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# Affordable Audio Visual Solutions for Library Displays

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## Introduction

In addition to their main directives, many libraries and archives also have some type of exhibit/display space. Libraries can learn a lot from museum exhibit design, where audio visual (AV) components are often incorporated into the traditional exhibit spaces. Visitors can get enhanced experiences of the physical exhibits through portable devices, digital kiosks, and other technological means. According to the Smithsonian's 2002 "Developing Interactive Exhibitions at the Smithsonian" policy guide, "museum visitors have come to expect a high level of interactivity in museum exhibitions, especially non-art exhibitions."<sup>1</sup> To keep up with changing user expectations, some libraries and archives want their displays to offer a measure of interactivity. This article examines a sampling of options for incorporating AV elements into displays for institutions with staff and budgetary limitations.

## Literature Review

With museums leading the way in exhibit design and enhanced visitor experiences, libraries, archives, and historical societies have an opportunity to review the steps taken within museums to evaluate the best methods of incorporating technologies into their displays. While most of the literature on exhibit design naturally focuses on museums, the concepts can be applicable to exhibit/display creation in other institutions with a bit of creativity and persistence.

For decades, museums have adopted emerging technologies to enhance exhibit experiences. The first museum audio tour technology was introduced in 1952 by Willem Sandberg in Amsterdam's Stedelijk Museum.<sup>2</sup> Keith Schneider writes, "Since [the time] tape recorders and audio tours were first introduced, art museums have embraced technology to provide more engaging ways for patrons to interact with exhibits."<sup>3</sup>

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<sup>1</sup> Smithsonian Institution. "Developing Interactive Exhibitions at the Smithsonian." Office Policy Guide. (2002): vii. Accessed on 14 June 2018 at <https://www.si.edu/Content/opanda/docs/Rpts2002/02.05.InteractiveExhibitions.Final.pdf>.

<sup>2</sup> Loic Tallon and Kevin Walker (eds.). *Digital Technologies and the Museum Experience: Handheld Guides and Other Media*. (Lanham, Md.: AltaMira Press, 2008): x, xiii.

<sup>3</sup> Keith Schneider. "The Best Tour Guide May Be in Your Purse." *The New York Times*, 13 March 2010. Accessed on 22 June 2018 at <https://www.nytimes.com/2010/03/18/arts/artsspecial/18SMART.html>.

Interactive components to exhibit spaces are not included simply to make museum experiences more vibrant than the older static models, but are often intended to account for the varieties of visitor learning styles. The theory of multiple intelligences, espoused by Harvard psychology professor Howard Gardner (*Frames of Mind: The Theory of Multiple Intelligences*, 1983), has greatly impacted educational models. Research by John Falk and Lynn Dierking (*The Museum Experience*, 2011; *Learning from Museums*, 2000; and more) has examined various approaches of museum design that account for multiple learning styles and motivations for learning. Museum design consultant Kathleen McLean writes that “[museum] exhibitions must accommodate all types of learners.”<sup>4</sup> John Falk explains that “the ‘one size fits all’ experiences provided for visitors by most museums (e.g. exhibits, programmes, tours) do not work equally well for all visitors all the time.”<sup>5</sup> Falk argues that once multiple learning styles and motivations are taken into consideration for visitor experiences, museums “improve the likelihood that occasional museum users will become regular users, and provide new and improved ways to attract groups of individuals who historically have not thought of museums as places that meet their needs.”<sup>6</sup>

Confirming visitors present with varied learning styles, study after study proves that enhancing the visitor experience by layering exhibit technologies is a growing trend worthy of emulation. Dinesh Katre and Mandar Sarnaik study the “cognitive needs of museum visitors” to inform better kiosk software design.<sup>7</sup> A National Science Foundation funded whitepaper “Making Museum Exhibits Accessible for All” examines the role technology can play in exhibits: “Where, for example, past exhibits might have included only text with visuals or dioramas, some exhibit designs now include audio elements that read aloud the text.”<sup>8</sup> The

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<sup>4</sup> Kathleen McLean. *Planning for People in Museum Exhibitions*. (Washington, DC: Association of Science-Technology Centers, 1993): 9.

<sup>5</sup> John Falk. “Understanding Museum Visitors’ Motivations and Learning.” *Museums Social Learning Spaces and Knowledge Producing Processes*. Ed. Ida Brændholt Lundgaard and Jacob Thorek Jensen. (Copenhagen, Denmark: Danish Agency for Culture, 2013): 122. Accessed 22, June 2018 at [https://issuu.com/kunststyrelsen/docs/museums\\_social\\_learning](https://issuu.com/kunststyrelsen/docs/museums_social_learning)

<sup>6</sup> *Ibid.*, 124.

<sup>7</sup> Dinesh Katre and Mandar Sarnaik. “Identifying the Cognitive Needs of Visitors and Content Selection Parameters for Designing the Interactive Kiosk Software for Museums.” *IFIP Advances in Information and Communication Technology* (Pune, India. Springer, 2010): 1. Accessed on 18 June 2018 at <https://hal.inria.fr/hal-01056244/document>.

<sup>8</sup> Madeline Rothberg and Christine Reich. “Making Museum Exhibits Accessible for All: Approaches to Multi-modal Exhibit Personalization.” *Creating Museum Media for Everyone*. Collaborative whitepaper by WGBH National Center for Accessible Media, Ideum, Audience Viewpoints, and Museum of Science, (Boston: December 2014): 1.

Metropolitan Museum of Art's Digital Media Associate Grace Tung writes about "Improving the Audio Guide" after an extensive study of visitor behavior.<sup>9</sup>

Users with cognitive disabilities might require even more diverse or specialized design elements. In his article "What's It Like to Have ADD?" Edward Hallowell, M.D. writes, "The way I go through a museum is the way some people go through [the department store]. Some of this, some of that, oh, this one looks nice, but what about that rack over there? Gotta hurry, gotta run. It's not that I don't like art. I love art. But my way of loving it makes most people think I'm a real Philistine."<sup>10</sup> Many studies address how museums can design for people with conditions such as ADD, autism, and other forms of being differently abled. Caroline Braden, Guest Accessibility/Special Needs Assistant at the Henry Ford Museum, offers many solutions in "Welcoming All Visitors: Museums, Accessibility, and Visitors with Disabilities."<sup>11</sup> The Institute of Museum and Library Services (IMLS) maintains an "Accessibility Resources for Museums and Libraries" page, with information to help museums design exhibits and spaces to account for the large variety of accessibility needs of patrons.<sup>12</sup>

There are a number of studies evaluating visitors' use of smartphones for accessing interactive components, instead of separate, dedicated museum technologies. In their study on smartphone museum guide usability, Othman, Petrie, and Power write, "Smartphones are increasingly being deployed by museums and other cultural spaces to provide guides for visitors, replacing dedicated audioguides or docents."<sup>13</sup> Some advantages are that there is no

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<sup>9</sup> Grace Tung. "Improving the Audio Guide: A Look at Our Visitors." *Digital Underground* blog of the Metropolitan Museum of Art. 19 June 2015. Accessed on 28 June 2018 at <https://www.metmuseum.org/blogs/digital-underground/2015/improving-the-audio-guide-a-look-at-our-visitors>.

<sup>10</sup> Edward Hallowell. "What's It Like to Have ADD?" FASlink Fetal Alcohol Disorders Society. Accessed on 11 August 2018 at <http://www.acbr.com/fas/adhdlike.htm>.

<sup>11</sup> Caroline Braden. "Welcoming All Visitors: Museums, Accessibility, and Visitors with Disabilities." Working Papers in Museum Studies 12 (University of Michigan 2016). Accessed on 11 August 2018 at <http://ummsp.rackham.umich.edu/wp-content/uploads/2016/10/Braden-working-paper-FINAL-pdf.pdf>.

<sup>12</sup> Institute of Museum and Library Services. "Accessibility Resources for Museums and Libraries." Accessed on 11 August 2018 at <https://www.ims.gov/issues/national-issues-priorities/accessibility-resources-museums-and-libraries>.

<sup>13</sup> Mohd Kamal Othman, Helen Petrie, and Christopher Power, "Measuring the Usability of a Smartphone Delivered Museum Guide." *Procedia - Social and Behavioral Sciences* (Volume 97: 2013): 629. Accessed 22 June 2018 at <http://www.sciencedirect.com/science/article/pii/S1877042813037270>.

equipment cost to the institution, and patrons are more familiar with their own phones than they are trying to learn how to use a new device.<sup>14</sup>

Despite research touting their benefits, not all experiences with portable museum guides and/or cell phones have been positive. Museum educator and author Marjorie Schwarzer asks “Are hand-helds so distracting that they ruin the chance for elevated experience with art? Or, by providing more information, do they actually increase visitor appreciation?”<sup>15</sup> Some visitors spend the majority of their time staring into the device screens, and not at the physical exhibits. In response, during one Whitney Museum of American Art exhibition, devices repeatedly gave messages to “please look at the artwork.”<sup>16</sup> A 2014 photo by Gijsbert van der Wal in the Rijksmuseum Amsterdam perfectly captures the tension of portable technologies in museums. Van der Wal explains: “A small group of high school students were sitting on the benches in front of Rembrandt’s *Nightwatch*. Almost all of them were either looking at their own smartphones or their classmates.”<sup>17</sup> The viral photograph was shared almost 10,000 times on social media within a few days, with some using it as a commentary on our times, captioning the photo with variations of “today’s youth is more interested in Whatsapp than they are in Rembrandt.”<sup>18</sup> Others cautioned that the image doesn’t necessarily show the full picture, arguing that the children were using a museum app to learn more about Rembrandt’s famous painting. The photographer explains, “I think a well-designed museum app should continuously direct the attention of the user from the phone to the actual objects on display. The children in the photograph didn’t look up, they just kept staring at their phones.”<sup>19</sup>

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<sup>14</sup> Ibid.

<sup>15</sup> Marjorie Schwarzer. “Art & Gadgetry: The Future of the Museum Visit,” *Museum News*, (July/August 2001): 39.

<sup>16</sup> Ibid.

<sup>17</sup> Gijsbert van der Wal. Photograph. 27 November 2014, Rijksmuseum Amsterdam. Accessed on 25 June 2018 at <https://www.flickr.com/photos/gijsvanderwal/15893868835>.

<sup>18</sup> Ibid.

<sup>19</sup> Ibid.



Rijksmuseum Amsterdam, 27 November 2014. Photograph by Gijsbert van der Wal.

Some museums have incorporated augmented reality (AR) apps to overlay digital content onto the actual physical views of exhibits via smartphones or tablets, using technology similar to that in games like Pokémon Go. Despite all of their positive uses, AR technologies have gotten recent attention in museums, particularly the Museum of Modern Art (MoMA), where a “group of renegade artists has co-opted the brightly-lit Jackson Pollock gallery [...] turning it into their personal augmented reality playground.”<sup>20</sup> This group, calling themselves MoMAR, have created an alternate app to the MoMA’s official one, where, in one example, Pollock’s painting *White Light* becomes “an interactive game.”<sup>21</sup> On their website, the group defines itself as “An unauthorized gallery concept aimed at democratizing physical exhibition spaces, museums, and the curation of the art within them. MoMAR is non-profit, non-owned, and exists in the absence of any privatized structures. MoMAR uses Augmented Reality to overlay art onto existing artwork and frames housed in museums and gallery spaces around the world.”<sup>22</sup>

In spite of this short list of technologies being misappropriated or simply achieving the opposite of their intended effect, museums will continue using technologies to enhance the museum experience. Whether simply to stay current or to account for varying learning styles or cognitive disabilities, technologies in museums are here to stay. Given the challenges the museum world has already addressed, libraries and archives are now in a position to more fully understand and prepare for what technology can bring to the perceived quiet, orderly realm of research facilities.

### **Inexpensive Technology-Enhanced Exhibits: Suggestions and Examples**

Like the often misattributed quote “Writing about music is like dancing about architecture,”<sup>23</sup> a display about music with no actual music leaves much to be desired. The first exhibit at the University of Mississippi’s Department of Archives and Special Collections to incorporate a multimedia experience was 2009’s *Still Got the Blues: A Silver Anniversary Exhibition*. The department wanted visitors to have a richer exhibit experience than just seeing displays of physical objects and signage. At the time, professional museum computer kiosks were cost

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<sup>20</sup> Miranda Katz. “Augmented Reality Is Transforming Museums.” *Wired*. 23 April 2018. Accessed 25 June 2018 at <https://www.wired.com/story/augmented-reality-art-museums/>.

<sup>21</sup> Ibid.

<sup>22</sup> MoMAR. Accessed on 28 June 2018 at <http://momar.gallery/index.html>.

<sup>23</sup> O’Toole, Garson. “Writing about architecture is like dancing about architecture.” Quote Investigator. 8 November 2010. Accessed 13 August 2018 at <https://quoteinvestigator.com/2010/11/08/writing-about-music/#more-1519>.

prohibitive and tablets had not truly emerged on the market. [Though Microsoft and partners Lenovo and Fujitsu created tablet computers a decade earlier, it wasn't until 2010 and the release of Apple's iPad, that tablets became mainstream.]<sup>24</sup> Rather than create fixed kiosks, the most cost-effective means the Archive found for delivering audiovisual content to patrons visiting the exhibit was through portable media players. Because of their comparatively low cost, relatively high storage capacity, and ability to play audio and video, eight Creative ZEN media players were purchased. Visitors to the exhibit could check out the devices at the Archives service desk. The twenty-one display cases each had signage pointing to the specific files to play on the media players. In addition to seeing a physical one-string guitar box banjo in an exhibit case and reading the explanatory text, for instance, visitors could watch video clips of bluesmen Napoleon Strickland and Lonnie Pitchford building different styles of one string instruments, and see and hear their different playing techniques. Rather than only read a description of North Mississippi African American fife and drum music, visitors could watch a video of Othar Turner performing. At just over \$100 per media player in 2009, the department was able to provide AV content for up to eight simultaneous exhibit visitors for approximately \$1,000. These devices provide adaptability and are incorporated into other exhibitions even a decade after their debut.

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<sup>24</sup> Julie Bort. "Microsoft Invented A Tablet A Decade before Apple and Totally Blew It." *Business Insider*. 30 May 2013. Accessed on 12 June 2018 at <http://www.businessinsider.com/heres-visual-proof-of-just-how-badly-microsoft-blew-it-with-tablets-2013-5>.





Visitor using a Creative ZEN media player to view exhibit video content.  
Photograph by the author.

Institutions wishing to offer audio-only playback options for displays similar to this have a wealth of options. As of the time of researching this article, there are dozens of varieties of portable audio players, with prices ranging from \$13 - \$80, and the majority around \$20/player. Portable devices capable of playing video are more expensive. While there are devices for as little as \$14, their video quality and battery life should be considered.

Regardless of hardware, using such devices allows patrons to hear musical or oral history examples at very little cost to the institution. Specialized museum AV guide devices offer more robust options than the media players used for the University of Mississippi exhibits, but costs are significantly higher. While more appropriate for larger museums with high visitor counts, such devices are likely too cost prohibitive for small museums or archives/libraries with minimal display spaces.

For 2018's "*No Two Alike*": *A Special Collections and University Museum Exhibition*, the department decided to use fixed kiosks for displaying AV content in the exhibit, to offer alternative interactivity to what had been done with our previous exhibits. The prices for specialized museum interactive kiosks were too high for the budget, leading the department to examine alternatives. The solution was to purchase tablet computers and mount them to the top of wooden pedestals.

Because of their widespread adoption and software development, four iPads (two standard 9.7-inch iPads and two 12.9-inch iPad Pros) were purchased. Another factor in purchasing tablets is versatility outside this specific use as kiosk displays. If not used in a future exhibit, there are multiple non-exhibit functions for the iPads within the department. Likewise, the pedestals can be used to display objects other than iPads (e.g. busts or other three dimensional art) if it is determined that a future exhibit will not require interactive technology components. If iPads are too expensive for your needs, there are significantly less expensive tablet options (Amazon Fire, Samsung Galaxy, Microsoft Surface, and more).



James "Son" Thomas folk art display case with iPad kiosk and 3D printed duck.  
Photograph by the author.

For this exhibit, a member of the University Communications department helped produce several short films providing more context to the displayed items. The films also show some of the three dimensional items from multiple angles, allowing visitors to see parts of the objects that can't easily be viewed within display cases. The exhibit utilized the library's newly purchased 3D scanner and printer to create a 3D image of one of the sculptures in the exhibit. Via the tablets, visitors can see a 3D rendering of the object and view a time lapse video of a replica of the object being printed on the 3D printer. Unlike the original displayed object, the 3D printed replica can then be held and handled by visitors.

While there are a number of iOS and Android kiosk apps, the department decided to use the Kiosk Mode for iPad app by Reality Interactive, LLC. This no-frills, freeware app effectively hides the browser URL bar and other user interface elements, forcing users to only see what the curators want visitors to see. To keep visitors from closing out of the intended kiosk mode view and using other features on the iPads, "Guided Access" was enabled and passcode set. According to Apple, "Guided Access limits your device to a single app and lets you control which app features are available."<sup>25</sup> "Guided Access" allows the Archive to limit users to the Kiosk Mode for iPad app. It also deactivates the home and power keys; curators can bypass all of this with a passcode. The kiosk app points to a simple exhibit website created in WordPress. The library already has a subscription to the business version of WordPress, but others can use the free version to easily create websites. A drawback to using the free version of most website creator sites is that the site you create often has their company logo and sometimes ads incorporated into your page. Web design software can be avoided altogether if someone on your staff knows HTML, CSS, and/or PHP and has good design skills. There are much more robust options for adding AV elements to exhibits, but our methods only took the cost of the tablets, pedestals, protective tablet kiosks, and staff time building the exhibit website.

Incorporating Quick Response (QR) codes mounted in display areas is a possible solution for underfunded institutions to integrate smartphone technology into exhibit spaces for almost no cost. By placing QR codes in or next to exhibit cases, visitors can quickly access extra content on their smartphones. One negative side effect to QR codes lack of popularity was the need for users to install third party apps to use them. Though many thought the QR code was obsolete, Apple

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<sup>25</sup> Apple Inc. "Use Guided Access with iPhone, iPad, and iPod touch." Apple Support. Accessed on 25 June 2018 at <https://support.apple.com/en-us/ht202612>.

added a native QR reader into its iOS 11 release in September 2017.<sup>26</sup> On 28 June 2018, Microsoft announced new support for QR codes through its LinkedIn social network.<sup>27</sup> With these large tech companies throwing recent energy into the QR code, this might still be a good option for adding AV content into physical exhibit spaces. Several Archives exhibits at the University of Mississippi have incorporated QR codes. A patron scanning a QR code in a display case of records donated by B. B. King, for example, is automatically connected to the library catalog entries for all of the sound recordings in the B. B. King Collection. Scanning a QR code in another display case about the integration of the University of Mississippi pulls up the James Meredith Collection finding aid. Using QR codes is an easy way of linking information in display cases with content in your library catalogs, finding aids, digital collections, and more.



Example of a QR code used in an exhibit case on James Meredith which links to that collection's finding aid.

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<sup>26</sup> Paul Armstrong. "Apple Just Made QR Codes A Must Have for Your Strategy." *Forbes*, 22 September 2017. Accessed 2 July 2018 at <https://www.forbes.com/sites/paularmstrongtech/2017/09/22/apple-just-made-qr-codes-a-must-have-for-your-strategy/#7da6097250dd>.

<sup>27</sup> Ingrid Lunden. "LinkedIn adds Microsoft-Powered Translations and QR Codes to Connect More of its Users Faster." *TechCrunch*, 28 June 2018. Accessed 28 June 2018 at <https://techcrunch.com/2018/06/28/linkedin-adds-microsoft-powered-translations-and-qr-codes-to-connect-more-of-its-users-faster/>.

There are some basic concerns with smartphone interactivity in exhibits. A 2018 Pew Research Poll finds that 77% of Americans own smartphones.<sup>28</sup> Despite this fairly high percentage, these numbers indicate that one in four people will not be able to access interactive portions of the exhibit. If your institution chooses to design exhibits that interact with smartphones, an option could be purchasing at least one device that could be checked out by visitors who do not own a smartphone. Most apps designed for smartphones are also accessible on tablets; having a tablet that can be checked out is another solution.

There are a number of companies that design museum apps for iOS and Android smartphones. Costs vary depending on app creation and required software updates, so unless someone at your institution can create mobile device apps, this could be expensive. Because time is also valuable, some of these commercial options might be more appropriate for understaffed institutions.

Exhibits could make use of multiple technology options. An exhibit with fixed kiosks, for example, could also use QR codes to allow users with smartphones to access the same content on the kiosks. This is useful when large numbers of concurrent visitors view the exhibit; the content can simultaneously be accessed on the kiosks and multiple smartphones.

No matter what technologies are selected, always consider accessibility issues when creating AV content for exhibits. Whether or not the institution mandates adding closed caption text to all videos, it is good to do so. Users unable to hear the audio can enable closed captioning to see a real time transcription of the spoken content. Advances in speech recognition software have made this process much easier. For instance, YouTube can now automatically caption any uploaded video. As these automated captioning services aren't perfect, it is recommended that all transcribed text be edited before making the final videos public. A useful source to make sure kiosks and web content are meeting the most recent accessibility standards can be found in the W3C Web Accessibility Initiative's *Web Content Accessibility Guidelines*.

Patron interactions with University of Mississippi Archive displays shows a wide range of behaviors. Some visitors take full advantage of the exhibit offerings: examining every displayed item, reading all signage, and engaging with the interactive technologies. Other visitors avoid the AV devices, limiting their experience to only viewing the items in the cases. In only a very few cases did a

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<sup>28</sup> Pew Research Center. "Mobile Fact Sheet." 5 February 2018. Accessed 22 June 2018 at <http://www.pewinternet.org/fact-sheet/mobile/>

visitor limit experiences only to the content included on one of the tech devices. In these instances, the visitors were only interested in listening to audio loaded onto the media players. In most cases, visitors only casually browse the physical displays and media devices. While it is clear that these displays offer several options for different learning styles, the Archive has not gathered data to determine their effectiveness.

Aside from making display case content more accessible through options such as text readers, not all displays need a corresponding technological device. In preparing new displays determine whether the displayed items sufficiently convey your message on their own, or could they benefit from an additional technological offering. In some cases, the displayed physical objects (photographs, letters, books) are adequate with no technology augmentations. In others, AV technologies can provide experiences a static display simply cannot. Would a display about a famous dancer be enhanced with video of the performer in action? Would audio of an author reading one of her poems provide something better than a display of the printed poem alone? Do objects in your display case have intricate designs or concepts that are best viewed from different angles? Could a technological solution make this possible?

Consider additional means of using technologies to increase interactivity with your displays. Most of these examples have illustrated how technologies can help visitors access audio and video, and/or consume information differently. However, in order to really learn, some people require more true interactivity with content. Quizzes can be fairly easily created on tablets, allowing visitors to test their comprehension of the displays. Consider partnering with computer science students to create simple tablet games that help users learn more about your exhibited materials. While these won't offer the sophisticated, immersive, interactivity of some top museums, they can allow for an enhanced learning experience over static displays alone.

Computer technologies not only allow for displays of AV content, provide more interactivity between visitors and displays, and offer accessibility solutions, they have become an expected component of the museum experience. Adrian Murphy notes, "as a new generation of museum goers emerges from a childhood not knowing anything but the smartphone world, it is becoming more apparent that they will expect new ideas in museum interpretation to include the use of interactive

technology.”<sup>29</sup> Advances in smartphone and tablet technologies, and their increased use by the public, are creating new possibilities and challenges for exhibit creators, but libraries, archives, small museums, and historical societies wishing to incorporate more interactive components into physical exhibits/displays can now do so for relatively little expense.

## References

Apple Inc. “Use Guided Access with iPhone, iPad, and iPod touch.” Apple Support. Accessed on 25 June 2018 at <https://support.apple.com/en-us/ht202612>.

Armstrong, Paul. “Apple Just Made QR Codes A Must Have for Your Strategy.” *Forbes*, 22 September 2017. Accessed 2 July 2018 at <https://www.forbes.com/sites/paularmstrongtech/2017/09/22/apple-just-made-qr-codes-a-must-have-for-your-strategy/#7da6097250dd>.

Bort, Julie. “Microsoft Invented A Tablet A Decade before Apple and Totally Blew It.” *Business Insider*. 30 May 2013. Accessed on 12 June 2018 at <http://www.businessinsider.com/heres-visual-proof-of-just-how-badly-microsoft-blew-it-with-tablets-2013-5>.

Hallowell, Edward. “What’s It Like to Have ADD?” FASlink Fetal Alcohol Disorders Society. Accessed on 11 August 2018 at <http://www.acbr.com/fas/adhdlite.htm>.

Institute of Museum and Library Services. “Accessibility Resources for Museums and Libraries.” Accessed on 11 August 2018 at <https://www.imls.gov/issues/national-issues-priorities/accessibility-resources-museums-and-libraries>.

Falk, John. “Understanding Museum Visitors’ Motivations and Learning.” *Museums Social Learning Spaces and Knowledge Producing Processes*. Ed. Ida Brændholt Lundgaard and Jacob Thorek Jensen. Copenhagen, Denmark: Danish Agency for Culture, 2013. Accessed 22, June 2018 at [https://issuu.com/kunststyrelsen/docs/museums\\_social\\_learning](https://issuu.com/kunststyrelsen/docs/museums_social_learning)

Katre, Dinesh and Mandar Sarnaik. “Identifying the Cognitive Needs of Visitors and Content Selection Parameters for Designing the Interactive Kiosk Software for

---

<sup>29</sup> Murphy, Adrian. “Technology in Museums: Making the Latest Advances Work for Our Cultural Institutions.” *Museums + Heritage Advisor*. 17 December 2015. Accessed 6 May 2019 at <https://advisor.museumsandheritage.com/features/technology-in-museums-making-the-latest-advances-work-for-our-cultural-institutions/>.

Museums.” Dinesh Katre; Rikke Orngreen; Pradeep Yammiyavar; Torkil Clemmensen. *Second IFIP WG 13.6 Conference on Human Work Interaction Design: Usability in Social, Cultural and Organizational Contexts (HWID)*, Oct 2009, Pune, India. Springer, IFIP Advances in Information and Communication Technology, AICT-316, pp.168-179, 2010. Accessed on 18 June 2018 at <https://hal.inria.fr/hal-01056244/document>.

Katz, Miranda. “Augmented Reality Is Transforming Museums.” *Wired*. 23 April 2018. Accessed 25 June 2018 at <https://www.wired.com/story/augmented-reality-art-museums/>.

Lunden, Ingrid. “LinkedIn adds Microsoft-Powered Translations and QR Codes to Connect More of its Users Faster.” *TechCrunch*, 28 June 2018. Accessed 28 June 2018 at <https://techcrunch.com/2018/06/28/linkedin-adds-microsoft-powered-translations-and-qr-codes-to-connect-more-of-its-users-faster/>.

McLean, Kathleen. *Planning for People in Museum Exhibitions*. Washington, DC: Association of Science-Technology Centers, 1993.

MoMAR. Accessed on 28 June 2018 at <http://momar.gallery/index.html>.

Murphy, Adrian. “Technology in Museums: Making the Latest Advances Work for Our Cultural Institutions.” *Museums + Heritage Advisor*. 17 December 2015. Accessed 6 May 2019 at <https://advisor.museumsandheritage.com/features/technology-in-museums-making-the-latest-advances-work-for-our-cultural-institutions/>.

O’Toole, Garson. “Writing about architecture is like dancing about architecture.” *Quote Investigator*. 8 November 2010. Accessed 13 August 2018 at <https://quoteinvestigator.com/2010/11/08/writing-about-music/#more-1519>

Othman, Mohd Kamal, Helen Petrie, and Christopher Power, “Measuring the Usability of a Smartphone Delivered Museum Guide.” *Procedia - Social and Behavioral Sciences*, Volume 97: 2013. Accessed 22 June 2018 at <http://www.sciencedirect.com/science/article/pii/S1877042813037270>.

Pew Research Center. “Mobile Fact Sheet.” 5 February 2018. Accessed 22 June 2018 at <http://www.pewinternet.org/fact-sheet/mobile/>

Rothberg, Madeline and Christine Reich. “Making Museum Exhibits Accessible for All: Approaches to Multi-modal Exhibit Personalization.” *Creating Museum Media for Everyone*. Collaborative whitepaper by WGBH National Center for



Accessible Media, Ideum, Audience Viewpoints, and Museum of Science, Boston: December 2014.

Schneider, Keith. "The Best Tour Guide May Be in Your Purse." *The New York Times*, 13 March 2010. Accessed on 22 June 2018 at <https://www.nytimes.com/2010/03/18/arts/artsspecial/18SMART.html>.

Schwarzer, Marjorie. "Art & Gadgetry: The Future of the Museum Visit," *Museum News*, July/August 2001.

Smithsonian Institution. "Developing Interactive Exhibitions at the Smithsonian." Office Policy Guide. 2002. Accessed on 14 June 2018 at <https://www.si.edu/Content/opanda/docs/Rpts2002/02.05.InteractiveExhibitions.Final.pdf>.

Tallon, Loïc and Kevin Walker (eds.). *Digital Technologies and the Museum Experience: Handheld Guides and Other Media*. Lanham, Md.: AltaMira Press, 2008.

Tung, Grace. "Improving the Audio Guide: A Look at Our Visitors." *Digital Underground* blog of the Metropolitan Museum of Art. 19 June 2015. Accessed on 28 June 2018 at <https://www.metmuseum.org/blogs/digital-underground/2015/improving-the-audio-guide-a-look-at-our-visitors>.

van der Wal, Gijsbert. Photograph. 27 November 2014, Rijksmuseum Amsterdam. Accessed on 25 June 2018 at <https://www.flickr.com/photos/gijsvanderwal/15893868835>. [Used with permission of the photographer.]

World Wide Web Consortium (W3C). Web Content Accessibility Guidelines. Accessed 2 July 2018 at <https://www.w3.org/WAI/standards-guidelines/wcag/>.