heritage

Review

Museums for Older Adults and Mobility-Impaired People: Applying Inclusive Design Principles and Digital Storytelling Guidelines—A Review

Kittichai Kasemsarn [1], Antika Sawadsri [1,*], David Harrison [2] and Farnaz Nickpour [3]

[1] School of Architecture, Art and Design, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok 10520, Thailand; kittichai.ka@kmitl.ac.th
[2] College of Engineering, Design and Physical Sciences, Brunel University London, London UB8 3PH, UK
[3] Department of Civil Engineering and Industrial Design, University of Liverpool, Liverpool L69 3GH, UK
* Correspondence: antika.sa@kmitl.ac.th

Abstract: The research problems addressed in this article pertain to the limited understanding and insufficient availability of digital storytelling guidelines for elderly and physically impaired individuals in museum presentations. The objective of this review is to explore digital storytelling guidelines along with the latest technology in museums catering to older adults and those with mobility impairments. This literature review included databases such as Scopus, ScienceDirect, and Google Scholar, covering the period from 2000 to 2023. Researchers comprehensively examined and employed content analysis to categorize all papers into three primary themes: (1) inclusive design for museum presentations; (2) trends in technology for digital storytelling in museum presentations; (3) guidelines for digital storytelling in museum presentations. This review article could enhance understanding and promote diversity, accessibility, and motivation among two specific groups of museum visitors, both onsite and online.

Keywords: museums; older adults; disabled people; mobility impaired people; inclusive design; digital storytelling

Citation: Kasemsarn, K.; Sawadsri, A.; Harrison, D.; Nickpour, F. Museums for Older Adults and Mobility-Impaired People: Applying Inclusive Design Principles and Digital Storytelling Guidelines—A Review. *Heritage* **2024**, *7*, 1893–1916. https://doi.org/10.3390/heritage7040090

Academic Editors: Eva Pietroni and Anna Maria Marras

Received: 27 January 2024
Revised: 5 March 2024
Accepted: 11 March 2024
Published: 24 March 2024

1. Introduction

Currently, many museums are embracing concepts centered around fostering visitor engagement and inclusive design principles [1–3] while prioritizing new target audiences [4]. Despite the positive development represented by the adoption of inclusive design approaches, museums face challenges in effectively engaging older adults and individuals with physical impairments, as it pertains to addressing their unique programming requirements. Additionally, there is a noticeable lack of scholarly literature and research focused on examining museum experiences and technology trends relevant to older adults and people with physical disabilities [5].

Historically, museums have often overlooked older adults, treating them as ordinary visitors [6–8]. However, with the global population's average age on the rise and advancements in medical care enabling longer and healthier lives, older adults have become a significant consumer demographic with considerable disposable income. They possess the financial means to access essential support services and facilities, including medical personnel and wheelchair ramps [6].

People with physical disabilities, constituting approximately 10% of the world's population, are a substantial demographic [9,10]. Research indicates that this group comprises extremely loyal customers who actively seek establishments providing accessible options meeting their requirements [7,9,11,12].

Furthermore, studies reveal that most museums globally present historical information in overly formal, academic, antiquated, and excessively high tech formats. Such environ-

ments and technologies are not suitable for all individuals, especially seniors and disabled people in need of special care [13,14].

In seeking strategies to enhance the engagement of these groups, this research proposes the use of the digital storytelling method. This method is widely employed to elucidate various forms of content, excluding direct advertising, such as novels, films, narratives, presentations, and interactives through digital platforms [15–19]. According to Ohler [18], digital storytelling is a form of media that integrates various media types into a unified narrative using digital technology. However, this introduces a research problem for certain reasons.

There is currently a limited availability of specific digital storytelling guidelines and information about technology for the elderly and those with mobility disabilities in the context of museum presentations and exhibitions [1,6,7,10,13,14]. Most digital storytelling guidelines present about general purpose [20–22], and interactive multimedia purpose, which could be applied into museum presentations [1,17,23–26]. However, for older adults and people with disabilities as target groups, there are only two studies [1,23] focusing on these target audiences.

Therefore, the aim of this review is to examine digital storytelling guidelines and the latest technology in museums for older adults and mobility-impaired individuals, framing the research question as follows: "How can a museum develop digital storytelling presentations with suitable technology to accommodate older adults, aged 60 or more, and people who have mobility impairments in functions related to the lower body extremities (mobility), such as wheelchair users and those requiring walking aids"?

Background: Scopes of Older Adults and Mobility-Impaired People in This Review Article

The definition of an older adult differs across countries, as there is no agreement regarding the chronological age that signifies advanced age. Numerous studies employ a cut-off age of 50, 60, 65, or even older. According to the World Health Organization (WHO) [27], older adults in developing countries are typically classified as those aged 60 or older. However, in Europe it is the case that 65 is more frequently regarded as the dividing line. Based on this, 60 or older was established as the age criterion for older adults in this review article.

Regarding disabilities, an additional seven-category scheme comprising cognition, vision, hearing and speech, body function, arm function, hand function, and mobility was initially proposed in research based on the principles of universal design [28]. At a high level of abstraction, three broad categories of impairments are frequently employed in information and communication technology (ICT): sensory, motor, and cognitive [29]. Neuromusculoskeletal and movement-related functions of mobility are categorized by the WHO [27] as follows: (1) functions associated with the lower extremities (mobility) and (2) functions associated with the upper extremities (motor). This review focuses on the criteria "lower extremities (mobility)", meaning those individuals with mobility impairments who require walking aids or utilize wheelchairs.

When it comes to elderly museum visitors, on the other hand, physical abilities and health conditions vary considerably. Some may rely on mobility aids, such as wheelchairs or walkers, while others may have minor mobility issues necessitating only occasional sitting. The limitations of people with mobility impairments, such as wheelchair users and those who rely on walking aids, are associated with the physical capabilities of older adults in this study. As a result, this review article concentrates on those in need of walking aids and those requiring wheelchairs on account of their mobility limitations. To guarantee that every visitor can fully utilize museum exhibits and facilities, it is vital to recognize these various restrictions.

By delineating these categories, a more precise evaluation of the ways in which varying degrees of mobility impairment impact the ability of individuals to visit and interact with museums can be achieved. This entails an evaluation of various elements, including the physical arrangement and design of the exhibit, as well as the presence of accessible

features, such as ramps, benches, and elevators to enhance the accessibility and enjoyment of museums for these individuals.

2. Materials and Methods

The present study employs the PRISMA [30] flow diagram and theory-based review [31]. The methodology comprises three fundamental components, as depicted in Figure 1.

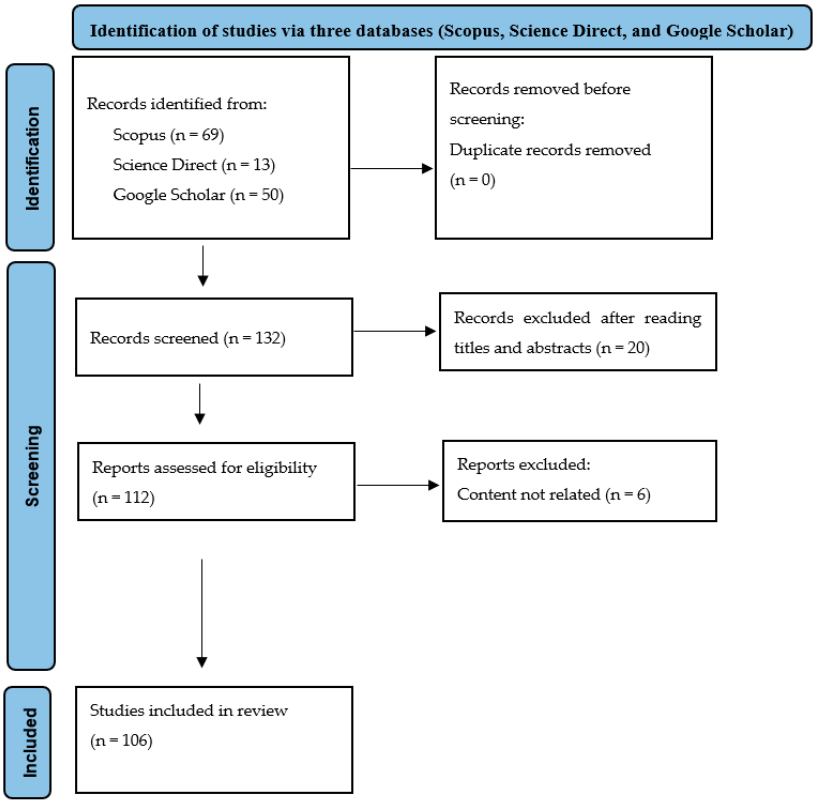

Figure 1. PRISMA [30] flow diagram.

2.1. Inclusion and Exclusion

As illustrated in Table 1, the inclusion and exclusion criteria were developed with the intention of identifying and evaluating digital storytelling guidelines assisting the elderly and mobility-impaired people with functions related to the lower body extremities (mobility) as target groups.

Table 1. Criteria for inclusion and exclusion.

Inclusion	Exclusion
Studies in English	Non-English
Publication in the 2000–2023 period (Scopus, ScienceDirect), 1990–2023 (Google Scholar)	Publications outside the timeframe were not selected
Journals, conference proceedings, textbooks, book chapters	Working paper, conference abstracts, and organization websites
Categories: Arts and Humanities; Social Sciences; Business Management and Accounting; Computer Science	Categories: Medicine; Nursing; Engineering; Agriculture; Economics; Econometrics and Finance

2.2. Conducting Searches in Diverse Databases

This review article used Scopus, ScienceDirect (as a primary database), and Google Scholar (as a secondary database). To acquire historical data for comparative analysis, the search terms "museum presentation", "digital storytelling", "older adults", and "disabled people" were employed between 2000 and 2023. In an effort to locate information regarding missing data and case studies from primary databases, researchers utilized Google Scholar as a gray area (not indexed in main databases but potentially relevant to the research topic) to conduct an investigation. Next, researchers searched Google Scholar for the top 100 articles through a review of titles and abstracts, from which 50 studies were selected.

2.3. Importing Data into Bibliographic Applications

In EndNote 20, the search results from all three databases were imported. This was achieved by selecting "Import into duplicate library" from the menu to eliminate duplicated articles. No duplicated papers were found, leaving 132 articles in total.

2.4. Articles Considered Relevant or Irrelevant

This phase involved three primary stages: a review of all 132 titles and abstracts, followed by the elimination of 20 titles. Subsequently, 112 pertinent articles underwent a thorough examination, resulting in the elimination of 6 titles. Ultimately, 106 articles were selected for inclusion.

3. Results

By employing a theory-based review approach [31], this review examined the significance of particular theories in three areas covering inclusive design for museum presentations, technology in digital storytelling for museum presentations, and digital storytelling for museum presentation guidelines. This category of review article contributes to the advancement of the literature by synthesizing and empirically applying a particular underlying theory [31].

Next, content analysis was employed to examine all 106 studies. This process entailed thematic coding, wherein the meaning of the entire sentence or paragraph was categorized as opposed to the individual texts themselves. The outcomes of the reliability assessment were reevaluated and categorized by a team of three researchers who deliberated on the ultimate coding. Briefly, the following three themes exist:

- Theme 1: Inclusive design for museum presentations (presented in Section 3.1)
- Theme 2: Trends of technology in digital storytelling for museum presentations (presented in Section 3.2)
- Theme 3: Digital storytelling for museum presentation guidelines (presented in Section 3.3)

3.1. Theme 1: Inclusive Design for Museum Presentations

The needs of museum visitors are diverse, encompassing both obstacles and incentives that motivate their participation in exhibitions. Therefore, to develop effective design and marketing strategies, designers must understand and strive to eliminate these obstacles [1,14,24]. In an effort to expand and enhance the potential clientele for museum presentations, this research employs inclusive design theory to identify the needs of visitors in digital storytelling presentations in museums, focusing on two specific groups.

Older adults: The majority of the tourism sector, including museums, tends to overlook older adults, treating them similarly to other visitors [6,7,10]. Despite the global aging trend, with improved health, increased wealth, and longer life expectancy, this age cohort is considered a significant consumer demographic [6]. Moreover, older adults in this group have ample funds and time to invest in facilities and services that can assist them, such as wheelchair ramps or medical services [32].

People with mobility disabilities: Globally, the number of individuals with disabilities is expanding rapidly. WHO [27] reports indicate that 15% of the global population, or more

than one billion individuals, are presently affected by at least one type of disability. This quantity is increasing rapidly due to the aging population. The United Nations adopted the Convention on the Rights of Persons with Disabilities in 2006, guaranteeing comprehensive integration for this demographic. This requires increasing their engagement levels in the public domain, and accessible tourism, including inclusive museums, is on the rise. A growing number of hotels, restaurants, museums, and attractions are announcing their accessibility to individuals with disabilities [33,34].

According to Ozturk et al. [12], individuals with physical disabilities tend to revisit locations that accommodate their accessibility needs, potentially generating greater revenue for the tourism sector through market liberalization. This notion aligns with Shaw-Lawrence's assertion that "countries seeking to increase their incoming travel markets must possess the requisite infrastructure and knowledge to cater to the unique requirements of tourists with disabilities" [8] (p. 8).

Moreover, several studies propose various applications of inclusive design adopted in museums:

- Accessibility for all museum visitors: Inclusive design principles ensure that museums are universally accessible, regardless of ability or disability [35–37].
- Enhanced learning experiences: Inclusive design enhances the educational impact of museums by catering to a wide range of learning styles and sensory preferences, thereby providing improved learning experiences [24,38].
- Cultural inclusivity: Inclusive design assists museums in representing and valuing the diverse cultures and backgrounds of their visitors [24,35,39].
- Social equity and justice: Inclusive museums advocate for social equity by ensuring equal access to cultural and educational resources for all visitors, including individuals with disabilities [40,41].
- Community engagement and collaboration: Inclusive design often requires partnerships with diverse communities, fostering enhanced community connections and active participation [42–44].
- Enhanced public image and increasing attendance: Museums adopting inclusive design appeal to a broader demographic, thereby improving public perception and attracting a greater number of visitors [45,46].
- Sustainability: The implementation of inclusive design principles ensures the continued relevance and accessibility of museums for future generations, contributing to their sustainability [44,47,48].

3.2. Theme 2: Trends of Technology in Digital Storytelling for Museum Presentations from 2010 to Now

3.2.1. User Experience (UX)

UX plays a crucial role in the design, evaluation, and development of various applications and technological devices today [49–52]. UX could be applied with digital storytelling on advanced interaction technology (e.g., AR, VR, immersive, muiltimedia interfaces, wearable technologies) [53,54]. For instance, the "CHESS" project, Acropolis Museum's application that could customize museum information in order to generate individualized narratives, begins with a comprehensive examination of the user's profile, demographics, interests, cognitive or conceptual change, value perception, and inspiration, presenting suitable information and interfaces matched to the user's interests and profiles.

User experience (UX) encompasses a wide array of ever-changing concepts, such as aesthetic, hedonic, emotional, and experiential variables. Furthermore, the analysis is excessively flexible, encompassing everything from a solitary facet of an end-user's engagement with a standalone application to the entirety of multiple end-users' interactions with the organization and its integration of services originating from various disciplines [53]. Conducting prior research on museum visitors, including their origins, technological and cultural literacy, age group, and preference for guided or unguided tours, is critical for

developing content and experiences that effectively cater to the needs of a diverse museum audience [50].

Applying for older adults and mobility-impaired people requires taking note of how several studies [50,55–57] suggest that UX in museums encompasses all user actions and reactions before, during, and after visiting the museums, as follows:

- Before visiting: presenting accessibility information, wheelchair accessibility, restrooms, and facilities on the museum's website.
- During visiting: presenting information about navigation, rest areas, and multi-sensory exhibitions, as well as providing easy-to-understand materials, large print brochures, and audio guides.
- After visiting: offering feedback channels through online surveys and reviews to enhance the user experience in the future.

3.2.2. Customization Information

In the past, interactive museum narratives aimed to present content on a device as a single piece for all users. Currently, cultural heritage museums prioritize personalization, allowing users to provide feedback, rate, or respond to inquiries about their interests. This enables tailored information presentation to match individual preferences, ensuring a seamless museum visit [51].

For instance, the "CHESS" project focuses on two key aspects to enhance museum visits. It emphasizes customization of visitors' information and provides users with an exploratory and awe-inspiring experience. Similarly, "Show Taiwan", a multimedia-integrated location-based guide application comparable to museum tours, encourages user-generated content, fostering idea exchange among educators and learners. A study suggests that this method significantly increases users' interest in cultural narratives [58]. The "STEDR" project, providing users with the capability to customize their profile and location via augmented reality, caters to diverse user interests, recognizing the importance of convenience in accessing, searching, filtering, and customizing information. Social media sharing is crucial, allowing users to share their experiences or information online, moving away from a one-size-fits-all content approach [49].

Applying for older adults and mobility-impaired people occurs in the context of disabled individuals, where museums like the Victoria and Albert Museum in London and the Museum of Fine Arts in Boston have developed programs to accommodate and focus on visitors with disabilities, offering specialized programming for those with mobility impairments, blindness, deafness, or learning disabilities [59].

The personalized accessibility map is an assisted wayfinding information approach suggested by Karimi et al. [60] for three groups: those with limited mobility, those with visual impairment, and those with hearing impairment. This map provides individualized details regarding wheelchair parking, the number of stair steps, slopes, grab bars, wheelchair lifts, low counters, and restrooms.

Yildiz [61] notes that the accessibility menu on the website of the Ludwig Museum in Budapest, Hungary, which debuted in 2005, provides details regarding exhibition accessibility as well as information concerning the museum's accommodations for individuals with disabilities and physical limitations. Additionally, the museum as a whole and nearly all of its exhibits accommodate senior citizens and wheelchair users. The building's entrance is designed to be universally accessible, and the information desk's color scheme enhances its visibility. In addition to providing sufficient space for sitting and resting, the lobby also features locker boxes. Vertical connections, including stairs, elevators, and ramps, are well-maintained and easily accessible. Accessible restrooms are situated on each floor of the structure.

The Mumok, which commenced operations in Vienna, Austria, in 2001, maintains an accessible website that details facilities, elevators, entrances, and exhibitions, as well as information on physical abilities and ages. A schematic accessibility map that is both straightforward and simple to use facilitates navigation within the building [61,62].

The DOX Centre for Contemporary Art in Prague, Czech Republic, offers specialized information on its website, such as details about the ramps in the museum that can accommodate all attendees and be utilized as exhibition spaces. The entrance (a sliding automatic door) is inclusive and accessible. The varying heights of the information desk appeal to a variety of users, and wide elevators feature seating for individuals with limited mobility. The size of the exhibition units is specifically designed to accommodate wheelchair users [61,63].

3.2.3. Mobile Device Technologies

Advancements in sensor technology of mobile devices have significantly influenced museum applications. Sensors can now capture information like compass readings, device motion, and GPS location, thus enhancing UX [64]. Projects like "CHESS", "STEDR", "Show Taiwan", and "The Westwood Experience" use mobile device sensor technology for user identification and map displays.

The evolution of technology has introduced 4D visualization as an alternative to 3D, incorporating a temporal element into visualization. This is exemplified by "The Westwood Experience", which uses mixed reality (MR) to connect the past and present. The narrative, introduced by the mayor of Westwood during a 1949 community tour, showcases inaccessible heritage sites through a temporal lens [52].

Advanced mobile devices can integrate real-time location data with traditional media, facilitated by augmented reality (AR). AR projects narratives onto physical locations via a mobile device's display and camera. MR effects, combining video, audio, and images in authentic settings, virtually convey narratives of fictional or historical worlds, connecting applications to the real world [52]. "Show Taiwan" enhances the location-based guide process by integrating multimedia elements activated by users' motion in their physical surroundings. "The Westwood Experience", "CHESS", and "STEDR" implement MR and AR to construct sequential narratives in physical location-based environments [49,51].

Applying for older adults and mobility-impaired people in the museum context involves several institutions, including The John and Mable Ringling Museum of Art in Sarasota, Florida, The Metropolitan Museum of Art in New York City, and The Melbourne Museum in Australia, that have specialized programming for individuals with disabilities. For instance, orientation materials for individuals with autism spectrum disorder (ASD) and their family members, including guided checklists, sensory maps, and social narratives, are provided through mobile phone applications [65].

Furthermore, according to Kruczek et al. [33], the COVID-19 pandemic demonstrated the potential of mobile phone technologies to enhance the accessibility of tourist destinations, particularly museums, for individuals with sensory impairments. Technology has been used in various ways to enhance accessibility, including the provision of online communication tools, smartphones equipped with audio guides, and the capability to directly translate text into sign language [66,67].

Ribeiro et al. [68] also suggest that currently a wide range of mobile applications exist, providing information assistance to users with mobility impairments or facilitating the collaborative development of accessibility maps to supplement conventional maps with pertinent accessibility data [69,70]. Typically, these applications furnish data related to locations that offer accessible amenities as well as those that do not.

In the context of museums, mobile applications have been created to assist visitors with various disabilities, including mobility impairments, by providing features such as audio descriptions, GPS navigation, large text options, and voice commands [68,71]. Ribeiro et al. [68] also suggest that AXSMap implements the storage and dissemination of data related to wheelchair-accessible amenities in public locations. AXSMap populates its database with information from the Google Places database and encompasses numerous global locations, although its primary emphasis is on North America.

According to Ribeiro et al. [68], mobile application technologies designed to assist seniors and people with disabilities should incorporate accessibility features. These fea-

tures can include automatic reading capabilities, the ability to adjust font size and image dimensions, customized color schemes, and an accessibility map. Furthermore, Roussou and Katifori [57] argue that these two groups require location awareness via the Global Positioning System (GPS). To facilitate visitors' movements and guide them to intended areas, museum staff or their family must also be aware of their location in the physical space. Therefore, navigation aids and subsystems for location and orientation detection are necessary.

3.2.4. Concise Content

In the past, digital storytelling could be defined as anything beyond a simple image accompanied by narrative voices, texts, or audio with sounds [72]. However, advancements in technology, particularly those found on mobile devices, have evolved at a faster rate than content or narratives [49]. This is evident in the complex and sophisticated methods of blending audio, text, video, and interactivity. Consequently, certain projects emphasize only the most recent technologies. Furthermore, interactive technologies can be prohibitively expensive and it may be better to prioritize the development of high-quality narratives and content that are adaptable across multiple technological platforms. Therefore, to establish guidelines for producing high-quality content and narratives, it is critical to prioritize user requirements and the content creation process [49].

Numerous studies have also recommended that, rather than emphasizing complex and high-tech methods (such as puzzle hunts, events, or games), narratives at museums should be kept extremely simple. A straightforward, simple, and uncomplicated narrative structure is sufficient for users [49,51,52].

Applying for older adults and mobility-impaired people in the case of digital storytelling in museums, Fletcher et al. [65] point out that for disabled people and seniors, sometimes simple technology and information is suitable for them. For example, a sensory map serves as an informational layout of the museum's gallery spaces that assists visitors in acclimating by emphasizing the presence of other visitors, noise, and light. A social narrative comprises optimistic first-person statements that an individual with ASD would either read aloud or to themselves as a means of anticipating subsequent events [73].

Kasemsarn and Nickpour [14] posit that digital storytelling, content, and information for the elderly and individuals with mobility impairments should be succinct, straightforward, unadorned, and devoid of hyperbole. Moreover, technological enhancements should be kept to a minimum and serve to accentuate the story's central concept. Due to its condensed nature, digital storytelling motivates the narrator to omit superfluous information and prioritize a straightforward narrative that conveys a clear message.

3.2.5. Virtual Reality (VR) and Augmented Reality (AR)

The prevalence of VR and AR technologies in museums has increased, providing accessible immersive experiences for individuals with mobility limitations or those who are unable to visit the museum in person. Certain museums have initiated the provision of VR tours, enabling individuals with mobility limitations or older adults to experience exhibits from the convenience of their residences or a designated seating area within the museum. VR is suitable for all generations because of its user-friendly nature and ability to transport individuals to remote historical or modern locations [1,33,74].

Furthermore, there is a noticeable increase in the enthusiasm and drive of older individuals to acquire knowledge and engage with ICT products [75]. In recent times, this has prompted scholars to direct their attention toward mobile applications and the implementation of AR, in addition to seniors and ICTs [75]. Certain research endeavors have been dedicated to exploring novel approaches that can assist and enhance the self-esteem of elderly individuals who lack familiarity with digital technologies. The ultimate goal is to improve their social inclusion, independence, and the accessibility and affordability of relevant technologies.

Moreover, with respect to AR, it refers to multimedia content—such as animation, video, websites, or 3D—that combines computer-generated images with video footage captured at an actual location using a video camera. AR is considered a fusion of the physical and digital realms [76]. According to Guimares et al. [77], a digital storytelling approach may be applied to AR in a number of categories: (1) natural heritage, (2) historical and archaeological sites, and (3) garden maintenance.

Applying for older adults and mobility-impaired people, the guideline for virtual reality (VR) in museums proposed by Vishwanath [78] is implemented at the Design Museum Helsinki in Finland and addresses the accessibility, inclusivity, and engagement of a diverse array of age groups, with a particular focus on senior citizens.

This VR experience comprises two scenes. The first involves a five-second looping video tutorial. In it, users select their preferred language and generation group (Silent Generation, Baby Boomers, Gen X, Millennial, and Gen Z). Users then proceed to the main scene, which consists of the following: (1) listening to autobiographical stories (approximately 25–40 s) about a contributed artifact, (2) engaging in virtual artifact immersion as the virtual environment undergoes a substantial enlargement (approximately 100 times the size of the artifact) to evoke the sensation of being "immersed" within it, and (3) collecting artifacts by amassing personal collections of virtual artifacts.

Nishchyk et al. [79] note that the design and development of augmented reality (AR) for the elderly has been the subject of few studies. Liang [80], for instance, presents design principles for AR with an emphasis on elderly users. The principles are, in general, as follows: (1) "hidden reality design principle"—elements generated by a virtual computer should not obscure practical real-world information; (2) "modality focus augmentation principle"—depending on the context, computer-generated elements ought to be presented in various modalities; (3) "instantaneous augmentation design principle"—in the event of a delay in the generation of virtual content, the user should be notified of the delay; (4) "layer-focus augmentation design principle"—according to the user's requirements, when more than one piece of virtual content is presented, it should be grouped; and (5) "accurate augmentation principle"—the augmentation should be pertinent and consistent with the actual content, taking into account the expectations of the users.

3.2.6. Artificial Intelligence (AI)

Museums have begun implementing the use of AI and robotic guides to provide individualized tours tailored to the needs of seniors and people with disabilities. In the context of AI, particularly eXplainable AI (XAI), the integration of XAI and HCI facilitates the development of more engaging interfaces that dynamically adjust to the specific needs and preferences of the target audience. Adapting to the visitor's pace and interests, it can respond to inquiries in multiple languages [81]. Additionally, it employs personalized mechanisms determined by the visitor's curiosity, learning progress, and automatic curriculum learning [82].

Dal Falco and Stavros [83] highlight the potential of contemporary technologies to be implemented in museums. For instance, certain rudimentary natural language conversation models can respond to inquiries from online visitors. The responses are selected from a predetermined set of potential answers. Prior studies and implementations have also been fruitful for works of a similar nature that integrate interactive storytelling and basic natural language conversation techniques [84].

When applying for older adults and mobility-impaired people, however, studies have identified only a handful of instances in which AI was implemented in museums to promote accessibility and inclusivity. The ArtiMuse project, for instance, seeks to transmit to future generations the uncommon manual expertise and knowledge associated with traditional craftsmanship, specifically the wheel-throwing pottery technique [85]. It was developed to enable both the modeling and recognition of expert technical gestures, i.e., to determine whether website visitors accurately imitate the gestures described on the page.

Scholarly investigations propose the use of explainable artificial intelligence (XAI), a collection of machine learning methodologies that generate justifications or explanations to elucidate or simplify the operation of a system. By implementing this in the context of museums, XAI aims to increase the transparency of cutting-edge models and support AI-based outcomes via a logical explanation, i.e., one that is intended for non-technical users. Its primary functions for the elderly and those with limited mobility, both on site and online, are as follows: (1) generate models that are easier to comprehend while maintaining a high level of performance, and (2) empower these populations to recognize, rely on, and oversee the emergence of artificially intelligent partners [86,87].

3.2.7. Internet of Things (IoT) for Enhanced Accessibility

Intelligent museum environments have been developed using IoT technology. In order to enhance accessibility and direct visitors with mobility issues along less congested pathways, sensors and connected devices have the capability to modify lighting conditions and sound levels, deliver personalized information, and aid in navigation [88,89].

Aman et al. [90] provide an additional illustration of an IoT-based museum tour guide system that is cognizant of its location. This system can identify the user's gaze on specific images and, using this information to trigger communication with a central processing unit, display explanatory content on interactive displays mounted on the museum walls.

When applying for older adults and mobility-impaired people, each individual museum visitor possesses a unique set of interests. Typical exhibits include a guiding system, a traditional multilingual tour guide, specialized sections for explanations by experts, computers, and handheld devices [90]. In the context of portable devices serving as guiding systems, certain museums offer audio devices that can be used to access exhibit explanations via a designated code number. For example, Kuusik et al. [91] put forth the "Smart Museum" system, which enables visitors to customize their visit and obtain information regarding the museum's exhibits by using RFID-localized PDAs [88,89,92]. Almeida et al. [93] discuss the potential application of ICTs that facilitate the Internet of Things (IoT) in the surveillance of elderly behaviors to support the provision of corrective interventions. Such projects employ a variety of technologies to monitor the behavior of the elderly, including AR, vision systems, wearable devices, and portable interactive devices, in addition to wireless sensor networks.

As noted by Chianese and Piccialli [94], the IoT implemented in museums can be divided into three categories: (1) the sensing layer, responsible for acquiring and transferring data, as well as facilitating collaboration among nodes in local and short-range networks; (2) the network layer, the purpose of which is to transfer data across various networks and applications; and (3) the application layer, where IoT applications and middleware functionalities are implemented. These enable seniors and individuals with disabilities to interact with environments and other objects and to receive relevant information via multimedia facilities.

3.2.8. Social Robots in Museums

According to several studies, robot guides typically serve primary purposes. Initially, museum guests would be identified and greeted via body or facial detection. For instance, the robot would recognize a visitor if they maintained eye contact for a minimum of five seconds and would use motion sensors to identify adjacent visitors before extending an invitation for interaction. The second function was to engage in conversation with the visitor and demonstrate the exhibits through natural and human-like body language, including questioning and providing verbal descriptions, adjusting posture, gesturing, pointing, and adjusting facial expressions. In conclusion, the robotic systems concluded the exchange by extending farewells or wishing the visitors a pleasant sojourn [95–97].

Applying for older adults and mobility-impaired people, this sees how the development of social robots for public spaces, such as museums, to assist the elderly or those with limited mobility, is becoming widespread [96]. The classification of robots as social robots

is based on their ability to interact with and assist humans. This makes them well-suited for museum environments, as they can greet, educate, or guide visitors. For example, visitors to the Smithsonian's National Museum of American History were assisted by a comparable robot named Minerva [98]. Throughout its two-week field trial, the robot engaged in interactions with over 50,000 visitors. This facially articulated robot can convey emotions through variations in facial expressions and vocal intonation. When queried, 36.9% of 63 individuals believed Minerva to possess human-like intelligence [96].

All eight factors in Theme 2 are summarized and presented in Table 2 below.

Table 2. Summary of the latest technology in digital storytelling for museum presentations.

Topics	Details
User experience	• UX is applied in many museum applications [49,51,52]. • Analyzing the user's profile, demographics, interests, shift in cognition or concept, sense of inspiration, and value [50]. • Understanding the needs of a wide-ranging museum audience [50]. • Users can rate, comment, or respond to questions about their interests using this feature, and they will subsequently see information tailored to their interests [51]. • (1) Before visit: present accessibility information: (2) During visit: present information about navigation and easy-to-understand materials: (3) After visit: offer feedback channels [50,55–57].
Customizationof information	• Ensuring that every visitor to the museum has a positive experience and the information they need [51]. • Contemporary cultural media aim to assist users in personalizing, customizing, and sharing their interests on social media, rather than providing one type of information for every visitor to the website [40,51]. • Presenting specific information for those who have mobility impairment, are blind, deaf, or have learning disabilities [3]. • Provide details about accessible facilities, wheelchair parking, the number of stair steps, slopes, grab bars, wheelchair lifts, low counters, elevators, and entrances, as well as accessibility maps for exhibitions that address physical abilities and ages [60–63].
Mobile device technology	• To improve a positive cultural tourism experience, GPS can be used to locate nearby locations and determine the social context (i.e., who is nearby) [64]. • Using GPS in a mobile device's sensor to display maps and find users [49,51,52]. • Using a mobile device's camera and screen, AR can tell stories at actual locations [49,51,52]. • Real-time accessibility maps with accessibility data for the elderly and those with mobility impairments [69,70]. • Supporting people with disabilities via audio descriptions, GPS navigation, large text options, and voice commands [68,71]. • Wheelchair-accessible amenities information in public locations [68]. • Offer accessibility features, including automatic reading capabilities, the ability to adjust font size and image dimensions, customized color schemes, location awareness via GPS, and an accessibility map [57,68].
Concise content	• It is preferable to concentrate on producing quality narratives and content that are cross-platform compatible [49]. • Just a straightforward and simple narrative structure is sufficient for all users [49,51,52]. • People with mobility limitations or older adults could experience exhibits at their convenience [1,24,33,74]. • Keep content for elderly and mobility-impaired people to a minimum and use it to accentuate the story's central concept [14].

Table 2. *Cont.*

Topics	Details
Virtual reality and augmented reality	• Improving the social inclusion, independence, accessibility, and affordability of VR and AR technologies [75]. • AR presents multimedia content, such as animation, video, websites, or 3D [76]. • Provide VR that is accessible, inclusive, and engages a diverse array of age groups and capabilities [78]. • Follow the AR principles for seniors: elements generated by a virtual computer should not obscure practical real-world information, and computer-generated elements should be presented in various modalities [79].
Artificial intelligence	• Understanding and presenting the specific needs, preferences, and interests of visitors in multiple languages [81]. • Personalizing the visitor's curiosity, learning progress, and automatic curriculum learning [82]. • Utilize an AI-based program that provides explanations and simplifies information in museum exhibitions for non-technical users, both on site and online [86,87].
Internet of Things	• Controlling lighting conditions and sound levels, delivering personalized information, and aiding in navigation [88,89,92]. • Enabling visitors to customize their visit and information by PDAs [88,89,92]. • Monitor the behavior of the elderly via AR, vision systems, wearable devices, and portable interactive devices, in addition to wireless sensor networks [93]. • Create systems for seniors and individuals with disabilities that facilitate interaction with environments and objects, as well as provide relevant information via multimedia facilities [94].
Social robots in museums	• Social robots for museums, to assist the elderly or those with limited mobility, are widespread [96]. • Minerva, with human-like intelligence, was used by the Smithsonian's National Museum of American History [96,98]. • Social robots for museums are used for greeting visitors and demonstrate the exhibitions [95–97].

3.3. Theme 3: Digital Storytelling for Museum Presentation Guidelines

Visitors to museums lack the incentive to engage with the narrative presented in the exhibitions [14,99]. These issues present a favorable chance to enhance storytelling to boost visitors' motivation. To achieve this objective, this study proposes digital storytelling, a technique commonly used in designing digital systems to present various types of stories, narratives, films, and novels [17,18,26,100,101]. In this paper, digital storytelling is defined as a medium that uses personal digital technology to integrate multiple forms of media into a cohesive narrative [18].

When using digital storytelling, a range of strategies, including plots, characters, conflict, humor, and competition, is employed to endorse and market products or services without resorting to aggressive advertising techniques [17,102,103]. Furthermore, numerous cultural and heritage sites across the globe have been extensively digitized as virtual museums or applications featuring digital storytelling. This has the effect of bringing challenging narratives or topics to life and establishing a stronger connection with viewers [101,104,105].

However, as mentioned in the introduction, there is currently a limited specific guideline for the creation of digital storytelling that caters to seniors and mobility-impaired people in the field of museum presentations, who are not the primary target audience. The majority of guidelines pertaining to digital storytelling primarily emphasize its application in educational settings within classrooms and game development.

A number of guidelines have been established by experts on the creation of digital storytelling presentations. They are grouped into four main purposes: (1) general pur-

pose [20–22]; (2) educational purpose [18,106]; (3) interactive multimedia purpose, which could be applied into museum presentations [14,17,23–26]; and (4) for older adults and disabled people [14,23]. However, for older adults and people with disabilities as target groups, there are only two studies focusing on these target audiences.

These guidelines have been meticulously crafted to assist storytellers in the development of digital narratives that serve various objectives and incorporate distinct components, as summarized and presented in Table 3.

Table 3. Summary of ten digital storytelling guidelines with different target groups.

Guidelines/Authors	Elements of Each Guideline	Category	Target
Take six: Elements [21]	Living in your story, Unfolding lessons learning, Developing creative tension, Economizing the story told, Showing not telling, Developing craftsmanship	General	General
Six elements of digital storytelling [22]	Personal, Begin with the story or script, Concise, Use readily available source materials, Include universal story elements, Involve collaboration	General	General
The seven elements of digital storytelling [20]	A point of view, A dramatic question, Emotional content, The gift of your voice, The power of the soundtrack, Economy, Pacing	General	General
Expanded and modified digital storytelling elements [106]	The overall purpose of the story, The narrator's point of view, A dramatic question or questions, Quality of the images, video, and other multimedia elements, Use of a meaningful audio soundtrack, The choice of content, Pacing of the narrative, Good grammar and language usage, Economy of the story detail, Clarity of voice	Education	Teachers, students
Story elements [18]	Point of view, Emotional engagement, Tone, Spoken narrative, Soundtrack music, Role of video and performance, Creativity and originality, Time, Story length and economy	Education	Teachers, students
Five elements of digital storytelling [25]	Media, Action, Relationship, Context, Communication	Interactive multimedia	General
Dimension star: models for digital storytelling and interactive narratives [26]	Concreteness, User contribution, Coherence, Continuity, (Conceptual) Structure, Stage, Virtuality, Spatiality, Control, Interactivity, Collaboration, Immersion	Interactive entertainment (games, applications, new technologies)	General
Digital storytelling guideline for older adults [23]	Story type, Imagery process and choice, Music and sound, Multimedia	Interactive multimedia	Older adults
A ten-step development checklist for creating an interactive project [17]	Premise and purpose, Audience and market, Medium, Platform and genre, Narrative/gaming elements, User's role and point of view, Characters, Structure and interface, Fictional world and setting, User engagement, Overall look and sound	Interactive entertainment (games, applications, new technologies)	General
Inclusive digital storytelling guideline [14]	The storyteller's point of view, A key question, The purpose, Story structure, Economy, The storyteller's voice, Soundtrack, Media, Background	Multimedia museum presentation	Youth, older adults, disabled people

3.3.1. Digital Storytelling Guidelines for General Purpose

Regarding Lambert and Hessler's guideline [20], Lambert was the initial individual to extend support to Atchley, who in the late 1980s pioneered the integration of digital media and oral storytelling as a media artist. Lambert, the founder of the Centre for Digital Storytelling in the United States, organized workshops to assist individuals in using digital techniques to tell their own stories. Lambert and Hessler [20] developed a set of seven principles, which are presented in Table 3 and detailed in Table 4. These principles serve as

a guide for storytellers as they construct their works. This guideline addresses the practice of narrating personal stories and non-interactive digital narratives.

Table 4. Digital storytelling for general purposes from three experts [20–22].

Elements	Explanation
Point of view	• What is the central argument of the narrative and what is the author's point of view? [20]. • It is recommended that every narrative be presented in the first person, narrated in one's own voice, drawing from personal and emotional experience of the occurrence [21]. • The narrator is encouraged to imbue the story with significance by demonstrating how the characters or occurrences in the narrative have affected their own life [22].
Concept	• A pivotal inquiry that sustains the audience's interest and is resolved toward the conclusion of the narrative [20]. • Disclosing the lesson learned, each narrative must have a concluding point that is revealed [21]. • It is anticipated that digital story creators will develop their narrative to a certain extent by composing and even recording their script prior to commencing any video editing, image digitization, or sound effect importation [22].
Emotional content	• Profound and emotionally resonant matters that establish a profound connection between the audience and the narrative [20]. • Constructing imaginative tension, effectively using tension and pacing to advance the plot while maintaining the audience's interest until the very end [21]. • Excellent narratives comprise critical components, including conflict, transformation, and resolution [22].
Showing not telling	• Demonstrating rather than telling the use of vivid details to convey emotions and information that are not explicitly articulated within the narrative [21].
Voice	• A method of personalizing the narrative to aid the audience in comprehending the setting [20].
Soundtrack	• Additional sounds or music that support and embellish the narrative [20].
Economy	• Employing a sensible amount of material to convey the plot without inundating the audience [20]. • Condensing the narrative, while maintaining the core of the story, employing minimal language and visuals to convey your argument [21]. • This requires meticulous editing and an extremely narrow focus [22]. • Produce a narrative using minimal technology and resources [22].
Pacing	• The story's progression rate, which indicates how slowly or quickly it flows [20].
Developing craftsmanship	• Excellent craftsmanship combines media elements ingeniously to communicate substantial meaning [21]. • Participants in the workshop provide and obtain feedback regarding their narratives and scripts [22].

In her book *Digitales: The Art of Telling Digital Stories* (2004), Porter [21] outlines her set of principles as six components of digital storytelling, as presented in Table 3. She drew inspiration from Lambert's original digital storytelling guideline to construct narratives through the lens of the storyteller's perspective and personal experience, as opposed to centering on an external narrative unrelated to the storyteller, as detailed and grouped in Table 4.

Salpeter [22] proposed six elements for developing digital storytelling projects from her observations of such projects. Similar to Lambert's principle, this guideline emphasizes that tales are based on the personal experience of the narrator, as presented in Table 4.

3.3.2. Digital Storytelling Guidelines for Educational Purposes

Robin's guideline [106] was published in the book *Digital Storytelling: A Powerful Technology Tool for the Twenty-First Century Classroom*. The objective of this guideline was to assess the quality of student work produced at Houston University [106], as presented in Table 3 and detailed in Table 5.

Table 5. Digital storytelling for educational purposes from two experts (Robin, 2008; Ohler, 2013).

Elements	Explanation
The purpose	• Early establishment of a purpose and consistent maintenance of focus are key qualities [106].
Point of view	• The point of view is effectively developed and enhances the story's overall significance [106]. • The scope of possible points of view in digital stories is extensive and is limited only by the perspective that the author wishes to impose [18].
A dramatic question	• A profound and significant dramatic inquiry is posed and resolved in the narrative's framework [106]. • A storyteller with sufficient dexterity to captivate the audience (either emotionally or objectively) [18].
Content	• The content establishes a unique ambiance or tone that corresponds with various segments of the narrative. The images have the potential to convey metaphors and/or symbolism [106].
Voice	• The voice remains audible and clear throughout the entire presentation [106]. • Tones may alter the genre or tone of a narrative [18].
Pacing	• The tempo (voice punctuation and rhythm) complements the plot and enables the audience to "get into" the story [106]. • The storyteller places the proper amount of emphasis on the narrative (Ohler, 2013).
Soundtrack	• Music evokes a profound emotional reaction that complements the narrative effectively. Complementary visuals to the music [106]. • Use of music in a suitably supportive capacity [18].
Media	• Images establish a unique ambiance or tone that corresponds with various segments of the narrative. The images have the potential to convey metaphors and/or symbolism [106]. • When determining which visual image to use, consider the amount of time and technology required [18].
Economy	• Throughout, the narrative contains precisely the right amount of detail. It appears neither excessively short nor long [106]. • Restrict input and story length and enforce economy [18].
Good grammar and language usage	• The use of proper grammar and usage (appropriate for the selected dialect) enhanced the text's clarity, style, and character development [106].
Creativity and originality	• It is imperative for educators to establish explicit criteria and mandate a specific proportion of media usage, given that digital tools may inspire students to construct imaginative narratives but do not ensure novelty [18,106].

According to Ohler [18], his primary emphasis is on the implementation of digital storytelling within educational settings. Based on his practical involvement in implementing digital storytelling with both educators and learners, he formulated the eight components outlined in Table 3. Ohler explains in his book that he adapted Lambert's guideline for educational purposes. However, unlike Lambert, Ohler does not emphasize the first-person point of view. Ohler [18] argues that instructors ought not to limit the manner in which

they present to a single pattern. Instead, they should illustrate points of view that are determined by the students themselves.

3.3.3. Digital Storytelling Guidelines for Interactive Multimedia Purposes

Regarding Paul and Fiebich's guideline [25], they investigated numerous digital storytelling initiatives. The research was conducted at The Media Centre and the School of Journalism and Mass Communication, University of Minnesota. This primary emphasis was on journalistic storytelling and interactivity. They further characterize it as interactive multimedia for journalism. Five components for the development of digital narratives are presented in Table 3 and detailed in Table 6.

Table 6. Digital storytelling for interactive multimedia purposes from five experts [14,17,23–26].

Elements	Explanation
Point of view	• What is the primary contention put forth in the narrative, and what is the author's perspective? [14,24]. • What purpose do characters fulfill (adversaries, allies, or helper figures)? [17]. • Which perspective will the user adopt (individually or in the third person)? [17].
Concept	• An essential question that maintains the attention of the audience and is ultimately resolved in the story's denouement [14,24]. • What is the project's fundamental concept and objective? [17]. • The origin of the source of the story construction [23].
The purpose	• Establishing a purpose early on and maintaining focus consistently throughout [14,24].
Story	• What substantial events or challenges occur during the course of the narrative [14,24]. • Communication pertains to the manner in which the narrative's substance is conveyed [25]. • Defines the story's dramatic arc and its constituent elements: events, characters, narrative objects, and themes [26]. • What significant occurrences or obstacles take place throughout the narrative? [17]. • How will the project be navigated by the user? [17]. • What is the critical outcome that this work aims to achieve? [17]. • Stories encompass both generalizability and specificity, such as significant individuals (memorial stories), events (adventure stories, accomplishment stories), locations (recovery stories, love stories), and discoveries (personal journeys) [23]. • Context is denoted by way of connecting the narrative to pertinent external information or material [25].
Economy	• The amount of content is adequate to communicate the plot without inundating the audience [14,24].
Voice	• The storyteller emphasizes the narrative in their work in an appropriate voice [14,24].
Soundtrack	• Music or sound effects that serve to augment and supplement the narrative [14,24]. • What is your intended approach to incorporating sound into your work? [17]. • The narrator employs an assortment of musical compositions to establish distinct ambiances during the digital narrative while sound effects are omitted. Various emotions were "reflected and expressed" through music in the narrative [23].

Table 6. *Cont.*

Elements	Explanation
Interactive multimedia	• Which media formats exist, including but not limited to the internet, mobile phones, and television? [14,24]. • The components or materials used in the construction of the story package. Digital stories are distinguished by their capacity to use any variety and combination of media [25]. • The extent to which the user is afforded the opportunity to actively participate in the story's environment [26]. • The user contributes to the structure of the narrative through system interaction [26]. • The extent to which the storytelling activity occurs in the user's physical environment or in a virtual world [26]. • What are the forms of media (such as the internet, mobile phones, or television)? Which platform (hardware) is it (such as a mobile phone, a computer, or a console game)? Which genre is it classified as (such as action or simulation)? [17]. • Which visual methods do you intend to employ, such as animation, graphics, and video? [17]. • The narrator may have employed both explicit and implicit uses of imagery to convey the story. Some photographs were used throughout, and they all had symbolic or metaphorical significance [23]. • Social media storytelling increasingly incorporates visual elements, such as graphics, videos, music, and new media [23]. • Immersion level: the extent to which the user is engrossed in the narrative [26]. • The capability for users to engage in collaborative story creation or experience [26]. • The connection and degree of interactivity between the user and the content is referred to as the "relationship" [25].
Background	• What is the world and the setting of the story? [14,17,24]. • Does the setting seem realistic or fantastical? [17].

For Schafer's guideline [26], as her doctoral dissertation, Schafer introduced the "dimension star model", a twelve-point guideline for digital storytelling that she subsequently published in the textbook *Investigations on Digital Storytelling—The Development of a Reference Model* [26]. As shown in Table 3, this guideline focuses primarily on interactive digital storytelling.

Next, the objective of Hausknecht's digital storytelling guideline [23] for older adults is to discover novel methods of communication with this demographic. This research investigated how seniors incorporated multimedia into their narratives. Additionally, this guideline emphasizes a technological society replete with multimedia and new media. This is due to the fact that older adults are increasingly using social media and other technological platforms to communicate, as presented in Table 3 and detailed in Table 6.

Miller's guideline [17] provides a comprehensive guide to interactive entertainment. The guideline and this book exclusively highlight interactive media, including but not limited to mobile devices, websites, video games, and interactive television. Furthermore, Miller [17] conducts a comparative analysis of traditional and contemporary (interactive or online) storytelling tools, providing guidance on how to modify this principle for application in each medium, as presented in Tables 3 and 6.

In the case of the inclusive digital storytelling guideline [14,24], they found that most digital storytelling guidelines focus primarily on general media for general audiences and not museums. Furthermore, most studies focus on the application of cutting-edge presentation technologies rather than the development of narrative structures. In addition, the majority of research does not target youth, the elderly, or individuals with disabilities. Consequently, this guideline, applied with inclusive design principles and created by interviewing target audiences and experts, is designed for different demographics—namely, young people, the elderly, and individuals with disabilities—and employs strategies to pique their interest in museum exhibits, as presented in Tables 3 and 6.

3.3.4. Digital Storytelling Guidelines for Older Adults and People with Disabilities

Regarding the several guidelines presented, there are only two studies [14,23] focusing on older adults and people with disabilities as target audiences.

In case of the inclusive digital storytelling guideline [14], the aim is to use inclusive design principles to understand the barriers faced by these two study groups and to determine the accommodations they require. Both of these two groups prefer to see the same characteristics as themselves (e.g., disabled people, seniors) as presenters. Seniors prefer content about religion, family vacation, and physical health or quality of life, as well as nostalgia stories about the past. In the case of story structure, they prefer straightforward, conventional, and conservative aesthetics with direct information, while no gimmicks, tricks, or hidden plots are necessary. Designers have to present brief segments of information. For this group, voice and soundtrack are essential. Lastly, this group prefers all settings (locations, characters) to be authentic (not cartoon or 3D) and for constructed historical settings to evoke sentiments of nostalgia. For disabled people, they prefer content about religion, accessibility, and transportation. In the case of story structure, this group prefers stable, fundamental, and conservative structures with one point of climax and dislikes new and rapid structures. Brief information, voice, and soundtrack are essential.

In the case of Hausknecht's digital storytelling guideline [23] for older adults, this guideline emphasizes a technological approach with multimedia and new media. This is due to the fact that older adults are increasingly using social media and other technological platforms to communicate as follows:

(1) Types of stories: stories encompass both generalizability and specificity, such as significant individuals (memorial stories), events (adventure stories, accomplishment stories), locations (recovery stories, love stories), and discoveries (personal journeys). (2) Imagery process and choice: the narrator may have employed both explicit and implicit uses of imagery to convey the story. Some photographs were used throughout, and they all had symbolic or metaphorical significance. (3) Music and sound: the narrator employed an assortment of musical compositions to establish distinct ambiances during the digital narrative while sound effects were omitted. Various emotions were "reflected and expressed" through music in the narrative. (4) Multimedia: social media storytelling increasingly incorporates visual elements, such as graphics, videos, music, and new media.

4. Conclusions

Digital storytelling guidelines, technologies, and resources that specifically address the needs of the elderly and individuals with mobility impairments in the context of museum exhibitions and presentations are scarce. The researchers read each article in its entirety and, using content analysis, classified the papers into three primary categories: (1) inclusive design for museum presentation, (2) technology trends in digital storytelling for museum presentations, and (3) museum presentation guidelines for digital storytelling.

Based on this, the following research question was considered: "How can a museum develop digital storytelling presentations with suitable technology to accommodate older adults, aged 60 or more, and people who have mobility impairments in functions related to the lower body extremities (mobility), such as wheelchair users and those requiring walking aids?"

First, although museums are beginning to acknowledge the unique requirements of visitors with mobility impairments and the aging global population, a pervasive oversight persists. Nevertheless, the positive consequences that museums can anticipate from implementing inclusive design principles are outlined in this article. These include increased accessibility, enhanced learning experiences, greater cultural inclusivity and social equity, and more community engagement. By adhering to these practices, museums not only accommodate the unique requirements of older individuals and those with limited mobility but also make a positive contribution toward the overarching objective of fostering more inclusive and hospitable environments. For museum designers to comprehend these heterogeneous groups and implement inclusive design principles, they must be aware of

both the barriers that make visiting museums a challenge and the drivers that attract these individuals to museums. Consequently, barriers could be eradicated, and visitors from these groups could receive more effective assistance.

Second, this review elucidates notable technological developments that have the potential to augment the accessibility of museums for elderly patrons and those with limited mobility. User experience, for instance, requires that designers comprehend and assess user profiles, demographics, interests, and needs through research and presentations regarding accessibility before, during, and after the visit. Accordingly, customization information must be provided that includes only pertinent details regarding accessible facilities (e.g., wheelchair parking, accessibility maps, and inclined surfaces). It is essential to utilize cutting-edge mobile device technologies, including automatic reading, location awareness via GPS, and accessibility maps. Additionally, individuals with mobility impairments could be assisted with online museum presentations using VR, and AR could be combined with multimedia to pique their interest. Online and in-person AI could be implemented to provide exhibition guidance and explanations, and the IoT, including wearable and portable interactive devices, has the potential to transform an exhibition into a "smart and accessible museum" system. This would allow visitors to personalize their experience while gaining multimedia-based information about the exhibits.

Finally, in the realm of museum presentation guidelines for digital storytelling, presenters who possess similar qualities to those of the visitors are favored. Religious topics, family vacations, physical health or quality of life, anecdotes from the past, memorial tales, and sentimentality are preferred by seniors. For individuals with limited mobility, prioritizing content regarding accessibility is crucial. These groups require information that is direct, conventional, and concise. A soundtrack and voice must also be provided for both groups. These individuals value feelings of nostalgia and prefer settings (e.g., locations and characters) to be genuine rather than cartoonish or two-dimensional. Eventually, multimedia and social media storytelling for the elderly could include components such as graphics, videos, music, and new media.

In conclusion, the significance of an inclusive design and digital storytelling approach to museum presentations and the inclusion of underrepresented target groups is emphasized. By taking into consideration the unique requirements, barriers, motivating factors, supported technologies and presentation guidelines of older individuals and those with limited mobility, museums have the potential to not only improve the accessibility and satisfaction of their displays for these demographics but also establish a paradigm for inclusiveness and active participation in cultural environments that benefits all.

4.1. Practical Implications of This Review Article

This article has undergone a comprehensive review process and has been condensed to provide insights pertaining to the identified research issue. If researchers, designers, museums, storytellers, and stakeholders wish to increase diversity, accessibility, and motivation in museums for these two groups through the use of technology and digital storytelling, literature reviews and examples in this article could be applied in three ways: (1) In-person presentations at the museums (e.g., AR, VR, or interactive presentations at the kiosks of museums); (2) Virtual online presentations (e.g., VR with online museums, GPS navigation, voice commands, AI with multiple languages); and (3) Short presentations (e.g., advertisements, social media videos, or brief narratives) designed to entice these two target group visitors to visit.

Moreover, it is our suggestion that museums adopt the following: (1) Establish inclusive design principles as a fundamental component of museum planning and development; (2) Utilize emerging technologies to generate individualized and accessible experiences that accommodate the distinct requirements and preferences of every visitor; (3) Formulate and execute precise and targeted digital storytelling protocols that cater specifically to the requirements of older adults and individuals with mobility impairments.

4.2. Limitations of This Article

As a result of the scarcity of relevant studies in the primary databases (e.g., Scopus and ScienceDirect), this review article employs Google Scholar as an intermediary platform to locate pertinent information and conference and journal case studies. Google Scholar uses a search engine equipped with "crawler robots" to locate pertinent web pages and has frequently faced criticism due to its lack of disclosure regarding its search algorithms, its untraceable approach to sorting search results, and the incorporation of content from non-scholarly sources into its search results. This implies that outcomes may vary depending on whether identical and repeated searches are conducted.

Author Contributions: Conceptualization, K.K., A.S., D.H. and F.N.; review and analysis, K.K., A.S. and F.N.; writing—original draft preparation, K.K.; writing—review and editing, K.K., A.S., D.H. and F.N. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the School of Architecture, Art, and Design, King Mongkut's Institute of Technology Ladkrabang (KMITL), grant number 2567-02-02-009.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Kasemsarn, K.; Harrison, D.; Nickpour, F. Applying Inclusive Design and Digital Storytelling to Facilitate Cultural Tourism: A Review and Initial Framework. *Heritage* **2023**, *6*, 1411–1428. [CrossRef]
2. Villeneuve, P.; Love, A.R. (Eds.) *Visitor-Centered Exhibitions and Edu-Curation in Art Museums*; Rowman & Littlefield: Lanhamu, MA, USA, 2017.
3. Woodruff, A. The museum can be visitor-centered: An intern's reflection. *Reflective Pract.* **2018**, *19*, 179–192. [CrossRef]
4. Chiovatto, M.; Aidar, G. Inclusive education in museums case study: Pinacoteca do estado de Sao Paulo. *Mus. Int.* **2012**, *64*, 69–79. [CrossRef]
5. Derby, J. Confronting ableism: Disability studies pedagogy in preservice art education. *Stud. Art Educ.* **2016**, *57*, 102–119. [CrossRef]
6. D'Hudson, G.; Saling, L.L. Worry and rumination in older adults: Differentiating the processes. *Aging Ment. Health* **2010**, *14*, 524–534. [CrossRef] [PubMed]
7. Sica, E.; Sisto, R.; Bianchi, P.; Cappelletti, G. Inclusivity and responsible tourism: Designing a trademark for a national park area. *Sustainability* **2020**, *13*, 13. [CrossRef]
8. Shaw-Lawrence, P. Enabling the disabled. *Travel Wkly.* **1999**, *59*, 8.
9. Lipianin-Zontek, E.; Szewczyk, I. Adaptation of business hotels to the needs of disabled tourists in Poland. *Probl. Perspect. Manag.* **2019**, *17*, 392. [CrossRef]
10. Shaw, G.; Coles, T. Disability, holiday making and the tourism industry in the UK: A preliminary survey. *Tour. Manag.* **2004**, *25*, 397–403. [CrossRef]
11. Lim, J.E. Understanding the discrimination experienced by customers with disabilities in the tourism and hospitality industry: The case of Seoul in South Korea. *Sustainability* **2020**, *12*, 7328. [CrossRef]
12. Ozturk, Y.; Yayli, A.; Yesiltas, M. Is the Turkish tourism industry ready for a disabled customer's market? The views of hotel and travel agency managers. *Tour. Manag.* **2008**, *29*, 382–389. [CrossRef]
13. Brida, J.G.; Dalle Nogare, C.; Scuderi, R. Frequency of museum attendance: Motivation matters. *J. Cult. Econ.* **2016**, *40*, 261–283. [CrossRef]
14. Kasemsarn, K.; Nickpour, F. A conceptual framework for inclusive digital storytelling to increase diversity and motivation for cultural tourism in Thailand. *Stud. Health Technol. Inform.* **2016**, *229*, 407–415.
15. Bahtiar, B.; Yusuf, Y.; Doyan, A.; Ibrahim, I. The Trend of Technology Pedagogical Content Knowledge (TPACK) Research in 2012–2022: Contribution to Science Learning of 21st Century. *J. Penelit. Pendidik. IPA* **2023**, *9*, 39–47. [CrossRef]
16. Kasemsarn, K. Creating a Cultural Youth Tourism eBook Guidelines with Four Design Factors. *Int. J. Vis. Des.* **2022**, *16*, 31. [CrossRef]
17. Miller, C.H. *Digital Storytelling 4e: A Creator's Guide to Interactive Entertainment*; CRC Press: Boca Raton, FL, USA, 2019.
18. Ohler, J.B. *Digital Storytelling in the Classroom: New Media Pathways to Literacy, Learning, and Creativity*; Corwin Press: Thousand Oaks, CA, USA, 2013.
19. Psomadaki, O.I.; Dimoulas, C.A.; Kalliris, G.M.; Paschalidis, G. Digital storytelling and audience engagement in cultural heritage management: A collaborative model based on the Digital City of Thessaloniki. *J. Cult. Herit.* **2019**, *36*, 12–22. [CrossRef]
20. Lambert, J.; Hessler, B. *Digital Storytelling Capturing Lives, Creating Community*; Routledge, Taylor & Francis Group: New York, NY, USA; London, UK, 2018.

21. Porter, B. *Digitales: The Art of Telling Digital Stories*; Bernajean Porter: Denver, CO, USA, 2004.
22. Salpeter, J. Telling Tales with Technology: Digital Storytelling Is a New Twist on the Ancient Art of the Oral Narrative. *Technol. Learn.* **2005**, *25*, 18.
23. Hausknecht, S. The role of new media in communicating and shaping older adult stories. In *Human Aspects of IT for the Aged Population. Acceptance, Communication and Participation: 4th International Conference, ITAP 2018, Held as Part of HCI International 2018, Las Vegas, NV, USA, 15–20 July 2018*; Proceedings, Part I 4; Springer International Publishing: Berlin/Heidelberg, Germany, 2018; pp. 478–491.
24. Kasemsarn, K.; Harrison, D.; Nickpour, F. Digital Storytelling Guideline Applied with Inclusive Design for Museum Presentation from Experts' and Audiences' Perspectives. *Int. J. Incl. Mus.* **2023**, *16*, 99. [CrossRef]
25. Paul, N.; Fiebich, C. *The Elements of Digital Storytelling*; School of Journalism and Mass Communication's Institute for New Media Studies and The Media Center: Thessaloniki, Greece, 2005.
26. Schäfer, L. *Investigations on Digital Storytelling: The Development of a Reference Model*; VDM Publishing. Müller: Saarbrucken, Germany, 2008.
27. World Health Organization (2011) World Report on Disability. Available online: https://www.who.int/teams/noncommunicable-diseases/sensory-functions-disability-and-rehabilitation/world-report-on-disability (accessed on 1 January 2024).
28. Story, M.F.; Mueller, J.L.; Mace, R.L. *The Universal Design File: Designing for People of all Ages and Abilities*; ERIC, Education Resources Information Center: Washington, DC, USA, 1998.
29. Fuglerud, K.S. *Inclusive Design of ICT: The Challenge of Diversity*; University of Oslo, Faculty of Humanitites: Oslo, Norway, 2014.
30. Liberati, A.; Altman, D.G.; Tetzlaff, J.; Mulrow, C.; Gøtzsche, P.C.; Ioannidis, J.P.; Clarke, M.; Devereaux, P.J.; Kleijnen, J.; Moher, D. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *Ann. Intern. Med.* **2009**, *151*, W-65–W-94. [CrossRef] [PubMed]
31. Paul, J.; Criado, A.R. The art of writing literature review: What do we know and what do we need to know? *Int. Bus. Rev.* **2020**, *29*, 101717. [CrossRef]
32. Burnett, J.J.; Baker, H.B. Assessing the travel-related behaviors of the mobility-disabled consumer. *J. Travel Res.* **2001**, *40*, 4–11. [CrossRef]
33. Kruczek, Z.; Gmyrek, K.; Ziżka, D.; Korbiel, K.; Nowak, K. Accessibility of Cultural Heritage Sites for People with Disabilities: A Case Study on Krakow Museums. *Sustainability* **2023**, *16*, 318. [CrossRef]
34. Sawadsri, A. Universal Design Guideline to Accommodate Disabled Occupants. In *Challenges for Assistive Technology*; IOS Press: Amsterdam, The Netherlands, 2007; pp. 796–801.
35. Giannini, T.; Bowen, J.P. Museums and Digital Culture: From reality to digitality in the age of COVID-19. *Heritage* **2022**, *5*, 192–214. [CrossRef]
36. Ibem, E.O.; Oni, O.O.; Umoren, E.; Ejiga, J. An appraisal of universal design compliance of museum buildings in Southwest Nigeria. *Int. J. Appl. Eng. Res.* **2017**, *12*, 13731–13741.
37. Zakaria, N.N. Barriers to social inclusion with the Egyptian museums; new approach towards disability. *Curator Mus. J.* **2020**, *63*, 115–130. [CrossRef]
38. Eardley, A.F.; Thompson, H.; Fineman, A.; Hutchinson, R.; Bywood, L.; Cock, M. Devisualizing the Museum: From Access to Inclusion. *J. Mus. Educ.* **2022**, *47*, 150–165. [CrossRef]
39. Kinsley, R.P. Inclusion in museums: A matter of social justice. *Mus. Manag. Curatorship* **2016**, *31*, 474–490. [CrossRef]
40. Heidelberg, B.M. Evaluating equity: Assessing diversity efforts through a social justice lens. *Cult. Trends* **2019**, *28*, 391–403. [CrossRef]
41. Huhn, A.; Anderson, A. Promoting social justice through storytelling in museums. *Mus. Soc.* **2021**, *19*, 351–368. [CrossRef]
42. Callahan Schreiber, R.; Goeke, M.; Bequette, M. Community-informed design: Blending community engagement and museum design approaches for sustainable experience development. *Curator Mus. J.* **2023**, *0*, 1–17. [CrossRef]
43. Salgado, M.; Marttila, S. Discussions on inclusive, participative and open museums. In Proceedings of the Beyond Control: The Collaborative Museum and its Challenges. International Conference on Design and Digital Heritage: NODEM 2013 Conference Proceedings, Stokholm, Sweden, 1–3 December 2013; pp. 41–48.
44. Tsipra, T.; Drinia, H. Geocultural landscape and sustainable development at Apano Meria in Syros Island, central Aegean sea, Greece: An ecomuseological approach for the promotion of geological heritage. *Heritage* **2022**, *5*, 2160–2180. [CrossRef]
45. Hollander, J.B.; Foster-Karim, C.; Wiley, A. Urban inclusivity through a service design framework. *J. Place Manag. Dev.* **2019**, *12*, 71–87. [CrossRef]
46. McMillen, R. The inclusive art museum: Determining disability access. *Int. J. Incl. Mus.* **2012**, *4*, 101. [CrossRef]
47. Gossett, A.; Gossett, A.; Mirza, M.; Barnds, A.K.; Feidt, D. Beyond access: A case study on the intersection between accessibility, sustainability, and universal design. *Disabil. Rehabil. Assist. Technol.* **2009**, *4*, 439–450. [CrossRef] [PubMed]
48. Villeneuve, P. Building museum sustainability through visitor-centered exhibition practices. *Int. J. Incl. Mus.* **2013**, *5*, 37. [CrossRef]
49. Floch, J.; Jiang, S. One place, many stories digital storytelling for cultural heritage discovery in the landscape. In Proceedings of the 2015 Digital Heritage, Granada, Spain, 28 September–2 October 2015; Volume 2, pp. 503–510.
50. Pietroni, E.; Ferdani, D. Virtual restoration and virtual reconstruction in cultural heritage: Terminology, methodologies, visual representation techniques and cognitive models. *Information* **2021**, *12*, 167. [CrossRef]

51. Pujol, L.; Roussou, M.; Poulou, S.; Balet, O.; Vayanou, M.; Ioannidis, Y. Personalizing interactive digital storytelling in archaeological museums: The CHESS project. In Proceedings of the 40th Annual Conference of Computer Applications and Quantitative Methods in Archaeology, Southampton, UK, 26–29 March 2012; Amsterdam University Press: Amsterdam, The Netherlands, 2012; pp. 93–100.
52. Wither, J.; Allen, R.; Samanta, V.; Hemanus, J.; Tsai, Y.T.; Azuma, R.; Carter, W.; Hinman, R.; Korah, T. The westwood experience: Connecting story to locations via mixed reality. In Proceedings of the 2010 IEEE International Symposium on Mixed and Augmented Reality-Arts, Media, and Humanities, Seoul, Republic of Korea, 13–16 October 2010; pp. 39–46.
53. Law, E.L.C.; Roto, V.; Hassenzahl, M.; Vermeeren, A.P.; Kort, J. Understanding, scoping and defining user experience: A survey approach. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Boston, MA, USA, 4–6 April 2009; pp. 719–728.
54. Tongsubanan, S.; Kasemsarn, K. Sustainability at Home: The Development of an Efficient Framework for Home Energy-Saving Applications. *Designs* **2023**, *7*, 101. [CrossRef]
55. Mohd Noor Shah, N.F.; Ghazali, M. A systematic review on digital technology for enhancing user experience in museums. In *User Science and Engineering: 5th International Conference, i-USEr 2018, Puchong, Malaysia, 28–30 August 2018, Proceedings 5*; Springer: Singapore, 2018; pp. 35–46.
56. Rodrigues, J.M.; Lessa, J.; Gregório, M.; Ramos, C.; Cardoso, P.J. An initial framework for a museum application for senior citizens. In Proceedings of the 7th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-Exclusion, Vila Real, Portugal, 1–3 December 2016; Association for Computing Machinery: New York, NY, USA, 2016; pp. 414–421.
57. Roussou, M.; Katifori, A. Flow, staging, wayfinding, personalization: Evaluating user experience with mobile museum narratives. *Multimodal Technol. Interact.* **2018**, *2*, 32. [CrossRef]
58. Chen, H.C.; Kao, Y.F.; Kuo, C.L. A multimedia storytelling in a rural village: The show Taiwan e-tourism service using tablet technologies. In Proceedings of the 2014 IIAI 3rd International Conference on Advanced Applied Informatics, Kokura, Japan, 31 August 2014–4 September 2014; pp. 525–526.
59. Woodruff, A. Creating Visitor-Centered Museum Experiences for Adults with Developmental Disabilities: A Collaborative Case Study. Doctoral Dissertation, The Florida State University, Tallahassee, FL, USA, 2022.
60. Karimi, H.A.; Zhang, L.; Benner, J.G. Personalized accessibility map (PAM): A novel assisted wayfinding approach for people with disabilities. *Ann. GIS* **2014**, *20*, 99–108. [CrossRef]
61. Yildiz, S. A Holistic View on Contemporary Art Museums in the Context of Accessible Tourism-Case Studies from Central Europe. *Karabük Üniversitesi Sos. Bilim. Enstitüsü Derg.* **2019**, *9*, 337–348.
62. Muñoz-Muñoz, A.M.; González-Moreno, M.B. The presence of women photographers in the permanent collections of ten European museums. *Curator Mus. J.* **2017**, *60*, 205–215. [CrossRef]
63. Jagodzińska, K. Do the buildings really matter? Czech, Polish and Slovak museums and centres of contemporary art in adapted buildings. *Cent. Eur.* **2018**, *16*, 112–133. [CrossRef]
64. Christodoulakis, S. Trends in Digital Cultural Heritage Management and Applications. *Digit. Present. Preserv. Cult. Sci. Herit.* **2014**, *4*, 17–25. [CrossRef]
65. Fletcher, T.S.; Blake, A.B.; Shelffo, K.E. Can sensory gallery guides for children with sensory processing challenges improve their museum experience? *J. Mus. Educ.* **2018**, *43*, 66–77. [CrossRef]
66. Xia, Y. How Has Online Digital Technology Influenced the On-Site Visitation Behavior of Tourists during the COVID-19 Pandemic? A Case Study of Online Digital Art Exhibitions in China. *Sustainability* **2023**, *15*, 10889. [CrossRef]
67. Załuska, U.; Kwiatkowska-Ciotucha, D.; Grześkowiak, A. Travelling from perspective of persons with disability: Results of an international survey. *Int. J. Environ. Res. Public Health* **2022**, *19*, 10575. [CrossRef]
68. Ribeiro, F.R.; Silva, A.; Barbosa, F.; Silva, A.P.; Metrôlho, J.C. Mobile applications for accessible tourism: Overview, challenges and a proposed platform. *Inf. Technol. Tour.* **2018**, *19*, 29–59. [CrossRef]
69. Cardonha, C.; Gallo, D.; Avegliano, P.; Herrmann, R.; Koch, F.; Borger, S. A crowdsourcing platform for the construction of accessibility maps. In Proceedings of the 10th International Cross-Disciplinary Conference on Web Accessibility, Rio de Janeiro, Brazil, 13–15 May 2013; Association for Computing Machinery: New York, NY, USA, 2013; pp. 1–4.
70. Miura, T.; Yabu, K.I.; Ikematsu, S.; Kano, A.; Ueda, M.; Suzuki, J.; Sakajiri, M.; Ifukube, T. Barrier-free walk: A social sharing platform of barrier-free information for sensory/physically-impaired and aged people. In Proceedings of the 2012 IEEE International Conference on Systems, Man, and Cybernetics (SMC), Seoul, Republic of Korea, 14–17 October 2012; pp. 2927–2932.
71. Kunjir, A.R.; Patil, K.R. Challenges of mobile augmented reality in museums and art galleries for visitors suffering from vision, speech, and learning disabilities. In *Virtual and Augmented Reality in Education, Art, and Museums*; IGI Global: Hershey, PA, USA, 2020; pp. 162–173.
72. Sarvas, R.; Frohlich, D.M. *From Snapshots to Social Media: The Changing Picture of Domestic Photography*; Springer: London, UK, 2011.
73. Zimmerman, K.N.; Ledford, J.R. Beyond ASD: Evidence for the effectiveness of social narratives. *J. Early Interv.* **2017**, *39*, 199–217. [CrossRef]
74. Marasco, A.; Balbi, B. Designing accessible experiences for heritage visitors through virtual reality. *E Rev. Tour. Res.* **2019**, *17*, 426–443.

75. Traboulsi, C.; Frau, M.; Cabiddu, F. Active seniors perceived value within digital museum transformation. *TQM J.* **2018**, *30*, 530–553. [CrossRef]
76. Figueiredo, M.; Gomes, J.; Gomes, C. Creating learning activities using augmented reality tools. In Proceedings of the 2nd Experiment@ International Conference—Online Experimentation, Coimbra, Portugal, 18–20 September 2013; pp. 301–305.
77. Guimarães, F.; Figueiredo, M.; Rodrigues, J. Augmented Reality and Storytelling in heritage application in public gardens: Caloust Gulbenkian Foundation Garden. In Proceedings of the 2015 Digital Heritage, Granada, Spain, 28 September–2 October 2015; Volume 1, pp. 317–320.
78. Vishwanath, G. Enhancing Engagement through Digital Cultural Heritage: A Case Study about Senior Citizens using a Virtual Reality Museum. In Proceedings of the 2023 ACM International Conference on Interactive Media Experiences, Nantes, France, 12–15 June 2023; Association for Computing Machinery: New York, NY, USA, 2023; pp. 150–156.
79. Nishchyk, A.; Sanderson, N.C.; Chen, W. Elderly-centered usability heuristics for augmented reality design and development. In *Universal Access in the Information Society*; Elsevier: Amsterdam, The Netherlands, 2024; pp. 1–21.
80. Liang, S. *Establishing Design Principles for Augmented Reality for Older Adults*; Sheffield Hallam University: Sheffield, UK, 2018.
81. Pisoni, G.; Díaz-Rodríguez, N.; Gijlers, H.; Tonolli, L. Human-centered artificial intelligence for designing accessible cultural heritage. *Appl. Sci.* **2021**, *11*, 870. [CrossRef]
82. Ten, A.; Kaushik, P.; Oudeyer, P.Y.; Gottlieb, J. Humans monitor learning progress in curiosity-driven exploration. *Nat. Commun.* **2021**, *12*, 5972. [CrossRef]
83. Dal Falco, F.; Vassos, S. Museum experience design: A modern storytelling methodology. *Des. J.* **2017**, *20* (Suppl. 1), S3975–S3983. [CrossRef]
84. Zancanaro, M.; Stock, O.; Schiavo, G.; Cappelletti, A.; Gehrmann, S.; Canetti, D.; Shaked, O.; Fachter, S.; Yifat, R.; Mimran, R.; et al. Evaluating an automated mediator for joint narratives in a conflict situation. *Behav. Inf. Technol.* **2020**, *39*, 1022–1037. [CrossRef]
85. Manitsaris, S.; Glushkova, A.; Bevilacqua, F.; Moutarde, F. Capture, modeling, and recognition of expert technical gestures in wheel-throwing art of pottery. *J. Comput. Cult. Herit. (JOCCH)* **2014**, *7*, 10. [CrossRef]
86. Díaz-Rodríguez, N.; Pisoni, G. Accessible cultural heritage through explainable artificial intelligence. In Proceedings of the Adjunct Publication of the 28th ACM Conference on User Modeling, Adaptation and Personalization, Genoa, Italy, 14–17 July 2020; Association for Computing Machinery: New York, NY, USA, 2020; pp. 317–324.
87. Guidotti, R.; Monreale, A.; Ruggieri, S.; Turini, F.; Giannotti, F.; Pedreschi, D. A survey of methods for explaining black box models. *ACM Comput. Surv. (CSUR)* **2018**, *51*, 93. [CrossRef]
88. Alletto, S.; Cucchiara, R.; Del Fiore, G.; Mainetti, L.; Mighali, V.; Patrono, L.; Serra, G. An indoor location-aware system for an IoT-based smart museum. *IEEE Internet Things J.* **2015**, *3*, 244–253. [CrossRef]
89. Wang, Y.; Yang, C.; Liu, S.; Wang, R.; Meng, X. A RFID & handheld device-based museum guide system. In Proceedings of the 2007 2nd International Conference on Pervasive Computing and Applications, Birmingham, UK, 26–27 July 2007; pp. 308–313.
90. Aman, M.S.; Quint, C.D.; Abdelgawad, A.; Yelamarthi, K. Sensing and classifying indoor environments: An Iot based portable tour guide system. In Proceedings of the 2017 IEEE Sensors Applications Symposium (SAS), Glassboro, NJ, USA, 13–15 March 2017; IEEE: Piscataway, NJ, USA, 2017; pp. 1–6.
91. Kuusik, A.; Roche, S.; Weis, F. Smartmuseum: Cultural content recommendation system for mobile users. In Proceedings of the 2009 Fourth International Conference on Computer Sciences and Convergence Information Technology, Seoul, Republic of Korea, 24–26 November 2009; pp. 477–482.
92. Mainetti, L.; Mighali, V.; Patrono, L. An IoT-based user-centric ecosystem for heterogeneous smart home environments. In Proceedings of the 2015 IEEE International Conference on Communications (ICC), London, UK, 8–12 June 2015; pp. 704–709.
93. Almeida, A.; Fiore, A.; Mainetti, L.; Mulero, R.; Patrono, L.; Rametta, P. An IoT-aware architecture for collecting and managing data related to elderly behavior. *Wirel. Commun. Mob. Comput.* **2017**, *2017*, 5051915. [CrossRef]
94. Chianese, A.; Piccialli, F. Designing a smart museum: When cultural heritage joins IoT. In Proceedings of the 2014 Eighth International Conference on Next Generation Mobile Apps, Services and Technologies, Oxford, UK, 10–12 September 2014; pp. 300–306.
95. Bazzano, F.; Lamberti, F. Human-robot interfaces for interactive receptionist systems and wayfinding applications. *Robotics* **2018**, *7*, 56. [CrossRef]
96. Fuentes-Moraleda, L.; Lafuente-Ibanez, C.; Fernandez Alvarez, N.; Villace-Molinero, T. Willingness to accept social robots in museums: An exploratory factor analysis according to visitor profile. *Library Hi Tech* **2022**, *40*, 894–913. [CrossRef]
97. Yousuf, M.A.; Kobayashi, Y.; Kuno, Y.; Yamazaki, K.; Yamazaki, A. Social interaction with visitors: Mobile guide robots capable of offering a museum tour. *IEEJ Trans. Electr. Electron. Eng.* **2019**, *14*, 1823–1835. [CrossRef]
98. Thrun, S.; Bennewitz, M.; Burgard, W.; Cremers, A.B.; Dellaert, F.; Fox, D.; Hahnel, D.; Rosenberg, C.; Roy, N.; Schulte, J.; et al. MINERVA: A second-generation museum tour-guide robot. In Proceedings of the 1999 IEEE International Conference on Robotics and Automation (Cat. No. 99CH36288C), Detroit, MI, USA, 10–15 May 1999; Volume 3.
99. Rizvic, S.; Sadzak, A.; Hulusic, V.; Karahasanovic, A. Interactive digital storytelling in the Sarajevo survival tools virtual environment. In Proceedings of the 28th Spring Conference on Computer Graphics, Budmerice, Slovakia, 2–4 May 2012; Association for Computing Machinery: New York, NY, USA, 2012; pp. 109–116.
100. Ryan, G.W.; Bernard, H.R. Data management and analysis methods. In *Handbook of Qualitative Research*; Sage: London, UK, 2000; Volume 2, pp. 769–802.

101. Cunsolo Willox, A.; Harper, S.L.; Edge, V.L. 'My Word': Storytelling and Digital Media Lab, Rigolet Inuit Community Government. Storytelling in a digital age: Digital storytelling as an emerging narrative method for preserving and promoting indigenous oral wisdom. *Qual. Res.* **2013**, *13*, 127–147. [CrossRef]
102. Alcantud-Diaz, M.; Vayá, A.R.; Gregori-Signes, C. 'Share your experience'. Digital storytelling in English for tourism. *Ibér. Rev. Asoc. Eur. Leng. para Fines Específ.* **2014**, *27*, 185–204.
103. Wexler, L.; Eglinton, K.; Gubrium, A. Using digital stories to understand the lives of Alaska Native young people. *Youth Soc.* **2014**, *46*, 478–504. [CrossRef]
104. Tolva, J.; Martin, J. Making the transition from documentation to experience: The eternal Egypt project. *Arch. Mus. Inform.* **2004**, *2*, 1–25.
105. Hein, H.S. *The Museum in Transition: A Philosophical Perspective*; Smithsonian Institution: Washington, DC, USA, 2000.
106. Robin, B.R. Digital storytelling: A powerful technology tool for the 21st century classroom. *Theory Pract.* **2008**, *47*, 220–228. [CrossRef]