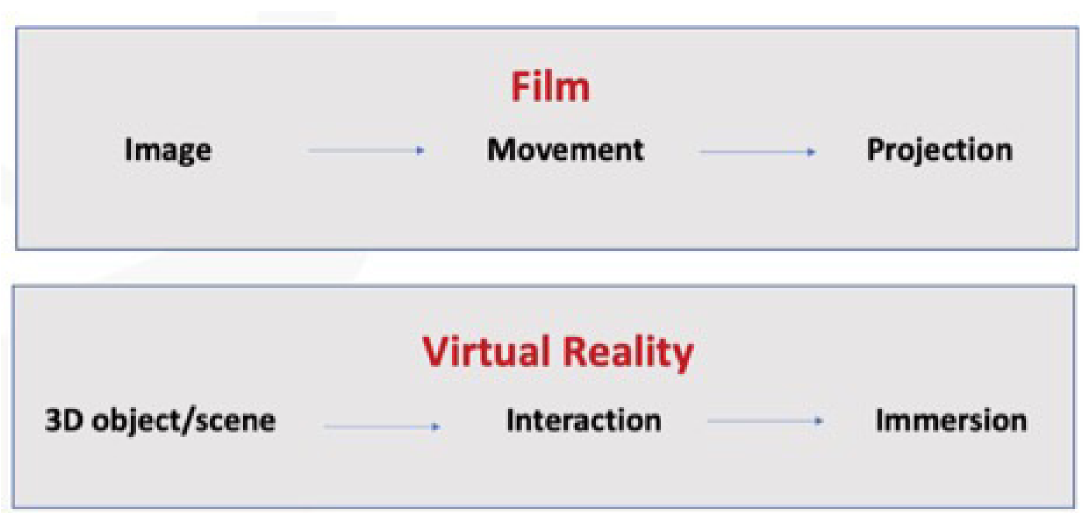

Figure 2. Comparison of film and VR.

Figure 3. Progressive richness of experience vs. cost.

General Applications in the Academy

In 2013 Rick Hunter and Steven Tucker, two students with a penchant for caving, were exploring caves about 30 miles northwest of Johannesburg, South Africa. Although Steven had visited what it now known as the Dinaldi cave many times before, this time he decided to follow a vertical crack only 18 centimeters wide. He found himself just wiry enough to fit and followed the crack into the earth for nearly 12 meters. As he put it later: "I entered into the chamber and got a glimpse of the walls and . . . literally everywhere that my head lamp fell, I could see fragments of bone."[1]

Rick and Steven had discovered the remains of *Homo naledi,* a previously undiscovered human species. It was, as they say, "a big deal," and was featured on the cover of *National Geographic* and much of the world's press.

To say these bones are precious is an understatement, yet researchers around the world need not just to access them, but to handle them for shape and to see how they're related to existing bones. This is where 3D modeling and virtual reality come into their own. Researchers in South Africa digitized the bones using a 3D scanner, both preserving them and making them accessible to others. Only 12 hours after the species announcement Kristina Kilgrove, a scholar and assistant professor at the University of West Florida, had downloaded the models and put them into her virtual lab.[2] Students and faculty could examine the models for free, test hypotheses against other virtual artifacts, and even create copies.

Homo naledi is now one of over 10,000 3D models available at Duke University's MorphoSource, a free online database of 3D scans created by assistant professor Doug Boyer. Within three months the *Homo naledi* scans were viewed over 43,000 times and downloaded 7,600 times.[3]

Early in 2018 we conducted a survey of ARLs. Only 40% of these libraries were offering services related to virtual reality. However, every one of their institutions were engaged in VR initiatives at the departmental level. Some examples of this are illustrated in Figure 4.

Virtual reality delivers better visualization and better spatial interaction than 2D alternatives. It becomes indispensable when items are too precious, too dangerous, too large, too small, or too complex to study using traditional techniques. Experiments to teach students on nuclear materials are cheaper, safer, easier, and less expensive when performed virtually. Mathematical and chemical structures are easier to display, understand, and manipulate in 3D space. 3D LIDAR maps of Mayan ruins are best explored virtually, as are X-rays and ultrasounds of the human body.

VR is needed when places are inaccessible, hard or expensive to get to, or in circumstances where rich or distant interaction is needed, as in the example of Palmyra detailed later in this paper.

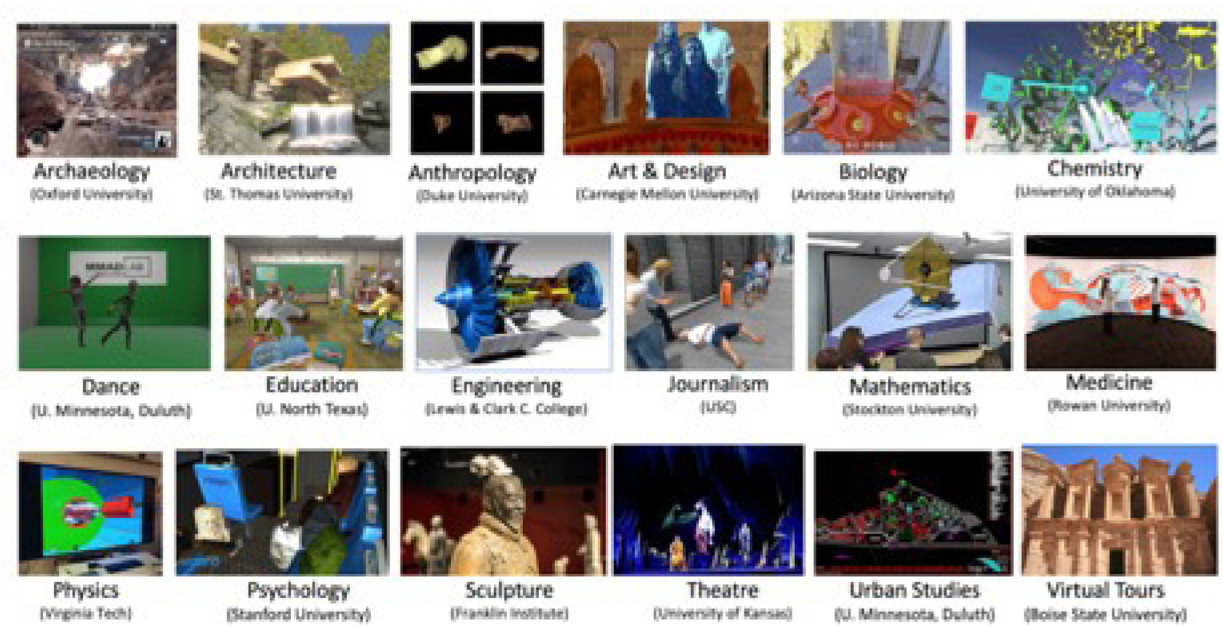

Figure 4. Examples of departmental academic use of VR.

VR and 3D are essential in any discipline that has spatial content. Dance, theater, architecture, urban studies, sculpture, and archaeology require representation, manipulation, and need to be experienced in three dimensions.

Because VR gives users a more intense experience, some have begun to call it "The Empathy Machine." Perhaps this is hyperbole but as Jeremy Bailenson describes, experiments have shown significant improvements in, for example, climate awareness when comparing content delivered via VR against other methods.[4] This aspect of the technology allows students to experience literature more intensely by experiencing, say, Harlem in the 1920s, allows journalist to improve their storytelling, and even enables psychotherapists to conduct unique kinds of therapy.

The Library's Role

The positioning of the library within its community will also help you decide if it should be participating in the emerging technologies space. At the University of Oklahoma, we've positioned our library as "The Intellectual Crossroads of the University," that is, the campus hub. We do this to underscore the importance of the library as a connecting point for all of the colleges and units on campus. We work with, collaborate with, and provide services to them all. Our agenda is not tied to that of any one college, but to the common needs of the entire campus. Since emerging technologies can be unproven and costly in the early stages, it makes a great deal of sense in today's environments, for the library to be a place where all units can access and evaluate these new technologies. In addition, the library's positioning means it's a valuable place for the work with these technologies (and all technologies) to benefit from the interdisciplinary environment created as a result of being the crossroads of the campus.

This might best be explained through a story about something that happened at our university. This story brings together a researcher/doctor from our health sciences complex in Oklahoma City, a recent Hollywood movie, our maker/innovation space on our main campus, our emerging technology librarians (on our Norman campus), and the resources and search tools at the disposal of our librarians. So, it's truly an example of multidisciplinary work and certainly one of collaboration. Here's what happened. Our researcher/doctor was working with a family that had a child who was born with one hand that was a palm with nubs around the edges, but not fully formed fingers. The family did not have the insurance or resources to acquire a commercially produced prosthetic hand as they are quite expensive, and because the child was young and growing quickly, the prosthetic hand would likely need replacement frequently before the child reached adulthood. The researcher/doctor had heard about the capabilities of the Innovation @

Figure 5. 3D printed prosthetic hand, Innovation @ the Edge, University of Oklahoma Libraries.

the Edge space in Bizzell Library and then attended a Marvel movie called *Ironman*. This movie featured a character in a body casing that included a mechanical hand. On the Monday afterward, he called our Emerging Tech Library team and asked them if there was any chance, using 3D technologies, that they could produce a mechanical hand similar to the one in the movie? Our team started searching and quickly found that indeed, there was a plan for such a device and that it required no electronics or motors, plus it could easily be resized to meet the needs of a small child. So, our team, using our lab and after conferring with the doctor, started printing parts and assembling the hand. (See Figure 5.) Then the doctor brought the child and his mother to our library lab for us to perform the actual fitting on the child's arm. The truly remarkable moment is when the child reached out with his now two hands, picked up his hat, and put it on his head. On his face was one of the most glorious smiles I've ever seen on a child's face. When people ask me why maker technologies belong in libraries, moments like this are why.

Due to the nature of many emerging technologies (space needs, noise, supplies, etc.), it is still judged best that these types of facilities have dedicated space. On our campus, we did this by *repurposing* library space that was being used as a student worker break space. We named it the Innovation @ the Edge. (See Figure 6.) It's about 250 square feet, so it's not overly large, but it was enough to get us started. As a bonus, it has large windows facing the main aisle of the library, where campus tours traverse, giving the lab additional exposure (and drawing a lot of attention).

As the various colleges have tried the technology and realized the potential benefit to their research and pedagogy, they've installed some of the newer technologies, like virtual reality, in their own colleges. We view that as a proof positive of the ideas and goals we discussed earlier in this article. In fact, statistics continue to show that utilization of the space has increased every year since its inception. We're certain that this is, in part, because the emerging tech librarian team has created robust programming that involves the lab and because our team works closely with faculty and staff to determine the best use of the emerging technologies in their work. As a result, we're now seeing 12 of the 13 colleges on our campus having at least one class whose students have assignments that must be performed in the Edge. We also assist the community to use this technology. For example, when community members search our libraries' discovery system, with one additional click, we run their search in a database of 3D objects. If, upon examining those objects, they want to use some of them with the 3D equipment in the lab, it's easy for them to download it directly to the Edge's digital storage so that when they walk into the Edge, the object is sitting there and ready for them to view or print.

Why do this? Because some analog content is not easily accessed. It can be fragile, destroyed, distant,

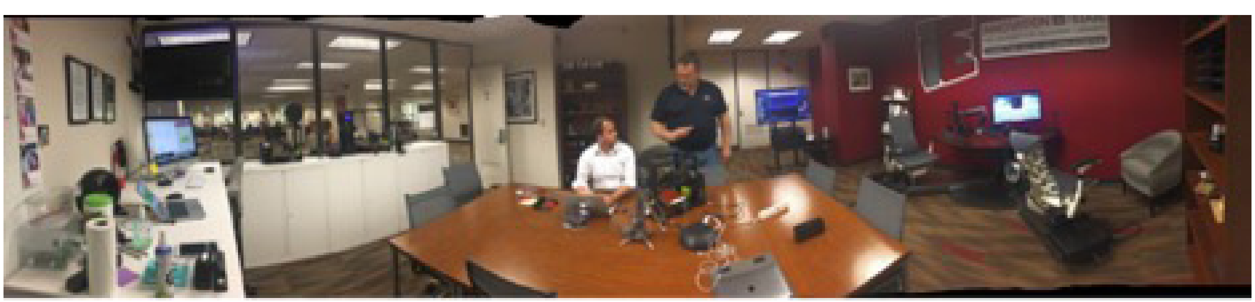

Figure 6. Innovation @ the Edge at the University of Oklahoma Libraries.

microscopic, protected, sociologically relevant, and so on. In addition, it enables the user to seek "first-hand, unmediated learning experiences with challenging objects."[5]

Of course, academia is not one of the most agile environments in which to introduce new or emerging technologies. Given our success in getting the technology adopted so widely on our campus, we're often asked how we've done that. We definitely gave some thought to the sequencing of the introduction. We introduce new technologies in this order: (1) library team, (2) the provost, deans, associate deans, department chairs, (3) department research liaisons, (4) new faculty (make them successful!), (5) faculty that regularly demonstrate leading-edge tech/thinking, (6) donors, (7) students, (8) college department meetings, and finally, (9) regular faculty. By the time we've worked through the first seven groups, we see the faculty coming into the library to find out what the buzz is about.

Once these community members are engaged, the challenge is to keep them engaged. Again, thoughtful programming can make a big difference. One of the most popular series we've run at the Edge is called "Portals" and is designed to entice people to try virtual reality and experience the power of this technology. Some of our most recent Portal events have included: (1) a tour of an Arizona archaic cave, (2) a tour of the Syrian ruins at Palmyra (before they were destroyed), and (3) a life-like sea turtle's experience. These events are asynchronous, MOOC-size, and work across multiple platforms including mobile phones, Oculus GO, and HTC Vive.

The tour of the Arizona archaic cave was particularly important because the cave was on private property and is inaccessible to the public. However, the property owner was willing to let the cave be photographically captured using a 360 camera, which became the basis for the virtual reality tour. We conducted the tour for the first time in September 2017 and as far as we're aware, it was the first time ever that a virtual reality class was held in higher education that spanned 7 remote locations (2 in Arizona, 5 in Oklahoma) with 15 total participants and an expert instructor located in Arizona who gave a tour of the cave, describing in detail the archaic cave art. The potential demonstrated by this exercise is enormous.

Of course, stories like those above describe a powerful form of metrics to share with administrators, but in today's world, metrics backed by numbers are equally important. At the time of this writing, we don't yet have numbers for the 2018 academic year (although all indications are that they will far exceed the ones for 2017). However, for 2017, we experienced the following usage statistics:

- 3200+ unique VR "sessions" across multiple locations.
- 20+ course Integrations, including
    - ~500 students for required course assignment (fall 2017)
    - "inspiring, eye-opening," and "learning objective achieved."
- 100+ "Intro to VR"-type workshop participants (110 so far in 2018 and we're not yet at the halfway mark).
- In 11 of the 13 colleges, at least one course is taught that has assignments that must be completed using 3D objects. (The last 2 colleges are expected to join in before this academic year is finished.)
- 95K in grant money secured in 2017, another $300K being applied for now.

We think it's important to point out that this is activity that is already happening at the University of Oklahoma Libraries.

Finally, as we turn to the future, we're the first to admit that VR/AR technology is still in its infancy in many ways. We're expecting enhancements that will make it less clunky, less cumbersome, and certainly even more affordable. We're seeing product announcements on a regular basis that serve as the foundations for those expectations. We also fully expect to see new platforms that feature self-contained PCs and require no cabling. There will also be the availability of open repositories of 3D objects accompanied by basic metadata, which will help libraries to produce value for their communities immediately.

The time to start introducing your communities of users to 3D and AR/VR is not at some distant point in the future, it's today. It's an open opportunity to help reposition your library as a central hub in your community, one that can help introduce and support the use of emerging technologies in research and pedagogy. Given what we've described above, why wait?

Notes

1. Cavers recount discovery of ancient human relative *Homo naledi*. (2015, September 10). Associated Press. https://www.cbc.ca/news/technology/cavers-homo-naledi-1.3222742

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