

# Interior Design Enhancing Accessibility for the Disabled: Improving Quality of Life through Smart Innovations

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## Abstract

Individuals with disabilities often face challenges in their daily activities, limiting their independence and reducing their overall quality of life, particularly in public spaces where their needs may be overlooked. This paper explores how interior and architectural design can significantly improve the lives of disabled individuals by enhancing accessibility, autonomy, and comfort in public environments. It focuses on integrating smart technologies to transform conventional, rigid spaces into adaptive, inclusive settings. The research identifies effective and modern design strategies aimed at creating environments that are responsive to the needs of individuals with disabilities, allowing for greater self-reliance and independence. It emphasises the importance of human-centred, thoughtful design approaches that empower people with disabilities to lead fulfilling lives. The findings offer valuable insights for architects, designers, and healthcare professionals, providing a framework for future advancements in inclusive design. The paper also presents practical recommendations for automating and digitising public spaces, both in new constructions and through retrofitting existing structures, to promote accessibility and inclusivity.

**Keywords:** Accessibility, adaptability, assistive, cognitive, self-reliance.

## Introduction:

People are known to be affected in their day-to-day lives through their surrounding environments, as the environments surrounding us affect our way of interaction and for people with disabilities, the case is the same. Moreover, the use and increase of thoughtful designs can make a significant change in their daily lives. In other words, architects and the power of architecture alone can tend to shape the lives of many people by improving their lives by enhancing their day-to-day experiences. This paper explores how interior designs and architecture in general can develop surrounding environments to upgrade the level of independence for disabled individuals in both public and residential places. Mostly this will be seen through the incorporation of smart technologies and the development and reliance on inclusive design principles to allow better accessibility, comfort and even autonomy. There is also the discussion of using advanced technologies that make residential and public places much more adaptive and responsive to the multiple and different needs of people with disabilities. Through this research, there will be in-depth insights for architects that focus on how they can promote independence by creating environments that anyone and everyone can adjust and interact with, leading to a much more fulfilling life.

## 1.Literature Review

### 1.1. Inclusivity

The use and integration of smart technologies have increased in recent years including designs that promote inclusivity, this has grasped the attention of many architects and mainly in architecture, it has been a main point to include such ideas in modern designs. This is mainly created and focused on improving the lives of disabled individuals and the quality of their lives, the aim is to help increase their independence through innovating efficient designs and concepts in the environments that they are exposed to. The following literature review focuses on how human-centred designs can be critical through many architects addressing the many challenges people with disabilities face in their daily lives in any public or residential

spaces. Much of the early accessible design research conducted was focused on following and adhering to international rules, such as the Americans with Disabilities Act (ADA) or other equivalent laws. The establishment of these rules was the main foundation for attaining fundamental accessibility in public spaces. In 2012 a research conducted by Steinfield and Maisel [1], it was brought to attention that it is a necessity to create inclusive spaces that people of all abilities can and may use. Through their study and efforts, the significance of universal design was now clear and that is due to the idea that goes beyond basic and simple adherence that environments that are flexible, adaptive and open to all kinds of people should be created.

As more studies took place, nowadays it has become very clear that smart technologies make lives much easier and adaptable. This is through people exploring how these technologies can enhance their daily lives, in general, to make surrounding environments further easier to interact with, heightening the level of independence in all kinds of people, especially people with physical and cognitive impairments. Hamraie [2], conducted a study that showcases how the application of smart technologies transformed surrounding environments into dynamic and responsive spaces. that was demonstrated through the use of technologies such as automated doors, wearable technologies, sensor-based lights and appliances that are voice-automated. It also demonstrated how people with disabilities are now surrounded by areas that are more functional as they can easily interact with their surroundings in a personalised manner.

As smart home technology integration has grown in recent years, it has become the standard in many cities and regions worldwide. This is because such integration demonstrates how revolutionary and transformative the notion has become for every person in their daily life. Many studies, like those by Demirir [3] and Neimeijer [4], show how wearable technology, smart appliances, and home automation systems may help individuals in real-time. People who are physically or mentally impaired often find it difficult to regulate their environments, but because of technology like the ones listed above, they are now able to control a lot of aspects that they previously might not have been able to. In this context, in residential locations, individuals may easily regulate the environment around them, adjusting the lighting, and temperature, and even improving home security and not having to worry about relying on others to feel comfortable. People can lessen their reliance on their caretakers and not have to rely on them as much thanks to these accessible interfaces. Numerous recent developments and designs rely on smart technologies and incorporate inclusivity. that is due to noticing how much people's surroundings might affect them. For instance, it has been clear that the layout of a person's surroundings typically impacts their mobility and independence levels. Their access to resources in the environment they are in can either promote the level of independence which leads to the enhancement of their experience or demote them by making the space surrounding them cause a higher dependency on others which would take away from their experience in any environment they are in and affect them [5]. There have been studies conducted regarding the development of infrastructure through incorporating digital factors that will make any city or area accessible for people with disabilities. Such developments were presented by Hollands [6] and Townsend [7], who mentioned multiple ways disabled people can have their lives improved. For example, there would be parking aid technologies for people with mobility issues, real-time audio navigation systems that can aid people with visual impairments and many other examples as the ones just mentioned.

Nevertheless, even though technological advancements offer almost unlimited opportunities to enhance accessibility, some scholars have their doubts and are sceptical about these technological integration systems in residential and public places. These scholars believe that there should be caution regarding people becoming too dependent on technology. Pullin [8] is among the academics that argue for a combination of technology-based solutions and, inclusive, considerate designs that mainly focus on enhancing users' experiences. There is also Kitchen [9] that conveys the idea that accessibility should be seen as a crucial part of the design process, taking into account the varied needs of all users instead of just a technical detail.

In conclusion, this literature review demonstrated the crucial importance of inclusive designs and smart technologies as it has shown how the lives of people with disabilities' well-being significantly improves through an increase in independence and promoting autonomy. Despite rules and recommendations providing a clear foundation for accessibility, the necessity for inclusive designs and smart technologies has become acknowledged. This will lead to future studies focusing on applying these trends on a larger scale, especially in redeveloping current spaces and creating new, fully inclusive environments that provide more independence and equality for people with disabilities.

## 1.2. Accessibility

There is countless proof that showcases those physical designs surrounding us can restrict the independence of disabled individuals, especially those who rely on mobility aids such as canes and wheelchairs. For instance, poorly maintained sidewalks, the absence of curb ramps and much more. In addition, the accessibility provided by public facilities, causes these individuals to feel socially excluded, which leads to a decrease in opportunities, interaction and a poor quality of life as they cannot even participate in community activities. Due to this issue, there has been the creation of the ADA which is the Americans with Disabilities Act [10] that is made for people to follow the legal measures that mandate accessibility but despite that, there are uneven implementations. Some studies were conducted on urban infrastructure, that present those inaccessible public areas do not just limit movements but it has an overall impact on an individual's well-being. In other words, these individuals are physically, and mentally affected and even their employment opportunities, as these people will avoid locations that provide major barriers. There have been recommendations [11] that suggest changes to include inclusive designs that would aid with diverse needs instead of rebuilding which would be costly and less effective. For many years people with disabilities have suffered from being reliant on others for support and that is due to not having enough access in their surrounding spaces and environments. Many architects in recent years began adjusting their designs to aid people with disabilities to have the autonomy they need, as this will make their lives easier, even in their own homes they will be able to get on with their daily lives with minimal struggles. There is a large body of research and evidence showing how public and private spaces, along with digital platforms, frequently do not meet the needs of individuals with disabilities, thus limiting their independence and daily activities. Listed below are some important points and references discussing how specific design decisions can result in obstacles.

1. Barriers in a physical environment in both public & private areas
  - a. Our day-to-day facilities such as public transportation and buildings rarely include inclusive designs and elements like elevators, or ramps and wide pathways for disabled individuals, which causes a barrier in their daily lives, mental and physical well-being.
  - b. Research conducted on Architectural Accessibility has shown that the majority of structures and public areas are not entirely accessible to disabled individuals, as they are obstructed due to the lack of necessary modifications which limits their independence.
  - c. A number of websites and applications [12] do not put into consideration the need of assistive technology in their designs, which causes people who are visually impaired to gain limited access to information online.
  - d. Reports produced by the World Health Organisation (WHO) have shown that only less than 10% of public sector websites comply with accessibility standards.

### 2. Accessible Housing

- a. Difficulties and limits are also found in private sectors such as accommodation. Many of the accommodations nowadays lack basics such as wide doorways, accessible toilets, etc. these basics can restrict disabled people from living safely, comfortably and independently.
  - b. A study conducted by the U.S. The Department of Housing and Urban Development (HUD) showed that accessible housing shortages directly correlate with increased dependency on caregivers and institutions.
3. Workplace Barrier
- a. Numerous schools and workplaces do not provide safe accommodations for disabled people such as accessible facilities, or ergonomic furniture, these factors hinder their participation. That is due to the simplest tasks requiring assistance or dependency on others which would affect them not only physically but mentally.
  - b. It has been discovered by the ADI that the reason for the high unemployment rate among individuals with disabilities is due to the absence of the facilities that would make them work without relying on others and take away from their independence.
4. Public Transportation
- a. The public transportation systems do not support or aid disabled people's mobility challenges. There are factors such as priority settings, routes, elevators and ramps that are absent in the system. This means that disabled individuals have to rely on others for a daily commute.
  - b. The International Transport Forum (ITF) suggests that a very small percentage of public transportation globally offers full accessibility, which means their mobility is highly restricted on a global scale.

### 1.3. Local Laws

There are international standards that govern both the building and designing of public spaces for handicapped individuals in Egypt [13]. Throughout the years these standards have been adjusted and updated to ensure accessibility.

#### 1. Framework and Regulations:

- Law No.10 of 2018 (Rights of persons with Disabilities): it guarantees basic rights for disabled individuals, including access to transportation, public spaces, education and even employment.
- Egyptian Building Code (ECP 306/2005): it is a general guideline for accessible building design, especially in public spaces, including ramps, door widths, signage, etc.
- Urban and Architectural Design Standards: The local planning regulations usually include the basic accessibility requirements, mostly in projects that involve public spaces and the government.

#### 2. Referenced International Standards

- ISO 21542 (Building Construction- Accessibility and Usability of Built Environment): This is a guideline that is considered the best practice for accessibility.
- CRPD (UN Convention on the Rights of Persons with Disabilities): Egypt's urban planning and architecture must align with the CRPD guidelines due to Egypt being a signatory.
- Universal Design Principles: It is to promote designs that aim to aid a wide range of abilities without the need for adaptability.

The code for Design and Implementation of Buildings and Public Facilities for persons with disabilities [14], known as the Egyptian Code of Practice No. 601 is strongly linked to law no.10 of 2018. Its key provisions are:

- It applies to:
  - Public Buildings (Schools, hospitals, government offices)
  - Outdoor Spaces (Parks, Plazas, etc.)
  - Private buildings accessible to the public (Cinemas, Malls, etc.)
  - Infrastructure such as pedestrian pathways and transportation hubs
- Architectural Designing Standards
  - Entrances:
    - Ramps with a gradient of 1:12 to 1:20
    - Tactile paving for people with visual impairments
  - Corridors and Doorways:
    - Width of 90cm and 120 for corridors
    - Thresholds to allow wheelchair access
  - Restrooms:
    - At least one accessible restroom per floor
    - Space for wheelchair manoeuvrability along with grab bars
  - Stairs:
    - Contrasting tactile and nosing indicators
  - Elevators:
    - Minimum size of 110cm x 140cm
    - Control panels with braille labels within accessible heights
  - Outdoor Pathways and Spaces:
    - Pedestrian paths at least should be 120cm wide
    - Handrails, Ramps, and non-slip materials
    - Pictograms, braille signage and high-contrast signage
  - Signage:
    - Must be within eye level (120-160cm)
    - Audio and tactile information to assist with any hearing and visual issues
  - Transportation and Parking:
    - Reserved parking spaces that are close to entrances
    - Public transport with lifts or ramps
  - Auditory and Visual Enhancements:
    - Visual displays and address systems for announcements

Due to the guidelines and regulations, the compliance to the law is mandatory for new construction projects and it is encouraged for any renovations of existing structures, and the municipalities and authorities are responsible to ensure adherence during approval and inspection phases.

### Local Challenges and Initiatives:

- Urban Projects: some initiatives focus on renovating historical and urban spaces, especially in places that get a large number of tourists like Luxor and Cairo
- Awareness Programs: There has been a higher effort to train engineers, urban planners and even architects to create inclusive designs.

## 2. Empirical Study

In this part of the research, we will analyse the results of a survey that has been sent out to a number of people to know more about the challenges people with disabilities face and if they believe they have enough accessibility in their communities or not. Ten of the questions were made in the form of multiple choice in which people had to pick from five different options (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree) and the rest were open-ended questions that included adding their own opinions and suggestions. This research is based in Cairo, meaning that most of the area, communities and facilities that are discussed here are about issues relating to accessibility in Cairo.

### 2.1. Survey Sample

The survey started with enquiring about the person's gender, age and occupation. Followed up with these questions, I believe that public spaces in hotels and restaurants surrounding my area are adequately accessible for individuals with disabilities. There are enough resources and facilities available for disabled individuals in hotels and restaurants in my community.

Transportation options in my area are accessible for people with mobility challenges, hotels and restaurants are adequately trained to assist individuals with disabilities, individuals with disability would feel safe navigating at hotels and restaurants in my area's surroundings, and there is sufficient signage for individuals with disabilities to find information.

Community events made in restaurants and hotels are designed with accessibility in mind, I believe that my local government prioritises accessibility for individuals with disabilities at public areas.

Do you believe people with disabilities have equal opportunities as any other individuals in your communities and surrounding areas? What do you think should be done to improve accessibility for disabled individuals at hotels and restaurants in your area/community.

Do you believe that there are adequate bathroom facilities to aid people with disabilities? How can this be changed/improved? Are there valet or enough parking spaces available for the disabled?

Suggest ways to help aid people with disabilities within facilities as the ones mentioned above.

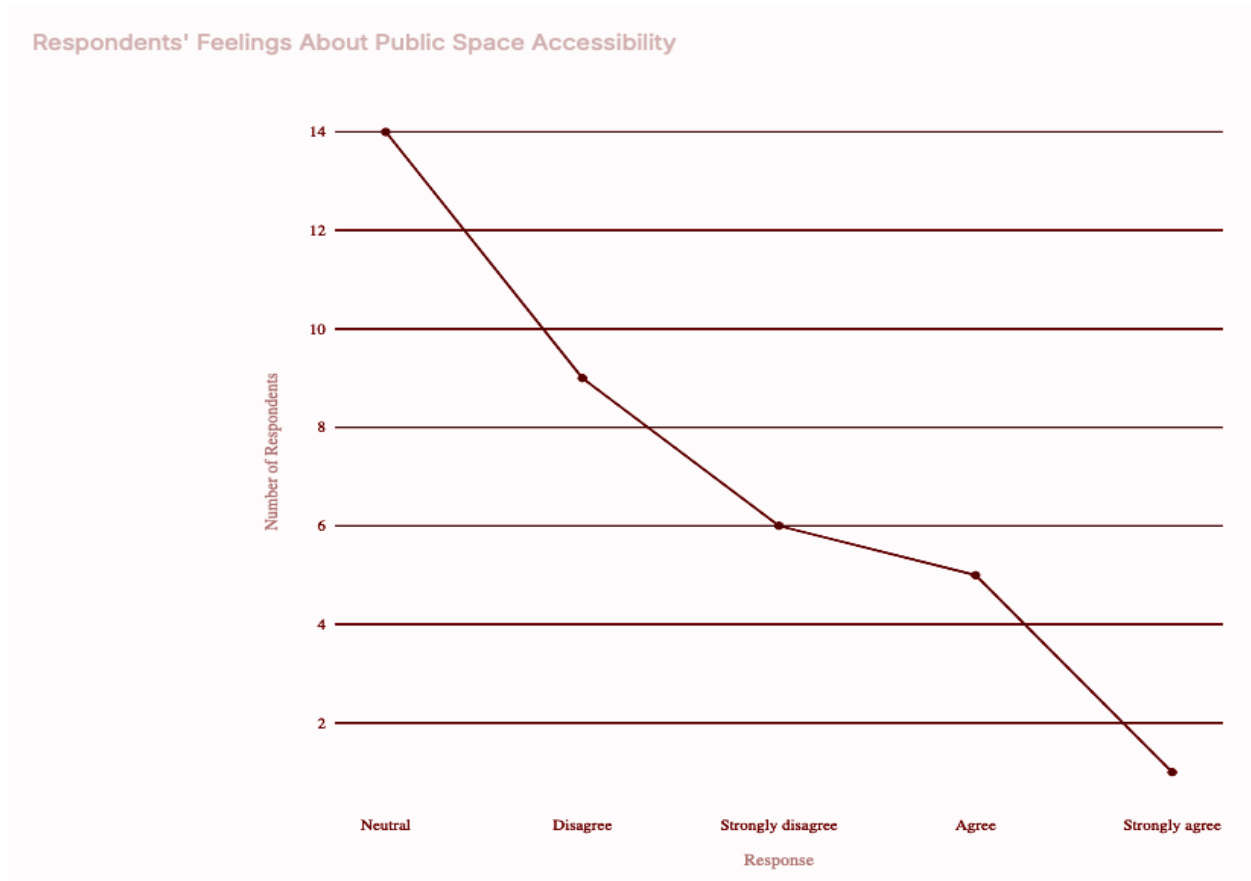
What do you think should be done in events held in hotels and restaurants for disabled people to feel included?

Please mention things that you believe are necessary to aid their accessibility at all times.

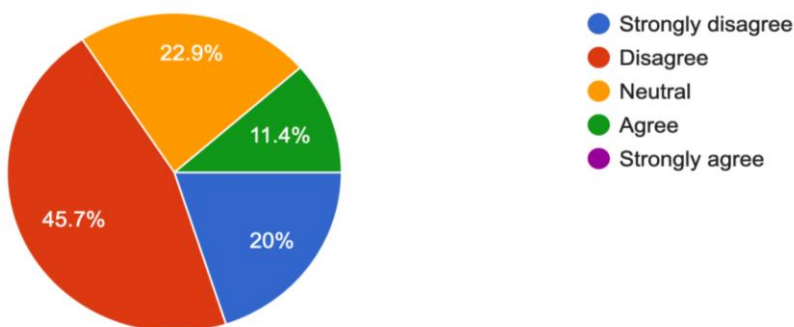
### 2.2. Survey Findings

Responses regarding accessibility for disabled individuals were mostly neutral, which represents a lack of awareness regarding this matter and disabilities in general. As the following graph represents, 14 respondents picked neutrals while 15 picked that they disagree with the matter of accessibility for the disabled and only five respondents' out of the 35 believe they have accessibility.





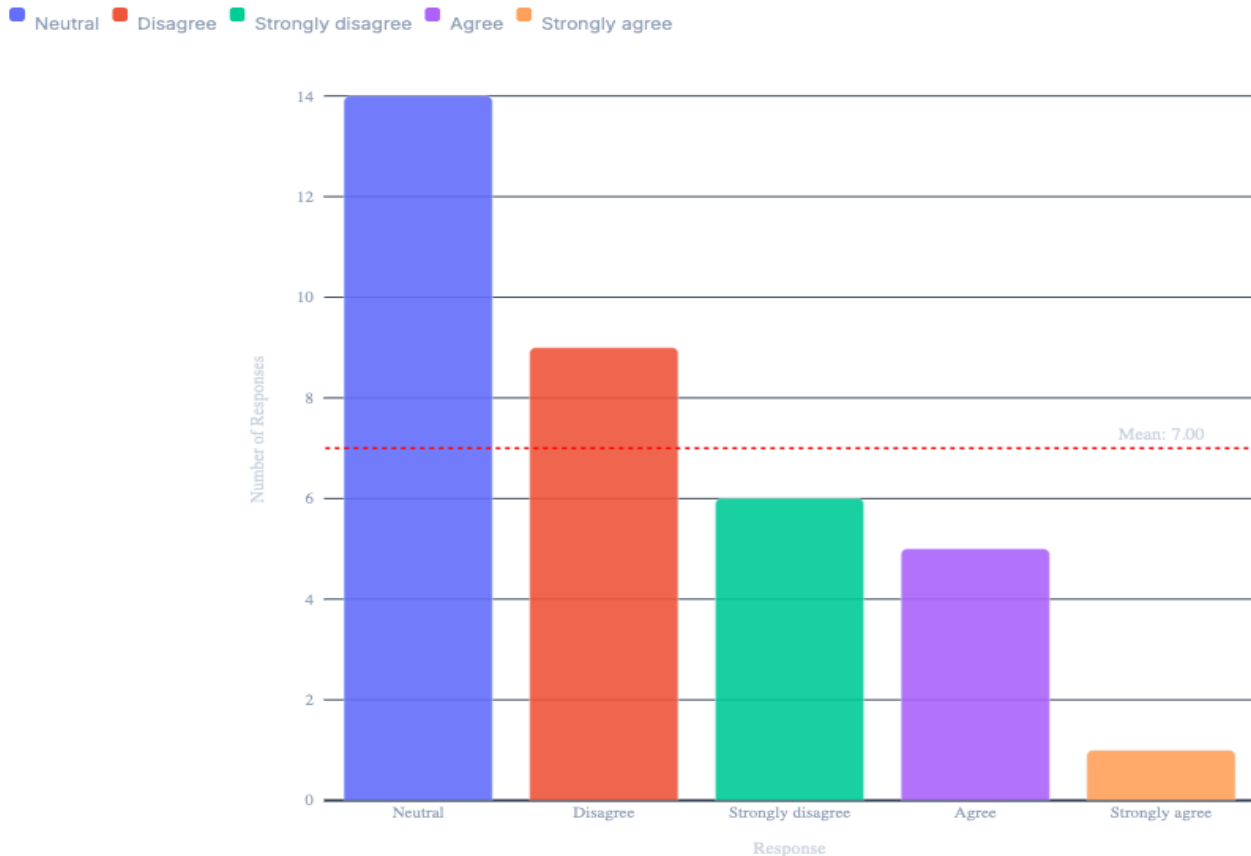
The findings mostly show that there is a lack of inclusive designs in public areas. Moreover, in public transportation almost all respondents have disagreed on finding accessibility, which is a main factor portraying that individuals with disabilities are highly restricted. As Represented in the chart below, these are the percentages that have been asked whether public transportation is accessible for disabled individuals or not.



In hotels and restaurants in general it can be clear that the accessibility rate is very low, which means that disabled individuals cannot navigate through public spaces freely or safely. Many of the hotels might provide ramps at the entrance and elevators in the hotel. However, ramps are not found throughout the entire structure. Restaurants on the other hand do not have ramps and even the toilets are inaccessible,

making it difficult for people to go freely to where they might desire, which means there are further restrictions to their movements and areas they might be allowed to go to.

Distribution of Responses Regards the Adequacy of Public Spaces in Hotels and Restaurants for Individuals with Disabilities



### 2.3. Improvements

Hotels and restaurants should go through a set of renovations to make the areas more inclusive. For instance, for current improvements, hotels can work on room accessibility, creating roll-in showers, accessible sinks, adjustable beds and ample floor spaces. Hotels can also work on their reservations and information as booking accessible rooms is considered a challenge, and availability is another challenge they go through as well. Finally, the best thing to provide in a place like a hotel is raise awareness related to disabled individuals and train staff to be able to handle and support guests with disabilities. The same training should be given to people working in restaurants, or people that work in hospitality in general. In restaurants the spaces should be adjusted and the layout should be fairly considerate to allow mobility, that means prioritising open floor plans with clear pathways. Menus on the other hand should offer braille menus, large-print menus, picture-based menus and digital ordering screens.

### 2.4. Future Designs



For future references hotels can include more technologically advanced options in their facilities. For instance, they can add customizable room controls that can have voice-controlled automation to adjust the temperature, curtains, lights, etc. There can be even accessible smart mirrors and tablets that can provide audio descriptions for people with visual issues and it can even assist them in requesting specific items or room modifications to enhance their comfort. Hotels can also enhance their booking systems and adjust their platforms to make requesting rooms with certain features easier, as they can add detailed accessibility filters, allowing the users to specify features such as lowered counters, visual alarms, specific bathroom layouts, etc. Hotels can also add virtual assistants like Google home or Alexa devices that allow hands-free control over different home features.

Restaurants should include more technological advanced designs in future designs such as Augmented Reality menus that overlay images and nutritional details on menus for customers with visual difficulties. Self-ordering tablets with accessibility features should be available as well, as self-ordering tablets can offer text-to-speech capabilities, easy-to-read interfaces and voice-activated ordering kiosks that can take accessibility to another level of enhancement. The main layout of restaurants should provide flexible seatings and adaptable furniture that will allow the staff to move freely along with people with disabilities, canes, and wheelchairs, which will make the environment feel more comfortable and safer. There can also be the use of wearable technology for servers that can be notified when certain customers require assistance which can make them respond to specific requests without intruding or violating the comfort of their customers.

### **3. Conclusion**

#### **3.1. Governmental Scale**

On a governmental scale there should be more laws and regulations associated with people with disabilities to make public areas more accessible to them and even public transport safe enough to navigate through their communities. In other words, they should set accessibility standards and fund accessibility initiatives for businesses to enhance accessibility. They can also impose penalties through regular auditing related to accessibility.

#### **3.2. Developer's scale**

Developers can include and integrate standards related to accessibility from the start and walk through guidelines that can aid them, and they can even include real users in testing to note the usability barriers. In addition, using accessible tools, such as screen readers, voice control and multiple different interfaces that can be adaptable, all while remaining updated and continuously evolving the accessibility standards.

#### **3.3. Designer scale**

Adding universal designing principles such as making spaces and products accessible by default is one of the main roles for a designer. Furthermore, a designer should aim to create designs that are clear and simple. For example, using high contrasts, large fonts, navigation that is tactile. They should promote inclusivity in their designs, and make inclusivity its own culture within organisations. They should also integrate adaptive and responsive designs that adjust to different devices and user needs.

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