

# Seeing the Unseen

(Notes on accessibility for visually impaired people in public space)

## GuideBook

Sauron Team  
Digital Society School

## Our Mission

We try to design a technology that will create an inclusive fan experience for people with visual impairments through sound and the sense of touch. We strive to raise awareness about the problems that visually impaired people face in their everyday life and hope to spread a deeper understanding of the matter.

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**“Alone we can do so little, together we can do so much.”**

Helen Keller



# List of Contents

This manual was created in order to provide the public and different cultural spaces with the information about visual impairment and what are the needs of visually impaired people. Moreover, we want to introduce steps that one could take on the way to the ideal accessible space for the visually impaired visitors. We also touch upon inclusive society and how it is portrayed by the visually impaired people themselves. Being inclusive means being accessible to everyone, letting visually impaired people be independent of others and providing sufficient help for those who need it. In the manual, we compare the situation right now and what could it be if we start acting now.

- Our Team
- Visually Impaired People
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- Customer Journey
- Interviews
- Planning Attendance
- Planning Transportation
- Services & Assistive Technology
- Inclusive Public Venues
- Conclusion



# Sauron Team

\* The Eye of Sauron, or Great Eye, was a symbol adopted by the Dark Lord in the Third Age. The Eye was used as a symbol on Armor and banners of Mordor, representing Sauron's quasi-omnipotence.



**ASSIA KRAAN** Track owner

She is a track owner of the 'Digital to Physical' track at digital society school. Assia's background is in media theory and design and she has contributed to the project with her skillsets as a digital transformation designer and provided us with support and supervision.



**GIJS HUISMAN** Senior Track Associate

Gijs Huisman is the Senior Track Associate of the Digital to Physical track. He directs research and design activities grounded in the United Nations' sustainable development goals. His research interests revolve around multimodal embodied interaction, digital/physical interfaces, and haptic technology.



**DAN XU** Team coach

She is a creative researcher from China and is currently working as a digital transformation designer at Digital Society School in Amsterdam. Dan has been the coach of this project and provided us with guidance and feedback throughout the process.



### Viktoriia Akhankova

Communication scientist  
Bsc in Communication Science

“ This project has taught me to work with an adaptive mindset in times of novel and challenging work environment. I learned to apply my knowledge and creativity in designing inclusive and sustainable solutions. ”



### Cemal Dağlı

Electrical Engineering  
BSc in Electrical Engineering

“ At first sight, this project seemed like something to help me a go out of my comfort zone. It is my passion to help people, but This project helped me create something for visual impaired people which was an inspiration for me. Also I improved my skills and gaining more hands on experience ”



### Boshra Javaheri

Experience Designer  
Master of Design  
BA in Architectural Engineering

“ We are living in an experience economy age. Still, at the same time, this experience is not distributed equally between people with different situations. When I heard about this project, I saw it as an opportunity to design something going beyond limitations and traditional ways of design. I learned to design an experience, not for the eyes but other senses ”



### Eden Oliveira

Entrepreneur  
MS in Marketing  
MBA in Business Economics

“ I have a background in social entrepreneurship, and I joined this project to be able to work for a social cause. I believe the program broadened my view and enabled me to identify opportunities in the technological domain. ”

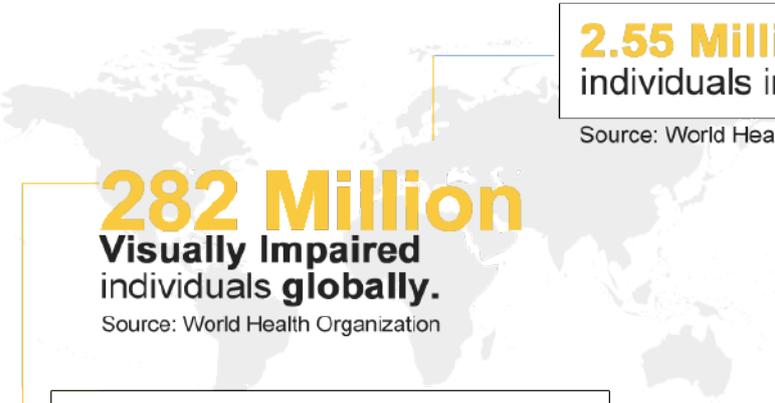


### Sumaya Mohamed

Biomedical Engineer  
BSc in Biomedical Engineer

“ This project allowed me to adapt a creative mindset to become a better researcher in a world where innovation is needed ” ”

## Regarding VIP\*:



**282 Million**  
Visually Impaired  
individuals globally.

Source: World Health Organization

**2.55 Million** blind  
individuals in **Europe**.

Source: World Health Organization



**81%** of those who are blind  
are **over 50 years** old.

Source: World Health Organization



**7.2 million** visually impaired  
adults in the **United States**.

Source: National Federation of the Blind

**57,983**

registered legally blind  
school age **children** in  
the **United States**.

Source: National Federation of the Blind

Between 2010 and 2050 the number of people  
in the US with **vision loss is projected to increase** by

↑ **87%**

Cataract

↑ **72%**

Diabetic Retinopathy

↑ **169%**

Glaucoma

↑ **114%**

Macular Degeneration

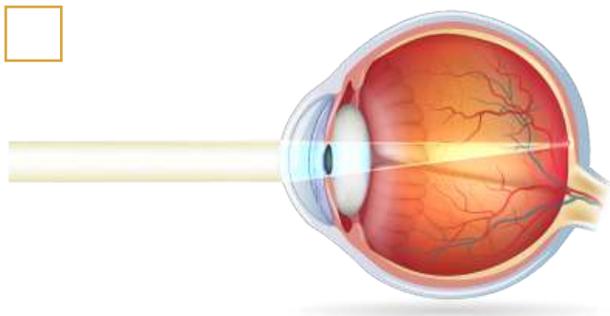
According to World Health Organization, globally, it is estimated that at least 2.2 billion people have a vision impairment or blindness, of whom at least 1 billion have a vision impairment that could have been prevented or has yet to be addressed. This 1 billion people include those with moderate or severe distance vision impairment or blindness due to unaddressed refractive error (123.7 million), cataract (65.2 million), glaucoma (6.9 million), corneal opacities (4.2 million), diabetic retinopathy (3 million), and trachoma (2 million), as well as near vision impairment caused by unaddressed presbyopia (826 million)\*. The total number is expected to increase by 72% over the next 11 years\*\*.

“Therefore, a large number of persons are suffering from a visual handicap which impedes them from accomplishing their daily activities. As a result, there is need for an assistive device based on an alternative modality, that can complement or replace sight by another sense -auditory, haptic (tactile or kinesthetic)” [1], or a combination of both- and that can offer a means to deal with blindness.

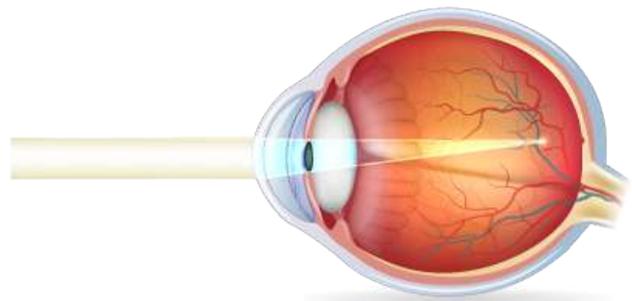
The most common causes of visual impairment globally are uncorrected refractive errors (43%), cataracts (33%), and glaucoma (2%).

# Refractive Errors

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Normal Vision



Myopia



We see the world around us because of the way our eyes bend (refract) light. Refractive errors are optical imperfections that prevent the eye from properly focusing light, causing blurred vision. The primary refractive errors are nearsightedness, farsightedness and astigmatism.

Refraction Errors are: myopia, hyperopia and astigmatism.



## Nearsightedness

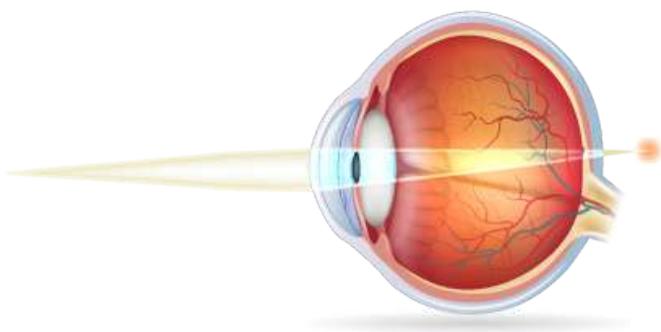
Nearsightedness, also called myopia, is the most common cause of impaired vision in people under age 40. The nearsighted have difficulty seeing distant objects clearly but will be able to see well for close-up objects and perform tasks such as reading and computer use.

### Symptoms:

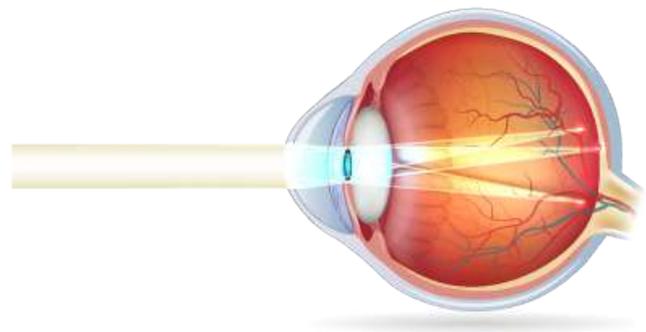
- squinting
- eye strain
- headaches and fatigue, when driving or playing sports

### Treatment:

In most cases, nearsightedness stabilizes in early adulthood, but sometimes it continues to progress with age. Nearsightedness can be corrected with eyeglasses, contact lenses or refractive surgery.



Hyperopia



Astigmatism

## Farsightedness

People with farsightedness or hyperopia can see distant objects very well, but have difficulty focusing on objects that are up close. The condition is sometimes referred to as "hypermetropia" rather than hyperopia.

### Symptoms:

- headaches
- eye strain
- squint or feel fatigued when performing work at close range.

### Treatment:

Farsightedness can be corrected with glasses or contact lenses to change the way light rays bend into the eyes.

Astigmatism is a type of refractive error caused by the irregularities in the shape of a person's cornea. In this condition, the eye fails to focus the light equally on the retina leading to blurred or distorted vision. It can be present at the time of birth or can develop gradually in life. Astigmatism is a common eye condition which usually occurs with myopia (nearsightedness) or hyperopia (farsightedness)

### Symptoms:

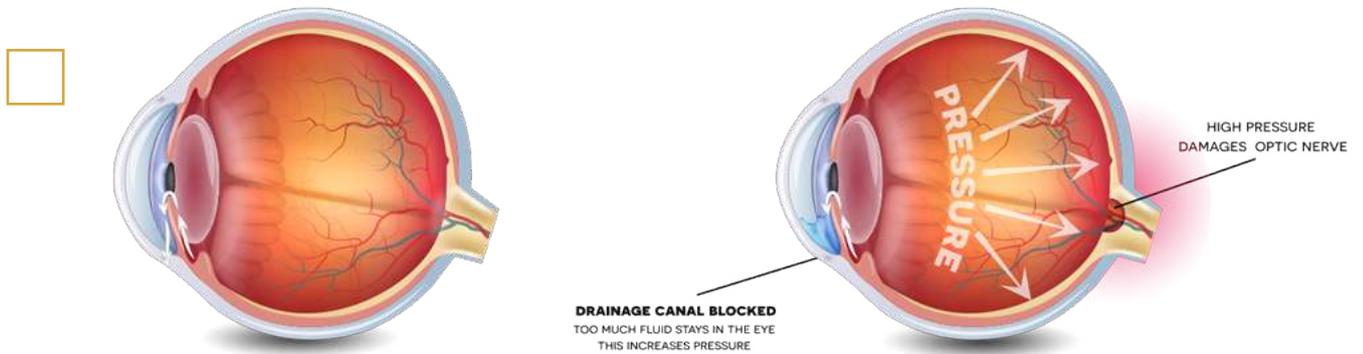
- blurred or distorted vision to some degree at all distances
- eye strain
- headaches
- squinting
- eye irritation

### Treatment:

Astigmatism can usually be corrected with eyeglasses, contact lenses or refractive surgery

# Glaucoma

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Normal Vision

Glaucoma

Glaucoma is a group of progressive eye diseases that leads to loss of nerve tissue and slow vision loss. When untreated, glaucoma will cause blindness.

**Symptoms:**

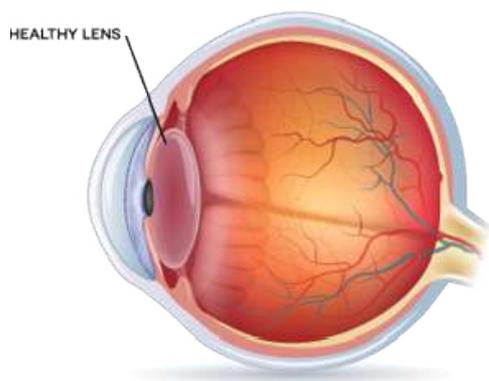
- severe throbbing eye pain
- eye redness
- headaches
- blurry or foggy vision
- halos around lights
- dilated pupil
- nausea
- vomiting

**Treatment:**

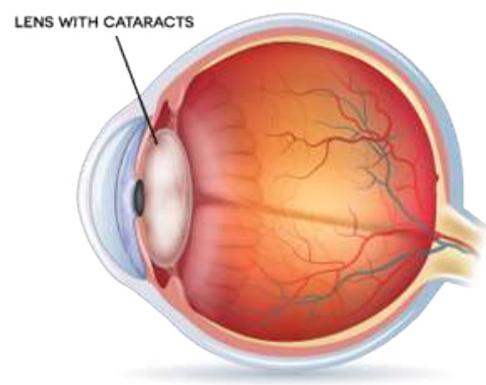
During treatment doctors may prescribe eye drops, oral medications, laser surgery, or microsurgery to lower pressure in the eye.

# Cataracts

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Normal Vision



Cataracts

Cataracts is a disease affecting the lens of the eye, leading to cloudiness or darkening of the lens, preventing light from filtering back to the retina. Individuals may have trouble seeing because the world becomes fuzzier or colors become duller. Also, they may have increasing problems seeing well at night, making night driving dangerous.

**Symptoms:**

- clouded
- blurred or dim vision
- increasing difficulty with vision at night
- sensitivity to light and glare

**Treatment:**

Cataracts can be removed only with surgery.

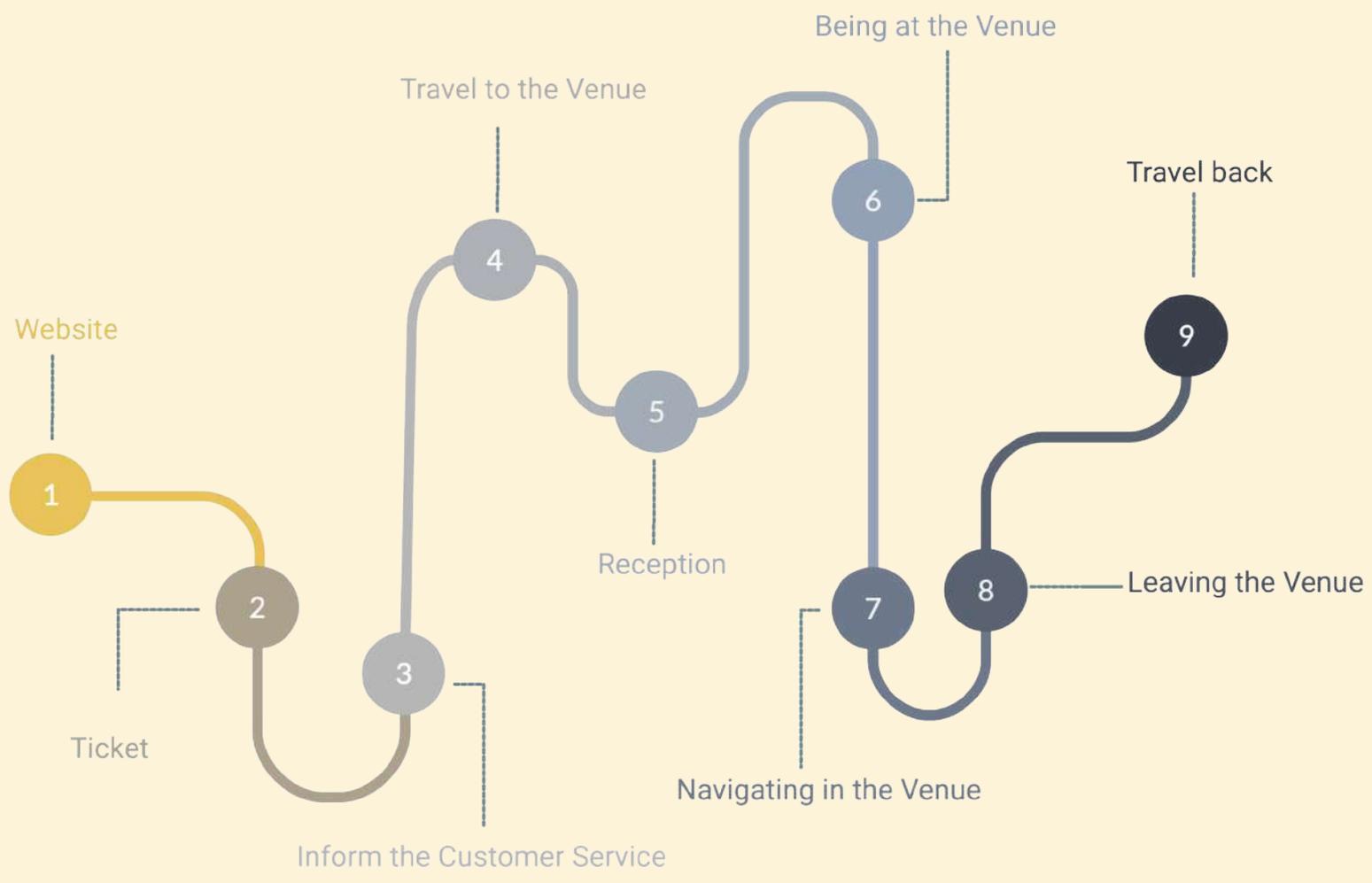
# VIP Journey in Public Venues

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As you can imagine, the customer journey of visually impaired people is rather different from what sighted people experience, when they go to public spaces. Lack of accessibility brings challenges to some of the steps undertaken during VIP's journey. We researched parts of their customer journey and demonstrated challenges they might have when coming to public spaces.

Some of these challenges re listed below.

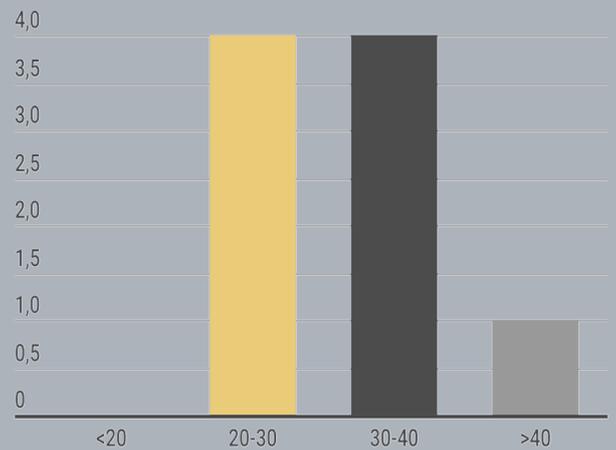
- Accessing website and application which are not designed accessible
- Getting contact information of the venue
- Non-inclusive options for public transportation
- All corridors and stairs were without designated signs and textures for VIPs
- No audio guide around to except for the tour guide so moving around will be difficult for VIP
- Not even one object for VIP to interact with
- No auditory follow-up way to interact with VIP



# Interviews



Gender



Age



Born being a VIP?

- Yes
- Don't Know
- No

# Insights

Along with some desk research, there were some interviews with VIP conducted to find out more information about the experiences and thoughts of the end-user, their challenges, and suggested solutions. The interviews were conducted with VIP from all over the world. There were people present from **Brazil, Turkey, Canada,** and the **USA**. We tried to seek the answer to the main question: what are the main challenges VIP go through in public spaces and how to tackle them? And although our interviewees came from different corners of the world, we often heard about the same problems and challenges. Among the challenges we heard about, there were a lack of trained professionals to guide and explain, not being able to navigate freely or lack of adapted materials appropriate to the inner/outer environment. When we asked about suggestions VIP might have for different public venues, they have mentioned such things as:



More guidance



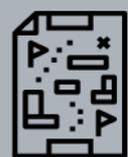
Braille displays



Indoor map  
for navigation



Replicas for  
people to  
feel the art



Make it easier  
by establishing  
landmarks on  
the route.



## Planning attendance: accessible website and customer service

When planning attendance, visually impaired people tend to go through more steps of preparation than sighted people do. Some of the first steps would be visiting the website of the venue and contacting the customer service. One of the first points of reference would be the website. First of all, audio assistance should be accessible on the website for different screen readers, both for texts and descriptive images. Secondly, for low vision visitors, allowance for enlarged text should be applied, meaning one should make sure that the layout of the website does not break when the text-only zoom is applied. An accessible website should include a good contrast of the main items on the website. As some visually impaired visitors, who have such conditions as glaucoma or cataracts have high contrast sensitivity and, thus, little contrast on the website makes it less accessible for them to interact with the main buttons or text. Examples of such buttons include 'cancel', 'proceed', 'next page' or 'login'. To achieve this contrast, one can make use of bold fonts, avoid thin fonts, enable highlighting features on the website or create a separate tab on the website that would have more contrast texts. As previously mentioned action buttons should have contrasting colors (e.g. 'go' and 'cancel'). Visual contents like images should have an extensive description so the reader software can explain them to VIP, descriptive subtitles are essential in video contents. If the venue of the web-

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site includes maps of the seating (e.g. theatre, stadium etcetera), it should be made clear which seats exactly are accessible, how to get to them and a clear description should be provided.

In addition to the website itself, there should be trained customer service available on the phone to provide any kind of information about the accessibility of the venue. Information regarding the seating, how to get to the venue, whether any trained guides are available, whether service dogs are allowed - all this data should be directly available at the call with customer service.

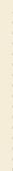
Extended guidelines for making website accessible  
<https://www.w3.org/TR/WCAG20/>



## Planning transportation/navigation inside the venue

Once a public venue decides they are ready to invite people with disabilities, they should provide assistance from the start of the journey and till the end. After VIP visits the website and decides to book the ticket, the next step would be getting to the venue itself. For people with visual impairment it takes more preparation and planning before reaching the venue. Exploring the way outside but also researching if there are navigation signs inside the venue - this is where the planning starts and where customer service should be providing information.

As visually impaired people may not see the obstacles on their way, they might not be able to avoid them. A visually impaired visitor should be sufficiently instructed on any obstacles that might appear on their way, especially if the visitor is about to spend time on their own. If it is a group tour, all the guides and visitors of that group tour have to be informed in advance that the person might not see them or other obstacles. If the venue is a stadium or concert hall, there should be braille navigation to specially assigned seats or there should be a guide, who can show the way to VIP seats.

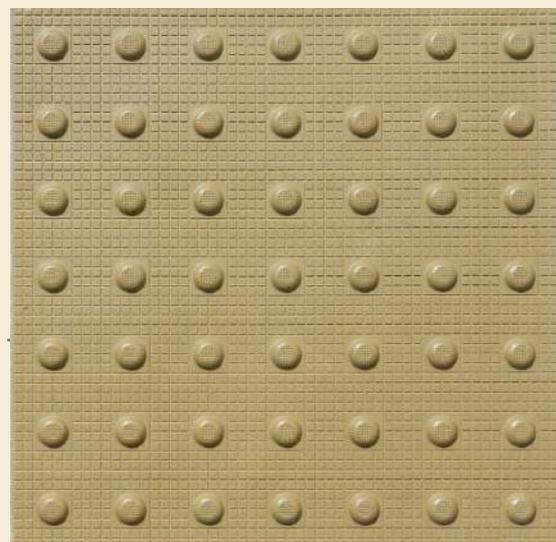


During the research phase of our project, we were informed that not all the VIP use Braille or know how to use it, so having only Braille might be not helpful for some of the visitors. That is why we would like to suggest Navilens as not only a part of navigation in a certain venue but as a tool to give the VIP maximum autonomy in moving around. Navilens is an application that is based on a system of artificial markers, which combines high density with long range. All that is needed for its implementation is the posters with markers of certain places for them (toilets, reception, elevators etcetera) and an application on one's phone in order to scan the code. Computer Vision inside the Navilens is capable of detecting markers at a great distance in full motion without the need to stop and focus the phone on a marker [2].

Venues, where the VIP have to use the stairs in order to get to a certain point (seat, exhibits etcetera), should add coloured contrast to the edge of the stairs to help the VIP orientate themselves. Moreover, a textured signal, like textured tape, could be added in case the VIP is using a cane to guide oneself. Another way to make the way to the venue (for example, from nearest bus/metro station) less intimidating and more friendly is to use tactile paving to indicate change between areas designated for bikes, cars or pedestrians.



**Block indicates "GO"**



**Block indicates "STOP"**

# Services and Assistive Technology for VIP

## Brail Display

A refreshable braille display or braille terminal is an electro-mechanical device for displaying braille characters, usually by means of round-tipped pins raised through holes in a flat surface. Visually impaired computer users



## Haptic Devices

Haptic backpack is a recent invention that detects nearby obstacles long before a person comes in contact with them. It alerts the VIP by vibrations that are emitted through different parts of the bag.

WearWorks Creates Haptic Wristband That Helps Blind People Navigate. It should be first connected with Google Maps. Then the direction should be said to google maps, after that if user is going the wrong way, provide gentle haptic nudges if needed to go left or right, and give no feedback if user is headed in the correct direction



## Trained Guides

Buddy system - create a buddy system and suggest other visitors if they want to assist/take a tour with a visually impaired person

Visually impaired people often rely on a sighted person for guidance or assisting them while doing something. Not having access to a trained guide/assistant may cause barriers for some when participating in different experience (which makes it less inclusive).

One solution to this is to stay in contact with organizations that provide such service to help VIP navigate through space



## Kurzweil

Kurzweil 3000 , a web-based literacy support program, provides real solutions for students who struggle to read fluently or who lack the reading skills necessary to achieve rigorous

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[kurzweiledu.com/default.html](http://kurzweiledu.com/default.html)

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## TapTap See

TapTapSee utilizes your device's camera and Voice-Over functions to take a picture or video of anything and identify it out loud for you

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[taptapseeapp.com](https://taptapseeapp.com)

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## Be My Eyes

Be My Eyes is a free app that connects blind and low-vision people with sighted volunteers and company representatives for visual assistance through a live video call.

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[bemyeyes.com](https://bemyeyes.com)

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## Seeing AI

Seeing AI is a free app that narrates the world around you. Designed for the blind and low vision community, this ongoing research project harnesses the power of AI to open up the visual world and describe nearby people, text and objects.

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[microsoft.com/en-us/ai/seeing-ai](https://microsoft.com/en-us/ai/seeing-ai)

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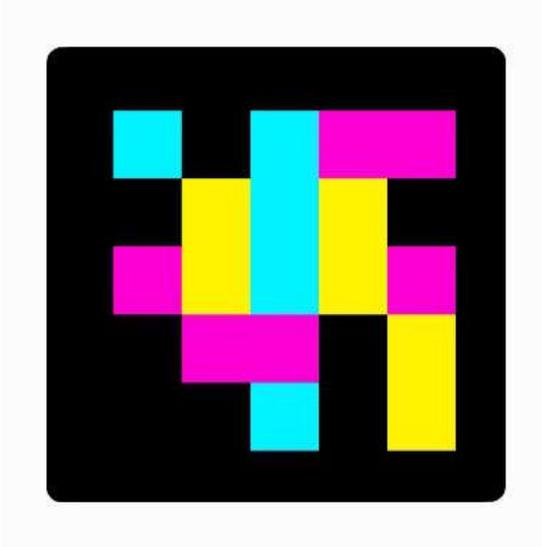
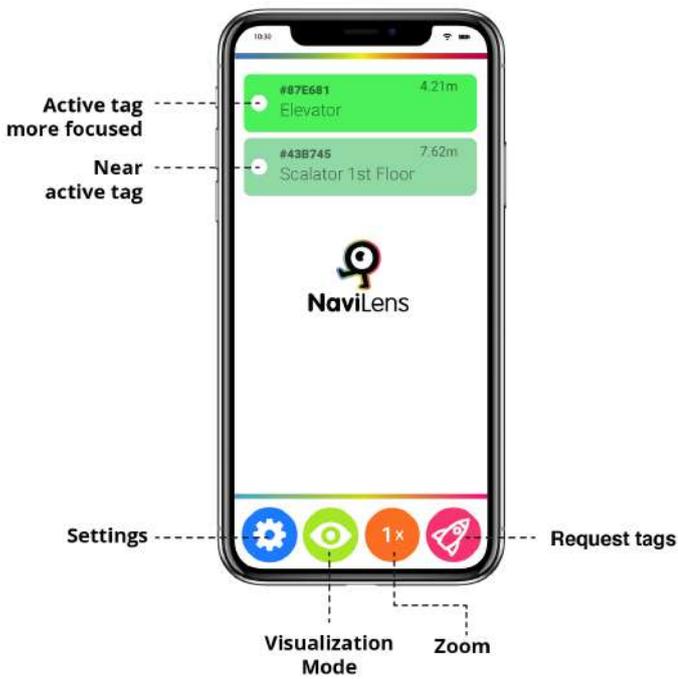
## OrCam

OrCam devices such as OrCam MyEye are portable, artificial vision devices that allow visually impaired people to understand text and identify objects through audio feedback, describing what they are unable to see.

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[orcam.com/en](https://orcam.com/en)

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## Navilens

Navilens is an application that is based on a system of artificial markers, which combines high density with long range. All that is needed for its implementation is the posters with markers of certain places for them (toilets, reception, elevators etcetera) and an application on one's phone in order to scan the code. Computer Vision inside the Navilens is capable of detecting markers at a great distance in full motion without the need to stop and focus the phone on a marker

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[navilens.com](http://navilens.com)

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# Sighted people can Experience VIP Vision

## Ziens App



Bartimeus developed an application for sighted people to understand the VIP different better. with this application, it is possible to create and experience a real-time simulation at anytime and anywhere. The app simulates the eye disorders diabetic retinopathy, glaucoma, macular degeneration, cataracts and retinitis pigmentosa

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[bartimeus.nl](http://bartimeus.nl)

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## Inclusive public venues

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In order to give a better representation of how some of the aforementioned advice can be implemented, we would like to introduce several examples of how different public venues make spaces more accessible to visually impaired visitors.

1

## **Van Abbemuseum**

Eindhoven, Netherlands

2

## **De Tweede Kamer**

The Hague, Netherlands

3

## **MuZIEum**

Nijmegen, Netherlands

4

## **Museu do Futebol de São Paulo**

São Paulo, Brazil

## Van Abbemuseum

[vanabbemuseum.nl/en/visit](http://vanabbemuseum.nl/en/visit)

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The first example is Van Abbemuseum, which is an art museum in Eindhoven. They are showing that museums can be accessible and inclusive in different ways, and not only in a way exclusive to visually impaired people, but a way in which everyone can enjoy themselves while visiting. People with visual disabilities and their guide dogs are welcome in the museum. Supervisors for the visually impaired have free entrance. Every second Sunday of the month there is a free van Abbe guided tour for the visually impaired, when visitors can touch the works of art, which come to life, for example, by using special sensory replicas and small reproductions of paintings and sculptures accompanied by smells, music and literature.

## De Tweede Kamer [tweedekamer.nl](http://tweedekamer.nl)

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Another great example of including visually impaired people into the experience is visiting De Tweede Kamer. A visitor experiences the venue with one's ears and hands by touching the maquette and listening to an audio description of the miniature reproductions. With every object one touches, a different story begins. This helps to experience the space in a different manner and get a sense of where you are in a novel way.





MuZIEum

[muzieum.nl](http://muzieum.nl)

Another museum that focuses on making an inclusive experience for everyone is MuZIEum. By providing experience for both sighted and visually impaired people, they were to, first of all, show to sighted people how the VIP experience the world, and, secondly, contribute to the employment of blind and partially sighted people. Raising awareness about social participation of the VIP is one of their missions.



Museu do Futebol de São Paulo  
[museudofutebol.org.br](http://museudofutebol.org.br)



Museu do Futebol de São Paulo is another example of full accessibility. Tactile floor for people who are blind or have low vision, tactile models and embossed images along the course of the exhibition and audio tours for VIP easily accessible via smartphone - all these solutions were implemented in the museum and allowed visually impaired visitors to fully immerse in the experience.

# Our Utopia

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An inclusive society aims at empowering and promoting the social, economic, and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion, economic, or other statuses. It is a society that leaves no one behind. With this guidebook, our team aimed at showing different public venues how they can enhance the fan experience of people with sensory impairments. Implementing one of the suggested improvements or using assistive technology will take any cultural venue one step further in creating an inclusive experience for all. As it was mentioned, when attending a public venue, visually impaired people tend to go through more steps of preparation than sighted people do: studying the website, the route to the place, or thinking of navigation inside the venue. All these small steps seem small to many, however, are crucial for a safe and confident visit of visually impaired people. We hope to spread more awareness on this issue so more public venues know of the matter, and, hence, have a chance to make a more integrated experience for the VIP.

This guidebook is written by Sauron team under the supervision of Digital Society School as one out of 10 projects that were carried out at DSS during spring 2020.

A big thank you from Sauron team to Digital Society School and all the stakeholders involved in this project, who helped us all the way. Mr. Jan Woering from ArenA provided access to ArenA, provided information and more importantly gave constructive feedback in every sprint review. Mr. Dick Lunenburg from Bartimeus who helped us to understand the context of the project better and made ideation for designing this experience easier. We would like to thank Mr. Paul De Nooij from Bartimeus, Woute Groot, Ruben Logjes, Vasilis van Gemert from Hogeschool van Amsterdam for providing feedbacks and ideas during our meet-

TRACK

**DIGITAL TO  
PHYSICAL**

**DIGITAL  
SOCIETY  
SCHOOL**

**JOHAN CRUIJFF  
ARENA**

# Thank You ...

## **References:**

[1] <https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment>

[2] [navilens.com](http://navilens.com)

*Pun T., Roth P., Bologna G., Moustakas K., Tzovaras D., Image and Video Processing for Visually Handicapped People, EUR-ASIP Journal on Image and Video Processing, Volume 2007*

*January 30, 2019- <https://www.rebuildyourvision.com/blog/vision-training/myopia-hyperopia-astigmatism-explained/>*

*<https://vispero.com/>*

*<https://www.aao.org/>*

*<https://www.bartimeus.nl/bartimeus-and-vision-2017>*

*<https://www.accessibility.nl/projecten/innovatie-en-ontwikkeling/mobiele-apps/zienapp>*