Article

"I Want to Experience the Past": Lessons from a Visitor Survey on How Immersive Technologies Can Support Historic Interpretation

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Abstract: This paper utilizes a visitor survey conducted at an open-air museum in New Harmony, Indiana to discuss design guidelines for immersive technologies that support historic interpretation–specifically, the visitor's ability to experience the past. We focus on three themes that emerged from the survey: (1) Visitors at this site skewed older, with nearly a quarter over 70; (2) Despite literature suggesting the opposite, visitors at New Harmony liked to learn from a tour guide; and, (3) Visitors said they wanted to "experience the past." The very notion of a single "experience" of the past, however, is complicated at New Harmony and other historic sites because they interpret multiple periods of significance. Ultimately, our findings suggest immersive technologies must be suited for older visitors, utilize the tour guide, and facilitate visitors' ability to "experience the past" in such a way that they feel immersed in multiple timelines at the same site.

Keywords: immersive technologies; augmented reality; design; cultural heritage; historic interpretation; museums; ubiquitous computing

1. Introduction

In their seminal study on American attitudes about the past, historians Roy Rosenzweig and David Thelen discovered that "Americans put more trust in history museums and historic sites than in any other sources for exploring the past" [1]. One of the reasons their respondents ranked these cultural heritage sites and institutions so highly was because the respondents believed they could experience "a moment from the past almost as it had originally been experienced." [1]. Though the site itself may and often does help visitors make that connection, most museums and historic sites also rely on historic interpreters to mediate between the past and present, between their objects and buildings and their visitors.

Much has changed since Rosenzweig and Thelen first began that survey in 1994, however. Visitors still want to "experience the past," but their ability to do so—in light of the industry's financial constraints and the visitors' own changing historical consumption patterns and preferences—has, perhaps, been curtailed. As such, museums and historic sites have looked to new technologies to reach more people with less money. Embodied [2], Augmented, and Virtual Reality [3] applications are particularly promising in this context, as they can enable visitors to immerse themselves in the past [4]. In order to be effective, however, immersive technologies at historic sites must not only work from an implementation standpoint: like in any other museum and public place, these installations have no utility if visitors do not use them [5]. Rather, they need to engage visitors by supporting the activities they enjoy doing during their visit, and by fitting the motivations that bring them to historic sites.

We want to highlight that this paper does not describe the implementation or evaluation of a specific, novel installation, nor is it centered on a literature review of existing

technologies for interactive guided tours. Rather, we conducted a visitor's survey at an open-air museum in in New Harmony, Indiana (Figure 1) to derive design guidelines for immersive technologies that can support historic interpretation—specifically, the visitor's ability to experience the past. In particular, we focus on three conclusions that emerged from the survey: (1) Visitors at this site skewed older (i.e., almost a quarter of them were over 70 year old); (2) Despite some literature that suggests the opposite, visitors at New Harmony liked and preferred to learn from a tour guide; and, (3) Like Rosenzweig and Thelen reported, these visitors said they wanted to "experience the past." The very notion of a single "experience" of the past, however, is untrue at New Harmony like at many historic sites, because they interpret multiple periods of significance.

Figure 1. New Harmony today includes a diverse group of buildings and spaces. From left to right, top to bottom: Atheneum Visitor's Center, Communal Bake Oven, Church Park (with the Door of Promise, as it looks today—this space was used by the Harmonists as a church, and by the Owenites as a community center), and Community House Number Two.

2. Background and Related Work

Historic interpretation at museums and historic sites, i.e., the process by which visitors "experience" the past by making meanings and connections to the past [6], has a long and storied history of its own. In the nineteenth century, this practice focused on didactic tools such as static labels and factual brochures that visitors read while touring the site [7]. It might also include the occasional special program, like a lecture or address which would have provided a more cohesive, albeit narrow, narrative about the museum or site. The chief aim of this type of interpretation was to deliver mere facts from knowledgeable staff—curators and experts who often wrote in a "voice that was technical, verbose, and

eminently curatorial"—to passive, presumably unlearned individuals [7]. With these types of interpretative practices, museums and historic sites were more often seen as what museologist Duncan F. Cameron called "temples"—that is to say, places where stories of exalted individuals were showcased without debate [8].

2.1. Third vs. First-Person Interpretation

By the 1930s, however, American attitudes about the past were slowly changing. The Roosevelt Administration pumped money into the Works Projects Administration (WPA), which set out to examine the lived experiences of average, everyday folk. They captured their findings in a variety of ways, from the oral histories they conducted of former slaves [9] to the guidebooks they crafted for each state [10]. This "documentary impulse" moved Americans away from the notion that history only happened from the top down and showed them their own role in shaping the historical record [11]. Perhaps it is not surprising that it was at this time when the first open-air museums in the country— places like Greenfield Village in Michigan and Colonial Williamsburg in Virginia—began operations. Although there was nothing ordinary about these museums—after all they were giant, sprawling campuses stuffed with authentic and recreated structures and objects— the stories they told and the way they told them catered to plebeian audiences eager to consume historical content in new ways. Specifically, these historic sites pioneered novel ways of presenting information through third, and then first-person, interpretation.

2.1.1. Third-Person Interpretation

Third-person interpretation had two major types of practice which started as early as 1876 but were not popularized until the 1930s [12]. Both had volunteers or museum staff lead tours of the site while divulging important information about its history and the objects on display. The difference between the two came in the attire of the guides. In one, guides, or docents, wore modern-day clothes. In the other, they wore period costumes. Regardless of the way they were dressed, guides spoke and addressed their visitors in the contemporary times and with contemporary language. These third-person interpreters did not replace labels, brochures, and lectures, but rather, supplemented them. Their role was to bridge the past and the present for the museum guest.

2.1.2. First-Person Interpretation

As the American social, cultural, politica, and physical landscapes changed dramatically, audiences pined for a bygone era [13,14]. They looked to the past to keep them anchored in an ever-changing and therefore alarmingly alien present.

Historic sites and museums obliged them by introducing full costumed performances in first-person interpretation. Interpreters played a specific role (or roles) as they dressed up and performed as persons from the past. This is perhaps best demonstrated in the shift that Plimoth Plantation underwent in the late 1950s through the early 1970s that transformed it from a dull "life-sized diorama" awash with pristine mannequins, to one that was gritty, dirty, and "real," as it was populated with first-person interpreters [15]. Costumed interpreters not only looked the part, they acted—replete with using personal pronouns— as if they lived in that period of significance. This interpretive device, also known as "living history," was implemented as a way to transport visitors to the past—museum guests could now interact with historical actors in a historical place using historical objects. Though guests could ask questions of the interpreters, there were significant limitations as interpreters were encouraged to never "break character."

At the same time other museums and historic sites, either out of financial constraints or out of practicality (after all, most collections could not support a living history interpretation), kept with the docents and guided tours. Though a dialogic conversation between interpreter and guest was always possible, and maybe even encouraged, it was also dependent upon the former's authority and the latter's ignorance. Thus, in both of these

cases, visitors were constrained in their ability to access the past; they were dependent upon mediators—in this case, guides and interpreters.

2.2. Museums Discover Their Visitors

Since Michael Frisch published his foundational text in 1990, museum professionals have grappled with many problems associated with "shar[ing] authority" in a world that is increasingly amenable to visitor input and demands [16]. Today's visitors want to "come to conclusions on [their] own, instead of listening to someone else's tainted conclusions" [1]; and museums have responded. As museum consultant Sten Rentzhog put it, by the late 1990s, museums "discovered their visitors" [17], and what they discovered, at least according to some studies, is that the guided tour—regardless of whether or not it relied on first- or third person interpretation—had become irrelevant [18]. The curated material interpreters conveyed was traditionally crafted from the top down, the delivery they used was restrictive, static, and could be condescending, and finally, the interpreters were no longer the sole authority on any given topic, considering the fact that visitors could often answer their own questions by using their smart phones. Perhaps the perceived problems of the traditional guided tour was best articulated in a Connecticut Cultural Consumers survey conducted in 2008 [19]. When asked to explain how they felt about guided tours, nearly 48 percent of the 4500 respondents used words with negative connotations such as "Trapped. Controlled. Insipid. Intimidating. Monstrous [and] Claustrophobic."

2.3. Using Technologies to Support Historic Interpretation

Additionally, meeting these new challenges head-on has been complicated by diminishing public funds and shrinking revenues [20–23]. Ultimately, this has led to the curtailing of both first-person interpretation and guided tours [24,25]. As such, museums and historic sites around the world have looked to emerging technologies to help tell their stories to more people and in cost-effective ways. Many of these technologies have either been used in ways to mimic (and therefore replace) the tour guide or to create immersive experiences for their users.

2.3.1. Technology to Mimic Tour Guide

One technological approach that mimics the purposes and experience of a traditional tour guide includes audio guides or tours that provide prerecorded information to the listener as they explore the site with a guide or by themselves [26,27]. Another example is a multimedia guide, which affords the visitor more opportunity to control their experience as they can—to some degree—control what content to access and when [28–30].

Not surprisingly, electronic museum guides are now considered "canonical applications" of context-awareness and location-aware technologies in the field of Ubiquitous Computing [31]. For example, in 2000, the GUIDE project used a tablet-like device (a Fujitsu TeamPad) and a custom-made wireless infrastructure to deliver information to visitors to Lancaster (U.K.) [32]. Many mobile based tour guides, however, are based on an outdated paradigm of historic interpretation: they deliver textual and multimedia content [33]—curated by museum interpreters or designers—that does not do much to provide an "immersive" experience for museum visitors. In other words, the current design of mobile technologies for historic interpretation is deeply grounded on the idea that visitors are expected to read text, watch videos, and absorb knowledge from an "electronic" tour guide.

2.3.2. Technology to Create Immersive Experiences

Meanwhile, immersive experiences that both put the visitor in control of the content and make them feel as if they are a part of the exhibit or program, take shape in a variety of forms, including the use of augmented reality [34], gamification [35], virtual reality [36,37], embodied interaction [38], and other second-person interpretation whereby visitors play specific roles in the program [39].

In particular, Virtual and Augmented Reality [3], along with embodied interaction [2], provide an opportunity to realign the design of technologies with current historic interpretation best practices. By supporting immersive experiences [40], this class of technologies have the potential to enable new levels of second-person interpretation, in which museum visitors can become part of the story of the exhibit or built environment [41].

Perhaps not surprisingly, then, the use of immersive technologies to enhance the visitors' experience in museums has been a common research topic for the visualization and augmented reality communities, as illustrated in the literature review presented in [42]. For example, Miyashita et al. [43] proposes to use a combination of tracking technologies to enable an AR character to guide visitors through an exhibition on Islamic art. The Westwood Experience [44] uses narratives and mixed-reality visualizations that combine historic and fictional narratives while taking visitors in a tour of Westwood in 1949. Damala and Stojanovic [45] recommend not to limit AR museum experiences to visual elements but to consider the wider range of opportunities offered by acoustic augmentation and by the design of the interaction with AR characters (and call this approach Adaptive Augmented Reality). Zhao et al. [46] observe that VR could be used in museum galleries to allow visitors to see artifacts that are not currently on display.

Creating and visualizing immersive 3D representations of buildings, objects, and artifacts [47], however, is not enough for enabling visitors to fully "experience" the past: without the proper support—support that docents and tour guides provide—they may not be able to interpret the physical or virtual objects in front of them. This is one of the reasons why museums and historic sites are slow to phase out the use of the docent and the guided tour.

3. Methodology

3.1. Case Study: Historic New Harmony

New Harmony, Indiana (Figure 1) is the site of not one but two failed nineteenth century Utopian communities. The town itself was founded by Father George Rapp, a self-proclaimed prophet, and his nearly 800 acolytes who had journeyed from Wurttenberg, Germany to find a suitable place to sustain their religious identity, communal living practices, and capitalist enterprises [48]. Initially, they settled in Harmony, Pennsylvania, but the location was not friendly to growing their burgeoning market on wine, clothe, rope, ceramics, and other goods. The navigable Wabash River, the affordable land price, and the promise of freedom in the untamed "west" brought the Harmonists—as they were then known—to the New Harmony area. When the Indiana climate and its people proved to be less hospitable than expected, Rapp and most of the rest of his Harmony Society, relocated to Pennsylvania and settled a new community, Economy.

Rapp then sold his entire town—about 180 structures including public buildings, manufacturing facilities, and single-family homes and housing complexes—to Robert Owen, a Welsh manufacturer and social reformer who sought a location to test his own secular Utopian community and ideas [49]. Owen's vision took shape in two distinct phases. The first was the creation of the Preliminary Society, whereby anyone (as long as their skin was white) could join if they signed the Society's constitution. These members promised to give to the community and be "useful" in its development. By 1825, nearly 1000 people signed the constitution but only 137 of them were listed as employed [50]. Owen forged on, founding his Society of Equality, the second phase of his utopia, in 1826. Little changed. Ultimately, Owen's lofty ambitions fell flat–hindered by a swelling membership unable to sustain themselves, as well as, ironically, a lack of community. He left New Harmony in the spring of 1827.

These two failed communities, the Harmonists and the Owenites, have shaped the narratives told at Historic New Harmony (HNH)—a unified program between the University of Southern Indiana and the Indiana State Museum and Historic Sites. According to their website, HNH preserves these Utopian legacies through the built environment and other objects in their collections, as well as through their exhibits, guided tours, and other

programming. Like many of the museums and historic sites around the world, Historic New Harmony grapples with telling multiple stories across different time periods. This is further complicated by the fact that these stories also span across an entire town. As such, Historic New Harmony is an ideal partner in exploring the complexity of designing immersive technologies to support historic interpretation.

3.2. Procedure

This paper is informed by a visitor survey conducted in the fall and winter of 2019 at Historic New Harmony. The survey included fifteen questions of different types: nine questions provided data categories for respondents to check (four of which also allowed for respondents to enter a "comment"), and six were open-ended and asked them to answer in their own words.

Many of the typical demographic questions museums often ask about educational background, occupation, employment status, gender, racial categories, and yearly income were specifically omitted as we wanted to ascertain how visitor interest could inform their decision to take part in various museum experiences. Moreover, recent research has suggested that such sensitive questions can, in fact, influence survey results not only by decreasing the number of people who take the survey but also by impacting the response rates to these and other questions and, more startlingly, the accuracy of the responses themselves [51]. Thus, in the end, only two of the fifteen questions yielded demographic information, specifically on the visitor's home zip code, as well as their age and the ages of everyone in their group.

The survey also included two questions about visitor motivations (What makes participants visit a historic site in general? Why visit this particular site today?) and six questions related to their specific experience at New Harmony on that day (e.g., what attractions they took part in and how they rated their experiences, whether they took a guided tour, etc.). The survey also included additional questions regarding possible future visits and visitors' habits of historical consumption (e.g., how many times they had visited New Harmony in 2019, and how many times they had visited any historic sites and museums in that year. We do not report on these last questions and responses as they have no direct implications for the design of immersive technologies. We did not use cultural probes to point participants to specific types of technologies, because the survey was designed as a way to elicit feedback for a broad spectrum of stakeholders (including the museum shop director, docents, curators and other staff, as well as businesses in the broader community, etc.).

In an effort to encourage as many people as possible to take it, the survey was conducted over the span of seven weeks from late October through early December and in two formats: visitors to the Atheneum (the visitor's center) received either a four-page survey (printed front and back and including a one-paragraph description of the purpose of the survey on the first page) from New Harmony staff or project assistants or a slip of paper with the URL to an online survey. There were no other accompanying materials. In the end, we received nine online surveys (though two were completely blank) and forty-six paper surveys (with one completely blank) for a total of fifty-two data-filled surveys.

3.3. Participants

The survey asked participants two demographic questions: their zip codes and the age of everyone (including the respondent) in the respondent's visiting group. Some conclusions drawn from these answers are that most visitors are older than age 41, and come from nearby, rural areas. In fact, although visitors were from twenty-eight unique locations around the United States, most of them came from places that were less than a four-hour drive away. In addition, a majority hailed from towns or small cities with a population of twenty thousand people or fewer (53%). Fourteen percent of visitors resided in small cities of a population between twenty thousand and fifty thousand. Finally, only 32% of visitors came from cities of more than fifty thousand people.

4. Results

The larger survey yielded much data of use to the staff and administrators at Historic New Harmony (e.g., information on visitor satisfaction of various attractions). For the purposes of this study, however, we focus on three conclusions drawn from the survey results that have direct implications for the design of immersive technologies: visitor demography, the use and effectiveness of the docents, and the visitor motivations.

4.1. Demographic Results on Age

The survey results confirmed anecdotal evidence that the tour guides and staff already knew: visitors to New Harmony are generally middle-aged. Indeed, the median age range is 56–70. Those in the lowest three age brackets (under 18, 18–25, and 26–40) made up approximately 27% of visitors. Those in the highest age brackets (41–55, 56–70, and over 70) comprised 73% of the visitors. In addition, those in the highest two age brackets (56–70 and over 70) comprised 49% of all visitors to the historic site. Specifically, visitors between the ages of 56 and 70 represented approximately 26% of visitors and those older than age 71 comprised 23% of visitors.

This is important to note because this is in line with the visitor demographic data we see at many history museums and historic sites around the United States, such as that reported in the Humanities Indicator published irregularly by the American Academy of Arts and Sciences (with the latest from 2019).

Key Takeaway: Most visitors are older than 41, and nearly half of visitors (49%) are at or over age 56.

4.2. Results on the Use and Effectiveness of Guided Tours

Historic New Harmony offers a variety of experiences for their visitors. As an open-air museum that spreads across the town, guests to the town of New Harmony can always explore the space on their own—although their access to many, but not all, of the historic building interiors is prohibited. Moreover, there are few interpretative devices—like informative historical markers and labels—available.

For a fee, visitors can take part in other experiences such as viewing an introductory video that details the history and importance of the site, a guided tour of the Atheneum (their Visitor's Center, which features objects, replicas, and a model of the town as it looked around 1824), and a two-hour guided tram tour that provides visitors the opportunity to see inside numerous and various (it can change with each tour) historic sites in and around the town. Some of those sites (e.g., Community House Two, Lentz House, and the Lichtenberger Building) have additional interpretative materials and exhibits inside; other sites are contemplative spaces (e.g., Church Park, the Cathedral Labyrinth, and Sacred Garden).

Our survey showed that 81% of respondents paid for the guided tour of the Atheneum and 15% paid for the guided tram tour. Eight percent of the visitors participated in both guided tour options. Additionally, almost every single person who took the Atheneum Tour and/or the Tram Tour said they learned new information (86% and 100%, respectively), and most of those said that the information they did learn was "meaningful" (81% and 100%, respectively).

Those who took the Atheneum Tour reported that they learned much from the tour guide (88%); from the objects (69%); and from the video (74%). This compares with those who took the Tram Tour, as 88% learned from the Tour Guide, 38% learned from the objects they saw on the tour, and 75% of respondents learned from the buildings themselves.

In the few written comments we received in response to the series of questions on this topic, once again, respondents were most enthusiastic about their tour guides. Some of the comments were "Very nice guide at the museum; very informative," "very informative guide," and "[Tour guide] was Terrific!" These findings once again support the notion that tour guides are, in fact, essential to the success of historic heritage sites.

Key takeaways: An overwhelming majority of visitors who took the guided tours of the visiting center and/or the outdoor campus "learned new and meaningful information." This was primarily achieved through the tour guide, which visitors generally liked, though they learned new information from a variety of activities (e.g., the film, the buildings, etc.).

4.3. Results on Visitor Motivations

Participants were asked what makes them visit a historic site or museum in general, and what made them choose that particular site, Historic New Harmony, on that day. Respondents overwhelmingly said they generally visit museums and historic sites to "Learn Something New" (51%). A second and substantial subset (28%) said they wanted to "Experience the Past." Sixteen percent of respondents said they wanted to "See Something Rare or Unique." Interestingly, only 5% of respondents wanted "To be Challenged." This corresponds to what some public historians have noted with regard to their attempts to challenge the dominant historic narrative at some sites. Interpreters at former plantations across the south, for example, have been met with hostility when trying to incorporate more information about the conditions suffered by slaves [52].

Additionally, those who came to New Harmony wanted to learn about the past. Interest in History was a leading factor for visiting Historic New Harmony on that occasion with 33% selecting it as one of the top three reasons they visited New Harmony. Sightseeing (at 20%) garnered second place. Art (16%) and Architecture (13%) followed suit. Religion and Spirituality, as well as Entertainment both had 7%; and shopping lagged behind at 4%.

Key Takeaway(s): Motivated by their "interest in history," visitors came to New Harmony to "learn something new," and to "experience the past."

5. Discussion

In this section, we discuss the implications (of the three conclusions drawn from the visitor survey) for design of immersive technologies that support historic interpretation.

5.1. Designing the Interaction for Older Visitors

The fact that almost a quarter of visitors were over age 71 (and almost half over age 56) indicates that the design of the interaction with immersive technologies at historic sites is a disjointed research domain from works that investigate novel technologies in museums as they mostly cater to children or younger adults (e.g., science halls). For example, it would be a bad design idea to ask visitors to a historic site to jump to change the content of a large display (as it is done, for instance, in [5]). Thus, we need to conduct foundational research to identify the best interaction modalities (e.g., mobile applications, traditional controllers, tangible [53], and gestural interaction [54]) that elderly visitors can use to control embodied, AR, and VR installations.

Some inspiration may come from literature on how older people interact with technologies (e.g., [55]). First of all, older people seem to enjoy the opportunities afforded by Augmented and Mixed Reality applications [56], in particular because these technologies increase their overall sense of engagement [57]. They may, however, need additional time to get used to novel interaction modalities than younger adults, because they are accustomed to more traditional ways of interacting with technologies [58,59]. Additionally, when crafting the interaction with immersive installations, designers need to avoid postures, gestures, or body movements that are perceived as strenuous or physically challenging [60]. A possible solution could be to allow interaction from a rested position to minimize fatigue [61].

Finally, we want to highlight that immersive technologies open up new opportunities for historic sites to serve older people with cognitive disabilities (e.g., dementia), as done, for instance, with the Sparking Memories project [62] and with the MoMA Alzheimer's Project at Museum of Modern Art in New York City [63]. In this context, Schall et al. [64] found that incorporating interactive art-based interventions that people with mild dementia can explore with their caregivers has a positive impact on the visitors' well-being. Designers

of immersive experiences should keep in mind, however, that work by Hendriks et al. [65] reports that the effectiveness of art therapy depends on the stage of the disease, as people with severe dementia tend to interact less with objects and others. Additionally, work by Lea and Oddgeir [66] highlights how art experiences are particularly successful if they evoke a personal connection with the artifact on display. This offers interesting opportunities for immersive technologies, as they could be used to better connect the art intervention with the visitors' past experiences, and to facilitate conversations with their caregivers [67].

5.2. *The Role of the Tour Guides in the Design Process*

The results of the survey show that the tour guide supports visitor learning in a way that endears the docent to visitors. Through their interactions with the guests, tour guides help create a sense of "immersion" into the history of the site. Thus, despite the aforementioned literature that lambastes guided tours, this visitor survey, and more recent studies [59] demonstrate that tour guides do have an essential role in the historic museum or site, particularly in enabling the second-person (i.e, immersive) interpretation of the site.

5.2.1. Designing for the Tour Guides

Thus, the most direct implication of our survey results is that we need to conduct research on how embodied, AR, or VR installations can be designed for the tour guides. We need to identify the challenges that tour guides (and other museum docents and interpreters) currently face in their work, and how they could use technologies while delivering a guided tour to enhance visitors' sense of immersion in history. This is similar to current research trends in formal learning settings (i.e., classrooms), in which the focus is both on designing technological interventions to facilitate students' learning and the work of the teachers (e.g., video annotation tools that facilitate teachers' reflection so that they can deliver more focused feedback to their students [68]). At historic heritage sites, for example, tour guides could use portable screens or pico-projectors (e.g., [69]) to activate AR elements at specific points in their tour. The Church Park site at Historic New Harmony (Figure 2 provides a good model for which to test these ideas. The original Harmonist brick church was constructed in the shape of a Maltese Cross, with arms of equal length. Each wing of the church contained an entrance, although the North Wing entrance was unique as it was the one with the "Door of Promise," designed by Father Rapp. The lintel above the door utilized a carving of a golden rose, a Harmonist symbol. All wings were used for religious purposes. When the Harmonists left, the Owenites repurposed this church as a community center and called it simply, "The Hall" [49]. Each wing of the hall now served a different purpose. The South Wing, for example, became a theater. After the Owenite community failed, the west Wing was used as a pork-packing facility for years until the church was dismantled brick-by-brick. By 1874, this former sacred place was a school house, an homage to the intellectual foundations the Owenites left behind. In respect to the Harmonists, the school kept The Door of Promise, which was eventually installed at the North end of the building.

Figure 2. Panorama View of Church Park as it looks today.

Thus, this single site, which no longer houses a Church, a community center, or a school, is home to a variety of stories from different periods of time. Today, the site is known as Church Park and is a public park that uses well-trimmed hedges to show the original shape of the cruciform church. It also has a replica of the Door of Promise at the North entrance of the space. A prototype AR installation could use the storied past of this location (disseminated through tour guides) as well as audio and olfactory clues to create an immersive experience whereby visitors will walk into the park via the North entrance and will hear all the different sounds of this space over the past two centuries. This system can be prototyped, for instance, using multiple Arduinos (one at each corner of Church Park), each equipped with a speaker and a pizoeletric actuator with a fan (that spreads scents in the surrounding space). As they move through each wing in a clock-wise fashion (denoting the march of time), they will encounter sounds and smells of early nineteenth century church services in the "east wing" and hear the tour guide talk of the history of that site at that time. Then, they will listen to "Actors" from early nineteenth century community theater in the "south wing" practicing soliloquies, as well as learn about the building at that period of time. As they move into the "west wing" they will be hit by the odious stench and mechanical noises of a mid-nineteenth century pork packing facility. The tour guide will be sure to explain the history of this place at that time. Finally, once they return to the North Entrance, they will hear sounds of children's laughter and learning coming from a early twentieth century school. The tour guide will discuss the location as the site of a former school.

5.2.2. Designing with the Tour Guides

Additionally, to create successful embodied, AR, or VR installations, we need to adopt methodologies that allow for collaboration with the tour guides. This has implications for researchers and museum practitioners, both on how to design novel installations and on how to conduct research/visitors' studies.

Design. The design should capitalize on the expertise of the tour guides (and other museum interpreters)—specifically, their knowledge of that particular site and its collections—by including them in collaborative design sessions [70]. For example, Claisse et al. [71] describes a collaborative design process in which their researchers interacted with museum interpreters to create an interactive installation at a house museum in the U.K. First, interpreters received a package with cultural probes [72] and were invited to individually reflect on their experience and expectations for the museum. Then, they collaborated with project researchers during a series of codesign workshops to create cabinets filled with tangible objects [53] that tell the story of the first inhabitants of that house museum. Similarly, Petrelli et al. [73] utilized a codesign approach to create an interactive narrative soundscape along the World War I trenches in the Italian Alps, in collaboration with museum curators, technologists, and researchers.

Thus, designing immersive experiences in support of historic interpretation is a deeply multidisciplinary work, because it requires a combination of multiple types of knowledge and skills. We want to highlight that technologists are not passive moderators in the process but also play an important role in this context: as we already discussed, traditional guided tours lack Personalization, Interactivity, and Collaboration (which are, instead, common ingredients in the design of immersive technologies). Personalization can help visitors better understand competing narratives at historic sites. As the visitor's "understanding of their museum experience is self-referential," personalization can provide additional "coherence and meaning to the [visitor's museum] experience" [74]. Personalization alone is not sufficient to address this aim in its entirety: museum visitors demand engagement [75]; thus, we need to allow them to interact with the historic narrative. Finally. museums are inherently social spaces where a "great deal of the time and energy" visitors use during a museum visit is "invested in social dynamics" [76]. Thus, supporting Collaboration is important, as the visitor experience will depend not only on each single visitor choice but also on the choices of others who are exploring the space at the same time. This helps reduce

the problems with traditional transmission-based learning as visitors learn from each other and not just from a sole authority figure. Personalization, interaction, and collaboration combined allow one to rethink the narrative that is presented to visitors (as observed by MacIntyre et al. [77], Augmented Reality is "a new media experience). One example is the notion of "Transmedia Storytelling" described by Guimarães et al. [78], based on earlier work in Portuguese by Jenkis [79]: using technologies to enable visitors to contribute with personal of fictional stories to the main narrative. Specifically, the work in [78] incorporates AR location markers at the Calouste Gulbenkian Foundation Garden in Lisboa, Portugal that visitors can use to switch from historic to fictional stories in which plants become kings and soldiers of an imaginary kingdom. Similarly, Nam et al. [80] discuss how the AR objects should be designed as prompts that stimulate people's creativity and imagination at particular locations through the site. Finally, designers should remember that the layout of the space (indoor vs. outdoor, large vs. small room, etc.) alters the visitors' experience of AR content, for example Shin et al. [81] found that the larger the space is, the higher is the sense of immersion and engagement in the narrative.

Research and Visitors' Studies. Similarly, research activities and visitors studies should not be disconnected from tour guides and museum docents. In other words, it is not enough to design interactive prototypes in-lab and then deploy them at historic sites or, vice versa, to design in-situ research activities without a functional prototype. Rather, research on the use of immersive technologies at historic heritage settings (and visitors' studies) should be informed by a "research through design" approach [82], in which experts from the domain of immersive technologies, tour guides, museum docents, and historians work together as the "designers" of prototype installations that are then tested and iteratively refined with museum visitors.

5.3. Supporting Immersion across Multiple Periods of Significance

Participants to the survey indicated that their major drivers for visiting an historic site was to learn something new and experience the past. In their review of novel technologies for supporting historic heritage, Beckele et al. [83] describes how—despite the variety of platforms, toolkits, and approaches—Augmented Reality (AR) and Virtual Reality (VR) applications have great potential to create a sense of immersion in history, by enhancing existing exhibits and allowing for the reconstruction of lost buildings and artifacts. The design of embodied, AR, and/or VR experiences that support historic interpretation, however, is complicated by the fact that the narrative at historic sites spans across multiple periods of significance. For example, at New Harmony, Community House Number Two was built by the Harmonists as a communal living space. The Owenites, however, used it as a center of science and education. After the Owenite community collapsed, the House served varying purposes, from an indoor business park to a cafe. As such, Community House Number Two can (and does) tell different stories about different pasts. An AR, VR, or embodied installation, much like the current tour guide, would have to tell all of these stories about this single structure. In addition, all of the other structures on the campus have a similar, complicated narrative.

Current implementations of AR and VR at historic sites are, instead, frozen in time: they facilitate connection between the present and one specific period of significance. For example, Papagiannakis et al. [84] describe an Augmented Reality reconstruction of Pompei in Roman times that brings back to life characters in al-fresco paintings at the site. Another notable example is England's Historic Cities app [85] that uses AR so tourists across twelve different heritage sites around the country can experience a specific place at a specific time. For example, in Stratford-upon-Avon a virtual William Shakespeare gives visitors a behind-the-scenes tour of his home. These specific installations demonstrate the complexity of telling multiple narratives across time at the same location. Thus, more work is needed to design and evaluate embodied, VR, and AR installations that support visitors' exploration of the hidden, different narratives that artifacts, built environment, and landscapes may tell across multiple periods of significance at one site. At New Harmony,

for instance, this complex narrative is particularly evident in their current interpretation of Community House Number 2. At this site, the ground floor tells the story of the Harmonist community and their use of Community House Number 2. The second floor elicits the tale of the Owenites and their use of Community House Number 2. Finally, the third floor hints at the subsequent uses of this particular site since the Owenite community left. Thus, AR at this site should use location markers (e.g., RFID, QR codes, etc.) to visualize different histories/periods of significance at different floors of the building.

An additional challenge in this regard is that, if we present visitors with multiple periods of significance, we need to include design elements that allow them to orient themselves in time—otherwise, visitors may get lost in the complexity of the historic narrative [86]. Incorporating timelines in the visualization or in the interactive space is surely an option (e.g., Lindley et al. argue that explicitly representing time in interactive systems may facilitate reflection [87]). Designers should, however, carefully map the interaction with visitors' cultural background: for example, Roberts et al. [88] explains that, when instrumenting the floor with an interactive timeline, such timeline should allow visitors to move away or toward the screen, because moving back and forth in time better aligns with our linguistic understanding that the past is behind us. Additional inspiration for creating a sense of immersion in multiple periods of significance may come from works—based on time geography [89]—that attempt to represent both time and space using interactive maps (e.g., Ress et al. [86]).

6. Conclusions

In this paper, we discuss three recommendations for design that emerged from the conclusions we drew from a visitor survey conducted at New Harmony, an open-air historic site in Indiana. In particular, the survey indicated that visitors skew older, want to learn from a tour guide, and are interested in learning something new and experiencing the past. In order to address these three themes, immersive technologies must be easy to use for older people, capitalize on the tour guide, and facilitate visitors' ability to "experience the past" in such a way that they feel immersed in multiple timelines at the same site.

This work was broad and exploratory by design; thus, future work should evaluate functional prototypes that implement the design strategies that we discuss in this paper. For example, it would be interesting to compare the impact of different approaches (embodied vs. virtual reality vs. mixed reality) on visitors' sense of immersion in the historic narrative and in their ability to learn something new from the site.

Abbreviations

The following abbreviations are used in this manuscript:

VR   Virtual Reality
AR   Augmented Reality
HNH   Historic New Harmony

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