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Designing museum spaces from the user experience | La progettazione degli spazi museali a partire dall'esperienza utente:

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Abstract

In the current context, museums are particularly focused on offering visitor-oriented services. Understanding the user's behaviours, needs, and motivations is of fundamental importance in defining interactions and personalised services that make the use inclusive.

Current experiments, digital technologies and new practices of "spectacularity", which generate "digito-corporal" experiences of the user, are shaping the functions and objectives of artistic knowledge for cultural spaces, becoming an integral part of the work of designers and researchers in this field.

Interactive installations and cutting-edge technological products are widely used in museums to improve visitor experience, enrich the content of museum exhibitions and diversify narrative forms to offer dynamic, immersive and multisensory visitor experiences.

Through a human-centric approach, the article proposes to explore the multidimensionality of the design of museum spaces for the visitor experience, deepening the concept of an immersive and narrative environment and the physical and perceptive involvement of the visitor in the interaction with the space and the exhibited objects.

Through the analysis of approaches and models present in the literature on the design of the visit experience for exhibition spaces and concerning the selected case studies, some forms of physical and technological interaction of visitors in cultural contexts will be explored in order to identify guidelines for the design of museum spaces centred on the user and the "space-user" relationship.

Keywords: Interaction Design – Creativity – Design for Experience– User Experience

Introduction

According to the recent ICOM definition, a museum is an institution that serves society, is open to the public, accessible and inclusive, offering diverse experiences for education, enjoyment, reflection and knowledge sharing. (ICOM, 2022).

Based on this reference, museums today are more committed to disseminating and adopting different strategies of engagement and interaction with visitors in order to offer more empathy with the exhibition spaces and current exhibitions. At the same time, museums are responsible for ensuring that the knowledge they offer is correctly conveyed and understood by visitors.

Visitors' experiences within cultural contexts are becoming the object of exploration and communication, understood as performative and interactive forms with the objects on display and with other users within the museum or art gallery.

In this context, digital technologies and the resulting interactions broaden how visitors can participate, enabling the dissemination of knowledge with direct user involvement and the identification of different cultural interests of the public.

Museum environments have become places where interaction design and experimentation with new technologies define the interest in promoting new modes of interaction and new cultural forms focused on understanding, entertainment and user experience.

Interaction can enhance participation modes and define flexible and personalised experiences, eliminating the one-way communication problem often typical of "traditional" exhibitions.

Based on these considerations, this contribution offers a brief overview of interaction design in support of museums, investigating approaches and models in the literature relating to the design of museum spaces.

Among these models, particular attention will be paid to the work of Mason (Mason, 2020) about some case studies identified in the literature in order to identify the process of space-person interaction in places of cultural fruition and improve the user experience through dynamic, immersive, multisensory and human-centric visits.

Methodology

Starting from the topic of interaction design for museum spaces, several approaches and models in the literature concerning the design of the visitor experience in exhibition spaces were identified and analysed. In particular, the study by Roppola (Roppola, 2013) and Mason's model were examined. (Mason, 2020)

Starting from this reference for user-centred design for the three-level visitor experience, several case studies were identified to define the three space-person interaction processes within cultural contexts.

User interaction and space fruition

With the development of multimedia technology, interactive devices in museum settings aim to transfer exhibition content through the stimulation of creativity and sharing. Various scientific studies point to the growing interest of visitors in interacting with works in an original and participative way (Solima, 2012), particularly by exploiting the features and potential offered by new digital media.

Visitors are often intrigued by "spectacles" offered by museums, which have become "experimental laboratories" for artists and designers, promoting cultural events of various kinds to a broad and diverse audience, far from the obsolete passive conservation mechanisms of traditional museums.

Another interesting aspect is discussed in the work of Nicholas Serota (Serota,

1996), who considers visitors and artistic communication to be processes at the centre of the transformation of museums. Visitors can interact with the artefacts and artists through physical relationships, participating in person and integrating with performances and events.

In this context, the traditional exhibition form is undergoing a radical change. Interaction design contributes to creating and diffusing visual, auditory, tactile and multisensory experiences through body movement and interaction in space. Starting from the fundamental concept of "people-oriented design", interaction design aims to meet the psychological and behavioural needs of visitors to achieve efficient and widespread dissemination of culture, creating complete visiting experiences.

This approach aims to define and design the interaction between users and products/ systems and it describes the possible behaviour of the user. Every time a person uses a product, a "dance" is established in which the user moves and the system reacts. (Garrett, 2010).

In cultural heritage, Wideström presents a classification framework for different types of interactivity in science centres and museums. The classification is based on three aspects of interaction: (I) level of participation, which concerns the influence of users on the content of the exhibition; (II) level of virtuality, which concerns the amount of interaction that takes place in real physical space as opposed to virtual space; (III) level of collaboration, which concerns the social interaction between users and can be distinguished as individual or collective. This model reflects the different types of interactions envisaged in science exhibition contexts, considered highly interactive centres involving a wide range of target groups to engage and educate simultaneously, where digital and physical materials and design spaces merge. (Wideström, 2020)

Insights from interaction design can also be used to evaluate and innovate the accessibility of exhibitions and to take technologically appropriate measures to meet visitors' needs (Saki Asakawa, 2019).

The purpose of interaction design is not only to contribute to "user-friendly" exhibitions for visitors. The knowledge and exploration of different ways to "create interaction", together with knowledge of emerging technologies, is of fundamental importance to innovate ways of "understanding" artistic culture.

By implementing modern interactive solutions, museums can also create research opportunities for interaction design and new technologies can be explored and evaluated in less constrained contexts, such as museums. (Bodin, 2021)

The different factors of an interactive exhibition contribute to the creation of exhibitions that are, at the same time, educational, entertaining and easy to understand. An example of this is the project by Schauble and Bartlett, who used educational theory to survey children about the "idea" of fossils and then design an exhibition in which the content was based on the considerations noted and interactive activities inspired by scenarios from everyday life (Schauble, 1997). A further reference is the project by Asai, Sugimoto and Billinghurst, who, inspired by collaborative learning between parents and children, created an augmented reality exhibition in which parents can take on the role of mission commanders and children of astronauts while exploring the lunar surface (Asai, 2010).

For this reason, the design of exhibitions for the "collaborative" visitor experience becomes a fundamental part of implementing museum policies for audience engagement (Reagen, 2014).

Over time, exhibitions have evolved to include a wider range of media, overlapping with art, advertising, architecture and graphic design. It is, therefore, an orchestration of space, media, content and narrative. (Reagen, 2014)

The contemporary museum exhibition represents an open and dynamic

communication and dissemination activity involving users in an ever-evolving process. As people's modes of communication, participation and communicative awareness increase, interaction design becomes an active part of the design of museum spaces, stimulating visitors' enthusiasm through "people-space" links within the cultural and museum context, understood as a place of physical and conceptual connection.

Approaches and models for designing the visitor experience in exhibition spaces

Over the past two decades, museums have undertaken various design strategies to create more personalised and immersive experiences, such as "affective", "participatory", "immersive", and "sensory" experiences (Bertrand, 2024). These strategies contribute to achieving objectives for experts in the field, which are oriented towards museum experiences and designed to facilitate curiosity and exploration. (Kenderdine, 2012).

Cultural heritage institutions are adopting immersive and interactive approaches to provide "more dynamic ways of communicating with audiences, encourage richer and more meaningful participatory practices and engage users with sites, institutions, collections and wide-ranging themes".(Bertrand, 2024).

For this reason, museums have shifted their focus to more "visitor-oriented" practices, adopting design and technological strategies of engagement, exhibition and display to promote "networked" culture, competitiveness, economy and tourism. (Kamariotou, 2021)

Nowadays, design addresses social issues related to user experience and is used as an investigative and experimental project. For example, the space for the work of art is becoming a place of "verification" of expectations, involvement, and perceptions, where projects do not need to be applied in series.

Experimentations, therefore, are becoming an integral part of the work of designers and researchers in this field because they produce very often unexpected results that allow original processes to be developed with user-centred learning and experimentation methods.

Scholars Laurberg and Schavemaker (Laurberg, 2016) highlight how museums are increasingly involved in speculative and research activities, often interdisciplinary, now widely integrated into the entire institutional planning process.

As an acquisition of knowledge, research in the discipline of design offers curators and designers an expanded narrative vision of an object, of a work of art, about its historical, artistic and very often functional relevance, giving rise to iterative processes of creation, revision and continuous improvement.

Today, exhibitions structured in terms of narrative design revise the role and modalities of technological factors coordinated in a "script" that Uwe R. Brückner calls a "score". (Brückner, 2011). In this way, the visit and experience can be managed simply and rhythmically, defining time, discovery, perception, understanding and assimilation. The visitor's attention is designed in sequence, and the exhibition can be experienced according to different stages of immersiveness, where digital intervention becomes an experience aimed at consolidating a humanised memory. For this experience, the design of exhibition spaces becomes a catalyst that prompts one to search for new information and make connections between different media content. (Borsotti, 2023).

The aim of designers in designing exhibition spaces is to satisfy visitors aesthetically and produce knowledge and personal visual and spatial interpretation. Understanding visitors' experiences and the factors that influence them is also important in producing research and conceptual developments to improve the design of user-centred exhibition spaces.

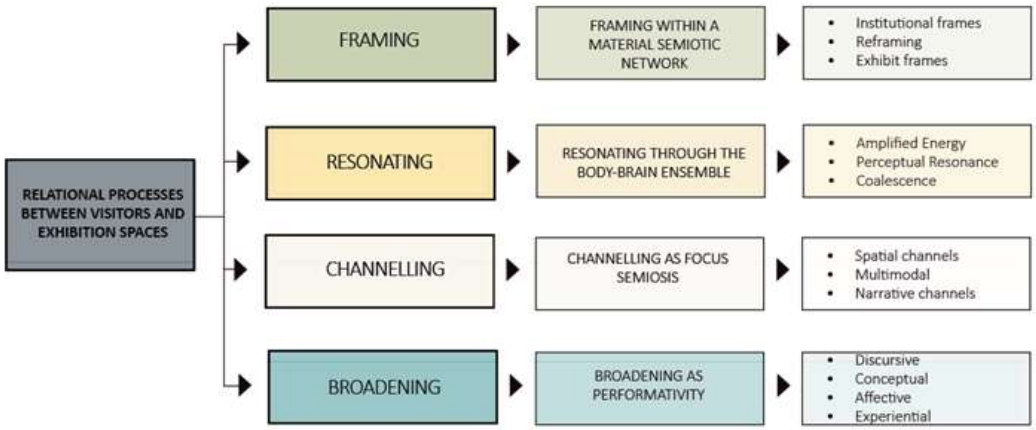

Figure 1. Roppola's model of the four key relationship aspects between visitor and exhibition space. (scheme freely reinterpreted by the author, 2025).

The experience of visiting a museum is a process of mutual interaction or "dialogue" between the visitor and his or her environment. (Reagen, 2014). It can be defined as an "immediate, subjective and personal response of an individual to an activity, environment or context outside his or her usual environment". (Packer J. B., 2013). In particular, the research conducted by Roppola (Roppola, 2013) reveals how visitors identify themselves about the exhibition environment and how the experience is influenced by design and related design decisions.

Based on the analysis of visitors' experiential reports, Roppola identifies and classifies four key aspects in the relationship established between visitors and the exhibition space (Fig. 1). The author defines the first process as "framing" where visitors introduce a discussion about museums and exhibitions in a generic (institutional, exhibition) sense. For the second key aspect, visitors identify how they are attracted to the exhibition environment immediately or effortlessly, a process the author called "resonance". Thirdly, visitors described how they were guided through the exhibition space, media and content, a process defined as "channelling". Regarding the fourth key aspect, visitors described how they experienced a "widening of the self", a process defined by Roppola as "widening".

These four main processes were then divided into categories describing how visitors find themselves about exhibition environments.

It is, therefore, evident that the study of experiences and interpretations in exhibitions can be significant for the organisational and overall structure of art spaces but, above all, for user-oriented museum design. Spaces dedicated to culture can, therefore, be redeveloped and shaped according to the needs of the public.

The user-centred design approach for the visitor experience in exhibition spaces - hybrid and physical - is further explored in Mason's contribution, according to which

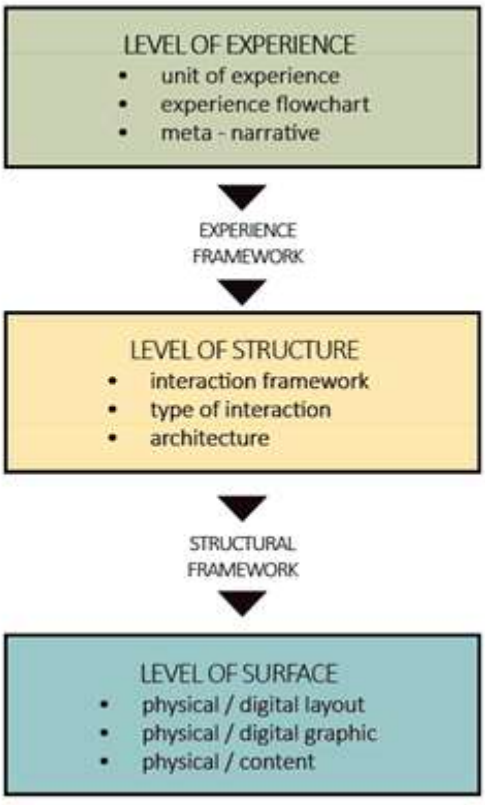

Figure 2. Design model for the visitor experience for exhibition spaces. (Mason, 2020)

such design must operate on three levels: (I) Experience, (II) Interaction, and (III) Visual elements. (Mason, 2020) (Fig. 2).

In particular, the "Level of Experience" defines "sub-levels" such as the units of experience, the flow of experience and the meta-narrative, including practices and design methods suitable for designing experiential structures underlying narrative environments.

The "Level of Structure" focuses on interactions and content organisation structure. According to Crampton Smith, designers at this level make the experience "visible" (Mason, 2020) by defining interactions and structuring content that shapes experiences over time. At this level, the structure is created for the definition of three interrelated design elements: first, the interaction framework, as the distribution of key interactions according to a structure resulting from the integration of the physical and digital dimensions; second, the information architecture that organises the content and defines the distribution of the different interactions within the information space; and finally, the definition of the types of interactions that visitors can perform within the information space.

Finally, in the "Level of Surface", the design elements have to satisfy the sensory demand of the product, such as the form factors of the physical and digital components, the appearance and visual elements, and the different design elements that make up the product presentation of the content, which are useful for understanding the exhibition and create display coherence between the digital interfaces and the graphic components (labels) of the exhibits.

The contribution of Borsotti & Mason (Borsotti, 2023) also defines how Visitor Experience Design (VX) is directly related to the design of exhibition environments defined as "narrative", given the special focus on the relationships between people (visitors), digital and physical spaces/places, digital content and exhibits.

In this regard, Austin defines a narrative environment as a "site of action and interaction between people, narratives and places" (Austin, 2020) emphasising that the practice of designing narrative environments is "particularly associated with the principles of User Experience Design".

The narrative factor, therefore, accompanies the discursive/immersive combination of an exhibition by representing the ability to decode and transmit more comprehensible meanings to a wider audience. Through the narrative system, therefore, exhibitions and the dissemination of culture relate to the visitor in terms of knowledge generation, no longer knowledge reproduction. According to Borsotti (Borsotti, 2023), the term "narrative" refers to the relationship established between "collection-visitor", while "narrative environments" refers to immersive, multisensory and interactive spaces shaped by the logic of the visitor's experience. Furthermore, "discursive" and "immersive" are indicators of change in the current method of offering culture within cultural heritage. The term "discursive" refers to the form of curatorial, interdisciplinary and synthetic design, while "immersive" refers exclusively to the spectacularization of the exhibition. (Laurberg, 2016).

It is no coincidence that Mark Wingley (Wigley, 2016) discusses this dualism in terms of exhibition space design, where the logic of reading is contrasted with the logic of experience, which uses the language of multisensoriality, claiming that they are intrinsically intertwined and dependent.

A narrative exhibition space, therefore, defines a structure of cognitive sequences that allow the simultaneous exploration of the contents of what is on display, whether explicit or implicit. Through the development of a narrative exhibition system, exhibitions relate to the visitor in terms of knowledge reproduction and knowledge generation. (Brückner, 2011).

Narrative exhibition space design, therefore, not only shows but also evokes, reveals, involves, excites and stimulates the user on a perceptive and physical level. Narrative amplifies the meaning of discursive by declining it as the communicative capacity

of the "collection-visitor" relational system to propose multiple modes of access and investigation.

Tools and methodologies for user experience in museum spaces.

Visitor experiences within a cultural space can also be defined as psychological, intimate and personal journeys that can determine the quality of the visit. Users can be actively involved in the narration, interpretation and transformation of their emotional and physical perceptions. Thus, a single product can evoke a diverse range of visitor experiences. (Packer J. &., 2016).

The study conducted by the author Leahy, entitled "Museum Bodies: The Politics and Practices of Visiting and Viewing" (Leahy, 2016), shows how many of our behaviours within contemporary museums have been shaped by artistic and cultural institutions, such as walking (and not running) in galleries, whispering rather than speaking, and the prohibition of touching. Leahy's work aims to reorient our attention from the museum as a collection of objects to the museum as a site of social, psychological, and corporeal practices.

Designing museum spaces, considering the level of experience and user-space interaction, represents the starting point for defining a set of factors capable of satisfying visitors' needs, emotions and expectations.

Further case studies have been introduced below, introducing the "new design trends". These references have been selected starting from Mason's contribution described above, which foresees the three macro-levels of the design of the visit experience.

The "Level of Experience" case study "The Weather Project" has been associated with it, which identifies three design elements: (I) the units of experience, (II) the flow of experience, and (III) the meta-narrative experience. These references define the result of the combination of knowledge from curatorial services and visitors and determining visit paths in the museum space.

With the installation "The Weather Project" of 2003, the Danish artist Olafur Eliasson created the illusion of the sun in a city usually characterised by fog and greyness to involve the visitors in the Turbine Hall of the Tate Modern in London (Fig. 3). The artist, through the use of "mirrored sheets" suspended from the ceiling, a semicircle

Figure 3. The Weather Project. Photo by Tate Photography (Andrew Dunkley & Marcus Leith) on Olafur Eliasson

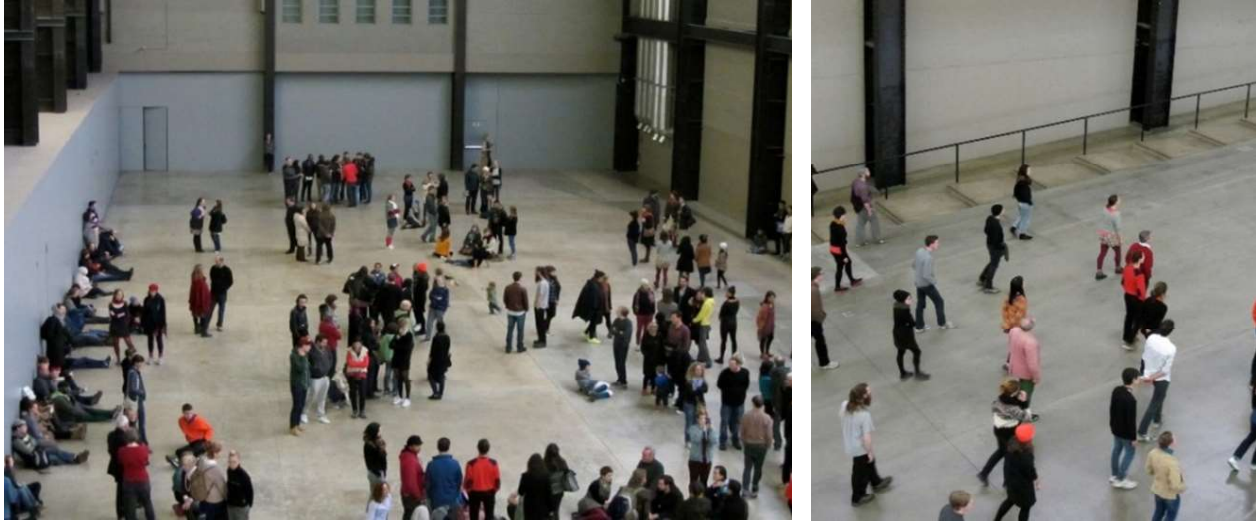

Figure 4. ino Seghal, These Associations, Tate Modern, Unilever Series Commission, 2012. Photo on johiggins

backlit by about 200 single-frequency lights and its reflection, created the image of a huge sunset, seen through the artificial fog emitted in the hall.

In this context, the experience level is totalising, perceptive and cognitive. It can be considered as a combination of elements that, when put into a system (unit of experience, the flow of experience and the meta-narration), generate value to the visit and define the completely immersive space-person interaction process.

For Mason's "Level of Structure", the case studies of Tino Segale and Carsten Höller were considered, focusing on the interaction and mobility of visitors within an art gallery, developing new practices of "spectatorial". This level focuses on the distribution of key interactions, from integrating physical and spatial dimensions to organising content for interaction with the information space.

Specifically, "These Association" is an installation conceived by Berlin-based Tino Sehgal in 2012 and commissioned by the Turbin Hall of the Tate Modern in London. It shows the process of iteration and interaction between unknown users without objects or paintings to look at, where the artist directed voluntary participants to move around the room and "stage" conversations. This practice generates natural, sudden, open connections and conversations within the museum and between unknown people. (Fig. 4).

Sehgal's intervention consists entirely of encounters between people who move unconsciously without directions in a new art form halfway between theatre, performance art and dance. In this way, visitors become active participants without using any technological device during the performance.

Like the following case study associated with the Level of Structure, the Florence Experiment, "The Florence Experiment" (2018) by artist Carsten Höller and neuroscientist Stefano Mancuso identifies itself as a blend of art and scientific research through the interactive installation inside the courtyard of Palazzo Strozzi in Florence.

It is an open-air exhibition space where the contemporary art installation questions the history of the Renaissance architecture of the building that hosts it. For this project, Carsten Höller has thus reimagined how one lives and moves in the open space. In fact, upon entering the courtyard, users found themselves in front of two imposing

Figure 5. The Florence Experiment. Photo by Samantha Vaughn su theflorentine

steel coils wrapped around a vertical pole that connected the third floor of the building to the courtyard and extended vertically for about sixty meters in height. (Strozzi, 2018).

Höller, known for his conceptual art interventions, created twin, intertwined, interactive slides that transformed the palace into a temporary playground for adults and children, thus reconfiguring the way users experience the familiar site of Palazzo Strozzi. (Fig. 5-6)

By focusing on the physiological and psychological aspects of the visitor, we witness the totalising experience of visiting in which the "subject is put on display". Visitors are not only spectators but also become active in the installation with their own bodies.For the selected case studies, people interact as an expression of creativity. For example, gestural interaction through the "movement" of the body is an important factor in designing user-centred exhibitions and displays. Furthermore, both projects focus not on technology but on defining experiences with a substantial physical-emotional impact.

Finally, the following case studies, "Connected" and "Zoom Pavillion", were associated with the "Level of Surface". According to Mason, for this level, the design elements are of fundamental importance in satisfying the sensorial requests of the

Figure 6. The Florence Experiment. Photo by Andrea Paoletti su theflorentine.

physical-digital product. They are defined as a useful means for understanding the exhibitions, such as being a bridge between the exhibition component of the work and the digital interface.

Indeed, installations at the Nxt Museum, such as Connected (2022) by Knol and Zoom (2022) by Lozano and Hemmer, are characterised by the use of technology to promote the visitor's interactive experience.

Specifically, Connected (2020) is an installation by audiovisual artist Roelof Knol that unites visitors in a ritual of connections through interactive visuals projected onto the floor, forming new networks between visitors who "experience" the exhibition. As personal space becomes shared, "Connected" examines the "space we inhabit" and invites visitors to become

Figure 7. Connected. Photo by Roelof Knoll on Roelof Knol.

familiar with others comfortably and safely. (Fig. 7)

Zoom Pavilion (2015). (Fig. 8), on the other hand, is an interactive installation consisting of an immersive projection on three walls, powered by 12 computerised surveillance systems directed at the audience. The work uses facial recognition algorithms to detect the presence of participants and record spatial relationships within the exhibition space. It also represents an experimental platform for self-representation with a large microscope that connects visitors to each other and robotic cameras that zoom and amplify images of the audience with magnifications of up to 35x. In this way, the zoom sequences disorient the users as they change the entire "landscape" of the image, from easily recognisable wide shots of the crowd to abstract and undefined close-ups. This work highlights the temporary construction of connective space to sensing and control technologies.

For such cases, the main feature is the presence of human-centric technological applications that offer visitors immersive experiences and deepen physical-digital experiences.

The artistic and multisensory practices for the exhibition space in the selected case studies demonstrate how the user is directly influenced by the media narrative and by the narrative environments designed to communicate stories and stimulate the definition of further levels of space-person interaction.

Interaction processes and guidelines for the design of experiential and human-centric museum spaces.

Current experiments and research in this context focus mainly on the sensorial aspects of users and on "artistic" practices that combine body-space-time.

For example, the visitor experience within the exhibition space through "the body" is one of the main museological practices used to create "direct links" with the museum and the heritage. Visitors should move in a "time" that is "rhythmically resonant", not only with the indications defined by the exhibition curator but, above all, based on the visitor's needs. (Leahy, 2016)

The use of current technological applications present in museum contexts defines innovative and personalised experiences in which devices act as facilitators and disseminators of information. Interactive digital technology is, in fact, a recurring theme in numerous research projects in the field of Cultural Heritage. In the new post-digital paradigm, technological and physical dimensions intertwine, shaping new guidelines in the design of exhibition spaces. In the last decade, museums have increasingly oriented themselves towards practices that aim to improve visits through hybrid physical-digital information spaces.

The post-digital museum considers the design of immersive spaces in the new paradigm that does not separate the digital

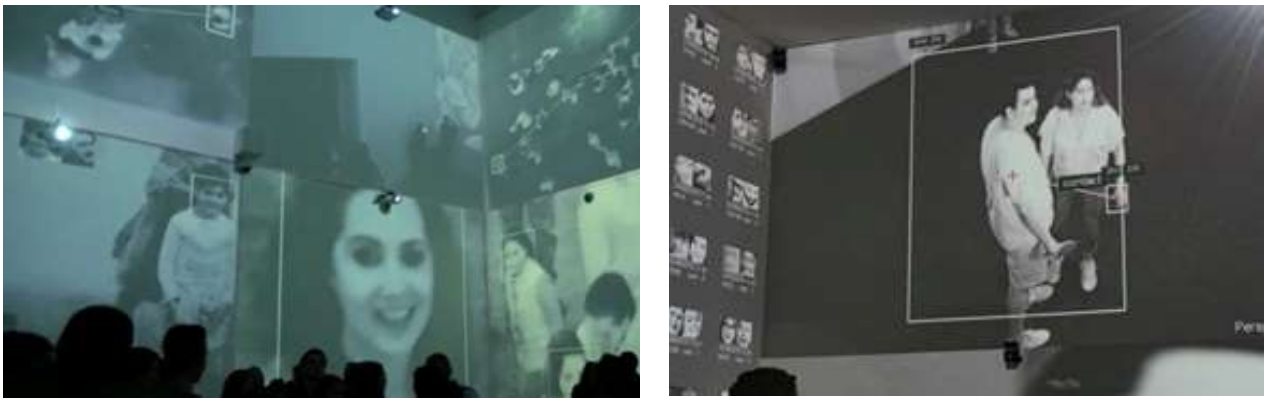

Figure 8. Zoom Pavilion.Photo by Rafael Lozano-Hemmer su lozano-hemmer.

experience from the overall museum experience. According to Borsotti's study, in the last decade, interest has shifted towards studies that investigate engaging and significant ways to improve museum visits in terms of visitor experience; in this regard, some scholars offer several examples of projects that consider the design of the visitor experience as central. (Borsotti, 2023)Among the studies that highlight the importance of experience, Calise's work, for example, addresses the temporal variations in the relationship between museums, visitors and their bodies, investigating to what extent technological developments contribute to influencing exhibitions and curatorial choices. In its materiality and movement habits, the visitor's body will be seen through "the technological lens", used as an immersive and interactive museum practice. (Calise, 2023)

From this, it emerges that the design of exhibition spaces can combine physical and digital components, such as offering useful tools to conceive the narrative environment as "a set of experiences" without neglecting the visitor's interaction, needs, and expectations. From the case studies analysed, it emerges that the design of exhibition spaces is usually driven by the need to provide visitors with services capable of integrating physical-digital-spatial interaction tools and systems without neglecting the "human factor" in this process.

According to Falk and Dierking (Falk, 2000), visitor interaction and participation represent two ways for museums to create new visitor experiences.

With these premises, this paper proposes, starting from Mason's model, some considerations and indications on the processes of space-person interaction that are useful for defining possible guidelines for the design of human-centric and experiential museum spaces.

From the analysis of the case study "The Weather Project", it emerges that the interaction process is of an "immersive" type as it shows that the exhibition space contributes to enriching the experience of visitors who can experience the context taken into consideration. In the case of the projects "These Association" and "The Florence Experiment", the interaction process is "creative" since the user's body is an integral part of the installation. Finally, the case studies "Connected" and "Zoom Pavilion" highlight a technology-related interaction process essential to the visitor experience.

In summary, in order to design experiential and human-centric museum spaces, it is necessary to take into consideration the different user interaction processes, starting from the "immersive" interaction process (which takes cognitive factors into greater consideration), the "creative" interaction process (which introduces the "corporeal" factor of the visit in a "direct" manner) and, finally, the "technological" interaction process (through the use of emerging technologies that define the current multimodal and multimedia communication channels).

Therefore, the visitor's experience with the combination of the previously exposed factors will be physically shared in the space, generating direct conceptual and affective links between the visitor and the space, in addition to narrative-immersive experiences, with the use of intermodal and advanced tools and systems.

In this way, the museum space will be able to reflect the interests and needs of visitors by becoming flexible (for example, engagingly using the physical space) and versatile, thanks to the use of technologies capable of producing multiple scenarios that enhance perception. Through the design methodology that places practices, approaches, and tools at the user's service, museum environments are identified as being able to mix physical and digital space, creative, corporal, and technological interaction for participatory and immersive experiences.

Conclusions

The design of exhibition spaces for user experience is now a key factor in engaging visitors through digital content, forms and artistic objects for total cultural understanding and the promotion of knowledge.

Digital technologies and new practices of "spectacularity" focused on the physical-corporeal experience of the user are shaping the functions and objectives of cultural spaces, proposing museums capable of offering multimodal and multisensory visiting experiences to the widest range of users. In the context of Cultural Heritage, research in the field of interaction design offers museum curators broader narrative visions. In this sense, design practices for cultural spaces enhance and increase the importance of user experiences in the visit process.

From the analysis carried out and the survey of the main case studies selected and analysed, the importance of interaction design in museums emerges to promote new methods of communication and experiences and remodel the contents exhibited based on visitors' specific needs.

In this sense, both the visitor and the museum's physical space represent the fundamental elements for the design of experiential museum spaces since both are necessary and characterising.

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