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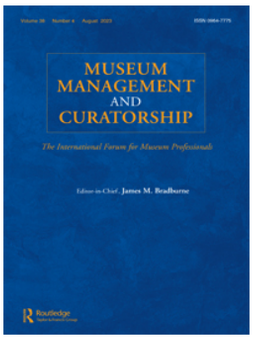

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Digitally enriched museum experiences – what technology can do

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ABSTRACT

The recent pandemic crisis, coupled with the rapid development of new technologies, has shown what new opportunities exist for designing enriched museum experiences. In this article, we collected the experience of six Dutch design agencies that are known for their portfolio in applying new technologies to museum experiences, also internationally. We start by clarifying the concept of museum experience design. Then, we discuss the role technology can play in designing museum experiences. We first review the types of technology that were mostly used in museums in the pre-Covid period and clarify the purpose of their use. Subsequently, we elaborate on the trends that design agencies see as the most important developments emerging post-pandemic and reveal the dreams they have for future applications of technology in museum experiences.

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Museum experience design; technology; storytelling; current practice; future trends

Introduction

Since the advent of New Museology (Mairesse and Desvallées 2010), we have seen a shift from a focus on collection items to a focus on the stories behind them and on the people and their stories in relation to those items. This change of focus has also resulted in revamped attention to museum experiences that are also meaningful for visitors, and not just memorable. These newly designed meaningful museum experiences have gained immensely in sophistication as these are more and more 'technology-enhanced or empowered experiences' (Neuhofer, Buhalis, and Ladkin 2014).

In this article, we will discuss the role technology has played and can further play in such 'renewed' museum experiences. We present some insights gained from the literature on the role of technology pre-pandemic and complement those with the views of some renowned Dutch design agencies on the trends they see ahead. The reason for complementing a review of the past from the literature with a forecast from design agencies is that design agencies are generally at the forefront of reflecting on applications of technology in experience design and, additionally, the agencies we selected have a heavy focus on designing such experiences. Interviews with representatives of these design agencies were held in January and February 2021 in the Netherlands, when museums had been closed for about 9 months due to the pandemic.

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In the next section, we will first contextualise and ground the term 'museum experience design', by briefly addressing the notions of 'experience' and of 'experience design' after which we will narrow this down to the concept of 'museum experience design'. We will then discuss insights from the literature on museum experiences and the role of technology pre-pandemic.

A view on museum experience design (MXD)

According to Marc Hassenzahl, one of the leading researchers and designers in the field of experience design, an experience is

> an episode, a chunk of time that one went through […] sights and sounds, feelings and thoughts, motives and actions […] closely knitted together, stored in memory, labelled, re-lived and communicated to others. An experience is a story, emerging from the dialogue of a person with her or his world through action. (Hassenzahl 2010)

So, experiences are *stories* we make of moments we lived, they resonate with the *emotions* we felt during those moments, and they require *agency* in the form of a *dialogue* with the social and physical environment in order to be perceived as positive experiences (Hassenzahl 2022). Also, for Duerden et al. (2018) experiences comprise an interactive and dialogic component which they further distinguish between

> the objective *interactive* [italics added, to cater for the dialogue component mentioned in the previous paragraph] encounters between participants and provider manipulated frameworks (i.e., erlebnis; e.g., dining at a restaurant, attending a concert, playing in a softball tournament) and the resulting subjective participant outcomes (i.e., erfahrung; e.g., feeling unhappy with the quality of food at a restaurant, being emotionally moved by a song at a concert, deciding to return next year to play in the same softball tournament and win the whole thing) of experiences. (603)

These 'provider manipulated frameworks' consist of various objective experience elements, that Rossman and Schlatter (2015) identified as the setting (the physical context in Falk and Dierking's model (2000)), the people involved, different salient physical and symbolic objects, animation, structure, and relationships (the social context in Falk and Dierking's model (2000)).

Our view on *museum experiences* is that these focus on experiencing (parts of) a museum collection, whether tangible or intangible, and whether inside or outside the walls of the physical museum building. In line with the new ICOM definition[1] of what a museum is, a museum facilitates a dialogue with communities and the public through participation and as such brings about interactions. In order for these interactions to be meaningful, visitors must play an active role (the agency discussed above in Hassenzahl's definition). Alternatively, the design must get them from passive to active – as only by engaging them will the resulting experience be memorable (Duerden et al. 2018). And we not only focus on the consumption of experiences but also on their production, for example through the use of digital technology. As noted for example by Prahalad and Ramaswamy (2004), there is a shift toward consumers seeking to engage more actively with providers in the co-creation of experiences. And since, according to Hassenzahl (n.d.), *experience design is* about consciously designing experiences created and shaped through technology, our interest in designing museum experiences is precisely to understand the role technology can play in them.

In the following, we will first summarise insights we gained from the literature about the role of technology in museum experiences before COVID-19, as well as what changed during and after the pandemic. We will then proceed by discussing the design agencies' views on the future, on the expected role technology can play in museum experiences, and on how decisions on technology and its role relate to the museum experience design process as a whole.

The role of technology in museum experiences pre-pandemic

Before the pandemic, the role technology played in museum experiences was somehow streamlined (for an overview of these technologies and their applications in cultural heritage in general and museums in particular see Bekele et al. (2018)).

Technology has since long played a role in designing museum experiences, with the audio guides being one of the earlier examples of it – not to mention other rather analogic forms of museum signage. Traditional technologies also include websites, which were originally used just to provide practical and functional information on museum accessibility and reachability. While websites remain important in providing this information, they appear pretty limiting at the same time. During the lockdowns, a few museums have started experimenting with reorganising their website by recycling and rethinking what content to publish there as a way to cater to the newly emerging and previously unknown needs of their audience which was forced at home.[2] This might become a new trend for website use, to support their audience's needs which might require more than just a functional website.

As reported in the literature (Bekele et al. 2018), the technologies that were mostly present in museums before the outbreak of the Covid pandemic can be grouped into:

(1) Social media
(2) Games
(3) Mixed Realities (MRs)

More specifically, *social media* can vary from the now trendy Tik Tok,[3] adopted for example at the Uffizi in Firenze to make the museum's collection relevant to a young audience, to the classical Facebook, such as in the case of Tate Britain where visitors need to access the virtual wing via the Tate Instagram account,[4] and Instagram as a tool for visual storytelling,[5] like for Tate in London, the Los Angeles County Museum of Art, or the Guggenheim museum. Museums like the Rijksmuseum in Amsterdam have been experimenting also with WeChat mostly focusing on the marketing possibilities offered by it to attract a wide and growing Chinese public.[6]

Games serve similar purposes of attracting a younger audience and lowering the threshold to the museum as at the Metropolitan Museum of Art in New York City, where part of the museum artworks are presented in virtual places inside the game,[7] or, as at the Monterey Bay Aquarium, where the Nintendo Switch game 'Animal Crossing' is used in combination with Twitch (a live streaming video service run by Amazon), to live stream a panel of their experts discussing natural history.[8] Another popular game that is often to be found in museums is Minecraft: its use is to visualise events and facilitate learning, especially for children that can then learn by playing. Minecraft has long been on display at the Design Museum in Breda, among others.

When it comes to *Mixed Realities*, it is mostly Virtual Reality (VR) that has been on the rise for quite some time now, and example uses of it abound: at the Victoria & Albert Museum in London, VR has been used in the form of a truly immersive event to support one of their new exhibitions, as an experience including a curator presentation and visual effects that played out in real-time as well as a preview to promote it;[9] at the Louvre in Paris, to contemplate Mona Lisa quietly despite the crowd around;[10] at the Isabella Stewart Gardner Museum in Boston to replace stolen items; at the National Museum of Natural History in Paris, to explore the links between different species; fostering curiosity, as a teaser or taster of what can be found by visiting a museum as with the 2015 Bronze Age VR project at the British Museum.[11] These are just the most striking ones. Augmented Reality (AR) has indeed been used less until now (and we will discuss further what the designers' view is with respect to both realities and their future applications). Interesting examples and uses include the use of AR to bring seventeenth-century documents from Rembrandt's day to life in the Amsterdam City Archives[12] or to experience the digitally restored Donuimun Gate, one of the Four Great Gates in the City Wall of Seoul.[13] In the literature pre-pandemic, we can also find examples of the Hololens from various museums, such as the Intrepid Sea, Air & Space Museum in New York City, the Kennedy Space Center and the Kyoto National Museum. Less predominant but still present also pre-pandemic and emerging lately is the use of chatbots (e.g., the chatbot at the Anne Frank's House in Amsterdam[14]) and of digital twins (like at the Natural History Museum in London as one of the first museums to embrace Digital Twin technology[15]). Live streaming services were also rather popular pre-pandemic, with TV, Facebook, or Twitch, as a way to bring the museum to people's homes. This concept, i.e., of bringing the museum to people's homes when people were not allowed to visit museums themselves, has seen a rise during the lockdowns worldwide. NFTs, facial recognition, and IoT on the contrary were only minimally used.

Technology adoption presents not only technical issues to weigh against but also socially relevant challenges when it comes to authenticity (for MRs see for example in Marques and Costello 2018), interaction, like with 3D printed replicas of collection items (Wilson et al. 2017) and their educational possibilities and potential benefits (see also Malik, Tissen, and Vermeeren 2021).

The role of technology in museum experiences has undergone a new impulse during and after Covid. The recent pandemic crisis has indeed exacerbated the shift towards experiences that are enhanced or empowered by technology, especially those completely online. Despite the fact that museums had to remain closed for many months worldwide, they have still remained very accessible (if not more accessible than ever) because they were very much present online. With more than 90% of the museums worldwide being closed during the pandemic, according to data collected by UNESCO (and reported in Zuanni 2023), their digital presence and activities *tout court* have increased. In particular, it is their online services that have increased with respect to the period before this disruption or were just started due to it (Zuanni 2023). Services are understood here as social media presence, online exhibitions and collections, and learning programmes (see Figures 1 and 2).

What these figures show is that many online (digital) services were not there yet, e.g., see Online exhibitions, Live events, and Learning programmes in Figure 2, and video content, learning programmes or virtual tours, in Figure 1. Next to the ones highlighted above,

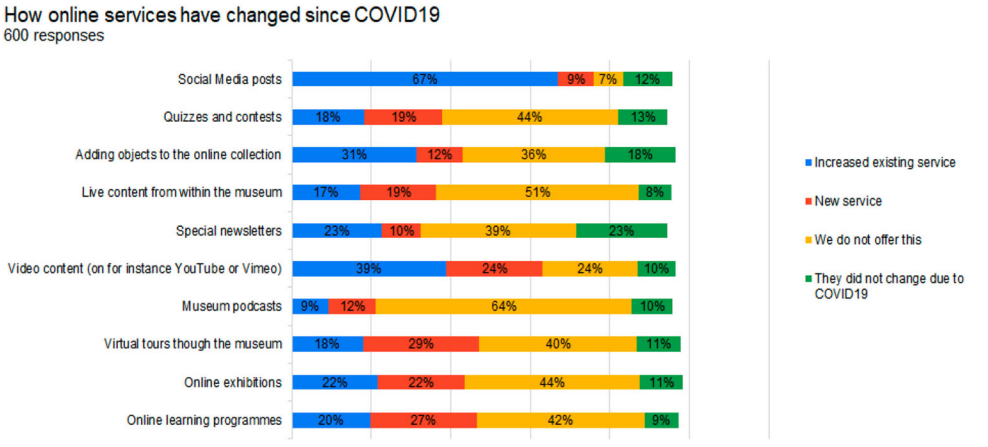

Figure 1. Results of a survey done in 2021, by the Network of European Museum Organisations on how online services in museums have changed since COVID-19 (reported in Zuanni 2023).

Zuanni also notices the emergence of a new trend which consists of collecting memories and witnesses of the pandemic, as a form of online-co-creative exhibition (2023).

Of course, not all museums could resort to an online presence, but many, and not only the bigger ones, did. For example, the MAS in Antwerp offered virtual tours, sometimes even having the curator explaining the museum collection from the safe space of their own homes. In other cases, guided tours have taken the form of live-streamed tours – this has been the case with the heavily promoted van Eyck exhibition in Ghent, which was supposed to be the pinnacle celebration of the year of van Eyck in 2020 with the reopening of the Ghent Altarpiece, after an 8-year long restoration. In other cases, viral events were organised, like the 'Stay at Home Museum', a series of events promoted by Tourism Flanders offering a look behind the scenes of important exhibitions, or the #ResistenzaCulturale launched by the Pinacoteca di Brera in Milan to engage audiences in social media contests. Both

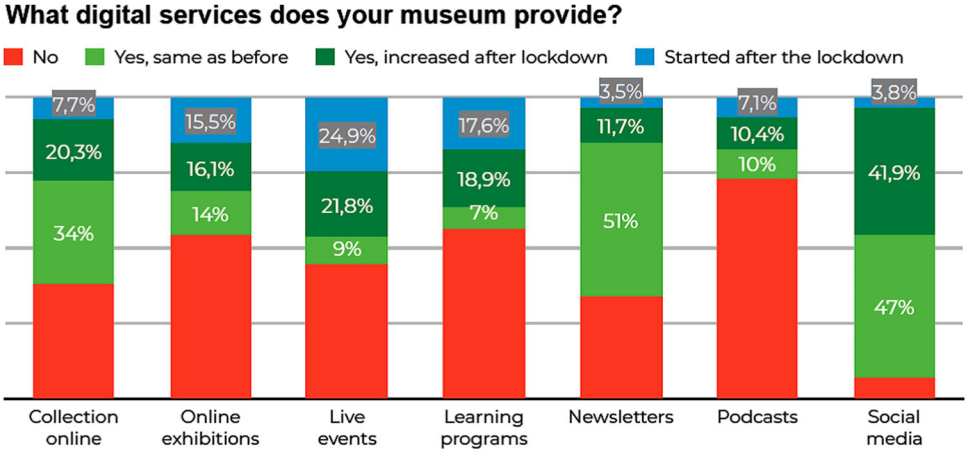

Figure 2. Results of a survey done in 2020 by ICOM on how digital services in museums have changed since COVID-19 (reported in Zuanni 2023).

events aimed at bringing the museum to the visitors and making them enjoy their collections from their own homes in a personalised way through the sharing of personal stories, as the social media contest encouraged them to do (Calvi and Moretti 2020).

These and many more movements (like the #MuseumAtHome and #CultureChezNous (Morse et al. 2022), that went viral during the pandemic) have put emphasis on the online presence of museums and have shown how they can be successful on social media.

Renowned Dutch design agencies' views on the role of technology in museum experiences

In order to better understand how museums approach the design of experiences for their exhibitions and spaces – what current practices in museum experience design we can identify, especially when it comes to the adoption of technology, and what insights we can derive to forecast the future – we have consulted representatives of six Dutch design agencies that are very active in the cultural sector and have an international portfolio. Such agencies are generally at the forefront of developing rich experiences and interactions and are therefore well aware of the possibilities of the newest technologies for doing so, as well as of how to best apply them.

Methodology

We interviewed representatives of the following design agencies:

- Fabrique (https://www.fabrique.com/): working in the field of museums and cultural heritage since 2000, focusing on museum websites, interactive installations, tours, identities, and apps. Their clients in the cultural sector include Design Museum London, Tate Modern London, and Rijksmuseum Amsterdam. The interviewee is innovation strategist and one of the founders of Fabrique with a design background.
- Kiss the Frog (https://www.kissthefrog.nl/en/): established in 2001, is a digital design agency specialised in designing and developing interactive visitor experiences for museums, science centres, and corporate visitor centres. Clients include Science Museum London, Maritime Museum Denmark, Melbourne Museum and National Museum of Qatar. We interviewed one of the partners at Kiss the Frog, with a background in experience design, who works there since 2007.
- IJsfontein (https://www.ijsfontein.nl/en/): since 1997 working in the field of designing playful learning experiences in various fields. In the field of museums, IJsfontein focuses on playful interactive installations, apps, multimedia tours, websites, etc. Clients include the Van Gogh museum Amsterdam, NEMO science museum Amsterdam, Palace het Loo (NL), Museum for Communication (Bern, CH). The interviewee is the creative director and one of the founders of IJsfontein.
- DOOR (https://www.unlockthedoor.nl/), is the cultural label of design agency IN10 (https://www.in10.nl/), founded in 1999. DOOR helps cultural organisations become future-proof with new presentation forms, digital storytelling, and experience design, through its vision of cultural immersive storytelling. Clients include Mauritshuis the Hague, Anne Frank House Amsterdam and Museum Boijmans van Beuningen –

Depot Rotterdam. We interviewed a service designer of IN10/Door who works there since 2016.

- Northernlight (https://northernlight.nl/): founded in 1997, is a creative design agency, creating transformative and purposeful experiences for brands, museums, and public spaces. Clients include Reiss-Engelhorn-Museen Mannheim, Rijksmuseum Amsterdam, Shandong Science and Technology Museum China, and Science Discovery and Planetarium Malta. We interviewed one of the directors and founders of Northernlight with a background in design.
- Tinker Imagineers (https://tinker.nl/): founded in 1991 (since 1999 under the name of Tinker Imagineers), is an immersive experience design agency, having its strength in design and creation for innovative museums and companies. Clients include, Maison Cailler – the Swiss chocolate factory, BBC Earth Experience, Natural History Museum of Denmark and Tirpitz Museum Denmark. We interviewed a senior experience designer who works for Tinker Imagineering since 2016.

We interviewed these designers between January and February 2021. During this period, most countries were still in lockdowns due to the pandemic and museums closed worldwide.

Procedure

A few weeks before each interview we sent our interviewees a list of topics we wanted to address during the interviews, including: (1) their perspective on museum experience design, (2) state of the art application of technology, illustrated by two example cases they were excited about, (3) technologies they consider that have potential but are hardly applied in museum experience design thus far, (4) their view on where this is heading to in terms of technologies for museum experience design (in a broad sense): trends that have emerged during the pandemic but that are also here to stay, (5) rationales they have as a designer in choosing for certain technologies, (6) dreams they may have as a designer: 'what if this were possible with novel technology'. The interviews took the form of a semi-structured online conversation about these topics via Teams™. Generally, the interviewees started by discussing the given topics, while we now and then asked for examples or asked follow-up questions to better understand their view. Most interviews lasted for about one hour, with the shortest being 57 min and the longest being 1 h and 29 min.

All interviews were recorded with the permission of the interviewee and automatically transcribed using Teams™. We explained them that they were free to withdraw at any moment during the interview. Additionally, we asked them for permission to mention in our publications their name, the name of their design agency, as well as the cases discussed during the interviews. All interviewees agreed on this and agreed that a reply by email sufficed for consolidating their consent.

Data analysis

Transcripts were read by the authors and recordings were consulted if necessary, to distil statements from them for clustering and labelling in the form of sticky notes on a Miro™ board. In line with the topics of the interviews, labels included elements relating to

museum experience design (both the act of designing and the (desired) nature of museum visits/experiences), as well as technology (in general) in relation to experiences and the distinct role of various specific technologies. Labels included: *design, experience, views on museums and visitors and audiences, visitor journeys, storytelling, (playful) learning, engagement, social/collaborative experiences, technology, physical/digital*. A total of 227 sticky notes were made containing quotes or paraphrases such as '*We aim at deeper, emotional learning, beyond functional transfer of information*' (IJsfontein; label: (playful) learning); '*Technology doesn't come first. The technology always comes second to the idea, to the concept, the interaction, the storytelling*' (Door/IN10; labels: technology, experience, design, storytelling); '*Tech serves to bring a spark to the visitor*' (Kiss the Frog; labels: technology, engagement); '*Identification is done in various ways. NFC or RFID we use a lot. It shifts towards biometrics. Facial recognition*' (Kiss the Frog; labels: technology); '*Online presence is also important to enlarge your circle of influence*' (Fabrique; labels: view on museums and visitors, audiences, visitor journey). This collection of quotes and labels provided us with insights into:

- the interviewees' views on the role of technology (in general) in museum experience design
- the interviewees' views on the application of specific technologies in creating experiences.

Results

In this section, we will discuss the views of our interviewees, first about the general role technology should play when designing museum experiences, followed by the various roles specific technologies may play. In the results, we will refer to the specific design agencies by adding their names in italics in brackets. What emerged quite strongly in our conversations and was shared by most experts is that technology is never the starting point of such a design and also never a given, but always an element that should match the overall objective of the experience to be designed. And that such an experience ought to be engaging, social, and playful.

How to choose technology in designing a museum experience

Museum experience design in general is approached as a collaboration between the museum and the design agency, and not as the commissioning of an assignment to a design agency (*Fabrique*). In this dialogue, technology is not seen as leading, but the museum's values and stories are. These values and stories determine which technology is the best fit for the story that must be told (*Fabrique*). Technology is not the first element to think of when designing an experience. Museums (museum education staff, presentation people) mostly approach design agencies with a story for which the right narrative medium is sought (*Kiss the Frog*) and rarely with a request for a specific technology.

Of all the examples we have collected during this research, there is only one case where the museum explicitly asked the design agency to develop an experience with a specific technology, regardless of the story behind the experience – this was the Maritime Museum in Amsterdam (Scheepvaartmuseum) which was so excited about the

possibilities of VR that they explicitly asked for designing a VR experience (*Northernlight*). The role of technology is to fit the message that needs to be delivered (*Kiss the Frog*), and the story that must be told drives the choice of which technology to use (*IN10*); a good story is more important for a successful design than the novelty of *the technology used to tell it (IN10)*.

Two important trends

Our interviewees recognise two important trends in the way technology is used for MXD: the first pertains to the use of digital immersive media inspired by Teamlab[16] to create a fully immersive interactive environment, and the second refers to the popularity of Instamuseums, which are trendy places a visitor goes to for social quality time as the taking of a nice *Instagrammable* picture at the end of the visit testifies (*Northernlight*). In the former, big immersive projections are used to portray the museum content. As for the latter, several of our interviewees believe that Instamuseums – aimed at mainly providing a space for taking pictures to share on Instagram – will not remain for long in the form they are now once visitors recognise that they are just nice places to take a nice picture to share. Originally born in 2015 with the Museum of Ice Cream in New York, such museums generally have no collection but some specific content, that is offered as a setting for Instagrammable pictures. According to one of our experts (*Northernlight*), in this form, Instamuseums will not survive, as these are purely hedonic experiences. However, if traditional museums would team up with them, they could provide content for such Instamuseums, thereby making the Instamuseums themselves more meaningful and at the same time gaining for themselves more visibility – this is what for example the Van Gogh Museum is currently doing with the Van Gogh Experience (*Northernlight*).

What experiences to design with technology

When designing an experience around the desired stories, design agencies mentioned a number of characteristics that they see as desirable, for current and future museum experiences: (1) *engaging, social* and *playful* experiences; (2) *hybrid* experiences, as these have the potential to be powerful in conveying stories; (3) thinking in terms of *visitor journeys* that start outside the museum walls, before an actual museum visit, and also continue outside the museum after an actual museum visit.

Engaging, social and playful experiences. Design agencies see *interaction and engagement* as important (*Northernlight, IJsfontein, Kiss the Frog*). This can make a visit *fun and playful* (*Northernlight, IJsfontein*). Engagement is something to look for and to trigger, to generate a *spark* in the visitor (*IJsfontein, Kiss the Frog*), to create an *emotional* involvement so that the experience is implanted in *memory* (*IJsfontein*), to *involve* and *challenge* visitors (*IJsfontein*) or to connect to a *broader audience* (*IJsfontein*).

The notion of playfulness has been mentioned by some interviewees (e.g., *IJsfontein*) as a means to design experiences in museums. The notion of playfulness is based on the concept of the magic circle, a situation in which people can try and fail (Huizinga 1938) while developing a personal understanding of the topic (*IJsfontein*). It is believed that the combination of gamification and storytelling can make people change perspectives (*Northernlight*) and that playfulness in relation to games is a better way to tell stories

(*IJsfontein*). Playfulness, our experts claim, is useful to trigger visitors to participate, to make them curious and wanting to learn (*Kiss the Frog*), to make them interact with the content (*Northernlight*), to develop personal meaning, in a word, to involve and challenge them (*IJsfontein*), and engagement can be triggered by promising fun (*Northernlight*).

Playfulness is especially relevant in free-choice learning, and learning in museums is indeed best described as free-choice (*Northernlight*). Its aim is to facilitate emotional learning rather than the functional transfer of knowledge (*IJsfontein*). In this respect, many of our experts indicated that their focus in design is *explicitly* on *social experiences* (*IJsfontein*, *Tinker Imagineers*, *Northernlight*) because they see *museum visits as social activities* (*IJsfontein*, *Kiss the Frog*). They believe that this is especially important for an *older audience* (*IJsfontein*).

Designing a museum visit *as a social experience* takes advantage of the fact that most people do feel *more engaged* when they can do things together (*IJsfontein*) and that *learning and behavioural change* generally occur in social environments (*IJsfontein*).

Technology can *facilitate or stimulate* the occurrence of *engaging social and family activities,* when used properly (*IJsfontein*, *Northernlight*), for example by *bringing people together* and making them *discuss* what they have just seen (*IJsfontein*) or by *creating an environment for sharing experiences* (*IJsfontein*). This is where for example *VR* could be used in a collaborative way (*Kiss the Frog*). This facilitation also occurs when technology is an object that people can *share or move around* (*IJsfontein*) like a *robot* (*IJsfontein*) or *screens* that are *positioned horizontally* as a table on which objects or elements can be placed or moved instead of being as traditionally upright (*IJsfontein*), because this would entice them less to be active and to be engaged with others.

Another emerging pattern in museum experiences is their degree of *hybridisation* (see also in earlier section).

Hybrid experiences. Many designers recognise that the combination of digital and physical experiences is becoming a big trend. This combination can be implemented in many ways. One, for example, is to put the computer in the real world instead of putting the real world in the computer and add interactivity to the real world (*IJsfontein*).

Another one is to have big immersive projections, such as Teamlab (see earlier): technology-wise, they are very interesting in a combination of projection and interactivity because they create a fully immersive interactive environment (*Tinker Imagineers*). The emergence of digital twins is an example of this. Unity and all those other game engines are making these digital experiences so realistic nowadays (*Northernlight*) that people almost do not know anymore what is real and what is not. As a matter of fact, Unity and Unreal are believed to be the two technologies that will play a more prominent role in the future. With the Unreal engine, very realistic 3D scans of objects with 20,000 polygons can be made. A museum can scan any object and it is even possible to build one's own digital museum in this way. In this 'personalised' digital museum, a visitor could do different things than in the physical 'real' museum. For this reason, this individualised experience can become an add-on to the real museum visit. One of the respondents compared this new hybrid experience to hip hop music: like with hip hop, the original soundtrack (in this case, the real physical visit) is clearly recognisable, but by sampling it, something new is made (*Northernlight*).

Panorama Mesdag (Figure 3) is another example of the merging of digital and physical elements: with the use of Micrio,[17] a visitor can now step close to the painting, across the dune, something that in the real panorama cannot be done.[18] This example shows not only how complementary the digital and the physical elements are (*Fabrique*), but also how their combination can create a completely different experience for the visitor.

Nevertheless, designers still believe that museum spaces will remain relevant, that visitors will still make use of the museum's physical space, because that is where value can still be found. Therefore, museums should add value there for example by offering something extra in their space, like more immersion, to differentiate themselves from what can be experienced at home while just looking at the screen of one's own laptop or smartphone (*IN10*). Or by facilitating sociability, as discussed in the previous section.

As a matter of fact, not all our experts believe in the digital turn that museums were forced to make during the lockdowns to remain relevant and visible. The virtual tours and all the other digital solutions that many museums had to develop during the lockdowns have not proven to be so successful according to some of our experts, although not many studies have been conducted so far (see in Morse et al. (2022), as one of the few studies that have been published on this, to our knowledge). Some do believe these virtual visits will never replace the real ones (*Tinker Imagineers*). Visiting a museum via virtual tours (virtually walking around through the galleries) will never become a big trend, because people still see visiting a museum as a nice adventure, as a day out. This is especially true for Falk's experience seekers (e.g., Falk 2011), which is a large group.

Holistic experiences as visitor journeys. Next to engaging, social, playful, and hybrid, museum experiences have also become more complex because many design agencies explicitly think about museum visits in terms of *journeys* or as an experience that is *integrated into a bigger (or more holistic) experience* in time and place (*IN10*, *Fabrique*,

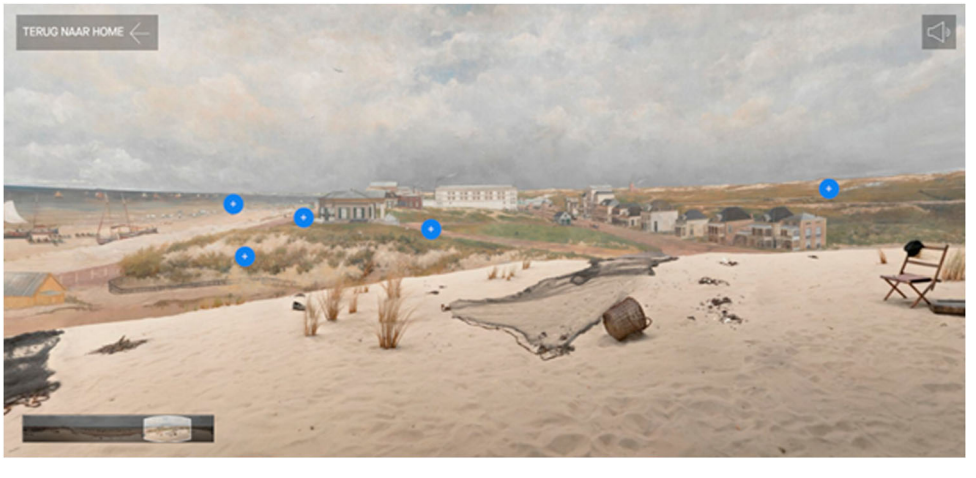

Figure 3. Using Micrio for zooming in and providing detailed information about elements in the panoramic painting by Mesdag.
Source: https://panorama-mesdag.nl/en/#/micrio/explore

IJsfontein, *Northernlight*). Above all, there is an opportunity to engage with the audience before and after the visit, especially in cases where visitors are '*forced to do so*' (e.g., such as with school visits that require more preparation on the side of the pupils) (*Northernlight*).

Currently, experiences *before* the museum visit mostly focus on providing *practical information* (opening times, costs, how to get there) (*IN10, Kiss the Frog, Fabrique*) or on *marketing* (*IN10*), but according to the design agencies, there are also opportunities to already give *a flavour of the museum visit experience* beforehand (*IN10, Kiss the Frog*). *Social media* is often the tool to communicate with audiences (*Northernlight*). Examples of 'before' include getting to know the museum itself on the *website* (*IN10*) or communicating an exhibit through posters (*IN10*). Kinderdijk, a heritage site East of Rotterdam, has an app that not only tells the story of the village during the visit, but also gives information about the local environment when travelling towards it (*IN10*). The Netherlands Institute for Sound & Vision in Hilversum did something similar by integrating the onsite experience with before and after (*Fabrique*). Other examples of linking the before and after visit with the onsite visit are the *Instagram stories* influencers tell about the Lust for Life exhibition in the Nederlands Fotomuseum (*IN10*) or the *personalised video* used by the Van Gogh museum to welcome the visitors when they arrive and before their actual visit (*Kiss the Frog*).

Experiences *after* the museum visit often focus on extending the experience, for example by collecting the visitors' *email addresses* to be able to extend to an after experience later on (*IN10*), or by providing souvenirs, which can be either digital, as with visitors taking a picture with some of the museum items, or physical (*Kiss the Frog*). Also making experiences emotionally involving, so that they are implanted in memory (*IJsfontein*), is considered a powerful tool to extend them in time beyond the real visit.

However, various design agencies also indicated how *difficult an integrated approach* to designing experiences is (*IN10*, *Kiss the Frog*, *Northernlight*): designing for before and after is not compatible with *the way (design) projects are normally setup* (*Kiss the Frog*) and one *cannot control the whole experience beforehand* (*IN10*). Moreover, it is *hard to trigger someone beforehand* to become immersed in a story (*Kiss the Frog*). The reasons that were indicated for this difficulty are diverse and pertain to both the visitors as well as the museums: visitors, on the one hand, are mainly interested in the *practical issues related* to their visit, prior to it (*Kiss the Frog*), while museums, on the other hand, are in *a fierce competition* with a multitude of other things that people might want to be doing (*Northernlight*). This additionally adds up to the fact that visitors are not really inclined to engage 'free-choice' with museum content before or after a visit (*Northernlight*). If a way to entice them is by sharing content on social media, then this should be really good, otherwise, it is very likely that people will not engage with it at all (*Kiss the Frog*).

A possible solution to this is to apply digital elements in the integrated design throughout the full customer journey (*IN10*). This approach to designing museum experiences as in service design allows designers to consider the experience as from the moment the visitor is still at home.

Applying specific technologies to distinct experiences. Analysing our experts' responses, a number of themes emerged related to what specific technology to use

best to design distinct experiences in museums. These themes include *identification & personalisation, immersion, hybrid experiences, social experiences, providing detailed information, increased engagement, playfulness, extending the journey/story, guidance*.

In Table 1 below, we attempt to match the technologies that were indicated by our experts to the above mentioned themes and then identify what the purpose of this combination is in relation to experiences. This is by no means a complete overview, nor a formal taxonomy of technology per experience type, but simply what we could draw from the interviews we conducted. Further, we will discuss opportunities and challenges for each technology identified.

The ones listed in Table 1 below appear to be the most popular technologies currently used in museums according to our interviewees. Further below, we discuss them in more details.

Apps. The recent pandemic has accelerated a phenomenon that was just beckoning before it: the collection breaking out of the museum walls, with the related increasing

Table 1. Technologies and how they may be applied in museum experience design.

Technology	Purpose in relation to experience	Rationale
Apps	Extend the journey to before and after the real visit. Relate digital experience to physical museum visit. Carry the museum in your pocket.	Extending the journey Providing additional information Increased engagement
Digital twins	Experiencing collection items also outside the museum.	Hybrid experiences
Sensors	Trigger a storyline (e.g., audio or video). Enabling interactivity.	Increased engagement Playfulness
Audioguides, GuideID podcatcher	Guide people through a museum. Provide extra information at the moment and place where it is needed.	Guidance/guided tour Providing additional information
Projections (also projection mapping)	Guide people through a museum. Provide extra information at the moment and place where it is needed.	Guidance Providing additional information
Immersive projections	Aesthetic experiences by projecting on objects or walls.	Immersion Increased engagement
Video/Movies	Provide additional information in an engaging way. Contextualising detailed information. Experiencing collection items also outside the museum.	Providing additional information Increased engagement Extending the journey (online videos)
Robots	Enable interactions that feel like social experiences.	Social experiences
AI/Machine Learning/Image recognition	Provide information at the right moment, when someone is looking at an object.	Identification Providing detailed information
Identification technologies (NFC, RfID, face recognition)	Take history of visit into account, and tailor experience to it.	Identification/ Personalisation
Augmented reality	Provide contextualised additional information in an interactive way.	Providing additional information Increased engagement Extending (*augmenting*) the story
Virtual reality (incl, social VR)	Experience an environment in which someone cannot physically be present at that time. Enable immersive experiences while retaining the qualities of social experiences.	Immersion Social experiences
Other technologies (Natural Language Processing, Deepfake)	Various future experiences.	Identification Personalisation

need to have the museum always 'in the pocket' (*Fabrique, Tinker Imagineers, IJsfontein*) for experiencing the museum and its collection outside of its walls, always and everywhere. A very popular technology to achieve this is apps. Apps are always related to the physical visit to a museum because they let visitors have the information they need precisely 'in their pocket' (*Fabrique*). Examples of this abound: from the wayfinding app for Tate Modern that was developed by Fabrique to the app for Rijksmuseum developed by Northernlight that would make people look at the artwork instead of at the screen (*Northernlight*). Apps work best with the content in the museum (*Fabrique*), especially when they do not compete with the collection (*Northernlight*). In some cases, social media apps, such as Instagram or image recognition apps, are used to extend stories and complement what is shown in an exhibit (*IN10*). Instagram can for example tell stories that trigger people to visit an exhibition (*IN10*). An example of this are the app and the Instagram stories that were developed by IN10 for the Fotomuseum in Rotterdam.[19] However, apps are also used to make holistic experiences as full visitor journeys (see above) possible. In this case, designers extend the museum story to before and after an actual museum visit. An example of this is the app for Kinderdijk[20] which guides visitors who are on the way to Kinderdijk along 'lovely local establishments on the way' (*IN10*). The design challenge here is how to make people start engaging with it before their visit actually starts.

Among the many apps that are on the rise in museum experience design are social media. Connecting social media, for example Instagram, to museum experiences does not happen so much yet. There is indeed still some reluctance on the part of the museums to connect to something that is out there beyond their control (*Kiss the Frog*), and that is constantly changing. However, with social media, a process of interactive feedback loops with the visitors is initiated and these loops can be used to improve the museum story and content (*Northernlight*). An example of this view is represented by the Rijksstudio,[21] an application developed for the Rijksmuseum in collaboration with Fabrique. This app makes a large part of the museum's collection available to the public to download. While originally intended to allow visitors to examine high-resolution images of the collection items, the Rijksstudio actually allows them to cut parts of the selected images and create their own masterpiece and share it with others by uploading it on the museum website (*Fabrique*). At the time this app was launched, however, the museum was scared to let anybody upload whatever they wanted on the museum website since they had no control over it (*Fabrique*).

Digital twins. The idea of the museum collection breaking out of the museum walls has also been translated into a certain degree of hybridisation: a hybrid experience, where physical and digital elements become one. This synthesis is well expressed by the notion of a digital twin. With Unreal or Unity, and many other game engines, this synthesis has become possible: why go visit any museum when one can see its collection digitally online for example? There are actually other reasons for wanting to visit the 'real' physical museum. These will be discussed further, e.g., for the social experience of having a nice day out with other people.

Sensors. Sensors are the next big technology in use in museums: they can be sensors like those in a smartphone that know how to translate any physical input to a computer

(*IJsfontein*), or capacitive sensors that can be put behind a wall or a painting and that notice a visitor's field of electricity change. Designers may use such sensors as a way of hiding the technology for the users, making it invisible so that the focus remains on the story (*IJsfontein*). In an exhibit developed by IJsfontein, one such sensor is placed behind the painting of a soldier holding up his hand. As a visitor, one is enticed to put one's hand on the soldier's hand. Approaching sensors or putting one's hand on them, can trigger small storylines to start (*IJsfontein, Northernlight*). Sensors can also be used in *interactives* in a museum: to measure the distance from a given object and trigger an action, to track the visitor's movement and start something (*Fabrique*), like *Kinect-Azure installations* (*Kiss the Frog, Tinker Imagineers*) or *gamification* at the Erasmus Experience (*IN10*).

Guided tours and projections. *Audioguides* are still in use, with technology like GuideID podcatcher, a RFID-based system that allows visitors to just scan RFID tags on an object in an exhibition (*Tinker Imagineers*). But also just as a *guided tour with projection* on the floor or on the artworks, in an art museum, to add special effects, explanations, guidance, information. And when the projector is off, there is no technology to see (*IJsfontein*). Another type of projection is *projection mapping,* by which it is possible to project on concrete raw materials to increase the experience aesthetically. This type of projection works at its best when the visitor stands at the right place in the room: then the perspective fits perfectly, otherwise, the magic is lost (*Tinker Imagineers*). The importance of *magical* museum experiences will be discussed in more detail further below.

Immersive environments. Similar to project mapping are immersive projections. This is yet another recurrent experience type involving the use of *immersive environments* (*Kiss the Frog, Northernlight, Tinker Imagineers*), which are based on projections and display technologies and foster interactivity (*Kiss the Frog, Tinker Imagineers*). Such environments[22] can also cater to the 'museum everywhere' experience discussed above, if they are implemented in public spaces or just outside the museum physical walls (*Northernlight*).

Video/movies. Movies and videos are one of the strongest ways to present content online (*Fabrique*). Also for museums. And video is believed to become much more the standard in how to present stories (*Fabrique*). Audiovisual productions, often with a timeline like in a film (*Tinker Imagineers*), can be engaging ways to tell these stories, especially for conveying concepts and abstract subjects. Video is believed by many of our experts to be the upcoming trend in how to produce engaging stories (*Fabrique*). A very specific and increasingly popular way of creating more engaging stories through video is by involving influencers, i.e., people that are known from their appearances in the media: they can strengthen the impact of a story (*IN10*). The Lust for Life | Ed van der Elsken exhibition held at the Fotomuseum in Rotterdam in 2019 is a successful example of how known influencers have become part of the exhibition by playing a role in telling its story (Figure 4). While the appeal to influencers for promotion is a known phenomenon because of their power to connect to specific audiences, their adoption in museum practices was still minimal before the pandemic (and the exhibition at the Fotomuseum had run just before it).

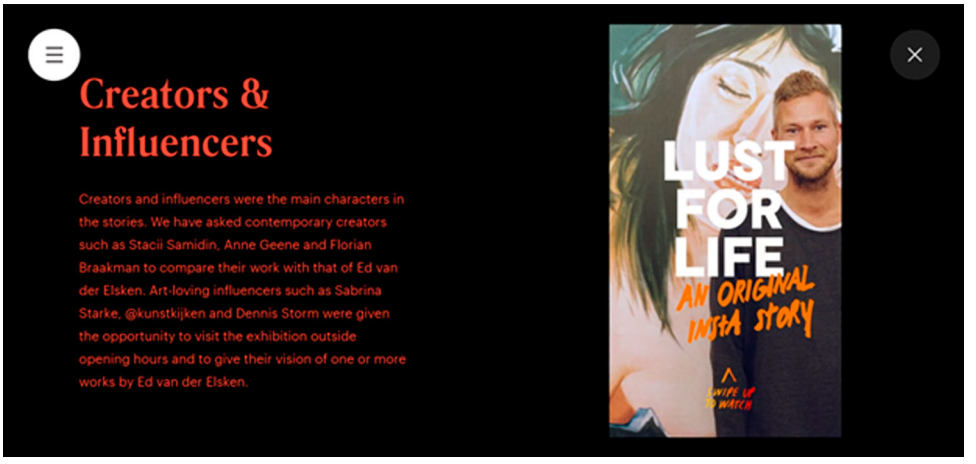

Figure 4. Influencer in an insta-story of the Nederlands Fotomuseum.
Source: https://www.in10.nl/en/work/nederlands-fotomuseum

Another exemplary use of video is for the creation of *open and magical experiences* (*Tinker Imagineers*). The risk with this approach, however, is that this might very easily bring the museum experience close to a theme park experience with a high degree of 'Disneyfication',[23] which not all museums seem to be in favour of. An example that was mentioned during our interviews is the more theme park-like design that has been adopted in the Chocolate Nation in Antwerp (*Tinker Imagineers*). The visitor walks through it in an experiential journey of smells, tastes, and sounds that bring them from the cocoa plantations in Africa to the port of Antwerp. The climax is this fantastic huge and magical machinery at the centre of the museum (Figure 5). In this section, visitors spend 4 minutes, learning about the production process while beholding the spectacular machines turning into motion. The design consists of many motors, projectors, lights and sounds that are activated in perfect synch to create a 'magical' real-life experience that most of us only experience in movies like Willy Wonka & the Chocolate Factory.

Robots. Robots are mentioned among the future trends. They are a technology that helps visitors to connect and to translate any physical input to a computer (*IJsfontein*). But they also allow visitors to still have a social experience: robots can be given a human-like behaviour so that it becomes more pleasant to interact with them (*IJsfontein*). A social and playful experience is what museum experience design should strive to realise (see earlier). And this is for example one of the reasons why VR is not so much in use yet: *social VR* is hardly used, because it is still so expensive and it requires visitors to wear goggles, but it would help if one could share this virtual reality space with other people (*IJsfontein*).

AI and machine learning. They are mentioned among the future trends. AI is something nobody really used yet, at the time of the interviews, although it is so much talked about (*Fabrique*) apart from few known examples like chatbots (for example at the MART in

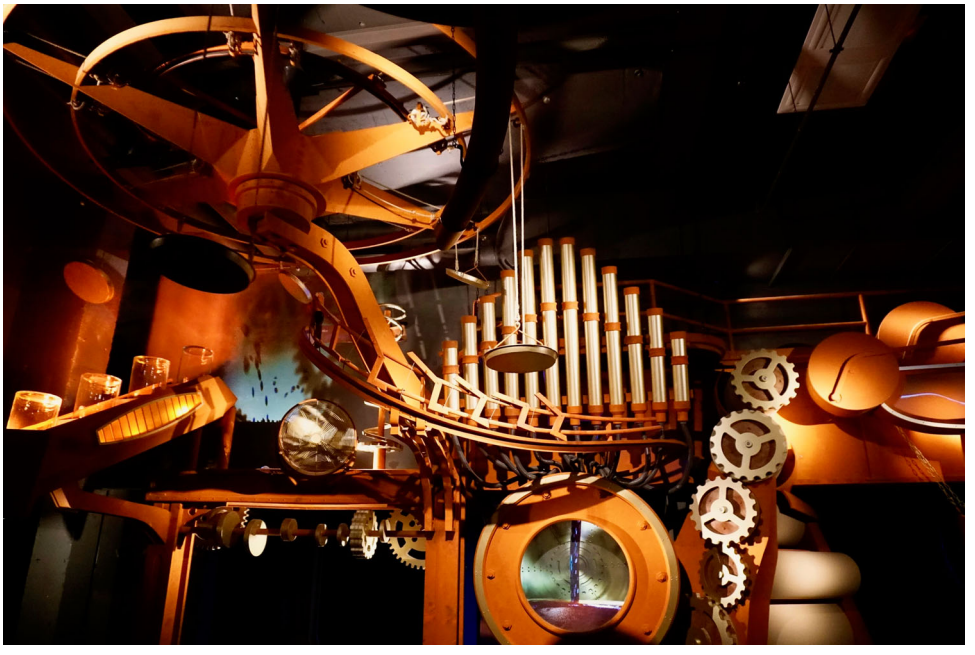

Figure 5. The magical effect in the Chocolate Nation in Antwerp.
From source: https://tinker.nl/en/work/chocolate-nation

Rovereto). *Image recognition* is used to recognise what the visitor is looking at and provide extra information (*IN10*).

Technologies for identification. Identification in various ways, e.g., via *NFC* or *RFID*, is often used and represents a shift towards biometrics. The issue with this technology seems to be more practical than ethical according to our experts and at least at the time of holding the interviews, and it relates to whether visitors should for example be given a wristband at the start of their visit that they can keep afterwards or not, in view of the operational costs involved (*Kiss the Frog*). In some cases, identification also allows for personalised experiences (IN10), e.g., through interactivity, collecting elements to reach a pre-given purpose. A more future-oriented challenge that was mentioned around personalisation, storytelling and video, concerns scenarios where there is a video cloud around a piece of art that, based on somebody's interests, would tell a story in the form of a personal documentary about that artpiece (Fabrique).

Augmented reality (AR). Although AR can be considered a very old technology (with recorded music being its oldest form, since it gives listeners the impression to be just at a concert, while in fact not being there (*Fabrique*)), some believe that not many really understand it and use it properly yet (*Northernlight*). Most of our experts however agree on the fact that AR is to be preferred over VR to design museum experiences (*Fabrique*), even though they have different opinions when it comes to its potentialities. However, its opportunities are believed to be phenomenal ('it is real size, real time, it is mixed with reality, so it is real life, so close to you' (*Fabrique*)). Based on these

considerations, it is hard to believe that AR is still underused. Some experts think that the reason for this lies in the fact that there is not yet an easy-to-wear device to allow users to engage with it (*Fabrique*) and partly also because of privacy issues (*Fabrique*). Additionally, AR, just as VR, does not always provide a social experience but often creates an isolating one (*Kiss the Frog*). The next evolution of AR is believed to be real holograms not only to show elements to people, but also for infographics, and, although this is not expected to happen in the near future, it will make AR obsolete (*Tinker Imagineers*).

Virtual reality (VR). VR is believed to be mostly used because of its goggles (*Northernlight*) and because of the spectacular experience it provides: it launches viewers into another dimension. But in this way, the social interaction is lost (*Fabrique*), and a VR experience remains a solitary, too individual event (*IJsfontein*). Although the experience can be made multi-user, it is still so expensive that this option is often not available to museums. This explains why its use is still limited (*IJsfontein*). Social VR is however one of the next developments to expect. One of the biggest potential assets of VR is that it provides access when the physical one is not possible (*Fabrique*). Theoretically, in the longer term, one can also expect that it will gradually change the notion of what real or authentic art is (*Fabrique*). Its possible downside, though, is that it also changes the notion of what a museum visit is: visiting a museum with people turns it into a nice day out, which is something that walking through a VR simulation of a museum cannot replace (yet) (*Tinker Imagineers*). VR can also be used as part of the design process, for example, to get a concrete feel of how a certain space would look like (as was done for the Tirpitz project[24] by Tinker Imagineers, for example). VR in a collaborative way would also be a nice add-on to the use of this technology (*Kiss the Frog*). The main shortcoming however that is ascribed to VR is that it is difficult to create with it something magical in which the technology is not visible: VR glasses ARE very visible (*IJsfontein*)!

Other technologies. The future will probably bring more *Natural Language Processing* (*Kiss the Frog*), also in combination with *Deepfake,* which are now just potential trends but hardly used (*Kiss the Frog*). And *facial recognition* for the identification of visitors**,** although this latter is found controversial by clients (*Kiss the Frog*).

To conclude this overview of existing and emerging technologies, the advice of our experts to museums is to use what is already out there and adapt it to one's own needs (*IN10*), rather than to develop *ad hoc* solutions, to *use existing platforms for creative purposes* (*IN10*).

Conclusion

What will the future of museum experiences look like? We interviewed six designers from Dutch agencies heavily involved in the design of museum experiences internationally.

Several emerging trends were identified by our experts about the way technology will be used in museums. The most important one is certainly that *the future of museums is hybrid.* Design agencies are thinking about how experiencing *virtual/online art relates to physical objects,* in terms of what people see as '*the real thing*'. In the future, *digital and online museum experiences may outnumber the physical* museum experiences (*Fabrique*. *Northernlight*, *IJsfontein*), whilst some design agencies emphasise that there will always still be room for seeing the real, physical objects (*Northernlight*) and visiting the real

physical museum (*Tinker Imagineers*). The primary museum experience will be digital but there might still be this very unique place where a visitor still has a touch with reality and in which they can see the physical items 'for real' (*Northernlight*). As *physical and digital will gradually become one* (as in the digital twins), the need to go to a museum will become smaller (*Northernlight*). One expert compares this situation to the time when people had no smartphones and most people pretended they would not need one (*Tinker Imagineers*). In line with this, also hybrid, digital twins-like experiences will become more prominent and claim their role as 'proper' museum visits (*Tinker Imagineers*), considering also that the *younger generation* of digital natives may think differently about *what 'real' art is* (*Fabrique*). And this, not to mention the fact that *digital* can play an important role for those audiences for which visiting the physical museum is not feasible because this is at the other end of the world, for example (*Fabrique*).

A variation on this hybridisation concept is to have the museum experience take place *on the visitors' Instagram rather than having something digital in a museum* (*Northernlight*), given the amount of time that people are already spending on social media.

Another emerging trend is that *the museum of the future is also a museum with smart, intuitive environments* (*Northernlight*). There, machine learning can play an important role if, for example, a machine can recognise that, when a visitor stands in front of a painting in which a certain colour is prominent (for instance, red), then it must mean that they like it (both the painting and the colour), and then the system can point the visitor to other examples that are similar to the original painting for content, author and/or colour.

Immersion combined with *personalisation* is already becoming more and more important in physical museum spaces (IN10). This focus on immersion results in *physical, spatial experiences*, in which a visitor is totally immersed, without a layer of technology in between (*Tinker Imagineers*). This is somehow what happens in theme parks, where the technology adopted is used to create magical experiences (*Tinker Imagineers*). But this easily becomes too Disney-like, and therefore too literal, for museums, leaving no space to imagination and abstraction.

These two trends (hybridisation and museums as smart, intuitive environments) together will gradually change the nature of a *museum as a place* and as *a space* (*IJsfontein*, *Northernlight*). *Museums as places* will mainly become *places for storytelling* about more abstract issues (*IJsfontein*). *Museums as spaces* will potentially also be positioned in third places such as marketplaces, religious places where people get together and can then have cultural, transformative experiences (*Northernlight*) – the participatory museum advocated by Nina Simon is already an example of this (Simon 2010). Museums as places will also be thinking more and more in terms of them *being a 'brand'* (*Fabrique*). Museums as spaces will be also those by known brands which more often *create their own museums* (e.g., energy companies creating an energy museum (*Northernlight*)). Museums as spaces may even emerge from unexpected fields, such as the dancing scene, or from fashion (*Northernlight*).

Notes

1. 'A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage. *Open to the public, accessible and inclusive,* museums foster diversity and sustainability. They operate and communicate ethically, professionally and *with the participation of communities*,

offering varied *experiences* for education, *enjoyment*, reflection and knowledge sharing'. 24 August 2022, ICOM General Conference, Prague.
2. Reorganise, Reuse, Rethink and Relaunch – Lessons from Philbrook – MuseumNext.
3. The Uffizi Gallery Leads the Way with TikTok Tactics – MuseumNext.
4. https://www.museumnext.com/article/tate-britain-partners-with-facebook-on-the-virtual-wing/
5. Museums should embrace Instagram rather than rejecting it. Here's why – MuseumNext.
6. How Can Museums Harness the Power of WeChat? – MuseumNext.
7. The Met take their collection onto Animal Crossing – MuseumNext.
8. Monterey Bay Aquarium Live Streaming Animal Crossing – MuseumNext.
9. https://www.museumnext.com/article/museum-heads-to-wonderland-with-virtual-reality-event/
10. Meaningful museum interpretations using virtual reality – MuseumNext.
11. https://www.museumnext.com/article/7-ways-vr-is-changing-the-museum-landscape/
12. https://www.museumnext.com/article/bringing-17th-century-documents-from-rembrandts-day-to-life-using-augmented-reality/
13. Augmented Reality brings Korean Heritage Site Back to Life – MuseumNext.
14. How Are Museums Using Chatbots? – MuseumNext.
15. What Digital Twin Technology Means for Museums – MuseumNext.
16. https://www.teamlab.art/.
17. Micrio – Ultra Resolution Storytelling.
18. https://www.panorama-mesdag.nl/#/micrio/explore.
19. https://www.in10.nl/en/work/nederlands-fotomuseum.
20. https://www.in10.nl/en/work/kinderdijk.
21. https://www.rijksmuseum.nl/en/rijksstudio.
22. Such as immersive projection rooms aka Motionexperience.nl, a want-to-be Teamlab rip-off, are also becoming more and more popular (*Tinker Imagineers*).
23. https://www.designweek.co.uk/issues/29-may-1997/museums-may-suffer-bout-of-disneyfication/
24. Tirpitz museum denmark – Tinker Imagineers.

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