The holistic museum experience – Lessons learned and thoughts on digital interactives for inclusive museum spaces.

Linda C. Miesen, Dr. Florian Wiencek, Dr. Kasra Seirafi

Fluxguide Ausstellungssysteme GmbH

office@fluxguide.com

Abstract

As digital designers, we are constantly looking for ways to create powerful and immersive experiences for seeing and non-seeing visitors alike. We want museum visitors to become involved and interact physically with digital touch screens, touch tables and of course mobile devices. Digital mediation has high potential for new perceptual and participatory approaches. Thus, we should not miss a chance and design interactives with accessibility and inclusion in mind. In this paper we present past projects, our own directive guidelines and thoughts on designing inclusive interactives at museums.

1. Introduction

Accessibility in museums is an imperative requirement, covered by international and EU law. It is based on the fundamental human right to integrate the individual into an egalitarian society, which is treated in the EU as part of the European Disability Strategy 2010-2020 (see Eardly et al., 2016). Yet, unrestricted access to qualified, participatory and collaborative educational experiences in museums is still underway.

The challenge for a museum, as a traditionally informal learning environment, is to cater to people with different learning-styles as well as a wide variety of people with special needs. Amongst the latter is a major group of visually impaired, on which we will focus in this paper as one of many target groups for “inclusive interactives”.[1]

When looking back in time and reconsidering the lessons learned from past projects, we discover that our own attempts to design with inclusion in mind can be broken down into two product design approaches. The first one being a Top-down or adaptive approach: Specialized products were designed to meet the needs of specific target users, such as people with disabilities ("Design for Disability" cf. Plos et al. (2007)), then these needs or solutions were extended to other users.

[1] An estimated number of 253 million people live with vision impairment: 36 million are blind and 217 million have moderate to severe vision impairment. It stands out that 81% of all those people who are blind or have moderate to severe vision impairment are aged 50 years and above. Research states that with an increasing population of older people, more people will be at risk of vision impairment due to chronic eye diseases (World Health Organization, Media Centre, Vision impairment and blindness, 2017).

We opted for this approach in several mobile visitor app projects, since the top-down approach seemed particularly appropriate for guiding solutions. Thus, we focussed on accessible content presentation and the available accessibility standards by WCAG 2.0 and BITV 2.0; but even more so to carefully orchestrate the available content for users. We will present this Top-Down approach in the following chapter.

In other projects (see Chapter 3) we adopted a Bottom-up or proactive approach: These products were designed for the maximum number of users, possibly including people with disabilities.
This was the case in our research project "Eyes of Things": With augmented reality functionality, we aimed at new levels of interactivity in inclusive museum guiding since AR enables the fusion of the physical gallery space with the digital information space.

The big challenge, yet, is to adopt a design methodology that allows designing a product from the outset to a wide range of users; a methodology that allows for a multiplication of contexts and needs and therefore limits product redesigns. Since the 1990s it has been consented that *Universal Design* and *Design for All* are the preferable methodologies in this respect, denoting design's social responsibility "to think beyond the minimum requirements… [to] understand the needs of users well enough to make informed judgements and to effectively use the input of users with disabilities" (Welch, 1995:1). In the fourth chapter, we will therefore present the Seven Principles of Universal Design that provide a framework. In fact, these principles outline the key points designers should consider when designing an inclusive interactive.

Another recurring question in our design processes is what role aesthetics can play within the holistic experience of the visitor. We therefore conclude with thoughts on the aesthetic dimension of museum interactives to guide our work.

2. Lessons learned from a Top Down Approach

Unsurprisingly, many of the design features that were designed to meet the needs of people with disabilities later became a key feature of our general digital offer for all users.

One example to this is the "Around Me"-Feature in the context of mobile guiding apps for museums. Here, the mobile device connects to iBeacons that trigger room descriptions as soon as the visitor enters the room. First designed as a tool for blind visitors to navigate in the museum space, we soon discovered that this inclusive aid helps all visitors find focus. We understood that for a majority of museum visitors, mobile guiding apps are solicited less for 'wayfinding' but rather for orientation in the sense of knowing what is around them. This concerns mainly the presentation of content as well as the storytelling through space as an – sometimes overwhelming – experience of traversing a network of exhibited objects and object-stories.

The "Around Me"-Feature was first applied to the Kennedy Space Center App in 2016 (see https://www.fluxguide.com/en/portfolio/kennedy-space-center/). From this project, we also learned that visitors prefer a prescribed circuit delivering a carefully orchestrated visit. To avoid 'missing things' visitors opt to be explicitly channelled through museum content. We enlarged the

“Around Me”-Feature from mere room descriptions to a choice of objects that are part of the guided tour and that are displayed in the App as soon as the visitor enters the room. In the same project for the Kennedy Space Center we wanted to make the App compatible with screen readers and interactive input gestures for blind users. As this may allow visually impaired users to read screen text and navigate through menus, we observed that the interactive experience remained at a non-optimal level. In fact, we needed to adjust the ways of interaction and representation of content, i.e. the user experience.

We did so later again in the museum App of the Federal Art Gallery of Lower Austria. Here, the whole App experience was redesigned in order to facilitate use of TalkBack and VoiceOver while at the same time content was reorganized in order to keep the educational directive and storyboard. But adapted UX for visually impaired users does not necessarily mean a reduction of interactive functionality. It also does not mean to exclude impaired users from gamified oder interactive knowledge mediation, that fosters their own thinking and interpretation of the exhibited objects. For example, the App contained a quiz extension. Each stop was enriched by interactive, multiple choice questions which could be answered interactively with feedback depending if answered right or wrong, etc. As we translated the App for impaired users, we decided to fully include hearing disabled people. Here, we did not simply translate the content for each stop, but also adjusted the user experience: e.g. Multiple Choice questions were presented as sign language videos just as the answer options, including color-codes in order to assist with the interactive selection of the correct buttons:

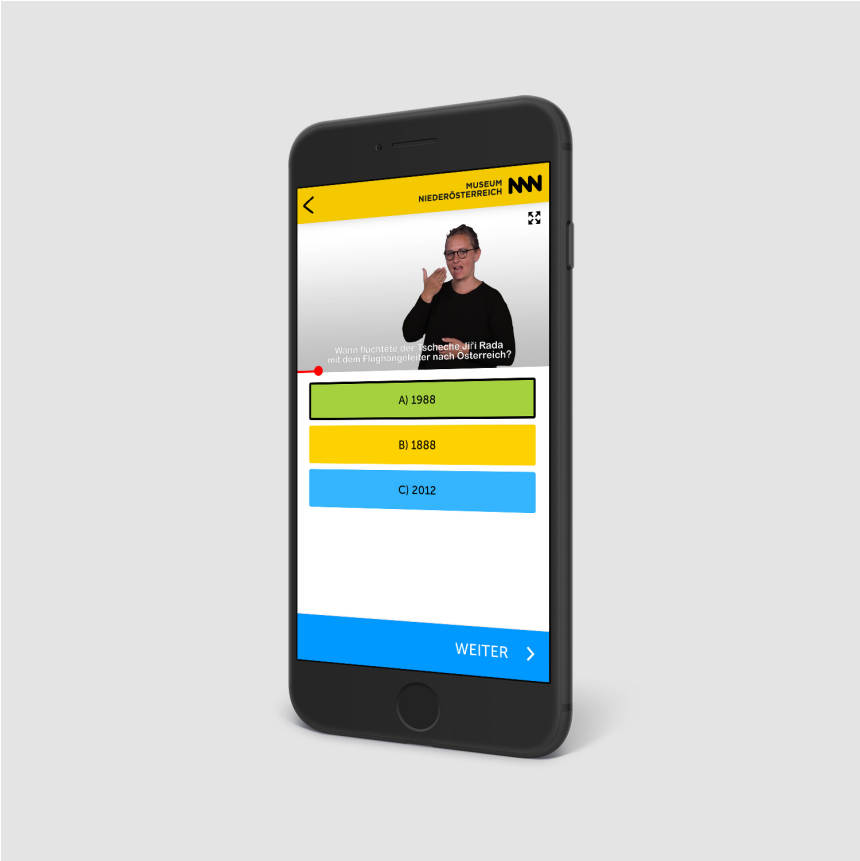

Figure 1: Museum Niederösterreich App. Photo: Fluxguide
Smartphone-Screen with Quiz question and answers in sign language. The answers are written out on the one hand in

the color-coded buttons, on the other hand they are spelled out in sign language. The right answer can be determined either via the writing or the color.

A lesson learned from this project is that thanks to the many existing and helpful design guidelines like WCAG, the redesign process of the App is a much easier task for the designer than the task for the museum staff to reorganize, adapt or translate existing content. In fact, we claim that it was the "adaption process" for the impaired visitors that resulted in better understandable, more accessible content for all visitors.

3. Lessons learned from a Bottom-Up Approach

The objective to be achieved in the next practice example, was to create powerful and immersive experiences that allowed all visitors to channel through the museum in a perceptual and participatory kind. In recent years, AR has been gaining popularity and developing by leaps and bounds, and it is impossible not to notice the possibilities of augmented reality applications. With augmented reality (AR), museums can reach a completely new level of integration of the physical gallery space with the digital information space towards a holistic museum experience that does not regard the physical and digital realms of experience as separate but rather as intertwined.

Augmented Reality is a very demanding form of interactive digital media. In many cases the media form focuses on visual mediation and augmentation of the physical world and the technologically intermediaries are very present. Be it holding up a phone in order to look through the screen, using it as a lens to experience information overlays over the physical world around the user. Or be it glasswear, where users need training in the way of interacting with it, since it needs a good amount of coordination of gaze and gestures. Moreover the current glasswear is still quite heavy and the experiences are sensorically very intense. Therefore "Audio Augmented Reality" can provide a more accessible form of augmentation experience, since it reduces the number of modalities expanding the physical space, while being able to still provide an immersive experience that takes into account and expands the physical space around the user.

One prototype of "Audio Augmented Reality" technology and experiences resulted from the EU Horizon 2020-funded research project „Eyes of Things" (EoT, see https://www.fluxguide.com/en/portfolio/eyes-of-things/). Here, a wearable camera board – with hardware-embedded computer vision combined with a pair of headphones – becomes a sensory extension for all visitors, recognizing the exhibition space and exhibited objects around them.

This setting, piloted in the Vienna Albertina, enables context-aware auditive mediation experiences. In the early prototype the device was able to identify trained images while visitors were walking through the gallery. When a new object nearby was identified the device played a short audio signal. By the press of a button on the side of the headphone an audio-experience could be started or – if another audio experience was still running – the user could switch to a new audio experience, that could continue also when moving forward through the gallery.

In the design of the user-interaction it remained important, that the visitor is always in control of the experience. Thus, playback is not started automatically but due to a user interaction (see next step), avoiding too much interference in the visitor experience. Rather the user gets an audio notification that is realized as an unobtrusive and discreet sound signal.

The start of a playback is triggered easily by pressing the (one and only) user button on the EoT enhanced headphone. This starts the audio playback. By pressing the button again, playback is paused. To continue a paused playback, the button has to be pushed again. This seems to be the most intuitive way for user interaction in order to cover the minimum user control of play and pause.

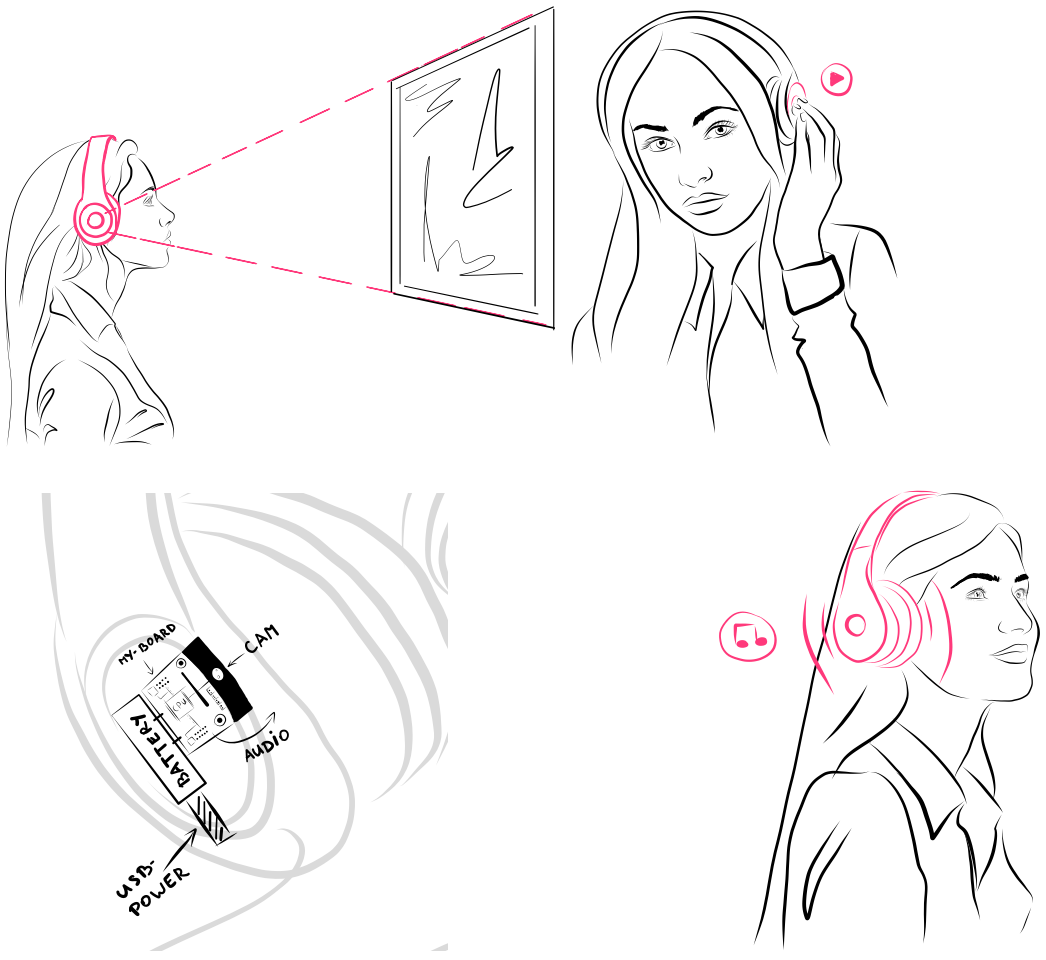

Figure 2: Szenario of Eyes of Things. Image: Fluxguide

Physically moving through the museum uncovers new scenes and context information. “Watching databases” (Lovink 2008) or navigating an information space of an exhibition is therefore combined with and triggered by a physical exploration of the space. Instead of using the paradigm of a generous interface (Whitelaw 2009) that provides an overview over the available information and enables the user to navigate the complete information space in a mediated form, this interaction

is realized in form of an ambiguous interface (Schofield 2014). This type of interface – understood here in a broad sense as "in-between" (Wiencek 2019) – fosters the exploration of the information space, building up curiosity by cues to information and experiences around the user, as well as transforming the traversal of an information space into an experience through new possibilities of interaction and storytelling.

While this prototype as a proof-of-concept was very simple and the technology is still in the experimental stages, the overall concept of "Audio Augmented Reality" offers immense opportunities for designing inclusive museum experiences. The underlying technology of marker-based context-recognition may become a context aware mediation device, along with other technologies allowing a computer device to know the location of a visitor inside an exhibition, such as indoor positioning with beacons, wifi-triangulation, infrared sensors or ultra-wideband technology along with head-tracking to allow spatial audio. I.e. the audio is not only placed in 3D space, but it is played back and rendered in a way that allows the users to "locate" the virtual sound source in physical space through the human's ability for spatial hearing.

This not only offers novel possibilities for sound cues for navigation, orientation and exploration, but also influences the storytelling from contextualizing single objects into an auditive experience. Imagine getting on demand context information on what is around you. The guide being able to highlight e.g. architectural features of an historic building beyond exhibited artworks while passing by, recommending artworks to look at that are nearby based on the works the visitor was previously exploring. Or what about turning a room into an immersive soundscape, transporting the visitor back into the history of the space. By walking through space the visitor explores a spatial narrative.

4. Thoughts on Universal Design of Inclusive Interactives

Earlier in the text, we argued that Universal Design is the preferable design methodology in this respect since Universal design generalizes *usability* to all user groups and not just targets users with a given product (Story et al., 1998). The goal is to consider all audiences in design projects and therefore minimize the risk of stigma by designing specific products (Coleman et al., 2003). In practice, designers may use seven principles (Connel et al., 1997) that enrich that definition. For the authors (Connel et al., 1997), these principles allow manufacturers and users, 1) to evaluate existing products and environments, 2) to guide the conduct of the design process, and finally, 3) to train users and designers on the features of products and environments that are more comfortable to use. These principles provide a framework for designers and outline the key points they should consider when designing a product of any type.

From our point of view, there are limits to these principles. For example, the desire to encompass all products causes confusion among designers. In particular, the lack of classification within the guidelines of the same principle. Indeed, some recommendations apply to the design of digital products while others to the design of physical objects without the field of use is mentioned. It is up to the designer to sort it out.

Yet, as designers for digital interactives, we have re-formulated the seven principles of Universal Design for our work:

Principle 1: Equitable Use – *The design is useful and marketable to people with diverse abilities.*

- The UX design appeals to diverse museum publics and offers everyone a comparable and non-stigmatizing way to participate. This must include that the design is aesthetically appealing but at the same time the lighting, color usage, fonts etc. are user friendly. In a digital user interface this could include sufficient contrast between foreground and background text, among numerous examples. At the end of the day it makes the content easier for everyone to read. These rather generalistic guidelines are also part of regulations for accessible information technologies, such as the BITV 2.0 in Germany or the Section 508 of Rehabilitation Act in the USA.

Principle 2: Flexibility in Use – *The design accommodates a wide range of individual preferences and abilities.*

- The UI provides information in different modalities such as diverse visual, audible, and if possible in tactile formats, meeting the needs of a wide range of users. Visitors with low vision but who cannot or do not want to read may still listen to the audio. All stations allow for right- or left-handed access and use. It provides adaptability to the user's pace.

Principle 3: Simple and Intuitive Use - *Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.*

- All interactive displays in an exhibition room should be organised in the same, recognizable way. Thus, all displays work as users would expect them to, so that they can refer to learned behavior. Information needs to be arranged consistent with their importance (hierarchy in information: location - danger - sensory experience).

Principle 4: Perceptible Information – T*he design communicates necessary information to the user, regardless of ambient conditions or the user's sensory abilities.*

- In other words, designs should provide for multiple modes of output. It allows readability and recognition of two-dimensional content, when thinking about visual impaired user groups. For example, switching between regular fonts and large fonts must be easy. But this principle also includes the translation or transcoding into sign-language for hearing impaired or descriptive audio for blind audiences, so that the information becomes perceptible as well as understandable for them.

Principle 5: Tolerance for Error – *The design minimizes hazards and adverse consequences of accidental or unintended actions.*

- In other words, designs should make it difficult for users to make a mistake; but if users do, the use of an application as well as a digital experience should not come to a full stop. Instead it should allow the user to go back to the step that is easiest to understand for this particular user.

Principle 6: Low Physical Effort – *The design can be used efficiently and comfortably and with a minimum of fatigue.*

- In other words, designs should minimize strain and overexertion. Any button or any touch point on a touch table should be within reach for the hands.

Principle 7: Size and Space for Approach and Use - *Appropriate size and space is provided for approach, reach, manipulation, and use regardless of the user's body size, posture, or mobility.*

- In other words, the ergonomic form of displays must provide for security and safety. A solution may be the integration of tablets into seating furniture.

In our design-practice we strive to work along these principles when conceiving digital displays for museums. When we are talking about digital displays for museums, we are referring on the one hand to examples of literal digital displays in use inside a museums, such as smart touchdevices, touch tables or multisensory tables are technological. They are concrete physical manifestations of interfaces for mediation and information. A wider definition by Jana Scholze (2004) subsumes a display under "presentational form" museum exhibits, including the following: „the arrangement of all presentation media, from exhibited objects over architectural constructions, cases, graphic material, light, sound to moving images as concrete spatial implementation or translation of an exhibition concept" (Scholze, 2004, p. 11). In that broader definition digital interfaces can be considered displays for art and culture in their own right and establishes digital technology as an important agent for cultural mediation (see Wiencek 2019). This does not only include the physical display technology itself but also what one would consider the user experience design and user interface design. The interface constitutes and designs always the "in-between" between the user and cultural objects or information (Wiencek 2019). This defines how users can interact with these entities.

The presentation of above principles demonstrates the ability and the need for design to take an active role in the cultural mediation process by offering accessibility, in terms of ergonomics, exploration or processing of information. Especially the work with associations can provide a valuable opportunity to not only understand the actual needs and challenges for specific user-groups better. Test-users can be recruited to give continuous feedback during the development phase of interactives. Yet we observe that digital inclusive media in the museum space most often is reduced to accessible navigation on mobile devices.

5. Thoughts on the aesthetic dimension of museum interactives

Another recurring question in our design process is what role digital media can play within the holistic aesthetic experience of the visitor. Users discover an artistic expression but at the same time they try to understand the meaning of multiple sensory experiences - may it be looking at a screen and touching buttons, listening to an audio or watching a video in sign language. This raises the question of the aesthetic dimension of interactivity as in designing a scenario or rule-based system offering the possibilities for multiple, very subjective aesthetic experiences or expressions, that only unfold through the active engagement and input from the users. As Arjen Mulder puts it: interactive projects are about the action they evoke in the user (Mulder 2007) while the meaning of such a project is only generated in the interactive process itself (Kluszczynski 1997).

These preliminary thoughts are echoed by philosophical approaches in modern Semiotics and Pragmatics. Here, aesthetics is defined as an immediate seizure (french: “la saisie”) of the work, by a non-intellectualized reception, but cognitive, pre-motor, sensorimotor and emotional. It is the touch that holds this veridictory capacity that reveals "what is behind what appears": By grasping the object we understand it conceptually (Beyaert-Geslin: 21). It is haptic that opens the way to a new aesthetic approach not organized from the vision but, according to Parret (2009), from "the touch, the approximation and the resistant materiality". This echoes very well in the German word "*begreifen*". It has a double meaning: first of all it means experiencing something by touching it, by evoking the sense of haptic, or in fact also by moving through space that also leaves an imprint on a person’s body. But in a second step the word also means getting to a cognitive understanding.

Thus, the step in-between would be bringing together the sensoric input with a person’s own horizon of experience and knowledge and generating meaning from the interaction of these two layers. This can be directly referenced to associative art pedagogy (Penzel 2015), that starts the meaning making process with the subjective perception and observation of an artwork or cultural object, the sonsoric experience and the associations going along with it. Only then the process is moved to an objectivized level. Knowledge is activated and the process leads to a methodologically led interpretation of the visitor in the end. So opposite to many mediation approaches using media, which directly jump into the objective level of activating or even reproducing knowledge, the holistic and inclusive approach starts on the perception by providing an aesthetic experience for all visitors to start an own subjective engagement with a cultural object, before invoking the cognitive level.

As designers, we conclude from these thoughts that interactivity must be designed carefully when the goal is to offer aesthetic experiences to visitors. Any so-called “touch-point” on a digital surface may become the connecting point to the artwork itself. The multiple sensoric objects are translations of realms of experiences of an artwork or information into formats that are perceptible by different senses. The goal is in the end to provide the same kind of “meta-experience” to a wide variety of visitors. And this act of translation goes along with interpretation, re-mediation (Bolter & Grusin 1999) or transformation of the initial realm of experience into a different media- as well as sensoric format.

Therefore, the aesthetic result is a creative product in its own right. Hence, while Universal Design enables visitors to use the interactive media in the best possible way, creativity leads the way to design sensory and therefore aesthetic experiences that are driven by multimodal content and its active perception throughout a museum visit.

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