BEYOND REALITY

Augmented, Virtual, and Mixed Reality in the Library

Edited by
KENNETH J. VARNUM

ALA Editions
CHICAGO 2019

KENNETH J. VARNUM is senior program manager at the University of Michigan Library. In this role, he is responsible for the library's discovery systems, document delivery and link resolver interfaces, and the library's evolving and emerging analytics infrastructure. Over his two decades working with public-facing technology in academic, corporate, and special libraries, he has gained a deep appreciation and understanding of the need to tailor systems and interfaces to the local user base. A frequent speaker and author, Varnum presents and writes about discovery systems, library analytics, and technology. In addition to numerous articles and chapters, he wrote *Drupal in Libraries* (2012), compiled the LITA Guide *The Top Technologies Every Librarian Needs to Know* (2014), and edited *Exploring Discovery: The Front Door to Your Library's Licensed and Digitized Content* (2016). He also edited Lorcan Dempsey's *The Network Reshapes the Library* (2014). Varnum received his master's degrees from the University of Michigan's School of Information and its Center for Russian and East European Studies, and his bachelor of arts degree from Grinnell College. You can contact him through his website at https://www.varnum.org/ or on Twitter at @varnum.

ISBNs
978-0-8389-1785-5 (paper)
978-0-8389-1810-4 (PDF)
978-0-8389-1809-8 (ePub)
978-0-8389-1813-5 (Kindle)

Library of Congress Cataloging-in-Publication Data

Names: Varnum, Kenneth J., 1967– editor.
Title: Beyond reality : augmented, virtual, and mixed reality in the library / edited by Kenneth J. Varnum.
Description: Chicago : ALA Editions, An imprint of the American Library Association, 2019. | Includes index. | Includes bibliographical references and index.
Identifiers: LCCN 2018049625 | ISBN 9780838917855 (paper : alk. paper) | ISBN 9780838918098 (epub) | ISBN 9780838918104 (pdf) | ISBN 9780838918135 (kindle)
Subjects: LCSH: Virtual reality—Library applications.
Classification: LCC Z678.93.S53 B49 2019 | DDC 006.8—dc23
LC record available at https://lccn.loc.gov/2018049625

Cover design by TJ Johnson. Cover image © kiankhoon, iStock Photo.

Text design in the Chaparral, Gotham, and Bell Gothic typefaces.

♾ This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

Printed in the United States of America

23 22 21 20 19 5 4 3 2 1

Contents

Preface

AT A TIME WHEN LIBRARIES ARE FACING A RANGE OF SIGNIFICANT challenges, including rapidly evolving needs for physical space, constant budgetary pressures, and growing concern over the confidentiality of patron-generated data, a new technology is emerging that offers an entirely new spin on these challenges. The suite of technologies encompassed by virtual, augmented, and mixed reality stands to open vast opportunities for new services, expand the way library materials can be accessed and integrated into nonlibrary venues, and alter the way we, as a society, interact with information. The real and virtual horizons these new technologies are establishing represent a new frontier in the way we do almost everything.

What are the technologies we are describing? There are three at the core of this book, all of them deeply intertwined with each other. We live in actual reality—the physical world around us. By contrast, *augmented reality* is enhanced reality, usually in a limited way. The user is perceiving the real world, but the computer is adding objects, information, or details that are not physically present. Heads-up displays in aircraft are an example of this technology—data such as routing information, other aircraft just past the visible horizon, the aircraft's speed, and the like can be displayed in the pilot's field of view without requiring a glance at the instrument panel. A possibly more familiar example is the popular Pokémon GO game played on smartphones, where computer-generated creatures are superimposed on a dynamic map of where the player is actually located.

Virtual reality is the computer-created counterpart to actual reality. Through a video headset, computer programs present a visual world that can, pixel-perfectly, replicate the real world—or show a completely unreal one. With sensors in the headset to detect the direction the user is looking (up, down, left, right; rotating clockwise, etc.) and moving in a physical environment (stepping left, right, moving backward, etc.), the computer simulates the resulting changing view.

If actual reality—in which the entire area of perception is perceived, unmediated, by the human senses—is at one end of a scale, and virtual reality—in which the entire area of perception is computer-generated—is on the other, then *mixed reality* is the entire continuum between the two, spanning the range from just a bit of computer-augmented information or presentation of objects, all the way up to the near-total simulation of the world around us. In today's society, most of our routine experiences with mixed reality are toward the lower end of this scale, where we have just a bit of extra information added to our daily life by computerized technology. As a society, though, we seem to be on a path where more fully integrated virtual realities are on the near horizon, and we're moving quickly in that direction.

What do these technological advances mean for libraries? How could they shape the services we offer our users, and the ways our users prefer to interact with us? What does this overarching trend mean for instruction? And how can we be confident that our services and offerings in this area are not running afoul of intellectual property concerns? This book seeks to address these questions.

Kenneth J. Varnum
Ann Arbor, Michigan
January 2019

AUSTIN OLNEY

1

Augmented Reality

All about Holograms

IN CASE YOU HAVEN'T HEARD, HOLOGRAMS HAVE ARRIVED. THERE is an exciting new technology known as augmented reality (AR). At the highest level, AR gives us the three-dimensional holograms we see in the movies, and at the lowest level, it is a nifty technology with many practical (or just plain fun) applications to daily life. AR merges artificial digital elements with the physical world, usually by means of a headset or other digital device. As people realize its potential, it seems to grow in popularity every day. It will most likely have an impact on our lives at some point in the near future. There are many benefits of adopting the technology, but what does AR look like when implemented inside a library? In this chapter, we will look at AR through the lens of the White Plains Public Library in New York, an institution I have had the pleasure of working in for the past five years. Here, the staff have implemented AR, to the delight of many patrons. The technology is a shining example of "new." The purpose of this chapter is to inspire library professionals to explore this emerging technology and consider implementing it at their own institutions. We will discuss the various aspects and practical benefits of the technology, why libraries should adopt it, and where it is headed.

WHAT IS AUGMENTED REALITY?

The official definition of *augmented reality* is "an enhanced version of reality created by the use of technology to overlay digital information on an image of something being viewed."[1] AR essentially consists of integrating digital content with a user's visual perspective in order to perceive additional elements, thus "augmenting" a user's space. The Forbes Agency Council describes it as "the ability to integrate digital data into a real-time experience."[2] AR tricks one's brain into perceiving elements that are not physically there. Digitally added stimuli appear to exist in one's approximate physical space, but these are in fact layers of artificial content that are visually overlaid. It is a holographic illusion with promising possibilities.

AR is an exciting new technology, harboring major potential. As the technology writer Om Malik enthusiastically states, "for those who have been believers in augmented reality, these are exciting times."[3] The practical uses of AR are growing by the day. A subcategory of AR, known as mixed reality (MR), refers to the specific ability to artificially interact with overlaid digital elements. It is essentially AR you can "touch," and this ability is where some of the most exciting breakthroughs are taking place. Being able to physically interact with content that appears to be real is an incredible innovation and offers endless possibilities.

Compared to its sister technology, virtual reality (VR), AR has a greater practical application to everyday life. Instead of transporting the user to an alternate world of digital content, as VR does, AR transports digital content to the user's space, seamlessly bridging the gap between the physical and the digital world. Due to this hybrid approach, an AR user is never detached from his or her surroundings and can absorb content without being masked in an artificial, omnidirectional world, as in VR. For those of you who have tried VR, you may have discovered how disorienting it can be to put on a headset and isolate yourself. When I rode a virtual roller coaster, I was so immersed in the virtual ride that it was a good idea to have a friend standing by so I wouldn't accidentally overturn the chair I was sitting in—that's how detached from the outside world you can get inside a virtual environment. But with AR, you don't shut out the outside world. Instead, the digital content is viewed as part of your everyday life and surroundings.

In many ways, virtual reality has overshadowed augmented reality, at least in the public's eye. Millions of people are purchasing and using VR headsets, such as the Oculus Rift (www.oculus.com/rift) and HTC Vive (www.vive.com), and it has become a relatively common practice to adopt the technology in libraries and at home. AR, on the other hand, has not necessarily had the same level of success, despite being equally deserving. One of the first large-scale releases of an AR headset, known as Google Glass, took place in 2013. It gained a great deal of attention but ultimately failed as a product.[4] Thus, AR

has not necessarily captured the imagination of society at the same level that VR has—yet. It may be that Google Glass was slightly ahead of its time.

But AR has been quietly integrating itself into society for years in various ways, without a great deal of public attention. Even though AR is only in its infancy (relatively speaking), it has already proven its practical applications. Whether it is an artificial line drawn on a football field, digital ads behind home plate at a baseball game, or cat ears and whiskers added to a cell phone's camera feed to achieve an interesting selfie, AR innovations have proven to be popular and useful for the general public, even if people don't necessarily understand how it is technically happening.

The evolution of AR technology shares many historical milestones with VR, such as the invention of the stereoscope by Sir Charles Wheatstone in 1838, and the first head-mounted display system in 1968,[5] but one of the first widespread, popular uses of AR technology was initiated by, of all things, the National Football League (NFL).

In 1998, a virtual "1st & Ten computer system" was developed and implemented by a company named Sportvision, Inc., to be included on a live NFL broadcast.[6] Through a technological illusion, the first-down line appears under the players on the field, as if they were physically moving over it. This yellow-colored line aided viewing of the game in real time and did so seamlessly. The first time it was used was during a game between the Baltimore Ravens and the Cincinnati Bengals.[7] It instantly gained the approval of football fans, to the point that when Fox Sports ceased providing the line in 2001 in order to cut production costs, most fans were displeased.[8] The "1st & Ten computer system" was an important step for a public becoming acquainted with AR.

Many people today are familiar with AR technology through the use of smartphones and other mobile devices and applications. Smartphones make it easy to use AR technology because they are commonly equipped with a camera, which allows for the streaming and modification of a real-time video feed, making it ripe for AR. There are several popular mobile applications that are available on major smartphones and harness this type of AR technology today, such as Pokémon Go, a game in which users can search and find virtual creatures at real-world locations; Snapchat, a communication application that includes a library of digital overlays to artificially modify a user's face; and Google Translate, a translation application that can digitally convert text from physical signs to different languages in real time.

There are several creative uses for AR technology that have proven to be worthwhile. For example, IKEA Place is an application that allows users to virtually place pieces of furniture in their room so they can observe how chosen pieces of furniture will look, augmenting what is seen through the smartphone camera's lens. The feedback of the information, in real time, creates an experience that is both helpful and awe-inspiring at the same time. It makes life more convenient, which is a great use of the technology.

It should be clear at this point that AR is becoming commonplace in society, and it may be the start of a major trend. The fact that many devices and apps now incorporate AR is an indication of a future society that will be immersed in it, and when it comes to libraries, the application of this technology is promising.

AUGMENTED LIBRARIES

There is great opportunity for libraries to integrate augmented reality. For centuries, libraries have been offering their communities the services and resources they depend on. With the relatively recent information technology revolution, many libraries have—in addition to the usual resources and services a traditional library offers—grown into educational community centers in which collaboration and learning are encouraged. As one *Chicago Tribune* contributor puts it, "in case you haven't noticed, libraries are becoming louder."[9] There is no better time to incorporate new AR technology. Accordingly, author Elizabeth Zak argues that "AR can and should be studied from every aspect of the field of LIS," but she declares this should only be done "if it is in fact a new direction toward our new normal."[10] Whether or not AR will become part of the "new normal" remains to be seen.

There have been several studies that support the use of AR in libraries. As researchers at Kansas State University propose, a library can be a more attractive place with AR.[11] They suggest it is possible to use AR as a game with puzzles to help patrons learn about library services. Another study shows that AR can enhance a patron's experience at a library, even with books. Modern pop-up books can be digitally extended, using AR technology, within the context of the work, "to rotate, tilt, and manipulate viewing angles of various objects."[12]

There are several libraries that are now implementing AR and associated technologies, and it is beneficial to observe the many ways we can now incorporate AR into existing services and also provide completely new services. For example, Diana Hellyar, a reference librarian at the University of Hartford, writes how "using apps and integrating augmented reality is a fun way to do a summer reading challenge."[13] In this particular case, they used an AR application called Mythical Maze that allows patrons "to scan stickers they receive from reading books, which unlocks augmented content via a mobile device, such as mythical creature animations."[14] Another library, the J. Willard Marriott Library at the University of Utah, offers AR and VR workshops to inspire students and faculty to use the technology within their research and areas of study.[15] (See chapter 4 for a description of these projects.) Other libraries, such as the North Carolina State University library system, lend AR and VR equipment, and they also host spaces for experiences, games, and development.[16]

Many libraries already incorporate AR in the services they provide, whether they are aware of it or not.

In 2016, many gamers were turned on to public libraries due to the Pokémon Go sensation, a popular application that uses AR technology with mobile phones. Several libraries seized the opportunity to offer a virtual "Gym," where Pokémon Go users could play the popular game in a specific location.[17] For many, this game was the first encounter with AR. Many libraries hopped on the bandwagon not only as a clever way to attract young patrons into the library, but also to encourage the use of exciting new technologies. In addition, many modern libraries are already familiar with incorporating simulation-based technologies, such as the nearly one hundred libraries in California that are adopting VR technology as part of one private company's initiative to spread awareness and distribute resources to an eager public.[18] Implementing VR, as we will see, is not far removed from implementing AR. It makes sense that AR technology should receive the same level of recognition and utilization by libraries that VR has attained, due to the former's greater immersion in the real world.

LOCAL AUGMENTATION

The popularity and capabilities of AR technology are two of the reasons why the White Plains Public Library (WPPL) became interested in it. The WPPL is an innovative library located in White Plains, New York, about twenty-five miles north of Manhattan.[19] It has been open to the public since 1899 and has been at its present location since 1974, serving a diverse population of over half a million visitors each year.[20] In an effort to educate the public and connect with a new generation of patrons, the library continually offers classes on a variety of topics, including augmented reality.

The WPPL is no stranger to innovation and is a great place for learning and engagement with new technologies. Part of the library's mission is to "offer new services that will bring adults into the library and provide them with the resources and opportunities for personal growth" and to "provide excellent opportunities for adults to learn."[21] The library has expanded its technological offerings for all ages and it now offers classes featuring AR. The recent addition of a new adult area, named "The Hub," has further expanded the library's technical offerings and spurred an interest in AR.

Back in 2013, the WPPL created a new digital media specialist staff position, to better connect patrons to the modern technological world. The digital media specialist teaches patrons to be digitally literate and provides them with the technology skills necessary for the modern world. I am the digital media specialist at the WPPL. By bringing expertise in all areas of computer-related technology and relaying that information to patrons and staff in an effective

way, the library is able to provide innovative services in many technologies, including augmented reality.

Seeing the activities of other libraries, as well as observing the current technical capabilities and general "buzz" surrounding augmented reality, has led the WPPL to experiment with offering AR. With the advent of advanced AR technology, there are practical benefits to incorporating it into the library's list of resources, as we will see. The WPPL is planning to acquire an upcoming AR headset, known as the Microsoft HoloLens, set to be released in 2019, as part of its new adult area.[22] (See chapter 2 for more information about the HoloLens.) The headset would serve to expose the public to advanced AR technology and open the door to interesting new creative projects, such as AR games that can be played "on top" of any flat surface.

By preparing the White Plains Public Library to implement VR in 2017, we unintentionally paved the road to providing AR services. The library is already equipped with the Oculus Rift and HTC Vive, and it has been running VR camps, classes, tryouts, and development sessions for teen and adult patrons. With many of the legalities and logistics now in order, such as a waiver form for patrons to sign in order to use VR equipment, the library is now nicely prepared for advanced AR implementation.

Even though advanced AR headsets are not widely available, there are several ways the WPPL has already implemented AR. After acquiring VR headsets and equipment, the library began offering informative classes such as "Augmented Reality vs. Virtual Reality: What's the Difference?" in which participants took part in a discussion about the two similar, but distinct, technologies. Since AR technology is still in its infancy and not yet widely available, true implementation of it has mainly been limited to mobile applications and tablet software, such as augmented coloring-book programs.

One of the most significant ways that the WPPL has incorporated AR is through a mobile application called Quiver. With Quiver, users are able to digitally make physical coloring-book pages become fully animated, three-dimensional models.[23] Using preselected printed artwork, one fills in the colors using standard utensils, such as a crayon, and proceeds to point a tablet equipped with the Quiver app at the page and watch it "come to life." Some of the artwork takes it one step further and includes AR games that you can play "on top" of a flat surface in the physical room. At the WPPL, patrons are provided with the technology and equipment to experience this AR process. It is an opportunity to take the current coloring-book craze to the next level.

Developing and implementing the AR coloring-book class were easier to accomplish at the library than it may seem. A colleague recommended the AR coloring-book application to me, and I instantly saw the potential of the new concept for a library class. We were already equipped with a set of tablets for youth, so I knew it was feasible. It was only a matter of installing the Quiver application and testing it out. I printed out one of the designated color pages for use and then installed the application. I asked one of the teenage patrons

at the library to color it in and proceeded to test out the technology. It worked seamlessly, I might add.

It required minimal effort to explain how to use this form of AR to the staff, since the process itself is intuitive. Although they were slightly intimidated by the AR technology, the staff quickly found it to be easy to use. I worked in conjunction with another staff member who ran a monthly coloring-book program for youth services, because I thought it was a perfect opportunity to test out the technology. With the Quiver application, and many other AR apps for that matter, the hardware and software take care of the complicated processing math needed to create AR, making the end process easy to use.

Having prepared the equipment and trained the relevant staff, the process of running the AR class was set to proceed swimmingly. With the application installed and preselected coloring-book pages printed, it was only a matter of showing the session participants how the process worked. The young patrons who joined the class were interested in coloring the pages and quickly filed in, ready to draw. As the teens colored, a staff member pulled out a tablet and demonstrated the AR capabilities of the coloring pages, using a particular teen's drawing as an example. This incentivized other teens who were coloring to finish so they could test out their particular page with the technology. Soon, many pre-equipped library tablets were being used to test out each teen's coloring page, and the atmosphere was playful and fun.

The response to the class was overwhelmingly positive. One of the participants, impressed by the technology, said, "It was cool how the color I put on the car you could actually see it on the car . . . you can see what you drew." He also enthusiastically stated, "I like the truck one . . . you could stop it and if you move the paper you could change the direction it goes . . . it seems futuristic." Another participant stated, "I liked the Power Ranger because it could kick and punch, and it was a cool feature." She was visibly enjoying herself using the AR technology with her artwork.

The combination of AR with a common activity such as coloring is beneficial because it attracts a variety of personalities and learning levels while at the same time making AR feel accessible. Both patrons who are interested in digital technology and patrons who are interested in creative art can simultaneously benefit from a library offering such an activity. In addition, the activity was relevant for multiple learning styles. Some patrons were happy to color and the AR features were simply an additional bonus, while others focused solely on the AR technology, testing the capabilities by drawing outside of the lines in deliberate attempts to see how the application would react.

The White Plains Public Library will likely offer more AR services in the future. It has proven beneficial to offer AR classes that harness the creative potential of smartphones and tablets to, among other things, simply allow patrons to test the technology. Although advanced AR headsets are not yet widely available, there are already plenty of related technologies for the library to experiment with in the meantime.[24] Adopting the technology will prepare

the library for the future, but it remains to be seen exactly where the field of AR is headed. It is exciting to explore how patrons of all ages can use AR technology to its full potential, for both entertainment and educational purposes.

AUGMENTED FUTURE

Augmented reality has the ability to drastically change the way people live their everyday lives. Whether or not this is an improvement is a matter of opinion. Regardless, the idea that you can bring in digital information to the physical world has monumental implications. The *Forbes* contributor Blake Morgan describes how AR has the potential to revolutionize society and consumerism: "Instead of customers having to seek out information, that knowledge can now be embedded in the environment in a way that anticipates customers' needs and helps them find solutions where they already are."[25] Just imagine being able to look at a coffee shop and see how much a cup costs; look at a hotel to see what rooms are available and where they are located in the building; glance at a train station or movie theater to see the schedules; or scan items at a store by simply looking at them.

There are several potential benefits to adopting augmented reality. The technology can make life more efficient, with, for example, artificial navigation lines to help someone find his or her way in an unfamiliar building, or the ability to virtually create computer monitors and televisions without purchasing any physical hardware. There are safety benefits as well, such as a driving system created by the Swiss-based company WayRay that uses AR on a car windshield, displaying directions and hazards and more.[26] In the medical field, AR has the potential to help patients with vision-related conditions, to enable remote, patient-perspective consultations, and even to assist surgeons in the operating room.[27]

In addition, there are educational benefits of using AR. Training professionals like surgeons or pilots with AR and VR has existed for some time, but the scope of possibilities within the realm of education is expanding to include more abstract concepts for learners.[28] For example, AR can help students visualize complex processes such as respiration or electromagnetism. The educational consultant Jeremy Riel, who supports the use of educational AR technology, asks, "What if the physical space of the classroom could be used to bring digitally created elements to a student's experience?"[29] There is no telling what the educational and societal applications of AR technology might eventually be.

Based on business trends, it appears that our society is heading towards digital augmentation in a significant way. There are predictions that AR will thrive financially, with annual spending doubling in 2018 and beyond.[30] Notable companies are hopping on board with AR technology as well, such as the online retailer giant Amazon.com, which recently released tools for artificial world creation.[31] Apple Inc. recently acquired Vrvana, an AR headset startup

company, for thirty million dollars, which might be an indication that the company is headed towards AR.[32] Apple has officially released the ARKit, an AR development platform for iOS devices (developer.apple.com/arkit). Even Google's parent company is attempting to bring the Google Glass headset back, apparently seeing more potential this time around in a different approach; the company is making the headset more lightweight and is giving it a longer battery life.[33] Based on the current trends, AR may be on the verge of growing exponentially in our world.

AR is generating success for regular companies, and it may be able to do so for libraries, too. The Forbes Agency Council discusses how AR can be a great asset for businesses, as with the aforementioned IKEA Place application.[34] In the same way, AR can be advantageous for libraries. Holographic technology is gaining popularity, and public libraries can serve as the bridge for the public to access this incredible new tool that is currently just out of reach.

AR technology will offer library patrons a wealth of possibilities in the future. There could be hologram conference rooms, where libraries purchase the expensive equipment for the public to experience augmented telecommunication sessions. There are also possibilities for libraries to provide resources on local and global history, such as having digital overlays of historic places, and capturing three-dimensional footage of historical persons for future generations to learn from as if they were in the same room. Outside of the library, a patron using AR technology could look at the building and be presented with information on upcoming classes and new book releases. AR even has the opportunity to change how we read books—transforming both fiction and nonfiction texts into an interactive and more meaningful experience. AR can provide the reader with additional relevant digital content such as images, audio and video clips, or games throughout the text (without disturbing other patrons!).[35] The possibilities are limited only by the imagination.

One of the most intriguing aspects of AR in libraries is the potential for book displays and general presentation. Patrons will be able to perceive objects, information, details, and models based on local surroundings. For example, they could look at a shelf of books and see reviews, synopses, author biographies, and more, without typing a word. As staff at the New Mexico State University ask, "How would you like to stand at the end of a stack of books, hold up your phone, and look through an app to tell you where exactly the book is on the shelf?"[36] In this world, book displays might rapidly evolve and become augmented beacons of knowledge.

Today, headsets are the optimal medium for experiencing AR, but this may transition to digitally augmented contact lenses a user could wear, making digital content available without bulk. In this way, AR content could be delivered seamlessly and could truly appear to exist in the real world. This could unveil possibilities we cannot yet perceive.

In the very distant future, AR may even get to the point where it is indistinguishable from real life. The next logical step after AR contact lenses would be to bypass the human eye entirely and stream content directly to the brain.

Index