

Augmented Reality in Public Libraries

Problem Statement

Augmented reality (AR) is an exciting new technology. Unlike full virtual reality, which places the participant within a virtual environment, augmented reality refers to tying virtual components to physical reality. One may have encountered virtual reality through a QR code, an image similar to a barcode which, when scanned with a smartphone camera, takes the user to a specific webpage, app, or document. AR got its first big burst of popularity in the summer of 2016 when the smartphone game Pokémon GO! was first released. The game included a feature where the player could have their phone camera on and see animated Pokémon characters as if they were appearing in front of them. During the Pokémon GO! boom, libraries and museums realized this technology could be used for their work.

Initially, our research explored whether or not a person's interest in AR is related to their age. The results of a casual survey we conducted revealed that there was no correlation between age and a person's interest in using AR at the library. This initial inquiry indicated that patrons across all of the age groups surveyed expressed an interest in AR in libraries. Some identified themselves as potential users of augmented technology. Others identified it as a sort of social good that would benefit patrons other than themselves. Still others recognized that libraries need to keep up with the technological times as a service to library users. With these comments in mind, our research team returned to the more general question "what gets people interested in AR?" Instead of looking at potential barriers, this research project focuses on benefits. The variety of ways survey respondents conceptualized the value of AR in libraries prompted us to approach this study from a user-centered design paradigm, which encourages us to think about what motivates users as they engage in technology, as well as what it is they want and need from

the technology they encounter at their libraries. In other words, we are interested in exploring how technology is made meaningful by the people who use it. In order to study this concept, we will examine two different formats of AR technology that libraries may want to consider by exploring the research question: “are library patrons more interested in using AR technology for wayfinding within the library or for fun and learning in an activity unrelated to library services?” Incorporating technology into the library is a constantly-evolving endeavor. This research will help libraries determine what methods of teaching and expanding technological knowledge will be most interesting to their patrons, and therefore, most beneficial to invest library resources in.

In order to approach this research question, we decided to explore two specific examples of AR technology. The first is Herning Bibliotekerne’s use of AR technology to assist in wayfinding within their 450,000-item collection, which is spread across four floors and 6,000 square meters. The Herning Bibliotekerne used INDOAR, an AR template by ViewAR, to map their library and create points of interest. Then the bibliotekerne created a map patrons can access from their smartphones and tablets, in which a smiling, animated robot guides them to the location in the library they are seeking to find. The second is the app Star Chart by Escape Velocity Limited. Star Chart uses AR to tell users what they’re looking at when they point their smartphone or tablet towards the sky. It can impose constellations (either as lines between the stars or as images based on 17th century illustrations) and point out Messier objects, planets, and other interesting astronomical entities. Using these two very different AR formats, we expect to learn what draws people to new technologies, and discover where libraries interested in investing in such technologies should designate their funds.

Literature Review

Augmented Reality: This pilot study will investigate whether patrons of a public library are interested in using augmented reality technology and if so, whether they prefer wayfinding technology or a learning activity. According to a report from the American Library Association, augmented reality is a form of immersive technology (Pope 2018). Pope also notes that AR is more common than many people realize; Snapchat and QR codes are everyday examples of this technology (p.6). Augmented reality technology displays virtual information overlaid on physical objects, combining digital objects with the real world. (Roy et al., 2022, p. 178; Pence, 2010, p. 137). The earliest augmented reality technology was developed in 1967, but was not widely available for use by the general public until 2008 (Javornik, 2018). A number of sources we consulted point out that the widespread appeal of augmented reality technology became exceedingly apparent in 2016 when Niantic released the game Pokémon Go!, an application that at its peak had 45 million users (Hornick and Wade, 2018; Javornik, 2018; LeMire et al., 2018; and Smith and Hottinger, 2018).

User-Centered Design (UCD): User-centered design is a concept first developed in the 1970s. In the 1990s and 2000s, usability engineering and design specialist Don Norman developed the concept further in his work on the experiences people have using everyday things (Travis, 2011). According to the International Standards Organization, user-centered design is organized around the following six principles (Travis, 2011):

- The design is based upon an explicit understanding of users, tasks, and environments.
- Users are involved throughout design and development.
- The design is driven and refined by user-centered evaluation.
- The process is iterative.

- The design addresses the whole user experience.
- The design team includes multidisciplinary skills and perspectives (Travis, 2011).

Researchers whose orientation in developing technology that is user-centered understand that the new tools should not force users to adjust their work habits and behavior. Instead, developers should accommodate an individual's already existing work habits (Interaction Design Foundation, n.d.). In order to carry such research out effectively, development teams should be holistic. UCD relies on the work of multidisciplinary teams of researchers and developers. They work together to understand product users' needs, motivations, and context. These teams include ethnographers, psychologists, software and hardware engineers, and intentionally include users in the design process.

User-Centered Design in Libraries: Elizabeth Zak argues that LIS professionals are particularly well situated to use UCD in research on augmented reality technologies in libraries (Zak, 2014, pp. 23-34). She asserts that most user-centered design is directed ultimately at product development. LIS professionals, on the other hand, are most interested in library patrons—their interests, needs, and behaviors. From the perspective of an LIS researcher, technology is only interesting because of its potential to meet the needs of technology users. Zak's general argument is that human engagement with technology is what makes technology meaningful and is supported by other LIS researchers, including Chow and Bucknall, who observe “whether the medium for transmitting information is a stone tablet, papyrus parchment, book page, computer screen, or a digital e-book, libraries around the world are still focused on meeting the information needs of their users” (Chow & Bucknall, 2011, p. 131). They go on to conclude “the technologies libraries use to achieve this objective, however powerful and innovative, remain a means to an end” (132).

Anuar and Othman's design of an app for the state of Sarawak, Malaysia is an example of UCD being used to make an app for creating digital archives to aid in cultural preservation (2020, pp. 7-25). Their study asked potential users of a digital cultural heritage app in Malaysia to participate in designing the web app interface. Tech designers found users made similar design choices, including "aesthetically pleasing and simple design to minimize the cognitive load on users, straight forward navigation to ensure that the app is intuitive and understandable, and the emphasis on visual representations" (2020). These suggested features were incorporated into the next iteration of design.

Agosto et al.'s evaluation of a library space for teen users is a step at producing data-driven general statements. The study asked young people and librarians at a public library to identify design features that contribute to a successful Young Adult area of the facility. Researchers asked both librarians and young adult patrons to record video reflections recounting what they thought were necessary features for a youth space to be successful (Agosto et al., 2015, p. 30). Patrons and staff alike identified similar features—such as comfortable spaces to hang out in—as important; however, the emphases each placed on why such priorities were important were different. They conclude, "broadly speaking, librarians tended to focus more on resources when describing their library spaces, whereas teens tended to focus more on the activities that take place there" (p. 35). The research team proposed that both motivations for shared priorities around features should be considered by library designers, stating "that libraries are not just places to house materials but also places where a wide range of activities and interactions take place" (Agosto et al., 2015, p. 39). The researchers concluded that they had finished their exploratory work, and recognized that in line with UCD principles, their next iteration of research should be to determine which of the priorities research participants

identified in their video reflections as important would have the greatest impact on patron experiences (p. 40).

In a 2014 conference paper, Yue and Beisler describe a project resulting from a user-centered design initiative at the University of Nevada at Reno. The Technical Services Department undertook to center the workflow of library users and to design access services around their information needs (Yue & Beisler, 2014). Technical Services staff first spent time observing and documenting the information-seeking practices of library patrons. They also documented how library staff instructed and facilitated user access. Then they reorganized their staff roles around those behaviors, better enabling the library to assist users in their work (p. 276-277). This paper provides an example of how user-centered design can transform operations in a library.

Each of these studies demonstrates ways in which user-centered design can improve library patron experiences. The cases are notably diverse, encompassing apps for specific projects, the design of physical spaces in libraries, and guidance for changes at the level of departmental operations. This suggests taking a user-centered design approach is appropriate for this library system's pilot program testing the viability of augmented reality technology for patron use at branch locations.

Augmented Reality in Libraries: The general increase of AR technology availability and use in society is mirrored by similar changes in libraries. Types of AR technologies are varied, and the ways in which they are used in library systems reflect those variations. According to Kannegiser, "libraries are using AR for collection discovery, library navigation, exhibits, instruction, and orientations" (Kannegiser, 2022). Although augmented reality is used across many kinds of libraries, research on the design, implementation and evaluation of AR in libraries

does not reflect that. Instead, studies investigate the potential such technology has as an instruction tool in academic libraries, both in wayfinding (in the form of library tours or orientations) and content instruction in information literacy and academic disciplines.

Concerned with making sure new college students are familiar with and comfortable in academic libraries, one common way LIS staff use augmented reality tools is in library orientation tours. Smith and Hottinger (2018) provide an example of one such study. Their article “Gotta Catch ‘Em All: A Case Study about Cal Poly Pomona’s Pokémon Go! AR Orientation” discusses a pilot project to evaluate an AR-guided library orientation tour for incoming students. The tour takes the form of a scavenger hunt. Rather than model an in-house-designed game on Pokémon Go!, the library staff used the game itself as the platform for the orientation activity. After students finished the scavenger hunt, they were asked to complete an exit survey about the experience (p. 154). Student responses showed that the decision to link the library tour to a moment in popular culture and online gaming was successful in engaging them in the activity. The researchers conclude that while paper-based orientation materials are easier, cheaper and less time-consuming for library staff to administer, augmented reality activities successfully engage students because they experience the space of the library more actively (p. 157).

Samantha Kannegiser (2019) reports on a similar AR-guided orientation pilot project at Rutgers University libraries. Her analysis of the post-activity findings shows that the most important impact the AR scavenger hunt style tour had was that it seemed to alleviate student anxiety around library use (pp. 157-158). Students also expressed that they felt confident in being able to find help at the library and that they were willing to ask for it (p. 159). In a 2021 study, Kannegiser refines her investigation into whether or not AR-mediated orientations alleviate anxiety by comparing the outcomes of an AR-guided orientation to those of a standard

library scavenger hunt orientation. Her findings again showed that, while the two types of active learning exercises were effective at orienting students to resources, the AR orientation more positively impacted student perceptions that librarians want to help them find the resources they need.

The research conducted on the design, delivery, and assessment of wayfinding activities, is consistent, with variations on the library orientation tour sharing both positive and negative features for users. Another type of augmented reality instruction in library and library-adjacent contexts includes work in archives to design exhibits. Calloway and Bishop's chapter "Augmenting Archives" describes for readers the process Archives staff at Washington College followed to research and develop a project where undergraduate students were able to use AR to research artifacts and design an exhibit to display them (pp. 93-112). Authors Bishop and Calloway observe that among other outcomes, one of the most important is that "traditionally, undergraduate students seldom, if ever, get the opportunity to work closely with rare primary source materials; instead, they work with facsimiles of these materials found in books and online. Augmented Archives leverages AR technology to give students their first opportunity for hands-on engagement with rare materials, and gives faculty the ability to craft instructional sequences to fulfill discipline-specific learning objectives using our collections" (p. 97).

Current publications devoted to the use of augmented reality technology in public libraries do not offer the kind of research analysis found in the literature of AR in academic libraries. Rather, readers are offered surveys outlining the history, current state of and potential for AR technology use in a general way. For example, Suzanne LaPierre's feature in *Libraries and Computers* magazine from April 2022 provides an overview of augmented reality use in libraries of all kinds and brief interviews with library professionals working with immersive

technology, commenting on the state of the field (LaPierre, 2022). Steph Waite's blog post in Web Junction is another example of the practical, advice-giving approach to the discussion of using augmented and virtual reality in public libraries, this time with action-oriented tips for professionals interested in incorporating new technology into their facilities (Waite, 2018). Such communication is an essential resource for the development of new services for library patrons.

That said, professionals needing to make planning decisions for pilot programs may also want more evidence-based discussion of how to go about introducing new technologies to patrons. The research on academic libraries offers some insight, but does not map perfectly onto the needs of a public library staff. Academic librarians, in partnership with faculty, have curriculum and learning outcomes they want students to meet. While learning is important in a public library context, success in achieving the goal of educating patrons isn't as tightly defined as that of an academic community. Additionally, user needs and concerns of students aren't perfectly congruent with those of public library patrons, with library anxiety and the need to learn library skills for courses being factors that are not as relevant to public library users. This study will contribute to the creation of a body of literature that address that information gap, and acknowledges the needs and interests of public library patrons as specific and distinct.

Methodology

This will be a mixed method study incorporating surveys (pre- and post-activity), two AR activities (with researcher(s) observing patron behavior), and a post-activity focus group interview.

The research team identified two branch locations of Thunder Cloud Regional Library System (Central Library and Miss Honey Memorial Library) so as to optimize the number of patrons who visit the library. A welcome table, situated outside the main entrance to each library,

will have tablets available for use. Instructions will be provided with the devices. Additionally, there will be (at least) one person from the research team at the welcome table to answer questions about the technology and give verbal instructions on the use of the tablet. A mixed method study will cover all bases and be easy to implement, especially using tablet technology to capture the information needed, such as answers to survey questions and timing of how long participants spend on the device performing the AR activities.

Participants will be asked to complete a pre-activity survey, with questions pertaining to previous experience with AR and other technology as well as library use habits. Upon completion of the pre-activity survey, patrons will participate in each of the AR activities: 1) wayfinding, which utilizes an app with AR built in (INDOAR) to help patrons navigate their way through the library to get where they need to go, and 2) a learning activity using the Star Chart app to look at the sky and see what the night sky shows you. Whether participants ask for help or not during the activities will be tracked, as will the length of time spent on each activity.

After finishing each activity, participants will complete a survey answering questions about whether/how much they enjoyed the activities, how easy or difficult the apps were to use, and what they might prefer to have access to in the library. There will be both closed-ended and open-ended questions. In order to gain even more insight, we will ask participants if they would be willing to come back and participate in a short focus group activity. This should be limited in the number of participants in order for it to be most effective.

We will not be actively recruiting participants for the study; however, we will advertise the study in advance on the library's website, on their social media sites, and on flyers in the libraries. We will use sampling of convenience, asking library users who approach the welcome table if they would be willing to participate in our study.

The independent variable in this study is the library patrons participating in the study, and the dependent variable is whether they prefer using AR for fun and learning (Star Charts app) or AR for wayfinding with INDOAR. The independent variable will be measured by:

- Logging individual sessions of device use to track the number of people who opt to participate in the activity on the device.
- Logging the amount of time spent using each app on the device.

The dependent variable will be measured by:

- Evaluating participants' answers to the pre- and post-activity survey questions, coding for themes pertaining to satisfaction levels in using each app and themes dealing with preferences for one AR technology activity over another.
- Tracking whether participants asked for assistance during an activity.

The population being studied is patrons of Central Library and Miss Honey Memorial Library. We will use a convenience sample, as patrons will choose whether or not to participate as they enter the library. In order to give as many patrons as possible opportunity to participate in the activities, we will conduct four sessions at each of the two locations: midafternoon and early evening on Tuesday and Thursday; and midmorning and afternoon on Saturday and Sunday.

There is an IRB requirement, so an application will be submitted to the Institutional Review Board. The study will be exempt because the human subjects being studied will not be subjected to any personal risks, such as health issues, financial issues, or privacy issues. Participants will be asked to sign a consent form (accessed on the tablet) authorizing the researchers to use all the information provided by participants in the study. The demographics collected will not personally identify anyone in any harmful way. We will only collect name and contact information if the participant is interested in participating in the follow-up focus group. The

study sample does not fall into the category of vulnerable people and is open to anyone willing to participate, regardless of ability. If the proposed activity is deemed inaccessible by any person, that will be valuable information for the researchers, indicating improvements must be made to the way in which AR technology is made available to patrons.

Keeping in mind a user-centered design approach as a means of enhancing users' experiences in the library, the primary objective of the study is to determine what the library community values in relation to library-provided technology, thus allowing the library to make informed decisions about how best to spend library funds in relation to the technology provided.

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