Artful Accessibility: Designing Technologies to Enhance Museum Experiences for Individuals with Mobility Disabilities in Art Exhibitions.

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Abstract

Accessibility gains importance and is becoming a central component on the agenda of cultural and heritage sites, such as museums, especially since the ratification of the UN Convention on the Rights of Persons with Disabilities. A range of innovative technologies are being designed to facilitate accessibility for museum visitors. These new technologies have the potential to trans-form museum experiences for people with mobility disabilities. The present-ed work is a work in progress, which demonstrates an innovative system that will enhance the visit experience for individuals with mobility disabilities in art exhibitions.

Keywords

Cultural heritage experience, Adaptive design, Inclusive design, Museum experience, Human-centered computing, Accessibility, Accessibility systems and tools.

1. Introduction

In recent years, there has been an increasing recognition in cultural and heritage sites, such as museums, of the need to cater for diversity within their audiences. More recently this importance has been acknowledged and explicitly focused for people who may require support to access and enjoy these sites. As exhibitions are transitioning from the more traditional "presenter of objects" to being "a site for experiences" and adding different forms of technology to achieve those ends, Inclusive Design becomes more critical [15]. The term inclusive suggests that no one should be excluded from experiencing the benefits of the museum, in other words that the whole world—and every citizen in it—should be involved and able to see its exhibitions [11, 26]. The importance of this issue is reflected in The UN Convention on the Rights of Persons with Disabilities [25], which argues that assistive and digital technologies have a central role in the lives of people with disabilities and therefore re-quires that national government address the assistive technology needs of their citizens [1].

Therefore, the museums, that play such an important role in society, are trying to be more responsive to visitors' varied needs, including for people with mobility, hearing, visual, and cognitive or developmental disabilities [2, 7]. Technology becomes able to create a more authentic experience, potentially bringing the user closer to previously inaccessible artifacts and sites, enabling them to function independently and with equity and dignity [9, 12, 13].

Developing technological solutions for people with disabilities requires different approaches, according to the type of disability, since there are many different forms of disability or specific conditions that may impact the way people face museum activities [11, 21]. Poria et al. [18], provided a study that focused on the obstacles and barriers participants with disabilities (people

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who use wheelchairs or crutches and visually impaired people) face while visiting art museums. In-depth interviews revealed that people with disabilities are not able to experience the museums as they wish, despite museums' efforts toward becoming accessible to all. According to their findings, the difficulties the visitors face are divided into two sections: those encountered outside the exhibition (such as physical obstacles on the way to and from the museum) and those experienced within the exhibition itself. Within the exhibition, difficulties are related to the public space within the museum, including issues like counter heights (at the cashier, information desk, earphone-rental station, and shops), as well as obstacles posed by the exhibits themselves [18].

Therefore, in our current work, we decided to concentrate on the specific needs of mobility disability at the museum itself with an emphasis on art exhibitions. There may be observable signs that a museum visitor has a physical disability, such as use of a cane, crutches, or wheelchair. In this context, features such as ramps, lifts, and elevators provide greater accessibility. So do less apparent accommodations like positioning exhibit descriptions at a seated person's eye level, paving a gravel trail, or installing a power door opener. The least obvious accommodation, however considered as the most common issue, is the positioning of the exhibit objects themselves, especially the height of the exhibits displayed [18]. Typically, visual items in exhibitions (e.g., artifact, graphic, prop) are displayed within cases, either free-standing or wall-hung. Those cases should be allowed to be viewed by people who use wheelchairs as well as people that are standing, be they short or tall. Therefore, they should be designed at the appropriate height and have a clear floor space to stand next to it and allowing other visitors, with disabilities and without, to pass by (see Figure 1).

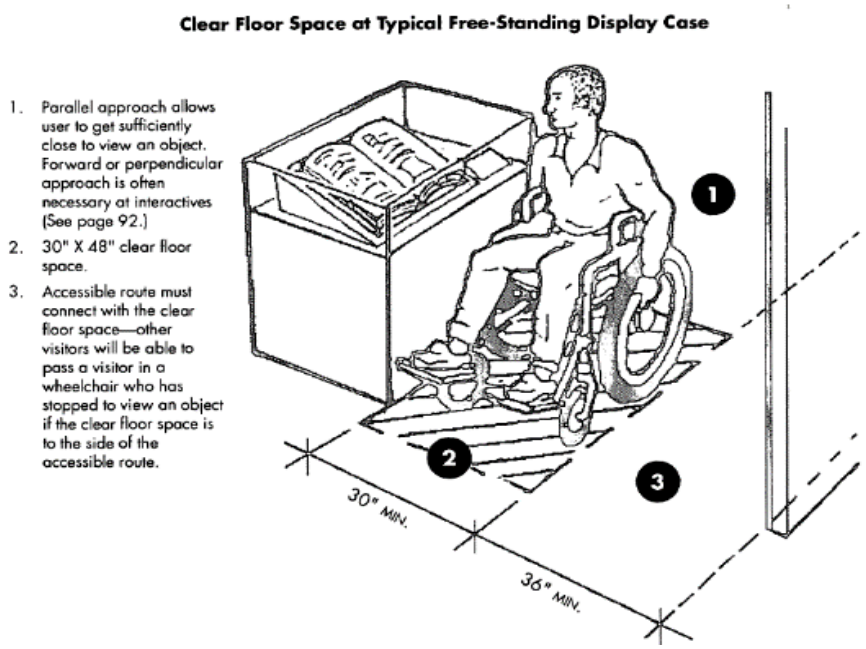

Figure 1: The ADA (Americans with Disabilities Act) Standards state for positioning Free-standing display cases [23].

The current paper presents a novel technique for designing wall-hung displays for exhibits and artworks. Our objective was to suggest ideas for techniques that may be used for creating exhibitions that can be experienced from a seated position, and at the same time be capable of accommodating a range of standing visitors. The rest of the paper is described as follows. We first provide a description of related work; we then present the suggested solution, followed by conclusions and future work directions.

2. Background And Related Work

Museums are progressively acknowledging the importance of addressing the diverse needs and expectations of their audiences. The types of adjustments for individuals with mobility limitations

tend to be the most thought about by museums and the most closely aligned with the ADA requirements [20]. The epidemiological COVID-19 crisis has highlighted the retrograde state of culture in terms of accessibility and usability, conditioned by the physical and web browsing limitations that for years impacted people with disabilities [17]. This health crisis gave the opportunity to develop more inclusive and accessible actions, adapted to the whole society [16]. The different cultural spaces, including museums, had to reinvent themselves to remain alive and accessible to citizens [11]. Therefore, we will assess the existing solutions both before and after the COVID-19 pandemic.

Before COVID-19, the available options for individuals with mobility limitations primarily consisted of wheelchairs (standard and smart), motorized scooters, ramps, elevators and accessible seating areas in auditoriums and theaters. Similarly, museums have also started placing increased emphasis on physical accessibility by ensuring wheelchair access to physical spaces [2].

Many museums facilitate universal access to their collections via multimedia and portable guides, making access available to all and enriching the visitor's experience [27]. There are numerous multimedia tourist guides in existence, however, only an insufficient number take accessibility criteria into consideration. For example, the Louvre Museum's multimedia guide, which integrates sign language and takes into consideration people with reduced mobility and includes a route for wheelchair-bound visitors [22].

Some museums have also created ways to help people view exhibit areas or buildings that are not fully accessible. For example, a virtual tour created by the Intrepid Sea, Air & Space Museum in New York City that is available on its website shows photographs and 360-degree panoramic views of inaccessible areas of its ship [2].

Another offering that some museums have for individuals with mobility limitations is an accessible map (e.g., Wheelmap[2]) that enables the collaborative creation of accessibility maps to augment standard maps with accessibility information [4]. For example, maps at Colonial Williamsburg and Old Sturbridge Village show buildings that are fully accessible, not accessible, or have limits to accessibility [2, 12]. These applications usually provide information about locations that support disabled facilities, and which do not, and share their opinion about each location. This approach is followed by AXSMap[3], a crowd sourced map, powered by Google Maps, that stores and shares information about wheelchair-accessible facilities in public places such as restaurants, hotels, etc. [6].

The COVID-19 pandemic has had a profound impact on museums, bringing about significant changes and presenting them with various challenges [5]. Virtual tours have become more popular in association with museums [19]. Digital initiatives in museums, and in particular the use of social media by museums, have increased during the pandemic [3]. The health crisis has expedited the progress of technological advancements in the cultural and heritage sectors, particularly in creating accessible and satisfactory services for individuals with diverse disabilities [10]. For in-stance, 3D reconstructions and virtual tours could allow people with permanent or temporary mobility impairment to visit unreachable places [19]; Virtual reality (VR) and Augmented reality (AR) systems enable the rediscovery of the ancient wonders or ruined sites using 3D models [24]; open data tools enable the archiving of data and interoperability between ancient manuscripts and images [8].

Still, remote access using technology is not a replacement of an on-site visit. In this respect, not all platforms or cultural sites themselves are accessible and inclusive for people with different types of disabilities [17]. For instance, we are not aware of any research or industrial work that has provided adaptable display cases or adaptable exhibitions. Therefore, our work fills this gap by suggesting a new approach to accessing today's static display exhibitions.

[2] https://wheelmap.org/
[3] https://www.axsmap.com/

3. Method

The greatest challenge for exhibition designers is offering engaging experiences for as many people as possible, catering to different abilities, interests, and preferences. Technology becomes able to reach the requirements which mediate user's experience. This helps create a more authentic experience, potentially bringing the user closer to previously inaccessible artifacts and sites [9].

When considering positioning objects in an exhibition (e.g., artwork, artifact, graphic, prop), it is very important to pay careful attention to how objects are displayed within cases, how labels are used, how lighting is designed, and how the information is delivered [23]. Artworks are usually hung on the walls of the museum or gallery in height that usually suits adults eye level. However, we suggest that they should be viewed by people who use wheelchairs as well as those that are standing, be they short or tall. Therefore, they should be designed following the ADA Standards, Smithsonian Guidelines for Accessible Design and other accessibility guides, that were analyzed to identify the basic concepts and requirements for universal design [14] [23]. More specifically, there is a need to take into consideration Item's Height from Ground: the distance between the ground and the item's centroid, i.e., how high the item is placed on the wall. Following specific guidelines pertaining to item visual accessibility, small items (to center line) should be placed at no higher than 1015 mm (40 in.) above the floor.

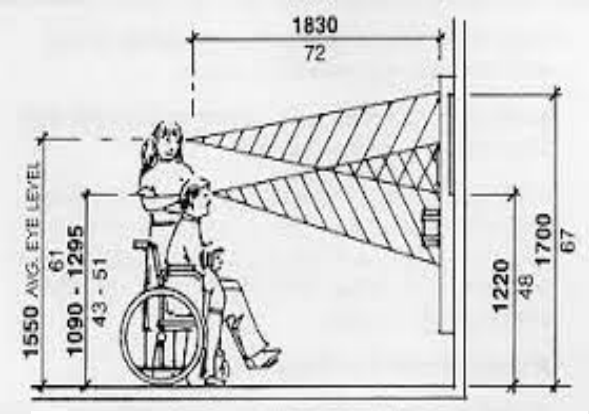

Figure 2: Average viewing sightlines [14].

A male adult who uses a wheelchair has an average eye level of between 1090 mm (43 in.) and 1295 mm (51 in.) above the finished floor (see Figure 2). Objects placed above 1015 mm (40 in.) will be seen only from below by most seated and short viewers. This is where we come into the picture with our contribution in this area of research, the innovative system that will enhance the experience for individuals with mobility disabilities in art museums and galleries by automatically adjusting the height of the artwork to the visitor. Therefore, in this scenario, the suggested solution involves integrating a small engine that can effortlessly lower the wall-hung display to the desired height. This implementation would facilitate accessibility and provide visitors with the ability to adjust the display to their preferred viewing level. We are planning to explore the suggested solution in the art wings of museums and galleries, such as the Hecht Museum at the University of Haifa, where paintings are currently hung using wires. In this case, adding an engine would be a straightforward extension, that will improve the experience for wheelchair users or visitors of varying heights, whether they are standing or seated. This modification would enable effortless adjustment of the painting's height, ensuring optimal visibility and engagement for all individuals (see Figure 3).

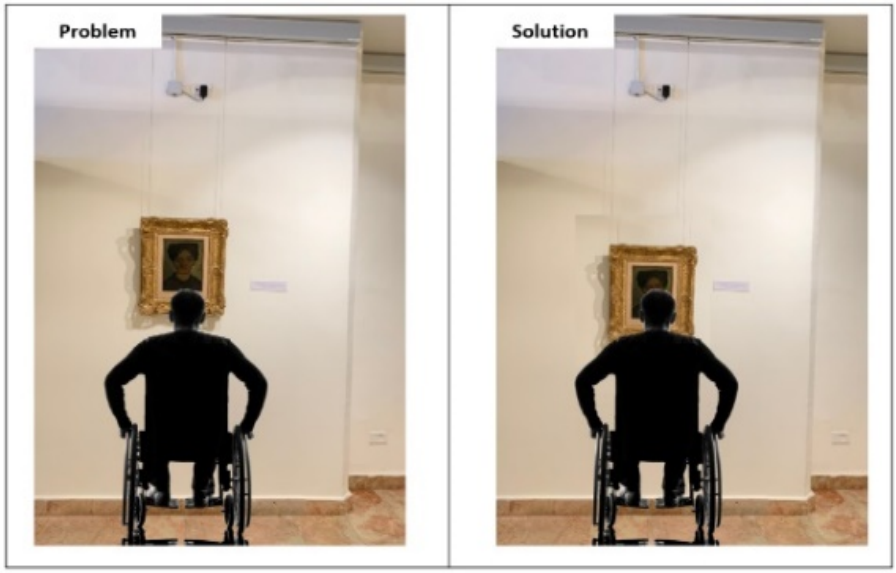

Figure 3: Adjustment of the painting's height in the art wing at Hecht Museum.

We suggest a system that will determine the right height of a painting given the height of the visitor. The system will include a proximity sensor (an ITR sensor for instance) to determine the presence of a visitor, a camera, to determine the visitor's height and a controller that will activate two mini motors for controlling the height of the painting that will hang on retractable metal cords. In this case, whenever a visitor approaches the painting, the suggested by us system is designed to identify the visitor positioned in front of the artwork and measure their eye level. Subsequently, it will calculate the optimal delta value, that should be made to raise or lower the exhibit. The calculated delta value, along with the specified direction (either upward or downward), will then be transmitted to the engine to facilitate the precise repositioning of the artwork. As a result, the height of the painting will be adjusted, if needed, and returned to its initial position once the visitor moves on (see Figure 4 that illustrates the proposed system).

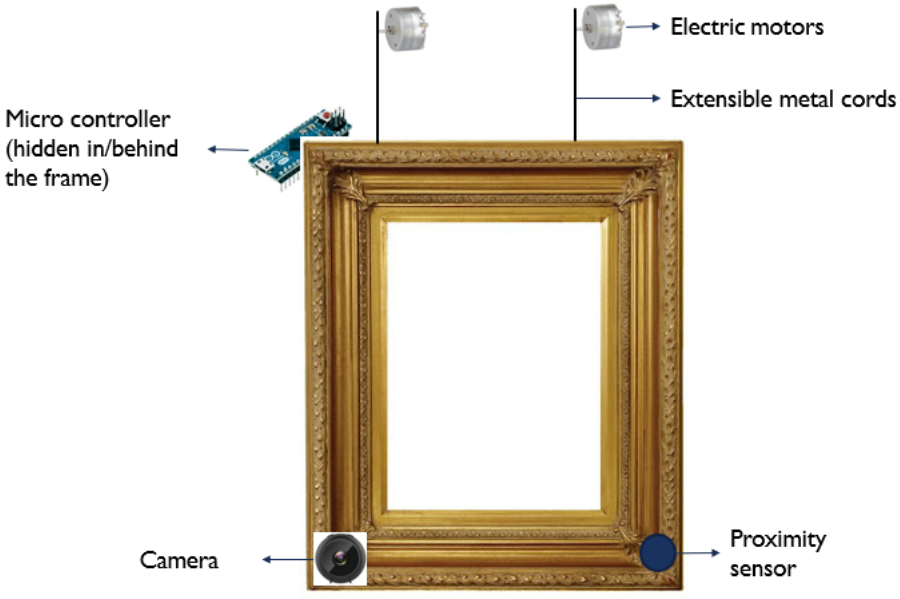

Figure 4: The proposed system.

4. Conclusions And Future Work

The presented work is a work in progress demonstrating an innovative system that will enhance the experience for individuals with mobility disabilities in the art wings of museums and art

galleries. We believe that the implementation of our system may have the potential to greatly enhance the cultural visit experience for all visitors. This includes individuals in wheelchairs, as well as those who are short and tall. To further gauge the potential impact, we are planning to provide an initial prototype, demonstrate it to the museum and conduct evaluation with end users. This will help us estimate the effectiveness and viability of the proposed solution.

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