Augmented Reality and AR Use in Library Settings

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Augmented Reality: A History

1968 Ivan Sutherland of MIT creates the first head-mounted AR display, calling it the Sword of Damocles because of its ominous appearance. To make this happen, he is aided by three of his students, Bob Sproull, Quintin Foster, and Danny Cohen.

1990 The term augmented reality is coined by Thomas Caudell.

1995 NHL attempts to use AR on a 'glow puck" but it doesn't work as expected.

1998 NFL uses AR to highlight the first down line, a change that will remain for decades.

2014 Google launches Google Glass for consumers.

2015 Snapchat filters are introduced to consumers. Use of these AR filters spreads to other apps.

2016 Pokemon Go app goes live and AR scenarios within the game are often screenshot and shared on other social media.

2020 Mandal Library in Norway implements AR system through library, directing patrons to books and giving further info on the book, author, and related books once a title is selected and viewed with special glasses.

Augmented Reality, also referred to as AR, is a technology with many applications, though most people don't always associate it with libraries. But I think it can and will be widely used in various library settings once its value there is realized, as AR is currently in use in some libraries today.

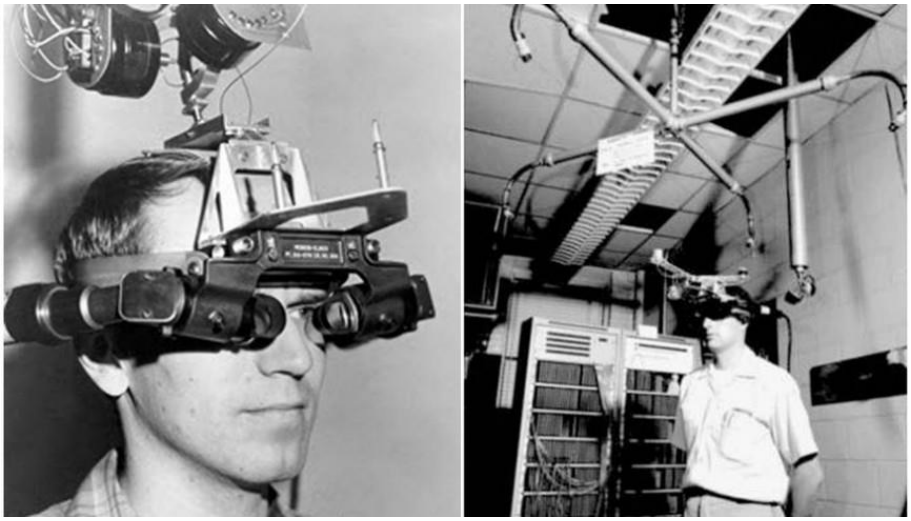
Augmented reality is sometimes confused with virtual reality. But while the technologies for both rose in popularity around the same time, they are quite different. Virtual reality involves a total simulation experience, often with a headset to provide the visual part of the experience, paired with controllers that allow some type of enhanced interaction with the simulation. It's immersive and typically viewed as a more desirable choice between the two. But augmented reality is more accessible and affordable than virtual reality, and people are using it every day, possibly without realizing it. Augmented reality happens when a user looks through a screen or lens- that can mean holding up a device, like a phone, to look at something, or wearing special eyeglasses with technology to overlay images on what you see in real life. AR is achieved when digitally created images appear within those images you see through the screen- as if the created/projected images coexist with whatever is in the picture in the real world. Anyone who has been in a Zoom call during the pandemic is familiar with the AR that is built into that system- don't have time to clean up your bedroom that doubles as your office? Just click on the filters and blur your background, while leaving your face clearly in focus. (But be careful not to end up like the lawyer who accidentally selected the cat filter and couldn't remove it during the call, and the whole world ended up hearing him plead to the judge "I'm not a cat".) We can easily see where AR is now, but where did augmented reality come from?

The first instance we know of using a type of augmented reality was in 1968 and was called The Sword of Damocles because it was a large device that hung above the user's head,

and it looked ominous. The stereoscopic display (as it was called then) was created by Ivan Sutherland at MIT (Massachusetts Institute of Technology) with the help of some of his students. In Figure 1, you can see how the apparatus looked and how much space it used (Tanzi, 2022). Most accounts of the Sword of Damocles note that it was not intended to be used on a larger scale and that the device was uncomfortable for the user. One video online shows how the user would need to hold the helmet while looking around, and that it would project an image of a cube in front of you, in your real-world surroundings (Picard, 2020). Movement was fairly restricted because of the large device hanging above the user.

Figure 1

Sword of Damocles images from AtomicDigital.Design



While the Sword of Damocles is noted as the first instance of a type of AR, it wasn't what we think of when we think of augmented reality today. Also, no one called it augmented reality back then. It was referred to as a "helmet mounted display" (Picard, 2020).

The term 'augmented reality' was first coined in 1990 by Boeing's Thomas Caudell (Cizmeci, 2021). Augmented reality as we envision it today emerged from military research in the 1990s, when the Air Force was designing a way for a robot's hands to be controlled via a

remote operator. This imaging technology superimposed the robot arms on the operator's arms and recreated the surroundings of the robot over the surroundings the remote operator occupied. It was a success and led researchers to think of new ways to use this technology (Rose, 2021).

The technical details of how augmented reality was developed would require more space than I have here, but today, there are user-friendly software packages to design AR experiences. As of the time of this writing, some of the more popular choices are ARCore and ARKit and Vuforia Engine (G2, n.d.). While higher level AR experiences might require more than that, those software programs are enough to get you started designing and creating AR experiences.

The ways that users can access augmented reality programs are called form factors. There are three form factors recognized for AR use, including mobile devices, headsets, and glasses. There are pros and cons of each, including pricing, availability, resolution, comfort, and more (Mealy, 2018). Mobile devices have seen widespread access to AR tech through programs like games, meetings, and social media. Glasses might also see a boost considering the very recent announcement from Google about a new version of Google Glass that can, for instance, translate conversations in real time for the wearer. A video released just two months ago, on May 18, shows a simulation of this very impressive and useful tech (Evans, 2022).

Within the AR software, programmers must keep in mind that no matter what they program, the background will change based on the user's environment. While programmers for virtual reality have total control over the entire look and feel of the user experience, programmers of AR have to plan for whatever might pop up. This means considering every detail in a new way. For instance, if you need to overlay directions for the user into the program, you must plan for those to be projected over anything from a white wall (smooth, light, flat) to a field of flowers (multicolored, dimensional, possibly moving in wind) and everything in

between. Because of this, when designing an AR experience, there should be plenty of time and resources allotted for testing and refining (Mealy, 2018).

This need for testing and refining is evident when we look at some of the earliest applications of AR technology. Augmented reality had a lot of potential in the 1990s and everyone wanted to figure out how to implement it for their industry. In 1995, the NHL (National Hockey League) attempted to make hockey pucks "glow" on screen for viewers at home, so that they could more easily track the game play. But because of how fast the puck moves during most of the game, it was ultimately scrapped when the glowing puck seemed to streak across the screen and served as more of a distraction and obstacle to watching the game (Tanzi, 2022). But a few years later, in 1998, the NFL (National Football League) took that information and decided they could use this AR technology to indicate a more static image- the 1st down line would be illuminated in yellow for viewers at home (Rose, 2021). Because they worked within the bounds of what the tech could do, it was a success. Still in use today, it's become standard practice in all NFL games. And while their first attempt at using AR wasn't a success, the NHL would later adopt a new way of using AR- today, you can see AR images on the ice if you're watching from home. They sell ad space on the ice, then use AR technology to display logos on the ice near center line. If you pay close attention to alternate "on ice" camera views, you'll notice the logos aren't present from those angles. Also, the images change during the game. They also pose some visual clarity issues, from my personal observation. Because hockey is a very fast game, if you watch closely enough, you will see blurring as players skate directly across the AR images at top speed. These examples are aimed at a wide audience, and all are passive examples of AR use.

Focusing instead on user-centric and active applications, we have many examples to look at. There are three widely used programs when thinking of AR use in daily life- one is the game

Pokémon Go. Introduced in 2016, it features AR when you are catching a Pokémon character. At that point in the game, the camera of your device will turn on and the AR will kick in, overlaying the image of the Pokémon in your environment- you can see this in Figure 2 (Harding, 2018). This gives the user a new view, because up until this point in the game, the programmed images have taken up the entire screen. This is the first point in which your actual surroundings become part of the game play.

Figure 2

Pokémon Go simulated image from Mic.Com

Another widely used, active AR interface was mentioned earlier- in Zoom calls, each user can select backgrounds or blur their existing background if they don't want the other participants to see what's happening behind them. Some of these backgrounds have movement, some are static, and some integrate the participant into the image (like the cat or potato filter, which makes the call participant appear to be a cat or a potato under the ground). There is no special skill set required for the user- they just click a button.

A third widely used active AR is filters within apps like Snapchat or TikTok (Tanzi, 2022). The user selects a filter, and the AR will overlay images so that the user's hair appears red, or they have freckles, or are wearing makeup, or it will give them a sad face, make them

have a bunny nose...there are more AR filters made every day. These appear in real time as the user is recording their video, and some filters can be manipulated while filming.

Additionally, some companies have started to use AR to assist customers. For instance, eyeglass company Zenni allows customers to "try on" different frames by recording a video of themselves and then selecting frames from the site (Tanzi, 2022). I attempted to use this feature and while it is user-friendly, the interface doesn't remind you to remove your existing glasses when recording for this application. I hadn't thought about that until I was doing the virtual try on, and wondered why it looked odd- it was because the AR was layered over my glasses, which were still on my face when I recorded the video. It is another example of testing and refining being so important. There are also programs people can use to help them correct their form in a sport using augmented reality (Rose, 2021). Or if you visit the LEGO store, you will see a screen for kids to interact with to make a LEGO set come to life while they hold it. My kids loved interacting with this technology a few years ago.

Because these are more niche applications made specifically for users of a certain product (glasses, sports, toys), they are worth mentioning, but might not be considered 'widely used'. Also, I'm sure there are many other AR experiences in use today. These are only to provide some examples.

In addition to these examples of successful augmented reality in daily life, it's important to note one AR attempt that was seen as a failure. Google Glass was released in 2014 and while the next version of this tech is about to be released, the first version was not successful. Part of this is due to a clumsy interface, with the user needing to access a panel on the side of the glasses to maneuver through options. Another problem was simply that not enough people adopted the technology early on (Mealy, 2018). Again we note there are several considerations when

choosing a form factor, and one of those is price. When Google Glass was released, the starting price was $1500. Also, that did not include the cost of adding a prescription if you needed corrective lenses. Adding a prescription to Google Glass added $225 to the overall cost. So they expected people who did not need glasses to drop the equivalent of a mortgage payment for a piece of tech that did not replace something they were already used to. All in all, it was a hard sell, and the price point was too high to get large numbers of people to adopt it right away. But even though Google Glass was not considered successful, researchers were able to learn from it and the concept of AR aided glasses is still seen as a worthy avenue of research, evident from the videos recently released about the next generation of AR-enabled glasses (Evans, 2022).

But bringing AR back to library-specific use, where do we currently see AR and where can we expect to see it soon? We can already see AR used in books. I was able to check out two juvenile books published by Lerner books, both with a space theme, that were subtitled as "An Augmented Reality Experience" (Hirsch, 2020). The basic concept is that there are icons on some of the pages- there were 4 icons in one book and 5 in the other, both having 26 pages of content- and you download an app, choose a subject, download files for that subject, and then point your phone's camera at the icons on the pages to interact with the book. I downloaded the app and started to turn the pages. I found interacting with the book to be clumsy and frustrating, at best. The books are very thin, tightly bound paperbacks. You must figure out how to keep the pages down and position the phone to recognize the symbol that triggers the augmented content. As an adult, I found this difficult to do, and imagine that children would find this just as frustrating, if not more so. The basic ones were not too bad, but some of the content requires you to double tap an image, or pinch the screen, which is hard to do while holding down the book with one hand. A spiral binding would allow the pages to lay flat so that this would not be an

issue, but the entire series (I saw 6 of these books) is bound like the ones I checked out. Also, the icon reader was very slow to recognize the icon to activate the AR images. Wondering if I needed to "clear" the last interaction before I could move on to the next icon, I tried to access the menu and it went back to the "choose a subject" screen and had to re-load the book's content to continue. Also, one image seemed faulty, and just showed up as a purple blob (Figure 3) on the phone's screen. Lastly, 2 of the 5 interactions in one of the books weren't even augmented reality. Those icons triggered a 360 photo to take up the full screen of the phone and were much closer to virtual reality than augmented, allowing the user to pan around the picture and see all the vantage points (Hirsch, 2020). While it was fun when it did work, an experience like this would leave any user wondering why people like augmented reality, or how it can be beneficial. It felt more like a company trying to use a gimmick to sell a series of books instead of having AR books that are made to enhance the user's experience. And it's yet another example of testing and refining being an essential part of creating an AR experience.

Figure 3

Screenshot from personal collection

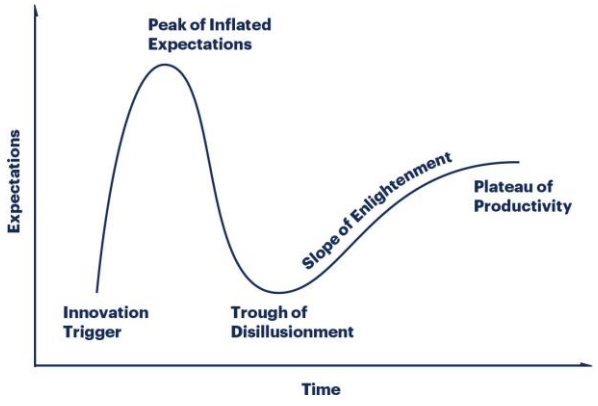
It's also a great illustration of the Gartner Hype Cycle's Trough of Disillusionment. Figure 4 shows the Gartner Hype Cycle. This graph represents how technology is adopted in our society. (A similar curve is seen in the Rogers Bell Curve, though that outlines *when* new tech is adopted by consumers.). The Gartner model begins before the Rogers model, when a technology

concept may not be available to consumers and the idea is still being ‘sold’ to people (Parsons, 2018). Currently, Gartner classifies AR technology in the Trough of Disillusionment, with a projection of moving to the next phase in the next ten years (Mealy, 2018).

I was also able to find a more user-focused augmented reality book, called SuperSight by David Rose, who is an inventor and entrepreneur that has worked with advanced technologies for many years. The book also featured an app, but no downloads were required to use it, and while it’s not been without some stumbling blocks, most of the AR features in the book truly enhance it, illustrating points and allowing for video to supplement what’s written. This book came out only one year after the juvenile space books, so the technology wasn’t vastly different. In any industry there will be quality variance, so these two examples show how much of a spectrum this technology is already showing.

Figure 4

Gartner Hype Cycle from BMC Blogs



Generally, when AR use in libraries is brought up (beyond books in the collection) the focus is on use by patrons- AR guiding them to materials, helping them navigate available resources, and occasionally for use by library planners to plan common spaces and layouts within existing libraries. I saw a presentation about how the Mandal Library in Norway uses AR

currently. They supply special glasses for patrons to borrow, and when the patron asks for a book, the glasses can direct the patron directly to the title they seek, giving more specific directions as the patron gets closer to it. There are also metadata overlays for the books selected- these will show information about the book, the author, and also list related materials. The Herning Library in Denmark is another library currently making use of AR technology for their patrons, and has AR signage available via an app that patrons can add to their smartphone or tablet (Tanzi 2022).

In all the books, articles, and presentations I watched, I was still wondering how AR could be used in libraries today. What use could motivate those already in the industry to be not only amenable to adopting AR use, but clamor for it? Then I stumbled upon Figure 5. It wasn't attached to an article that I could access- it appeared to be a still from a video, but one that I had not seen. As soon as I saw it, my jaw dropped. This would be a revolutionary game changer for the way libraries exist currently, and its value is instantly recognizable to anyone working in a library today, whether that be a public library, academic library, or private library. It's a universal need for any facility that houses books that are shelved in any order.

Figure 5

Figure 9 from ResearchGate

This basic still screenshot (Margam, 2017) from ResearchGate was the one that gave me an “a ha” moment. If you could get AR to recognize when a book is out of order on the shelf, without having to rely on a person doing shelf reading, that would absolutely change the game for people working in libraries every day. Shelf reading is a necessary task for any library, as books are often shelved in the wrong spot, either from well-meaning patrons or employees who become distracted. For those who aren’t familiar, shelf reading is done as often as possible, and is useful in keeping shelves in an orderly manner for both staff and patrons to be able to locate items. It involves a meticulous, one by one check of a shelf, to ensure that all the materials there are in order and in the proper place, and it can’t be done very quickly, as speed reduces accuracy. And while it’s a straightforward task, shelf reading is not easy- when you’re scanning spine labels for numbers and letters to all be in order, it’s quite easy to miss incorrectly shelved items, especially if you are doing it for a long stretch. But if you can allow the augmented reality to clearly mark the problems and all you need to do is fix them? That would have a significant impact for any library, big or small. Part of my job, for instance, is pulling requested books for patrons. Almost every day, my list is about 75 items long (we break it down among the 7 of us in my department, so that we each have a list of about 70-80 items each morning) and I have yet to pull a list in which no books are misshelved. In fact, just last week, we located three books that the entire department had all been looking for all week long. All three had been placed in the wrong spot. Collectively, we spent hours looking for those books. The patrons had to wait a full week longer to receive their requested items. And all the time we spent searching, we were put off task of getting books to other patrons. This seemingly simple technology would save a lot of money- between the employees spending their time more efficiently and the books that are replaced because they have been “lost” when really, they are just on the wrong shelf- this could

be enough to get even reluctant budget-makers to take a second look. In regard to the Gartner Hype Cycle, I think this would fall into the Slope of Enlightenment. It's not a glamorous application of the technology, but it's something any size library could benefit from, and its use would clearly lead to a Plateau of Productivity. This, however, is specifically about an application of the technology and not the tech itself, so in general, I would agree that Gartner is the expert in determining where AR fits in their hype cycle. Also, in my opinion, this emphasizes how close we might be to coming out of the Trough of Disillusionment, and on track with Gartner's projections.

Augmented reality has a firmly established place in our daily lives, whether or not we recognize it in its many forms. And it has the potential to make some fairly dramatic improvements in our lives. As with any new technology, we will have to play around with it to see how it can best be used. There are bound to be spectacular flops as well as groundbreaking innovations, but we may not know which is which until they are put to the test by the general public.

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