allySenseScape

Multisensory Indoor Navigation using AI Assistant for People who are Blind or have Low Vision (PBLV)

GRADUATION PROJECT

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PROGRAMME: M. Sc DESIGN FOR INTERACTION (MEDESIGN SPECIALISATION)

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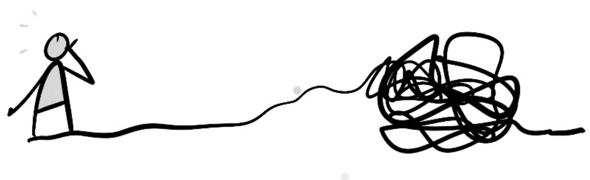
CLIENT : ENVISION TECHNOLOGIES BV

FACULTY OF INDUSTRIAL DESIGN ENGINEERING

TU Delft



"I mean..yeah..waiting for someone to help me get coffee isn't a big deal, but wait (!) why should I have to wait for all these small tasks?"

ally SENSESCAPE

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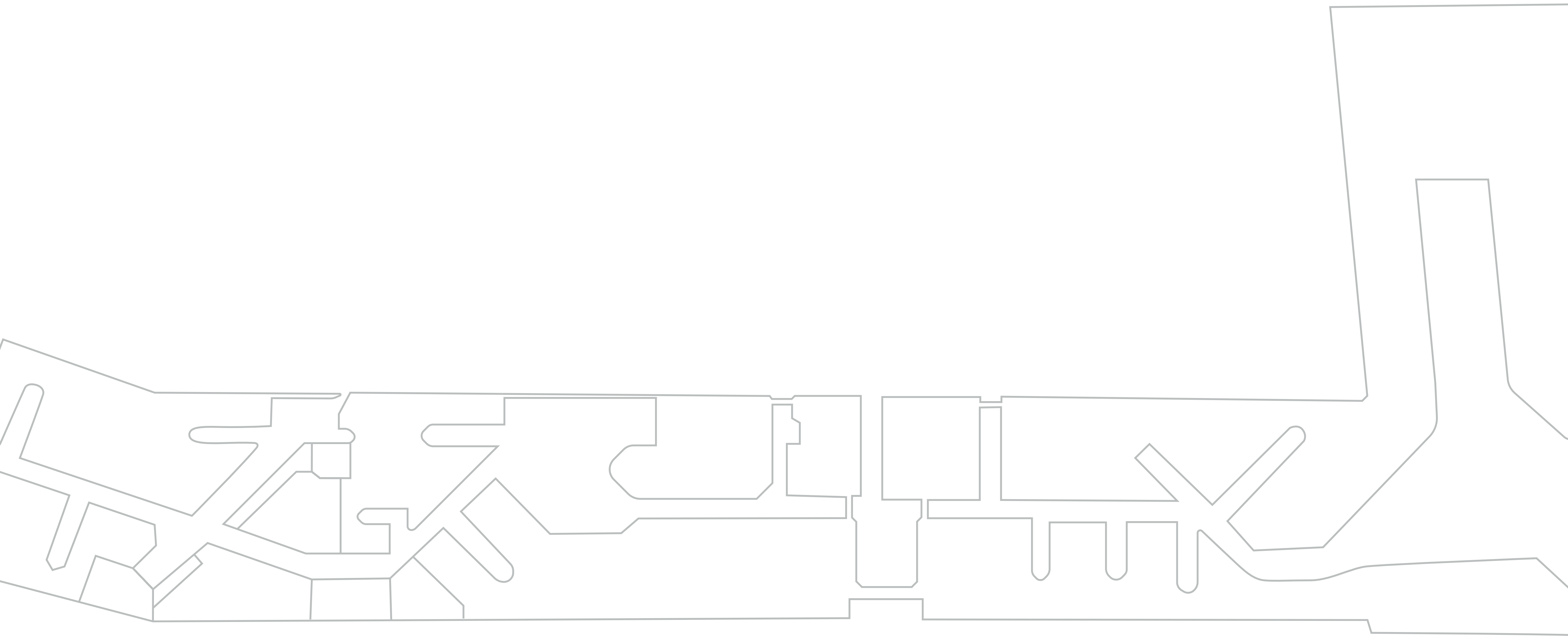

For me, it’s more like am I being an inconvenience to this person.
As two people that, you know you and I, one of them can see and the other one cannot. We don’t really have a way of communicating without words. Right? There is no body language.
So if you’re sitting there quietly, typing on your keyboard, There’s no way for me to know, are you really busy? Or are you just, like, a little bit busy?

Yeah. So so how much of an interruption is it for me to come and tell you, hey and ask for a help.

ally SENSESCAPE

Multisensory Indoor Navigation using AI Assistant for People who are Blind or have Low Vision (PBLV)

Graduation Project

Project Duration: 100 Days

Chair: Dr. Dipl. Des. Stella Boess

Mentor: Dr.ir. A.I. (Ianus) Keller

Client Mentor: Ferkan Metin

Client: Envision Technologies BV

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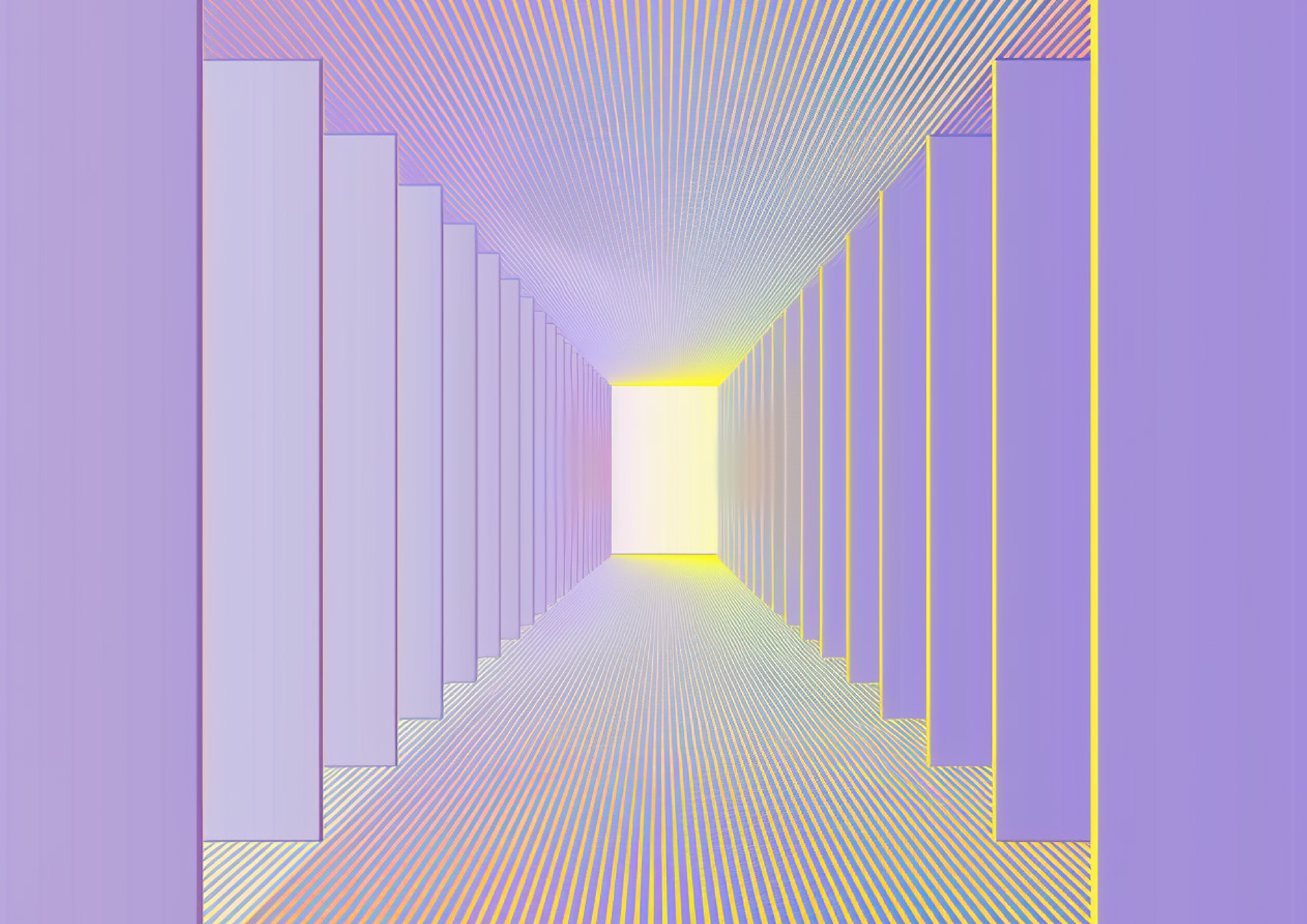

ACKNOWLEDGEMENT

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To Ferkan – thank you for your regular one-o-ones and check ins along with sharp product insights, realism, and steady support. His openness to explore possibilities during this graduation project while staying rooted in user and business needs has been instrumental. And he did this while being very open to leave the final decisions on me – it was important to know and have his support whenever needed.

To the research and test participants who shared their stories, challenges, and ideas with me - I cannot thank you enough. Learnings from their real-life experiences has helped a lot to shape the project and they serve as the key and most important source of insights for this project. This project would have remained abstract without your honesty, patience, and generosity.

To my friends, and family – your emotional and intellectual support carried me through moments of doubt and clarity alike. While this project goes on, many things in life still goes on, and it's nice fortunate feeling to have people who are close to us to talk, take a walk, take a break for small activity or study session, or even reflect along with. I am lucky to have many such nice friends and family.

"When I want coffee, I know I can't get it on my own because it's usually touch screen. So, I must wait for someone who is also going in the same direction so that I can go along and ask them to touch on the right coffee. But wait! Why should I have to wait for a coffee?!"

"I was doing a one-year program. I like Mathematics but there are many visuals in that which teachers would show in the presentation. I couldn't see that and had to schedule meetings based on availability – and eventually I ended up finishing my 1-year program in 3 years."

"I can learn some main routes in offices, but as I grew in position, I had to visit multiple floors and then multiple office buildings, it was no longer easy to remember all the routes after that. And I must wait to walk with someone in such cases. And since I can only hear people typing or talking, I am not sure how busy they are to ask them to guide me to this new meeting room for example."

PREFACE

I remember a sentence from my secondary school: “We don’t realize the presence of air; we only notice its absence.”

Many among us have different needs in terms of environment, product, technology etc. Yet we still seem far from making spaces and things inclusive for all. This project began with the intent to understand the issues people who are blind or have low vision (PBLV) face in everyday places – specifically workspaces and educational environments.

The project wanted to address the notion of inclusivity. Many activities emerged through this project, but key overarching theme in a lot of these activities was the emotional conflict between autonomy (or its absence) and the hesitation of bothering friends/family with their needs - frustrations around waiting for help, simple tasks taking longer, etc.

During a workshop in AccessAbility Week 2025, a Paralympian presenter shared that the Paralympics is held two weeks after the Olympic Games because that time is needed to make the same spaces accessible. To this, someone in the audience asked, “Why aren’t they made accessible from the start? Wouldn’t that save time and effort?” When we say ‘normal’, it seems to exclude everyone who does not match that ideal. Is that why ‘normal’ designs still require afterwork?

There are two very interesting domains I am touching on in this project – Inclusive Design and Interactive Technology Design (a course in the MSc DfI program at TUDelft until 2023-24). While I’ve worked on design projects (including for the consumer market), this kind of project is very new to me. I often felt I don’t know enough - so there’s excitement in this challenge of delving into the unknown while knowing the outcome can positively impact someone’s life. Since what I’m designing for isn’t my own lived experience, it’s vital to learn from those who live it. In the co-design approach described in *Convivial Toolbox*, users are regarded as experts of their lived experiences. Rather than passive recipients of solutions, they actively contribute to insights and idea development *(Sanders & Stappers, 2012, p. 23)*

To conclude accessibility should not be an afterthought. It must be embedded intentionally into design from the beginning, so that everyone can decide for themselves if a solution meets their needs. True choice only exists when access is guaranteed. While these words feel like stating the obvious, the reality is often far from it. I hope more such projects broaden the definition of ‘normal’ in accessible design and lead us toward born-inclusive designs and environments. I hope this project — and many others — is one small step in expanding that definition.


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EXECUTIVE SUMMARY

Introduction

This graduation project, part of the MSc Design for Interaction at TU Delft, explores how virtual personal assistants (AI) can support independence and productivity for people who are blind or have low vision (PBLV) in educational and professional environments. During research and testing one idea related to more-than-human design emerged - if guide dog already works realiably, AI could enhance and not replace.

Methodology

A co-design and mixed-methods approach was used, involving desk research, interviews, co-creation workshops, and iterative prototyping. Close collaboration with PBLV users, stakeholders, and the Envision team ensured the solution was grounded in real needs and aligned with existing technology directions.

Identified Issues

Key challenges included:
Navigation to places like meeting room (that is different each time)
Interaction with touchscreens (Coffee Machine, Meeting room calender etc)

Focus Area

Based on capabilities on existing AI vision models and user needs - a value (to users) vs complexity (in terms of feasiblity) graph was plotted. Two areas (using touch screen and navigation to non-fixed locations (locations that don't always remain the same room like meeting rooms) emerged as two shortlisted areas out of initially 19 areas identified. Eventually, with further testing with real users, and evaluating the impact that working one of these two areas can have (considering their frequency/repetition throughout the day - which was more for navigation) - navigation was selected as the focus area for the last stretch of the project.

Proposed Solution

Proposed solution is called Ally SenseScape (like landscape - but here the guidance utilises multiple sensory cues). It utilises existing system of Envision - which is their Envision Glasses and Ally app.

<u>Adding a new location</u>: A staff or any sighted person can add a new location in the Ally SenseScape library using Ally app or ally website. The process includes selecting the building (or adding, if it's first time), STEP 1: uploading a floor plan for the floor to add, STEP 2: the app requests photos of all turns or critical locations (people can touch the spot on the map and add 6-8 photos), STEP 3: adding any non-visual sensory information for each of the spots (like flooring - carpet/wooden, any particular sounds, smell at each location etc)

<u>Using the system</u>: Users (wearing Envision Glasses) can say 'Hey Ally' and continue the conversation by sharing where they are and where to want to go to on the floor and the AI refers to the building/floor and guides using voice. It also has access to compass information for more accuracy or verify location by taking photos.

CONTENT

Image Source:
https://www.tudelft.nl/en/ide/about-ide/delft-design-history#c40594

ABOUT INDUSTRIAL DESIGN ENGINEERING (& DfI) AT TUDELFT

The Faculty of Industrial Design Engineering (IDE) at TU Delft is one of the world's leading institutions for design education, research, and innovation. Founded in 1969, IDE was born from the growing recognition that design plays a crucial role in shaping the interaction between people, technology, and society. As the Netherlands rapidly modernized during the post-war era, there was a clear demand for designers who could not only give form to products but **also integrate engineering, aesthetics, human behaviour, and sustainability in their work**.

The foundation of IDE was driven by a need to merge the creative spirit of industrial design with the technical rigour of engineering—**creating a discipline that was as imaginative as it was functional**. It reflected a broader European movement toward user-centred design and systems thinking, while also responding to local needs: the Dutch tradition of pragmatism, social responsibility, and innovation.

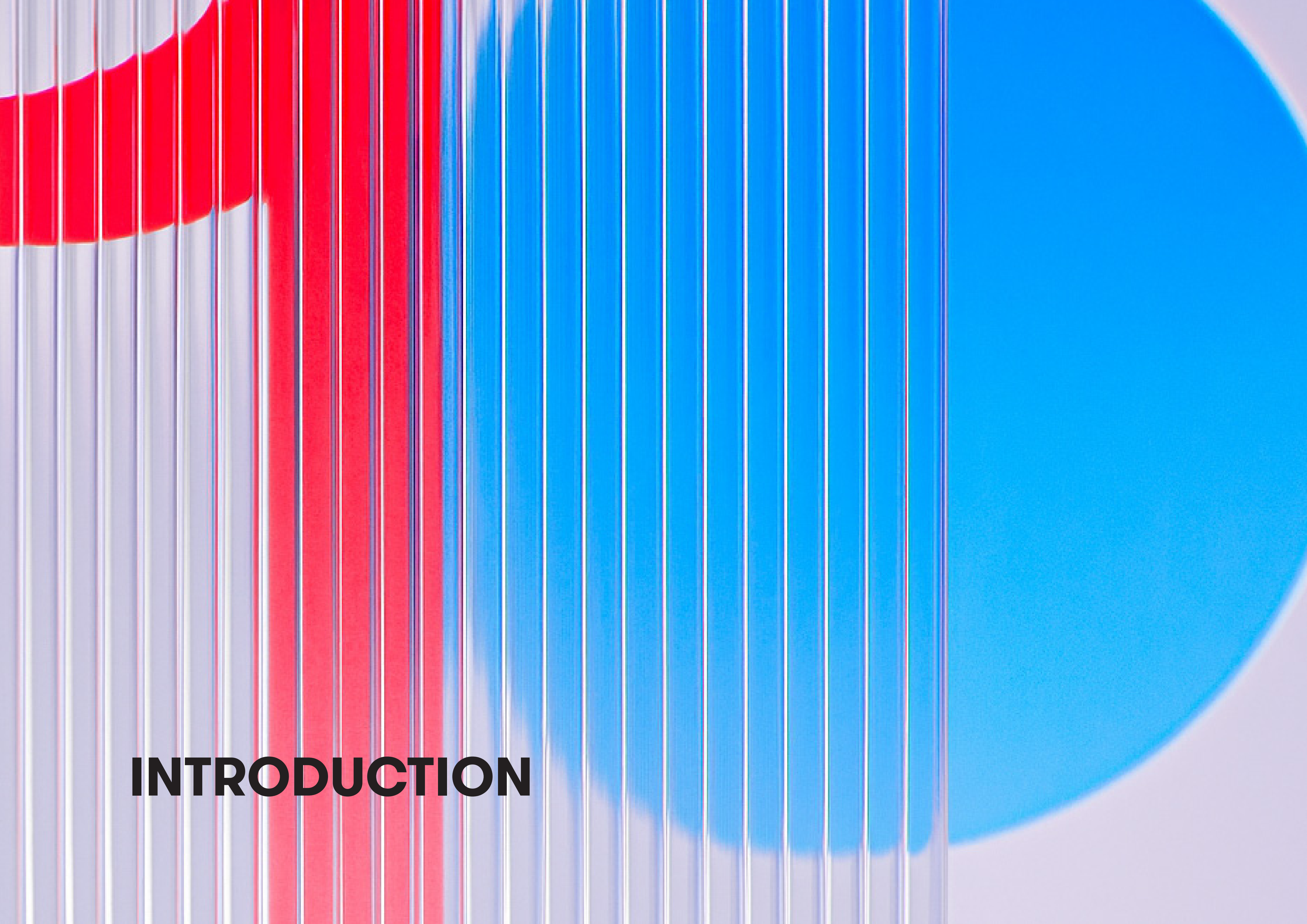
Over the past five decades, the Faculty has evolved into an ecosystem of design thinking, with a strong emphasis on multidisciplinary collaboration. IDE's approach positions the designer as an agent of change—someone who navigates between the needs of users, technological possibilities, and complex societal challenges. Its students and researchers engage with real-world problems, partnering with industry, governments, and NGOs to create meaningful, sustainable, and inclusive solutions.

Among the key master programmes within IDE, Design for Interaction (DfI) stands out as a reflection of the faculty's human-centred ethos. Introduced in response to the increasing complexity of human-technology relationships, **DfI focuses on designing products, systems, and services that foster meaningful and intuitive interactions.** Here, the user is not an afterthought, but a central figure in the design process - understood not just through functionality, but through psychology, emotion, context, and behaviour.

Design for Interaction embodies IDE's belief that products are more than objects; they are touchpoints in a broader narrative of experience. Students are trained to explore people's latent needs, challenge assumptions, and prototype solutions that improve quality of life—especially in a world where digital and physical boundaries are blurring.

Today, Industrial Design Engineering at TU Delft stands as a global leader in design education—anchored in Dutch design values, driven by research, and committed to shaping a better future. Its legacy is not only in the products or services designed, but in the mindset it fosters: one that combines empathy, systems thinking, and innovation to create lasting societal impact.

image source: https://www.tudelft.nl/en/ide



INTRODUCTION

1.1 ABOUT THE PROJECT

This project aims to design a product or service that enhances independence and productivity for people who are blind or have low vision by leveraging a virtual personal AI assistant in the context of educational and work environments. Despite considerable advances in assistive technologies, blind and low-vision users continue to face significant challenges in navigating spatial environments,

managing information, and maintaining autonomy in dynamic, visually dominant contexts. As pointed out by Keates and Clarkson (2008), many such technologies struggle to move beyond prototype stage, and even among the most successful solutions, user adoption remains low when the learning curve is high and the perceived functional value is limited. If a new system—even one offering potential improvements—demands substantial behavioural adaptation but serves only narrow or infrequent use cases, adoption is often minimal. This underscores the importance of designing systems that not only solve real problems but also align with users' existing habits and cognitive strategies (Keates & Clarkson, 2008, pp. 198–199). The project begins with identifying issues faced in the selected context, then narrowing down to one activity based on the value the solution can bring while considering technical feasibility, and finally exploring ways of solving the identified issue.

Envision, a company dedicated to empowering people who are blind or have low vision through smart assistive technologies (including AI-powered glasses and mobile solutions), provided the industry context and expertise for this project being the client for this project. When this project started, Envision had been working on it's accessible personal AI assistant 'Ally' (www.ally.me).

This project investigates how an AI-powered personal assistant can be integrated into existing assistive tools to address key navigation and productivity challenges in workplaces and educational settings. Rather than replacing what already works, the focus is on identifying realistic, feasible approaches that could enhance existing experiences and can likely be implemented within 6–12 months. By designing inclusive, scalable, and user-centered guidance, the project aims to support greater independence and confidence in daily professional and academic activities while respecting existing tools and workaround strategies. Through research, co-creation, and iterative prototyping, the goal is to lay the foundation for solutions that can be meaningfully implemented and further developed to meet real-world needs.

1.2 ABOUT THE CLIENT

The project has been done in collaboration with Envision (client), a technology startup that develops tools for the blind and low vision community using AI and computer vision. Their core products include the Envision App and Envision Glasses, which aim to provide real-time, AI-powered access to information in the user's surroundings. Envision Technologies BV is based in Rotterdam and works on enhancing accessibility for people who are blind or have low vision (PBLV). Envision has been working recently on a personal AI assistant (called Ally) with the vision to enhance accessibility for people who are blind or have low vision. The

envision app

envision glasses

envision ally

envision enterprise

app is available on android, and iOS along with a web version. It is designed to be accessible and can be interacted by typing as well as through voice. Besides, Envision already has Envision Glasses (envision app running on Google Glass 2 hardware) which has camera access and touch interactions.

Envision has been actively developing Ally, a virtual assistant designed to support people who are blind or have low vision in navigating daily tasks more independently. Ally was launched publicly in beta in early 2024 and officially rolled out in March 2025. It builds on Envision's expertise in smart glasses and AI-powered assistance, offering features like reading, describing scenes, and providing contextual support through voice interaction. Since its launch, Ally has continued to evolve, with new features and integrations being added gradually to make it more helpful and personalized. This ongoing development reflects Envision's commitment to creating practical, user-centered solutions that empower blind and low-vision users in their everyday lives. Since as a company they work on accessibility, the team at Envision is keen on finding use-cases and contexts where this personal AI assistant can work to positively support or enable the users (PBLV). **With this intent to look for making more use cases for Ally (Personal AI Assistant), the thought evolved as a promising direction to explore for a graduation project in collaboration with Envision.**

ios

android

web

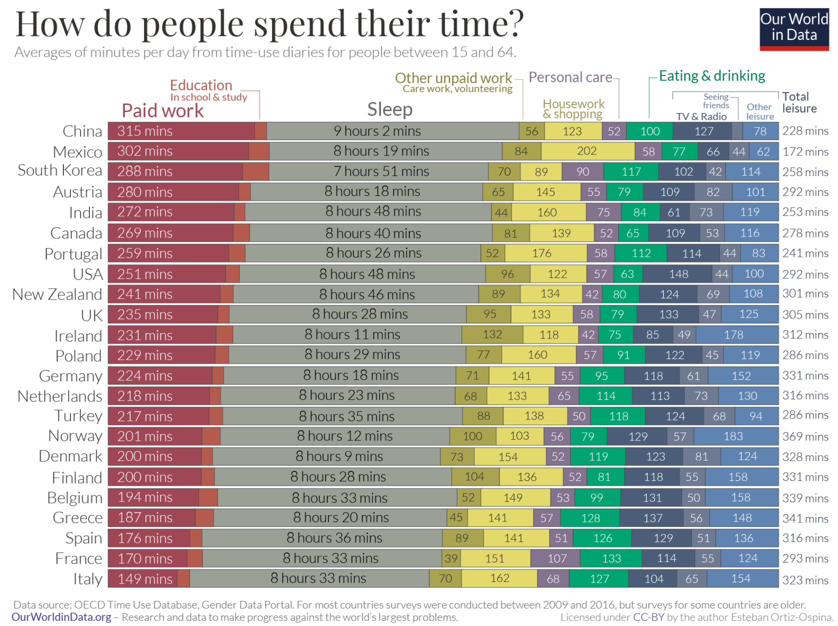
glasses

1.3 CONTEXT OF THE PROJECT

As described in the previous heading Envision was already working towards making personal AI assistant which is accessible to people who are blind or have low vision - one of the areas that Envision was interested in - was identifying the issues people (PBLV) face in the context of work and educational environments. Both are places where people spend a significant amount of time in their lives apart from their own homes. The data shown here (https://ourworldindata.org/time-use) is interesting to look at which indicates a significant about of time spent for paid work which is only second to sleeping. For students, time spent at universities can be comparable until they go on to full time working roles.

> *“My master’s was originally one year but was extended due to the nature of the content. A lot of coding was taught by example on the screen, which I couldn’t follow in class. I did most of the studied material in the two years after that, one-on-one with the teacher.*
>
> (Quote from user interview)

This direction was the beginning of the project. Reports indicate that usually people take significantly longer finishing their education and face challenges in both obtaining and maintaining employment as the environment and resources are largely designed without enough or no attention to make it inclusive. (CBS, 2020; Goertz et al., Journal of Visual Impairment & Blindness, 2010; RNIB, 2020; WHO, 2011; Microsoft Netherlands, 2017).



Navigating around or working on everyday tasks with limited or no vision requires individuals to constantly adapt to tools and systems that were often not designed with them in mind. While assistive technologies have made significant strides - especially with advancements in AI over the recent years - the integration of such technologies to identify and solve issues faced in the context of mainstream education and work environments still needs work. And these two are the spaces where people spend a lot of their time of a week. This project emerges from a growing need to explore how intelligent tools, particularly virtual personal assistants (AI), can meaningfully support independence and productivity for people who are blind or have low vision in these contexts. While re-designing the complete space/environment or building can be a big barrier as an afterthought towards inclusivity, the potential of personal AI assistants can offer solutions to at least some, if not all, of the problems faced by the users and enhance accessibility.

1.4 ABOUT THE USER GROUP

The project focuses on **People who are Blind or have Low Vision (PBLV),** particularly those engaged in the context of academic or professional environment. These are contexts where independence and productivity are not abstract ideals but daily necessities—whether it's navigating a software, accessing documents, attending a meeting/lecture, walking to meeting rooms or just taking a coffee break.

1.4.1 The Term "People who are Blind or Low Vision"

The term People who are Blind or Low Vision is the 'people-first' nomenclature of the otherwise popular term 'Visually Impaird People' which traditionally focusses on the ability rather than people. Thus, this term is a people focussed term used in Envision and now becoming more accepted as people are becoming aware of the thought behind this naming.

This term 'People who are Blind or have Low Vision' is an umbrella term used for people who are facing some or the other kind of challenge related to their vision from colour blindness, low vision, light & shadow perception, tunnel vision, age related macular degeneration (AMD), cataracts, glaucoma, cataract, diabetic retinopathy, and many other situations in between to fully blind (detailed in next sub-heading).

Traffic Scene

Traffic scene as viewed with localised central loss of acuity

Traffic scene as viewed with mild global loss of acuity

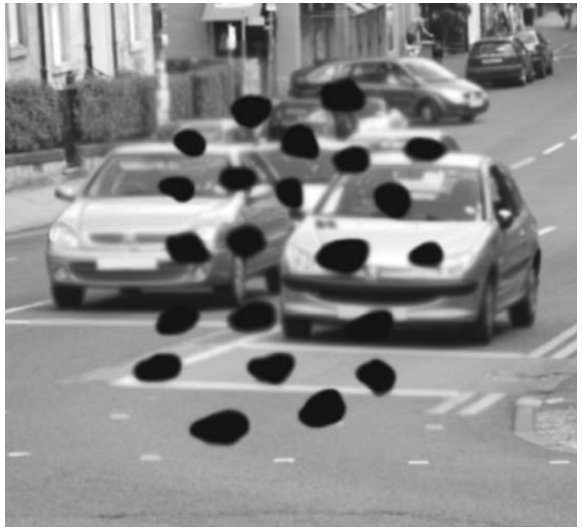
Image Source: Dickinson et al., 2007 (Springer Nature), used for academic purposes under fair use.

Traffic scene as viewed with severe global loss of acuity

Traffic scene as viewed with nystagmus

Portion of traffic scene that might be seen by a person with 'tunnel vision'

Portion of the traffic scene seen when half the field of vision is lost



Traffic Scene as viewed by a person with mild blurriness and blots

Traffic scene as viewed with distracting visual light disturbance

Image Source: Dickinson et al., 2007 (Springer Nature), used for academic purposes under fair use.

1.4.2 More about Different conditions in 'PBLV'

PBLV covers a broad spectrum of visual conditions that affect people in diverse ways. For instance, some individuals experience central vision loss, as in age-related macular degeneration (AMD), which impacts their ability to read, recognize faces, or perform tasks requiring fine detail. Others may have peripheral vision loss (common in glaucoma or retinitis pigmentosa), making it difficult to detect objects or navigate safely in their surroundings. Conditions like cataracts can cause overall blurred vision, significantly reducing clarity and contrast, while diabetic retinopathy may result in scattered blind spots across the visual field. There are also other types of visual conditions that can be managed by using corrective glasses.

Furthermore, some individuals may have residual light or shadow perception, tunnel vision, or fluctuating vision, all of which present unique challenges in daily activities. Color blindness, though often less disruptive in terms of acuity, affects the ability to distinguish certain colors, which can hinder specific tasks.

Recognizing these diverse experiences is essential when designing inclusive solutions, as each type of visual impairment may require different assistive strategies, technologies, and environmental adaptations to support greater independence and productivity *(Hersh & Johnson, 2008)*.

Also, because of these diversities the way they strategise and operate in their everyday tasks differs, so does their wants. For example, people with low vision use larger monitor attached to their laptops or also wish if the environment is high contrast. While if someone is fully blind, they usually need to plan their travel in advance, remember the regular routes to navigate or sometimes take help from family or friends if needed.

1.4.3 Potential of AI for PBLV

Artificial Intelligence (AI) holds transformative potential for enhancing the independence and productivity of people who are blind or have low vision (PBLV). Over the past decade, AI-powered technologies have increasingly bridged accessibility gaps by enabling real-time interpretation of visual information, providing context-aware guidance, and facilitating more inclusive interactions with the digital and physical world. Companies like Envision have pioneered wearable solutions, such as smart glasses that use AI to read text aloud, recognize faces, describe surroundings, and identify objects, thereby empowering users to navigate professional and social environments more confidently (Envision, n.d.).

Similarly, applications like Seeing AI, developed by Microsoft, leverage AI to convert visual information into spoken feedback through a smartphone, helping users read documents, recognize products via barcodes, understand scenes, and even identify currency (Microsoft, n.d.). Other tools, such as Be My Eyes, combine human volunteers with AI support to provide on-demand visual assistance, illustrating a hybrid model of community-driven and automated help (Be My Eyes, n.d.). Additionally, AI has been integrated into mainstream devices—for example, Apple's VoiceOver and Google's Lookout—which use computer vision to interpret and describe visual content, further normalizing accessibility in everyday consumer technology (Apple, n.d.; Google, n.d.).

The convergence of AI with sensor-based and context-aware technologies has also enabled more intelligent physical solutions, such as advanced mobility aids or smart canes equipped with obstacle detection and navigation guidance. As AI continues to evolve, it offers new opportunities to design highly personalized, adaptive solutions that cater to the diverse and dynamic needs of PBLV, reinforcing their autonomy and participation in educational, professional, and social spheres (Hersh & Johnson, 2008).

In addition to general-purpose AI apps, there are also solutions that leverage QR codes or other optical markers to provide location-specific or context-specific information. For example, Wayfindr and some smart building systems use QR codes or NFC tags placed strategically in environments like public transport hubs, museums, or offices to provide audio navigation instructions when scanned with a smartphone. Another example is Clew, an app designed to help PBLV navigate indoor spaces by creating custom routes using visual markers and spatial mapping (Clew, n.d.).

Moreover, solutions like Navilens use colorful, high-contrast QR-style codes that can be scanned from a distance and at wide angles, providing dynamic spoken guidance and information about surroundings (Navilens, n.d.). Such marker-based approaches complement AI-based object and text recognition by offering reliable, fixed points of reference in complex environments.

Lastly, recent advancements in large multimodal AI models—such as OpenAI's ChatGPT, Google Gemini, Anthropic Claude, xAI's Grok, Perplexity AI, and DeepSeek—illustrate the rapidly growing capability of vision-language systems. While not all of these models currently provide full visual interpretation, many are being developed with or have introduced vision capabilities that enable them to analyze images, describe scenes, or assist with document understanding. This trend suggests a future in which highly generalizable vision models can be further integrated into assistive solutions for PBLV, offering even richer, more adaptive support (OpenAI, 2024; Google, n.d.; Anthropic, n.d.; xAI, n.d.; Perplexity AI, n.d.; DeepSeek, n.d.).

1.5 STAKEHOLDERS

Primary Users: Individuals who are blind or have low vision (PBLV) in educational or professional roles. Their primary interests include enhanced accessibility, greater independence, and reduced barriers they face in daily tasks—ranging from navigating physical spaces to accessing digital information or collaborating with colleagues. Ensuring that their needs, preferences, and lived experiences are central to the design process is essential to creating a solution that genuinely supports their autonomy and productivity.

Envision (Client): Envision serves as the client and a strategic partner in this project. Their interests include leveraging personalized AI to advance accessibility solutions that align with their mission of empowering PBLV communities. At the same time, this project presents opportunities to explore new technological directions that can complement and strengthen Envision's ongoing focus on developing their personal AI assistant 'Ally', potentially expanding its capabilities and value for users in educational and professional contexts.

For the project, the main focus has been PBLV as it is in the initial phase of identifying the issue and testing design directions, however for further development more stakeholders' involvement might be important.

Tertiary Stakeholder
Secondary Stakeholder
Primary Stakeholder

1.6 INITIAL DESIGN BRIEF

In today's increasingly digital and interconnected world, people who are blind or have low vision (PBLV) continue to face significant barriers in educational and professional environments. Tasks such as navigating complex spaces, processing large volumes of information, and collaborating effectively can hinder their independence and productivity. At the same time, advances in artificial intelligence and virtual personal assistants offer promising opportunities to reimagine inclusive support systems. Against this backdrop, the following design brief outlines the direction of this project.

not getting strander or unwillingly dependent especially in situation where they might be alone

time needed to do the activity

design/solution

Design a **product/service or approach** to **enhance independence and productivity** for **people who are blind or have low vision** in the **context of educational and work environments.**

user group

context

The brief served as a launchpad for contextual immersion, identifying the issues faced by the users, iterative ideation, and eventual prototyping - anchored in iterative design and aligned with Envisions technological capabilities.

1.7 DESIGN CHALLENGES AND SCOPE

While AI offers the promise of augmentation and automation, the central challenge is to design an assistant that does not overwhelm, overstep, or undermine the user's own agency. The personal AI assistant should support the users as a pace that works well for the users in right pace, and in a reliable way each time. Also, to be more ideal solution the design should possibly be repeatable or scalable to more locations – also a good scope for the viability (business) aspect.

1.7.1 Design Challenge

How might we design a personal AI assistant that supports to do the identified task reliably each time, supports the feeling of independence and and increased efficiency. Since this project is with a client, there's expected to be a lot of attention of feasibility in real life and how big of the problem is being solved through the design solution for people who are blind or low vision—without removing their sense of control, context, and confidence.

1.7.2 Scope Considerations

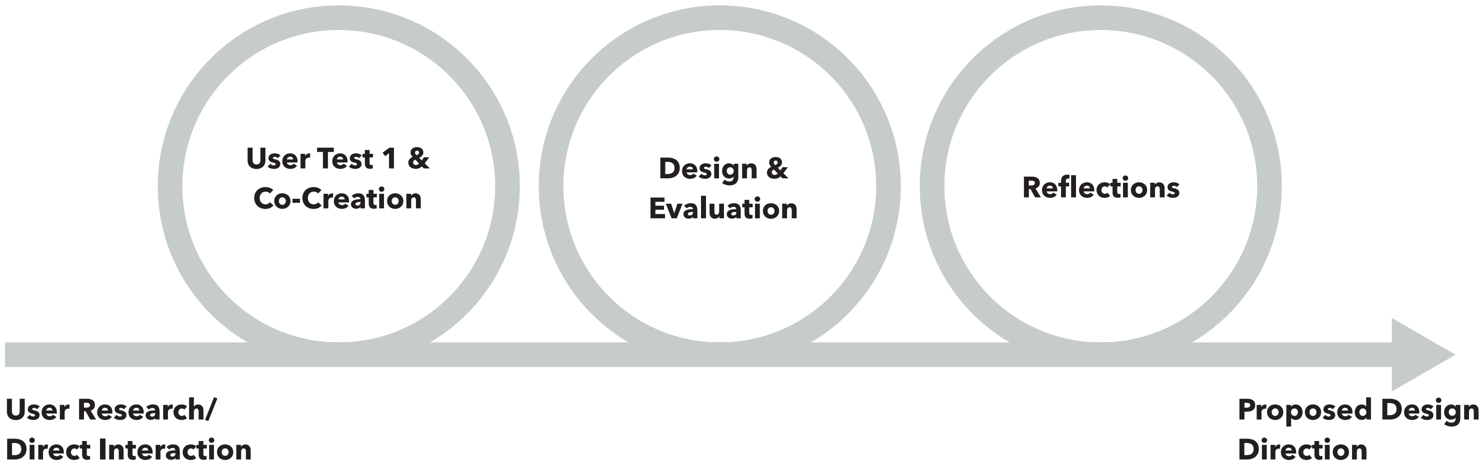
The addition should be easy to use, reliable and repeatable to different locations (other universities and offices)

It should likely be feasible within 6-12 months after the end of this project.

The focus is on day-to-day tasks that currently affects independence and productivity is someway.

1.8 OVERVIEW OF THE PROJECT

This graduation project explores how virtual personal assistants powered by AI can enhance independence and productivity for people who are blind or have low vision (PBLV) in educational and professional environments. Despite technological advances, PBLV continue to face barriers in daily tasks—such as navigating dynamic indoor spaces or using touchscreen interfaces -often leading to dependence on others. The project is conducted in collaboration with Envision Technologies BV, a startup focused on AI-driven accessibility solutions, particularly through their existing Envision Glasses and the Ally virtual assistant. Using a iterative prototyping, co-design and mixed-method approach, the project involved in-depth user research, AI feasibility testing, and iterative prototyping. Through this process, two key problem areas emerged: navigating to non-fixed indoor locations (like meeting rooms) and interacting with inaccessible touchscreens (like coffee machines). Based on user needs, frequency of occurrence, and feasibility within Envision's ecosystem, indoor navigation was selected as the design focus. The resulting concept, Ally SenseScape, offers audio-first, voice-guided navigation using Envision Glasses—leveraging floor plans, sensory landmarks, and compass data to provide step-based, user-paced assistance. This chapter introduces the motivation, context, and design direction, setting the stage for Chapter 2, which details the research and insights that shaped the concept further.



RESEARCH AND INSIGHTS

2.1 PROJECT STRATEGY

This project adopts an iterative, participatory design approach, with a focus on close engagement with people who are blind or have low vision. The strategic goal is to explore how a virtual AI assistant can enhance independence and productivity in educational and work environments without compromising user agency or accessibility and valueing what already works well.

The strategy is built on several guiding principles:

Users as experts: Drawing from co-design philosophy, especially scenario-based and tangible co-design approaches, users are seen as experts in their own lives, capable of shaping the tools they use (Gooda Sahib et al., 2013; Brewer, 2018; *Sanders & Stappers, 2012, p. 23*).

Real-world relevance: The assistant is envisioned as a grounded, modular companion that integrates into actual workflows, responding to context rather than controlling it (Boess et al., 2024).

Feasibility with impact: The design direction is continuously refined through feedback from users and stakeholders at Envision, ensuring alignment with both immediate product potential and longer-term visions (Piedade et al., 2025).

Balance of autonomy and assistance: Echoing critiques of techno-solutionism, the assistant is conceptualized as a supportive layer that respects individual approaches and avoids imposing assumptions, emphasizing flexibility and self-determination (Angelini et al., 2023; Spiel et al., 2023).

This strategic framing enables a design process that is empathetic, responsive, and implementation-oriented—bridging inclusive design research with practical realities.

2.2 RESEARCH OBJECTIVES AND QUESTIONS

The object of this project is to design a personal AI assistant that supports people who are blind or have low vision in educational and work environments by enhancing independence and productivity. That also means identifying and having clarity on which activities must be focussed where there are issues, and understanding what already works (including their personal approaches).

2.4 Research Objective and Questions

Main Research Objective

1. To identify the issues faced by people who are blind or have low vision (PBLV) in educational or work environment.

2. To explore how a virtual personal assistant (AI) can support for the issues identified in objective 1.

Key Research Questions

1. What are the primary accessibility barriers (physical and digital) faced by PBLV in educational and workplace settings?

2. Which tasks currently cause significant delays or dependence on external assistance for PBLV in these contexts?

3. What are some accessibility related needs and wishes of the users?

4. What tasks or challenges remain difficult or unsolved despite current accessibility solutions?

5. What existing assistive technologies or strategies do PBLV currently use, and how well do they meet users' needs? What do they seek help of other people for?

2.3 METHODOLOGY OVERVIEW

The research methodology combines qualitative, user-centered, and exploratory design methods, applied across different phases of the project. Each method contributes to building a deep understanding of user needs, validating the needs & ideas, checking feasibility of ideas, co-creation, and shaping the concept in iterative loops.

The following methods were used:
Desk Research: To understand the landscape of assistive technologies, AI integration in accessibility, and productivity needs of visually impaired users and existing studies.
In-Context Immersion: In this project, this refers to approaching through the concept of abstraction (TUDelft IDE Course: IDEM205 Cognitive Ergonomics for Complex Systems, 2024) and trying to get first hand experience of doing familiar task withouth visual cies to emphathise better with real user experiences.
User Interviews: Conducting semi-structured interviews with people who are blind or low vision to uncover routines, workarounds, frustrations, and unmet needs.
Shadowing: Quietly observing how users navigate daily activities, transitions, and tool ecosystems, helping surface hidden pain points and behavioral patterns.
Co-Creation Sessions: Collaborating with users during ideation (including Envisioner's Day) to generate, test, and evaluate early ideas and design directions.
AI Video/Image Model Experimentation: Testing visual capacity of multiple AI available right now to understand their performance and usability in the context of tasks.
User Journey Mapping: Visualizing task flows, pain points, and tool interactions across various daily scenarios to identify opportunities for AI support.
Persona Development: Synthesizing user characteristics and needs noted based on interaction with real users into key personas (e.g., Jan and Julia) to ground ideation and test relevance across contexts while maintaining participant's privacy
Value vs. Complexity Mapping: Prioritizing directions based on their perceived user value and technical feasibility to down select focus area out of multiple identified issues.

These methods were not conducted as isolated steps but as an evolving, reflexive process - enabling insights to feed directly into design pivots and feature refinements.

Ethical Considerations: Participation was completely voluntary, with consent obtained before any interviews or research sessions. Participants were given the choice between online or in-person formats, and audio or text-based modes of consent, to ensure comfort and respect their preferences. They were told they could skip any questions, and care was taken to avoid sensitive topics. Recorded data were deleted after transcription. Information used are anaonymised to ensure privacy. Images used in this report are presented in a way that is if not recognisable to the participant.

2.4 RESEARCH

2.4.1 Desk Research

The desk research aimed to understand the current landscape of challenges and opportunities for people who are blind or have low vision (PBLV), especially in educational and work contexts where independence and productivity are essential. Historically, assistive technologies for PBLV have relied heavily on low-tech haptic solutions such as long canes for navigation and Braille for accessing printed information. While these tools remain widely used and valued, many advanced electronic travel aids have struggled to gain adoption due to factors such as excessive complexity, high cost, poor alignment with user needs, and limited added value compared to existing aids (Hersh & Johnson, 2008).

One recurring challenge is the so-called "last ten yards" problem. While GPS-based tools can guide users to a general location, they often fail to provide precise information about building entrances or fine-grained spatial details, which is critical for confidently reaching the final destination (Hersh & Johnson, 2008). Apps like BlindSquare, which use clock-face concepts to give directional guidance, have shown potential but still require more integration into everyday contexts and user routines (BlindSquare, n.d.).

Parallel to these findings, rapid advancements in AI and wearable technologies—such as smart glasses with integrated language models—are opening up new possibilities. These systems promise real-time text recognition, object description, and contextual scene understanding. However, literature strongly cautions against techno-solutionism and the tendency to over-engineer speculative AI agents that act independently of user control (Spiel et al., 2023; Angelini et al., 2023). Instead, the focus must remain on tools that enhance user agency and provide support in a transparent and flexible way.

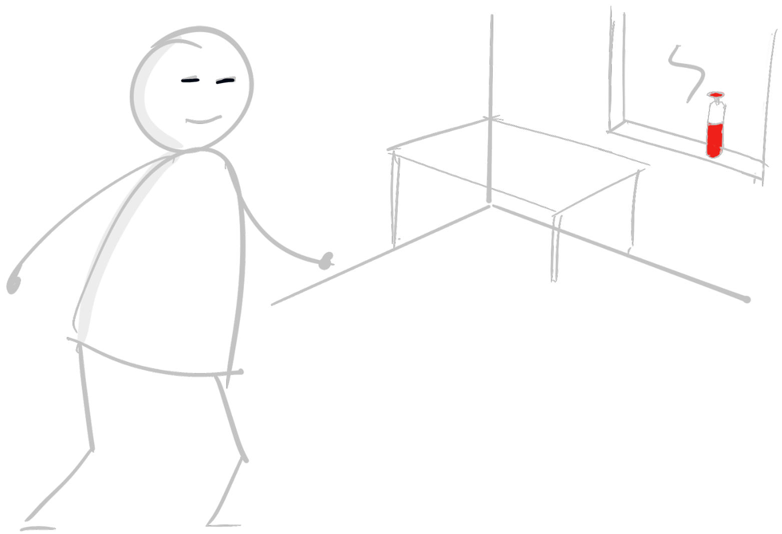
Participatory and co-design studies reinforce this perspective by treating PBLV as experts in their own lives. Approaches such as scenario-based design, tactile co-creation, and voice-based workshops show that involving users meaningfully throughout the design process leads to solutions that are better aligned with their needs and expectations (Brewer, 2018; Gooda Sahib et al., 2013). These methods emphasize shared meaning-making rather than top-down assumptions and help avoid creating "disability dongles"—technologies that appear innovative but fail to integrate into real user contexts (Spiel et al., 2023).

Overall, these findings shaped the strategic direction of this project: rather than developing a speculative, autonomous AI agent, the focus is on creating a grounded, modular virtual assistant that supports PBLV in navigating daily tasks with greater independence and confidence. **The aim is to design an assistant that integrates seamlessly into existing workflows, respects individual ways of working, and evolves with feedback from users and stakeholders.**

2.4.2 Initial Explorations

2.4.2 a. In Context Immersion

This was one of the initial exercises conducted to get a sense of perception and strategy to navigate and do simple task in a familiar space. People who are blind or have low vision are experts in terms of their strategy to navigate around in the



environment and do the activities that they need to do. Based on the approach of abstraction (*Reference: TUDelft IDE Course: IDEM205 Cognitive Ergonomics for Complex Systems, 2024*), the exercise was simplified to an environment which was very familiar "own student room" (mine and two fellow students in the same student housing) and the task was as simple as moving a water bottle from window to table while eyes were closed. This required them (starting with me) to be aware of the space – walls, furnitures, and idea of distances. In case of one of the students, furniture was slightly moved while eyes were closed.

This exercise revealed several important insights:

1. Navigation and task execution rely heavily on permanent or semi-permanent spatial anchors (here walls), not on mobile or temporary objects.

2. Environmental familiarity plays a key role in confidence and efficiency.

3. Even minor, unexpected changes in the layout can cause disorientation, which becomes more pronounced without visual cues.

2.4.2 b. AccessAbility Workshops

During AccessAbility Week at TU Delft, I attended three workshops that were highly relevant and provided valuable insights into current developments in accessibility. One of the sessions was hosted by Microsoft, where they shared their multi-decade commitment to inclusive design and presented an inspiring project developed in collaboration with the Rijksmuseum. This project focuses on making artworks accessible to people who are blind or have low vision through AI-generated narration, illustrating how cultural experiences can be made more inclusive.

In another session by Apple, I was particularly impressed by the depth of consideration given to accessibility throughout their entire design process. A striking example highlighted how, if a user unboxes a new iPad and connects a Braille keyboard even before the first setup, the device automatically detects it and adapts the initial configuration experience to support Braille input. This approach underscores Apple's philosophy of integrating accessibility features seamlessly "out of the box" rather than as optional add-ons, emphasizing that inclusive design should begin from the very first moment of interaction.

2.4.2 c. Shadowing

Diving further in my research, I conducted an insightful shadowing activity where I followed a blind professional throughout their workday—from arriving at the office to completing various tasks and eventually leaving. This allowed me to observe both the accessibility challenges they encounter and the clever personal strategies they've developed, such as precisely timing their entry into a revolving

door or identifying the correct floor in a lift without visual cues, and if the lift door opened on the right floor (he pressed the desired floor button to cross check - the door reopens if it is the right floor, and doesn't respond if it is not the desired floor. However, this constant need for vigilance can contribute to a significant cognitive load. Some tasks were managed with impressive skill, while others–like checking the availability of a meeting room–remained frustratingly inefficient,

> *"Sometimes I go to the meeting room where we are supposed to have next meeting, and sometimes there are people from precious meeting still there. They expect me to know they are there as it is a glass door, but I can't see. I have heard people talking about me saying he is the one who walks in meeting room like this.*
>
> (Quote from user interview)

even with assistive apps, sometimes requiring multiple attempts. These "small" tasks often reveal larger systemic gaps: for instance, how can someone who can't see be expected to know if a glass-walled meeting room is already occupied? Or adjust the office temperature if controls aren't tactile or audible? As more office systems go digital and rely on touch screens, even making coffee now requires assistance. **While not all these issues carry equal weight, together they paint a picture of a workspace still lacking in seamless accessibility.** Listening to their reflections and decision-making throughout the day added deeper context to these observations.

2.4.2 d. Zeizo Beurs

Zeio Beurs /Vijnedag is an annual fair in Utretch. Envision was exhibiting there and it was a nice opportunity at one place to get to see different accessibility devices or products that various companies were working on. It was also a nice opportunity to interview an expert - who had very low vision and had been working as product manager with sensotech for their accessibility hardware for low vision. The details and insights are mentioned in the interview section.

Among many new and interesting things observed in the fair, one possibly relevant for the project is the adaptation in the touchscreen of Geldmaat. To support it for people who are blind or low vision, as soon as the user plugs in their earphone the screen changed to black, and the audio instruction continues.

Physical tactile buttons can be used to make further choices in that.

2.4.2 e. Digital Accessibility and AI Workshop by Microsoft

I also attended a separate event titled Digital Accessibility and AI, hosted at the Rijksmuseum and led by Larrissa.

Herman Eberstadt from UWV shared his experience of building an internal accessibility network, emphasizing the importance of connecting with colleagues with different abilities and fostering inclusion within organizations.

Ruben van Sprang from Rabobank discussed using a maturity model to improve accessibility systematically and highlighted the value of real user stories to gain leadership support and drive impact.

The event showcased tools such as Microsoft 365 Copilot, which can generate accessible documents and image descriptions automatically, and Cephable, which enables device control using facial movements. Microsoft also collaborated with Shapeways to create 3D-printed adaptive mouse parts.

A particularly inspiring example was Microsoft's collaboration on a ballet performance with live audio descriptions. By recording practice sessions and using AI to generate detailed transcripts, they enabled a real-time audio experience for audiences who are blind or have low vision.

These insights underline the importance of focusing on practical, user-centered AI solutions that enhance independence and participation – a principle that strongly aligns with the goals of this project.

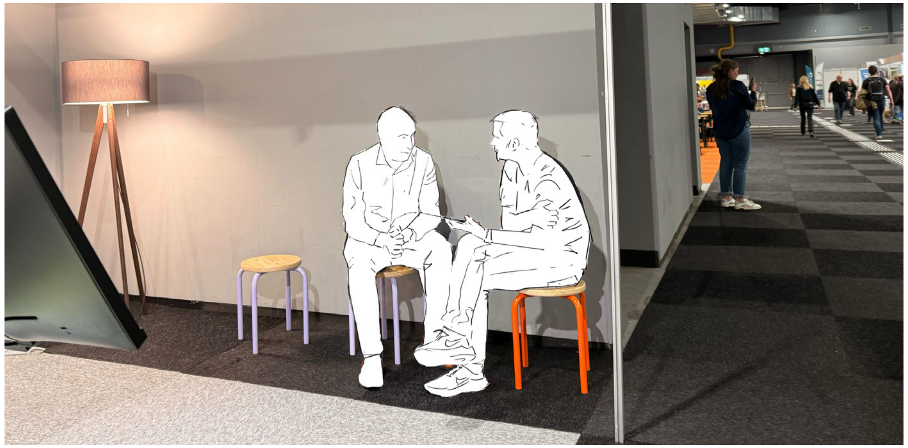
2.5 Interview

Set up and Approach

The research objective was to understand the everyday experiences, challenges, and workarounds of people who are blind or have low vision (PBLV) in educational and professional environments–especially around navigation and independence in shared spaces. To explore this, I set up a series of semi-structured interviews with a total of 11 participants.

The interview group included:

- 2 recent graduates reflecting on both university and early work experiences
- 8 mid-to-senior level working professionals, including freelancers and business owners



• 1 expert who has worked for nearly two decades in making workplace environments more accessible

Participants had varying levels of vision—from low vision to fully blind. The group also reflected a mix of work contexts, including office-based, hybrid, and freelance settings.

Each session lasted 30–40 minutes. With informed consent, audio recordings were made and later transcribed. The audio files were deleted immediately after transcription to ensure privacy. Participants were given the choice to skip any questions or stop the interview at any point.

These interviews gave deep insight into routines, pain points, existing strategies, and unmet needs, and later helped map out the user journey, shape the statement card analysis, and define key focus areas. In total there were 10 interviews conducted. Each of the interviews were for the duration of 30-40 minutes. Two interviews were with recent graduates who shared their experiences at university as well as at their workplace. All other interviews were with working professionals – most of them were at mid to senior level in their works, including business owners. The group involved a mix of work from office, hybrid work, freelancers working from cafes or also working from home. In terms of their vision, the participants were from low vision to fully blind. Apart from this set, I also interviewed an expert (11th interview) who has been working for almost 2 decades on making workplace environment more accessible.

With informed consent, the interviews were recoded (audio only), transcribed and then the audio was deleted soon after transcription.

The total length of the audio overall was around 6 hours. The transcript was analyzed with the approach of Statement Card Analysis (TUD Delft IDE Course ID4216: Contexts and Conceptualization).

Through the statement card analysis, overall 3 themes emerged - navigations, digital content/touch screen, emotions/feelings. These are described in next sections. Mainly based on Shading and Interview, user journey was created (next topic) which helped to clearly note different activities throughout the day.

Overall, the interviews also helped to gain a good understanding of usual daily life around education and workplace (which led to mapping the user journey – in next topic), issues faced (add visuals in statement card analysis), existing approaches to solve (or ignore) issues faced, their needs and desire.

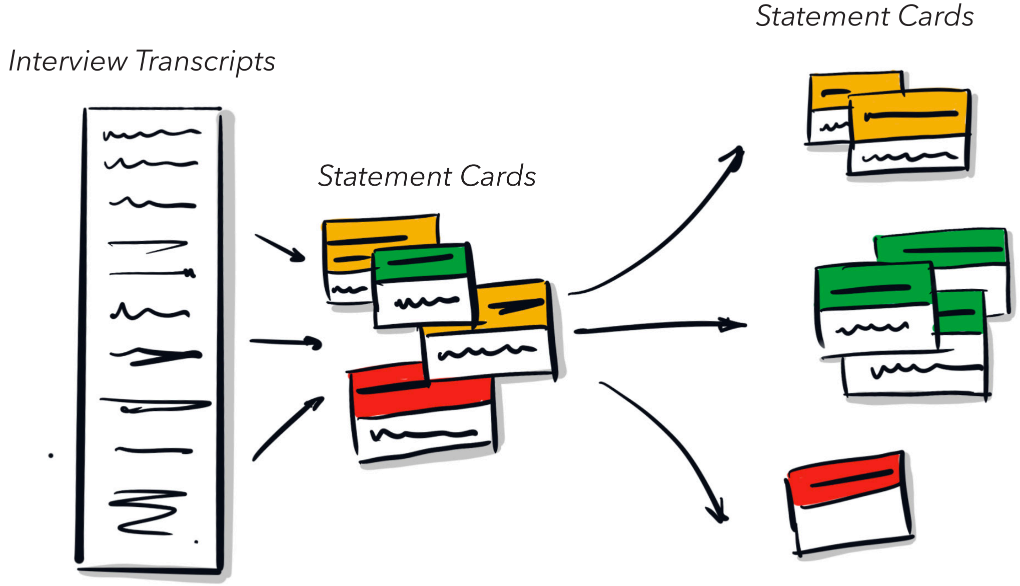
""Once while walking back during a group work, I went and joined another group. Since this was a new place, I didn't remember the route."

"The little adapter that connects the screen to my laptop disappears in the office… it meant that I couldn't work from the office yesterday"

"In the auditorium, there's a lot of glass, and when the sun shines, it reflects on the floor – I can't see anything. Navigating to the right table can also be tricky"

"I like to do things by myself without having to ask for help, but sometimes I have to make a compromise. For example, when I want to put my lunch in the fridge, I'll ask someone to press the latte button on the coffee machine."

"Google Analytics is generally accessible, but I don't always know when it's not working – sometimes I just refresh the page. A lot of dashboards are very visual, easier for people who don't code, but harder for me."



"Solving any glitches (screen reader jamming or stopping), is hard. Restarting is only way. Especially in work from home situation."

"Touchscreen coffee machines… I memorized where the buttons are, but it's not truly accessible."

"I memorize routes, but hybrid desks changing daily makes it hard (difficult)."

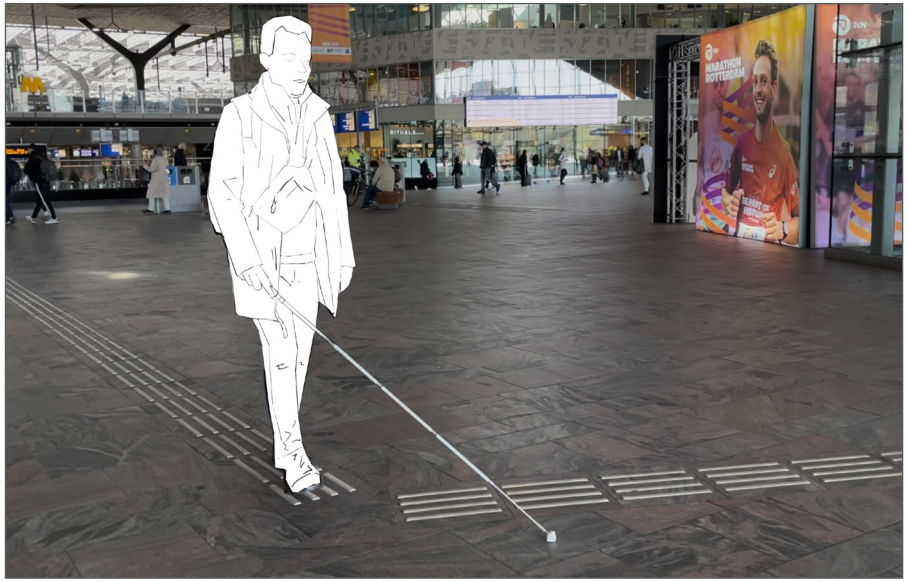
"I know that could be quite annoying… I'm aware it's a pressure on people around me"

"My master's was originally one year but was extended due to the nature of the content. A lot of coding was taught by example on the screen, which I couldn't follow in class. I did most of the studied material in the two years after that, one-on-one with the teacher."

"I'm waiting for the next wave of AI tech… where I don't have to ask so many questions."

2.6 User Journey

This user journey has been visualised based on shadow mapping and interview to illustrate typical office going day of people who are blind or have low vision. This user journey draws together the findings and describes the current situation in terms of experience, issues and existing work arounds.



Leaving Public Transportation Area - Tactile Path to Exit (usually memorised)

Open spaces without tactile markings are difficult to navigate. He shared that he always needs someone to pick him up from the stations beause of such difficulties.

These revolving doors are tricky to time well and get in, he did it very skillfully using the cane. He initially tried to slow it down, but the button didn't work

Tactile Buttons for elevators help

Some elevators open too silently to notice.

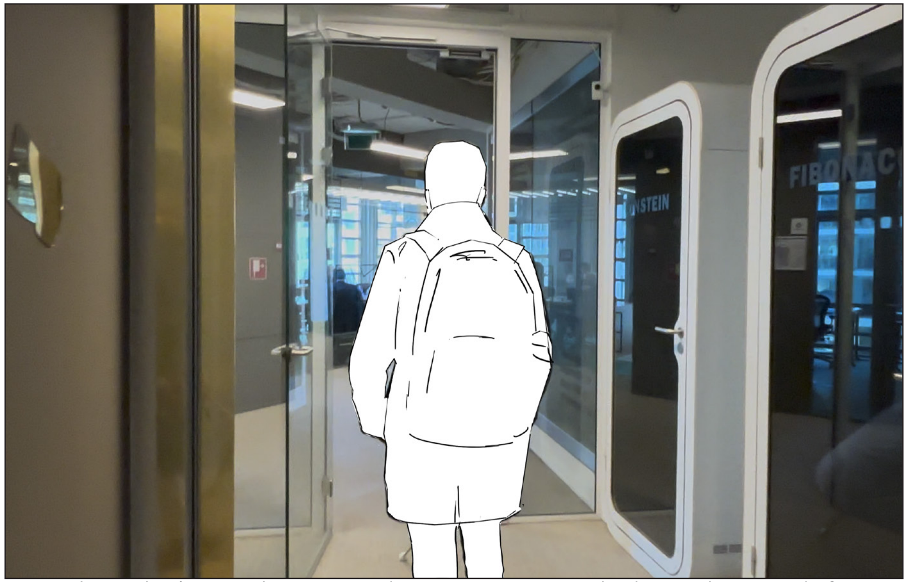
Tactile Buttons for elevators help. But it does not say, which floor it opens on.

The door has place to tap card and enter. This particular one does not work. And the placement of card tapping area isn't consistent on the same floor.

This another door just after, remains open. But needs card to tap in order for the card to work in this area of the floor on the day.

Hereafter, the route seemed to be memorised.

Turns after a few steps to head straight into the hallway was quite perfect using the cane.



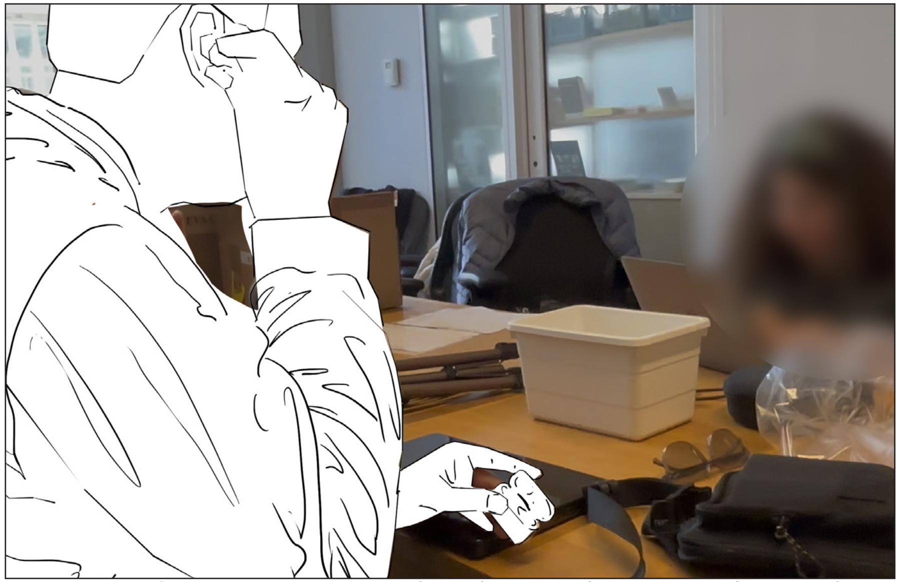
He shares he knows there is another turn as soon as he hears the sounds from server room on the right. It was very low huming to notice, he remembers.

new people. But difficult to navigate.

Finally, here I am. Hey Everyone, who are are in office today?

People helped in finding an empty chair. Settling down was an easy task.

Quite Familair place to walk around and hang jackets/coats



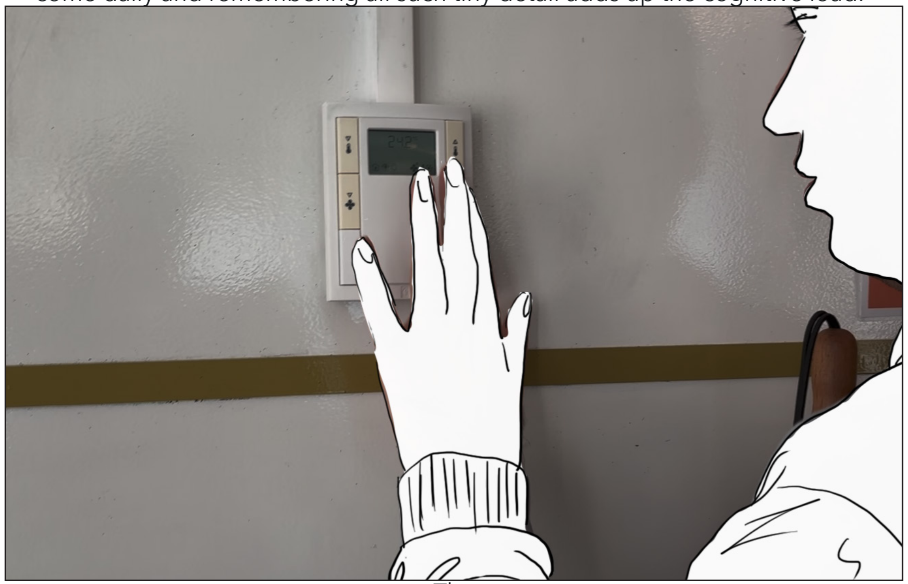
Operates laptip in voice over mode and starts with putting on the airpods.

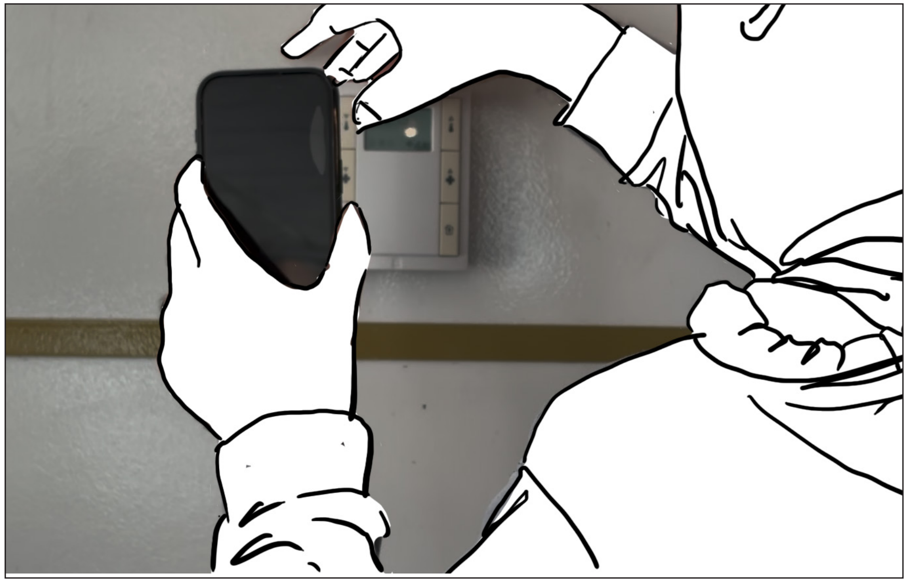
Checks email, calender, website, documents, etc.

Leaves for a meeting room to attend a meeting.

Another entrance, but this has the card reader on the other side of the door. He doesn't come daily and remembering all such tiny detail adds up the cognitive load.

Collect check-in baggage from the belt





The

Collect check-in baggage from the belt

Getting coffee needed multiple interactions on the screen - selecting a coffee, strength, sugar, milk, confirm. And there was another machine nearby for oat milk.

Washroom in inclusive but the information is through a printout, needs help to identify, and then orient correctly when inside.

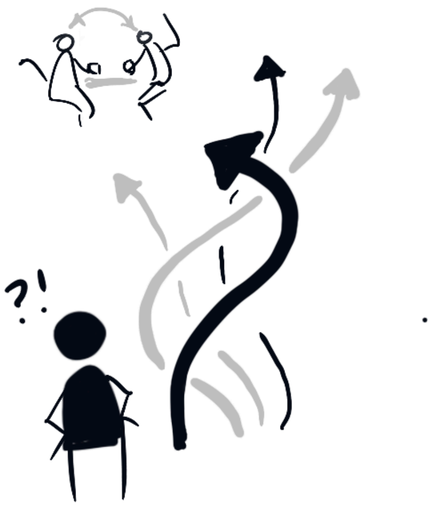
By evening, walks back to the elevator, and walks out of the building towards the train station.

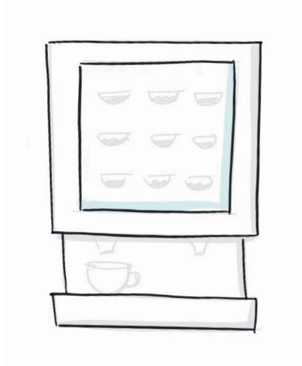
2.7 OVERALL IDENTIFIED ISSUES

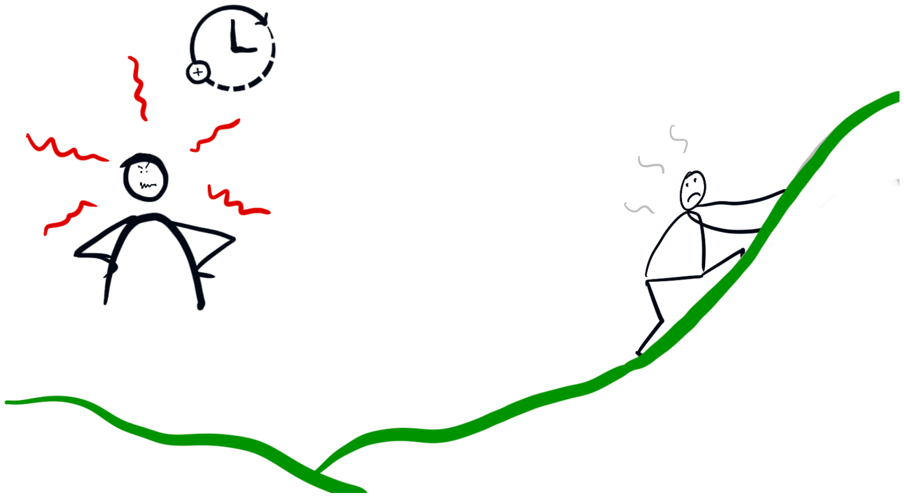
Overall, there were 19 issues identified which are listed below in 3 broad categories:

Category A: NAVIGATION

1. Finding an empty spot (among seating/working space) especially in places which don't have fixed spot
2. Navigation to rooms which are not at fixed locations (for example meeting room, or classrooms)
3. Identifying location of card reader to open doors. The positions aren't consistent even on the same floor. And some doors don't have it.
4. Doors don't have clear physical indicator (example, a door has grab handle which affords pulling more, but has 'push' printed over it)
5. Lifts/Elevator have tactile buttons – which helps to recognize the buttons. But there is no way to know if the lift has opened on the desired floor.
6. Navigating in open areas without walls or tactile path – example train station to office building
7. Guide dog user was in a difficult situation during fire emergency in the building. Someone brought the dog out, and the owner (fully blind) couldn't find for quite some time.
8. Bright sunlight or high glare makes navigation difficult.







Category B: TOUCHSCREEN & DIGITAL CONTENT

9. Digital Documents that are not structured well are difficult to read
10. Website pop-ups or captcha are sometimes inaccessible
11. Software or online forms requiring visual dependent interaction (like drag and drop) are inaccessible
12. Apps with AI helps, but they still need human help as sometimes the AI is not reliable enough
13. Touchscreen don't have speech or texture making it inaccessible – example coffee machine, meeting room touch screen, thermostat, payment machine at canteen with touch screen.
14. HR portals are not accessible – a. people use excel as a workaround, b. People are not comfortable sharing personal details but still need to depend on others to help with those tasks as the HR portals are not accessible.

Category C: FEELINGS

15. Always feeling like being one step behind those who can see.
16. Prefer independence but occasionally needs to wait or compromise ("looking forward to future AI and reduced dependence on people"
17. Worries about overburdening others with seeking help
18. Human support compensates for tech gap
19. Low contrast environment makes it difficult to find object

2.8 TESTING, USING AND ANALYZING AVAILABLE AI VISION MODELS

With this series of multiple testing done in the last week of March 2025, my aim was to see if any exiting AI vision model could potentially address the challenges identified and noted in the previous part. For each of the identifies issue, I dedicated a sheet of paper, wrote the issue, ideas on how to solve it (small tests) and used the most used and popular AI tools right now.

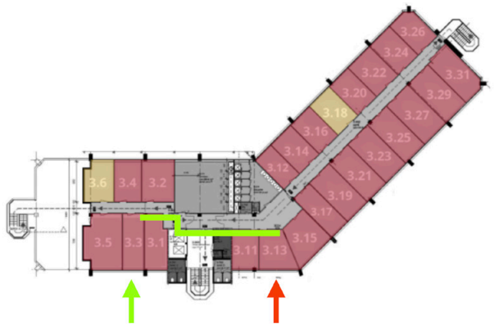
My aim was to see if any existing AI model could already address these challenges, or if the tasks were still too complex for current AI. I ran small, focused experiments using models like ChatGPT, Grok, and Ally (by Envision), as well as others like Gemini. For all the issues identified in previous sections, I worked on possible ideas in which I could use AI and attempt to check if the selected AI could solve the issue, or any limitations in the available video models. The Test insights were noted in simple format as below to record observations.

For example, to test indoor navigation, I uploaded a floor map and asked the AI to guide me from Room 3.3 to 3.13. The task involved walking straight, turning right, then left, and finding the correct room on the right side. Some parts worked, but others didn't. The instructions often assumed the user could see, and in many cases, the AI only processed the image after I asked multiple times. In simpler tasks, like asking the AI to guide a pen to a specific spot, the results were better. Gemini sometimes gave confusing or silly answers, which showed that very clear prompting was necessary. Overall, ChatGPT, Grok, and Ally gave the most helpful responses, but many tasks still need improvement before they're fully useful for blind or low vision users.

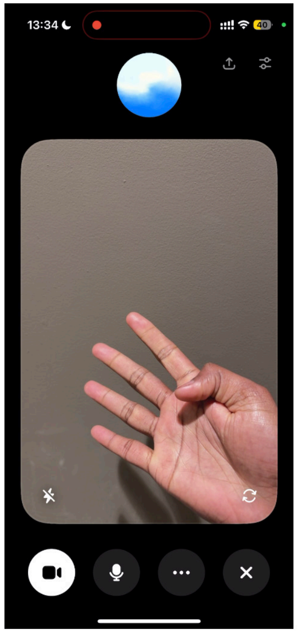
It became important that custom GPT prompt includes that the intended use is PBLV and the instructions to support were adjusted to refer non-visual references.

Key Insights from AI Model Testing:

Navigation with Floor Maps: When prompted to guide a user from Room 3.3 to 3.13 using a static floor map, AI models provided a route that was mostly correct. However, instructions were often framed as if the user had visual access (e.g., "3.13 is on your left"), making them less suitable for blind or low vision users. In two cases, directional guidance was reversed, indicating inconsistency in spatial interpretation. I**mprovised attempt was floor plan along with pictures around each turns**.



Lack of Real-Time Visual Processing: To test live video understanding, different numbers of fingers (changing number) were shown in front of the camera. ChatGPT consistently responded with a fixed count, suggesting it was using a single static frame rather than updating with continuous visual input. This indicates a limitation in processing live video feeds dynamically. *Although while writing this report ChatGPT Agent was introduced which can potentially make it proactive in this context, in near future. Last test was on July 22, with agent which does not yet have proactive possibility in video mode. The ideas are based on tested feasibility until June.*



Need for Repetitive Prompting: AI responses often required the user to repeat questions or issue follow-up prompts. For instance, when navigating or asking about surroundings, the AI did not continue proactively or maintain awareness of prior input unless explicitly asked again (like checking if the next turn in closeby).

Touchscreen Interaction & Hallucination: Tests involved asking AI to help identify specific spots on a touchscreen, such as a coffee machine menu. In simpler tasks, such as selecting a known coffee option, the AI was able to guide the user. However, when the requested item was not on screen, Gemini still attempted to guide, resulting in confusion. In another case, hallucinated guidance led to selecting the wrong drink ("hot milk" instead of "cappuccino").

Simpler Spatial Tasks Performed Better: Tasks that involved basic spatial alignment—such as guiding a pen to a specific spot—were executed more effectively than those requiring interpretation of environmental layout or dynamic navigation.

Model Comparisons (as on end of Mar 2025): Among the models tested, Perplexity, Claude and Gemini had no camera access. SeeingAI is suitable for really basic tasks like read or describe and didn't work for any of the 19 tasks. For Ally, if the question required camera, it takes one look captures the image and the camera closes - which means if the hand isn't in the frame yet, it might not even see it. However, if the hand is visible and close to the desired touch screen option (for example), it tells the movement once and closes. ChatGPT is overall better than the rest but along with it's own limitations. Although the camera live view remains open, one needs to ask everytime to check and then it accesses the visual. Hallucination, and the need to ask questions repeatedly are common drawbacks of all. By repeated question - the reference is to situations like "Can you keep checking and let me know when I am near the wall?" - and AI checks only once, unless it is asked again.

2.9 OBSERVED CAPABILITIES AND LIMITATION OF CURRENT AI MODELS

Since ChatGPT performed better, it makes sense to use it for further tests. And thus, these insights are noted for ChatGPT vision model. These insights also helps to evaluate what might be feasible in ideation phase, and futher.

What works well

1. Provide route directions from a floor plan
AI could correctly generate basic navigation instructions from a floor map (e.g., "walk straight, turn right, find Room 3.13"), when the route is simple and clearly described. If the scale is mentioned in the map, the gauidance improves.

2. Floor Plan with Images enables the GPT to verify location better
• AI (especially ChatGPT) could analyze an uploaded image or still frame and compare it with the knowledge data base of locations to detect user's location on the map. If places look similar, the GPT gets confused. But usually the detection is right by capturing and comparing the photos.

3. On touch screens where the layout is fixed and works in single touch
• In simpler cases, users were able to follow AI instructions to locate items like a cappuccino option on a coffee machine touchscreen. This requires asking the GPT multiple times as it only processes single photo as a time.

What might not work well

1. Fails to process live video feeds continuously
• Whenever a question is asked, the GPT uses the video frame just after the question to respond to the question

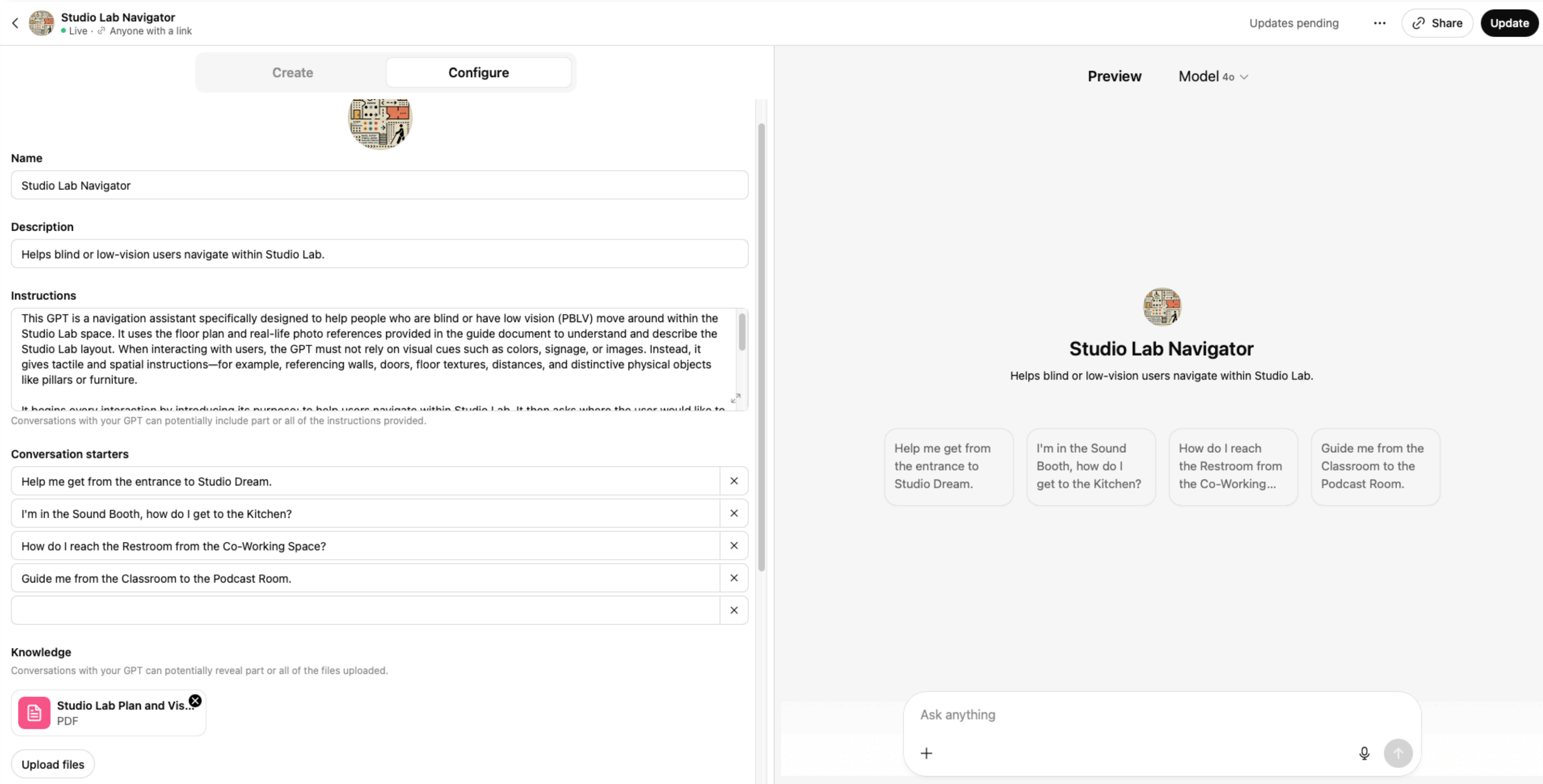
2. Flips spatial orientation (left/right errors)
• In two situations, the direction instruction on left/right was opposite to the real.

3. Requires repeated prompting; not proactive
• It does not continue offering guidance unless asked again, limiting usefulness in multi-step interactions.

4. Hallucinates content or options
• There are situations of hallucination and guiding even when the requested location or coffee didn't exist.

5. Cannot identify dynamic environmental changes
• If the environment changed after the initial image upload the AI does not detect or adapt to those changes unless explicitly asked.

6. Doesn't judge the distance well
• Can't accurately say how much should the hand be moved or how many steps/meters is the wall in front (unless provided information - the knowledge file of the GPT, includes such details)

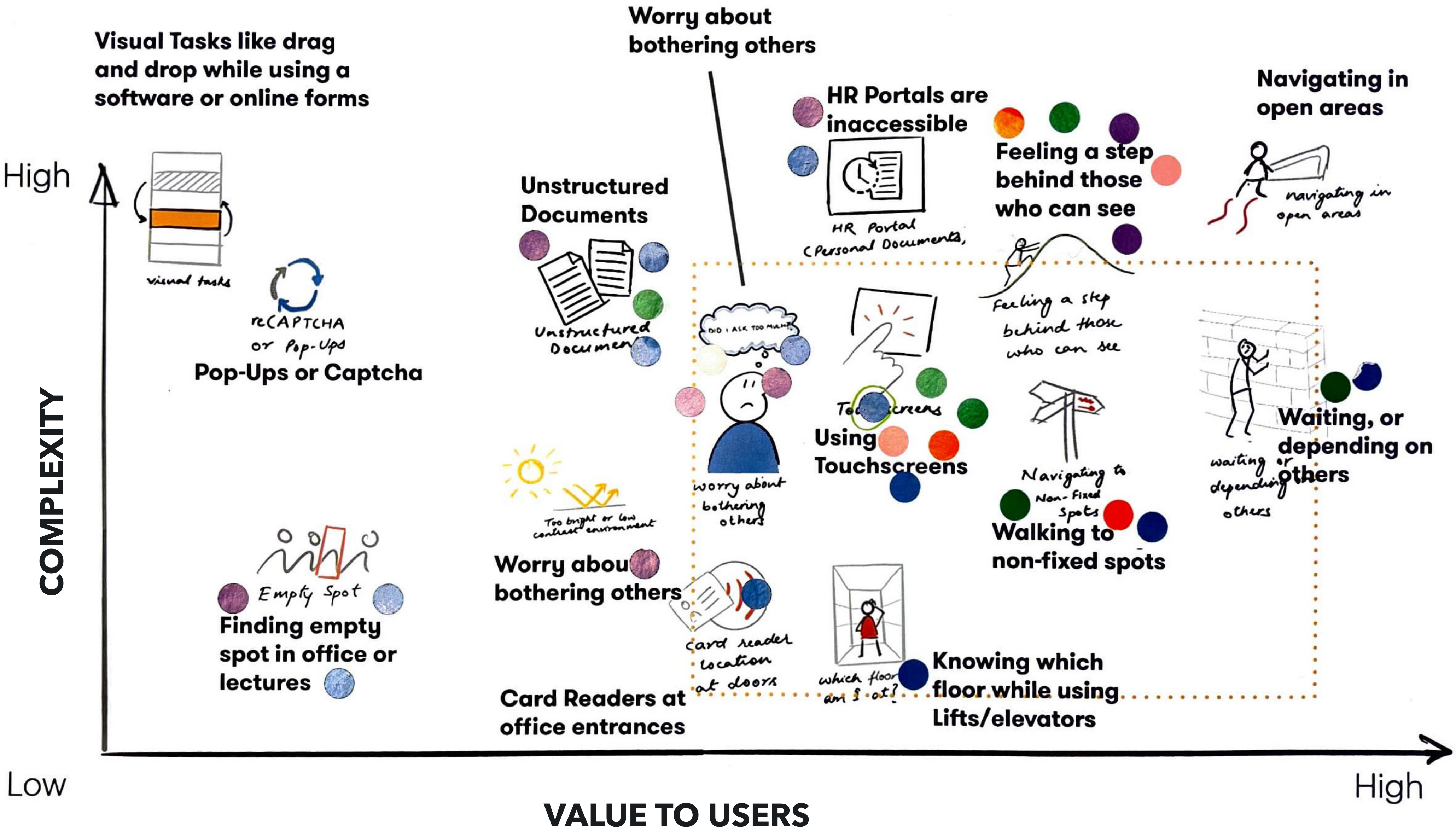

Studio Lab Navigator
Live · Anyone with a link
Updates pending
Share
Update
Create
Configure
Name
Studio Lab Navigator
Description
Helps blind or low-vision users navigate within Studio Lab.
Instructions
This GPT is a navigation assistant specifically designed to help people who are blind or have low vision (PBLV) move around within the Studio Lab space. It uses the floor plan and real-life photo references provided in the guide document to understand and describe the Studio Lab layout. When interacting with users, the GPT must not rely on visual cues such as colors, signage, or images. Instead, it gives tactile and spatial instructions—for example, referencing walls, doors, floor textures, distances, and distinctive physical objects like pillars or furniture.
Conversations with your GPT can potentially include part or all of the instructions provided.
Conversation starters
Help me get from the entrance to Studio Dream.
I'm in the Sound Booth, how do I get to the Kitchen?
How do I reach the Restroom from the Co-Working Space?
Guide me from the Classroom to the Podcast Room.
Knowledge
Conversations with your GPT can potentially reveal part or all of the files uploaded.
Studio Lab Plan and Vis...
PDF
Upload files
Preview
Model 4o
Studio Lab Navigator
Helps blind or low-vision users navigate within Studio Lab.
Help me get from the entrance to Studio Dream.
I'm in the Sound Booth, how do I get to the Kitchen?
How do I reach the Restroom from the Co-Working...
Guide me from the Classroom to the Podcast Room.
Ask anything

2.10 DOWN SELECTING FOCUS AREA

Approach: Value vs Complexity Mapping, Dot Voting

To find a focus area out of the 19 identified issues and thus have a focus area for next stage of the project, I used a Value vs Complexity mapping approach. On the x-axis is the user-perceived value (higher value to the right), and on the y-axis is implementation complexity (more complex towards the top). For each issue, I judged the value based on user interviews and research, and estimated complexity based on small tests for the available AI vision models. For example, an issue navigation in open spaces was placed higher in complexity due to lack of reliable references that AI can use, however if it can be solved, it would also offer more value to the user. Ideally, I looked for issues that offer high value to users but are still achievable or moderately complex.

Post this mapping and sharing my research with the team at Envision, I invited them for dot voting to further focus on the most promising areas. They responded based on their own understanding and experiences. Each individual had maximum 3 votes that they could use and place it for the idea that they thought (based on their understanding of the project and own experience of working at an accessibility startup) could be most promising to solve.



Visual Tasks like drag and drop while using a software or online forms
visual tasks
reCAPTCHA or Pop-Ups
Pop-Ups or Captcha
Empty Spot
Finding empty spot in office or lectures
Worry about bothering others
Unstructured Documents
Unstructured Documents
Too bright or low contrast environment
Worry abou bothering others
Card Readers at office entrances
card reader location at doors
DID I ASK TOO MUCH?
worry about bothering others
HR Portals are inaccessible
HR Portal (Personal Documents)
Using Touchscreens
which floor am I at?
Knowing which floor while using Lifts/elevators
Feeling a step behind those who can see
Feeling a step behind those who can see
Navigating to Non-Fixed Spots
Walking to non-fixed spots
Navigating in open areas
navigating in open areas
waiting or depending others
Waiting, or depending on others
High
COMPLEXITY
Low
High
VALUE TO USERS

2.11 DECISIONS FOR NEXT STEPS

Post the dot-voting, the following two areas emerged as potential focus areas for further works in this project.

1. Using Touch Screens

We see touchscreens almost everywhere now – coffee machine, while ordering at a restaurant, printers, touch panels outside meeting rooms, getting a train/ tram ticket, ATM machines, self-checkout and many more, and we can't imagine the world moving away from touchscreen, at least in the short foreseeable future. In the context of educational and office environment, coffee machine and touch screen panels outside the meeting/lecture rooms are very common. That also means being dependent each time one needs a coffee. During an interview, one of the participants said, "I always have to wait for someone else going in the same direction as the coffee machine so that I can ask them and go along and they can touch the coffee for me. I don't mind. But wait, why should I have to wait for someone for such small tasks?"

In the context, if this is solved, there would be freedom to do these small tasks without the need of depending on others. It's also a feeling of independence and they don't have to wait for anyone

"*I always have to wait for someone else going in the same direction as the coffee machine so that I can ask them and go along and they can touch the coffee for me. I don't mind. But wait, why should I have to wait for someone for such small tasks?*

(Quote from user interview)

2. Walking to Non-Fixed Locations

When we follow a same pattern, it's easier to remember. It's similar in case of routes within or outside of a building. However, with hybrid work culture becoming more common, people don't always have to be in office. So, the seating doesn't remain the same that can be learnt and followed each day. The situation is even more pronounced in case of meeting rooms for example, it's very common that each time we book a meeting room, we get another meeting room – rarely the same again. And as an individual grows in roles and ranks within an organization, they also must check in with multiple teams who report to them – sometimes in different buildings. Indoor navigation and especially for point A to B where B can always change becomes challenging. One of the participants mentioned during interview, "I always wear an earphone while using my laptop as I have to hear and work to know what is happening on the screen. If I don't use earphones, it might be a disturbance to others. Once I removed my earphone 3 minutes before our meeting, so that I could walk to the meeting room with others who are also in the same meeting. But I realized they had already left for the meeting. I was really clueless how to go."

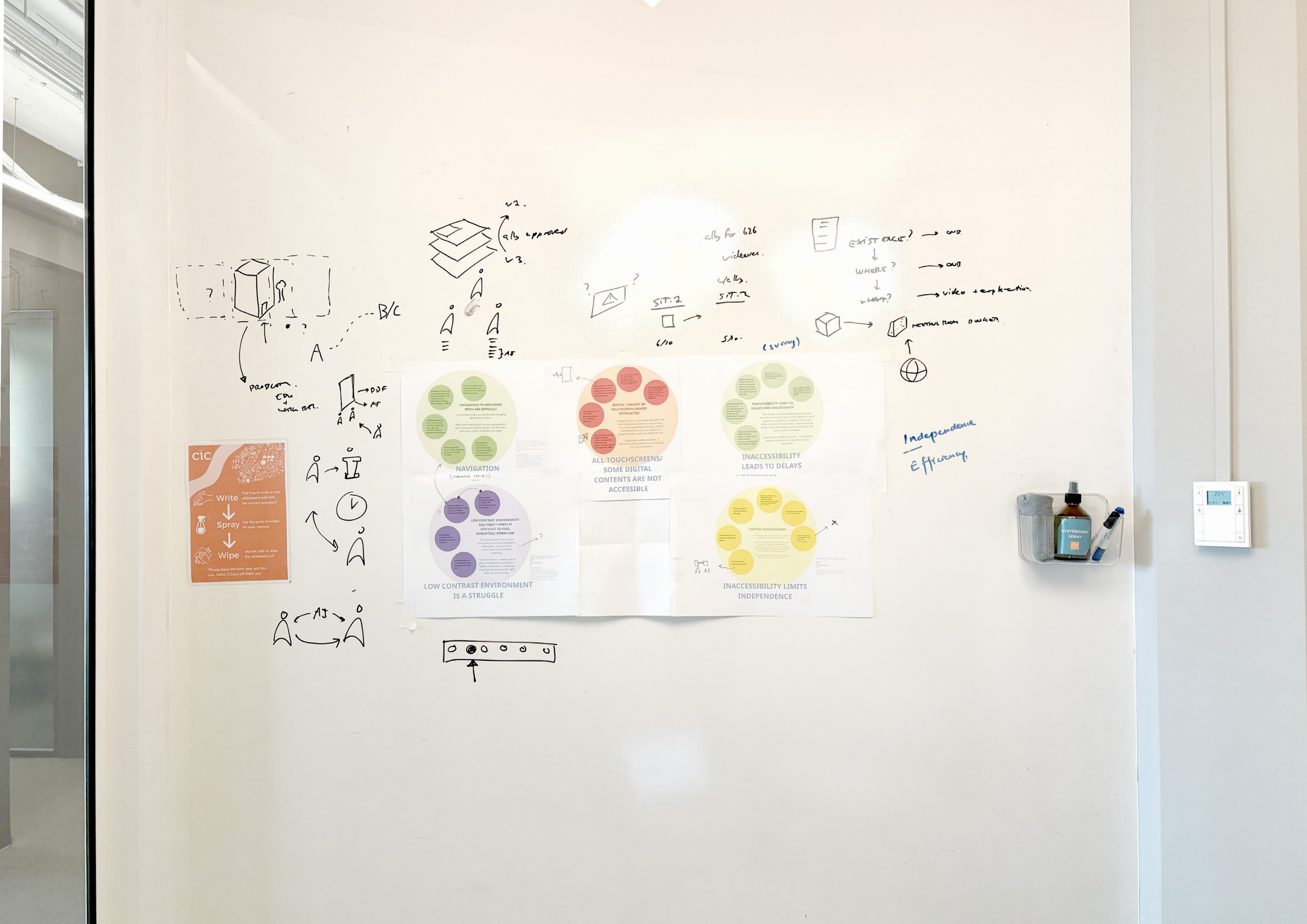
In this context, if this issue is solved it opens the potential of short navigation from one place to another within the office environment. This can possibly help a lot in indoor navigation, as of now there is no good solution available for people who are blind or have low vision. It has higher impact potential as this activity happens more oftern than using a touch screen - for example going for lunch, meeting, washroom, coffee etc.

For going further in the project, and deciding one of these two directions, prototyping and testing with the users seemed like a realiable way to already include the real users – and get their reaction before the final design is even ready. The next chapter details about prototyping and testing working on a few ideas and testing with real users along with co-creation.

> *"I always wear an earphone while using my laptop as I have to hear and work to know what is happening on the screen. If I don't use earphones, it might be a disturbance to others. Once I removed my earphone 3 minutes before our meeting, so that I could walk to the meeting room with others who are also in the same meeting. But I realized they had already left for the meeting. I was really clueless how to go.*
>
> (Quote from user interview)

2.12 CHAPTER CONCLUSION

Chapter 2 outlines the research process and key insights that shaped the direction of the project. The primary aim was to understand the daily barriers faced by people who are blind or have low vision (PBLV) in educational and professional settings, and to evaluate how a virtual personal assistant (AI) could meaningfully support them. Using a mixed-method, iterative approach—including desk research, interviews, shadowing, co-creation workshops, early prototyping, and AI model testing—the chapter identifies 19 specific issues clustered around navigation, touchscreen accessibility, and emotional impact. A value vs. complexity mapping, combined with user feedback and stakeholder voting, helped narrow focus to two key areas: touchscreen interaction and indoor navigation to non-fixed locations. Testing current AI vision models revealed their potential (e.g., in interpreting floor plans and images) as well as limitations (e.g., no live video processing, frequent hallucination, need for repeated prompts). Users preferred guidance that was hands-free, paced by them, and grounded in physical or sensory landmarks. Based on real user feedback, iterative testing, and technical feasibility, navigation emerged as the preferred focus area due to its higher frequency and greater impact on autonomy. This chapter not only grounds the design direction in lived experience but also prepares the foundation for Chapter 3, where early design concepts are prototyped and tested in collaboration with users to conclude on one out of the two shortlisted activities.



NAVIGATION
ALL TOUCHSCREENS/ SOME DIGITAL CONTENTS ARE NOT ACCESSIBLE
INACCESSIBILITY LEADS TO DELAYS
LOW CONTRAST ENVIRONMENT IS A STRUGGLE
INACCESSIBILITY LIMITS INDEPENDENCE
Independence
Efficiency
EXISTENCE?
WHERE?
WHAT?
video + explanation
B/C
PDF
(survey)
Write
Spray
Wipe
WHITEBOARD SPRAY

EARLY IDEAS, TESTING & INSIGHTS

3. TESTING & CO CREATION

3.1 Early Ideation Approaches

Following the key insights from Chapter 2, the early ideation phase focused on developing possible approaches for two main use cases: navigation and touchscreen interaction and then decide one of the two as focus area for the next phase of the project.

3.2 Goal of the Test

Testing effectiveness of guiding through voice/images and how well the approach supports the participants in navigation as well as in guiding to use a touch screen.

3.3 Envisioners Day (Testing and Co-Creation Session)

The structured test session was conducted on 16 May 2025 during Envisioners Day at the Envision office. Envisioners day is a recurring event organised by Envision every few months where people who are blind or have low vision are invited to try new technologies. Envision team has a list of participants, and groups on their social channels where they share about the next upcoming envisioners day and invite participants. Those who wish to attend, sign up to join.

Three participants (PBLV) took part. Each session lasted approximately 30–40 minutes and included the following components:

1. Touchscreen Interaction (approx. 15 minutes)

Participants interacted with a simulated coffee machine interface (iPad), guided by the custom GPT. The goal was to assess how independently and effectively users could select an item. Feedback was collected via:

• A 1–5 Likert scale
• Open-ended discussion
• Real-time observation

2. Indoor Navigation (approx. 15 minutes)
Participants tested two AI-based methods:

• Text-based Guidance: Audio instructions delivered step-by-step, relying on the user's environmental awareness (e.g., corners or walls).
• Photo-based Guidance: User sends a photo; AI responds with guidance based on visual match to reference photos.

Each method was rated and discussed to understand usability, speed, and clarity.

3. Individual Reflection (5–10 minutes)

Participants shared their own past experiences and described their imagined "ideal solutions," based on the assumption that anything was technically possible, and if they felt one of the two was more important for them to be solved.

Sessions began with a consent process and closed with open feedback, all of which informed the next phase of concept development.

3.4 Ideas in Navigation Test

Photo + Audio: Users share a photo of their current location. AI compares this with a set of reference photos, determines their position on a floor plan, and provides further guidance to the destination. Repeats until the destination. (Takes time to process, needs hands to take photos using phone, but is reliable to verify the location from the knowledge file data).

Audio Only: AI uses pre-fed floor plan data to provide turn-by-turn audio only instructions from the user's current position to the destination. (No processing time, and the pace can be better adjusted to user but users needs to be aware of the srroundings or location themselves)

Ideas in Using Touchscreen Test

AI Audio Guidance: The layout of a touchscreen (e.g., coffee machine) is provided via a photo—captured either through a smartphone or Envision glasses. The AI then guides the user's hand to the correct selection.

AI Audio Guidance + Physical Marker: In addition to the audio guidance, tactile markers (e.g., textured tape indicating row and column edges) are placed around the screen to support orientation and physical referencing.

3.5 Testable Target

(currently broad): Primarily testing on communication/guiding approach

A. Navigation:

1. Effectiveness of AI guidance using photo input

- Can AI correctly interpret location and give accurate next-step instructions based on images?

2. Effectiveness of audio-only navigation

- Is voice guidance alone sufficient for a blind user to confidently reach a destination?

3. Clarity and usability of spatial instructions and orientation

- Do users understand terms like “turn to 2 o’clock orient correctly” or “walk 10 steps”? Or is there some other more accepted preferences.

4. Comparison between photo + audio vs. audio-only modes

- Which mode feels/works more accurate, efficient, or practical?

B. Touch Screen

1. Usability of AI-guided touch interaction without tactile markers

- Can users locate and press the correct option - (currently used hand/finger-based measurements)

2. Impact of tactile markers on performance and confidence

- Do physical markers improve accuracy, speed, or independence?

3. Clarity of AI instructions - Communication

- Are participants able to follow instructions like “slide your hand down three hand widths” without confusion?

4. User preference between interaction types (with vs. without markers)**

- Which approach do users find more intuitive and usable?

3.6 Prototyping

Each interaction was approached through two layers:

1. User Experience: How the user would interact with and experience the solution.

2. Technological Feasibility: What the technology would need to do in the background.

3.7 Wizard of Oz Prototyping and Test Plan

For prototyping, the focus was on the interaction experience, assuming the technology would function as intended. Assumptions on feasibility of AI model was based on the testing outcomes with different AI vision models presented in Chapter 2.

How Navigation Prototype was Tested

The AI was given a floor plan and photo set of a real testing route (from one room to another). A custom GPT model was trained using this dataset and tested multiple times beforehand to ensure it provided accurate directions. Meeting room ‘Hexagon’ to ‘Envision Office’ was trained and refined to guide using photos. And return route was trained to guide using audio only.

How Touchscreen Prototype was Tested

A replica of the office coffee machine interface was created using an iPad placed at similar height to the actual machines using cardboard prototype. This was set up in a quiet meeting room for uninterrupted testing. The custom GPT was provided with the same screen layout it would receive via photo input. The goal was to evaluate communication: how clearly the AI could guide the user’s hand to the correct selection. The GPT was iterated and refined before testing to improve its guidance accuracy.

3.8 Individual Insights

Individual Participants

Participant 1: **found the touchscreen interaction with tactile markers to be the most effective**, rating it 5/5 for **enabling independent use without assistance**. **He found the navigation system ineffective**, especially with a guide dog, **due to slow, overly detailed instructions** and **lack of real-time adaptation,** and **expressed a preference for simple, voice-only interfaces** for both navigation and touchscreen use.

Participant 2: found the **touchscreen with tactile markers more usable**, rating it higher and noting it helped simplify interaction, while the **hand-based distance measurements caused confusion**. He found the **navigation instructions overwhelming**, suggested s**impler, more step-by-step guidance.**

Participant 3: referred the **touchscreen interaction with tactile markers**, which allowed them to visualize the grid layout and navigate it independently, especially after some trial and explanation. **He found the navigation support ineffective,** rating both modes 2/5 due to **lack of real-time feedback**, ambiguous or non-relatable instructions (e.g., "space becomes wides"), and emphasized the need for a **continuous, vision-based system (like glasses)** that could assist more naturally during real-world mobility.

3.9 Overall Insights

Both Navigation and Touchscreen were seen as something with good potential and practically useful by the participants, if possible.

A. Navigation

Key Findings:

1. Both image-based and audio-only navigation systems were rated low in effectiveness (mostly 1–2 out of 5).

2. Image-based navigation required the user to take photos manually – impractical for blind users managing a cane or guide dog. Continuous video feed with regular image processing

3. Audio-only navigation provided too much information at once, lacked confirmation feedback, and used vague spatial terms.

4. Some instructions were visually descriptive but not tactilely useful (e.g., "the curtain wall" - when curtain was on the other side of the glass wall which AI could see but users couldn't touch or feel).

Main Challenges

- Cognitive overload: Long, stacked instructions were hard to process. It was later adjusted during the test (in audio only mode) and that was more useful.

- Lack of real-time adaptation: AI couldn't detect if the user had already moved or missed a step. Frequent video (image frame) processing and audio only guidance can be a better possibility if it is within the technical feasibility right now at Envision.

- Inadequate error recovery: No feedback loop if the user strayed from the intended path.

- Unclear cues: Some participants couldn't feel or verify the landmark (e.g., a curtain behind glass).

- Device handling: Holding a phone to take pictures while using a cane or guiding a dog is unrealistic. And sometimes (like during the test), one user also had a coke can which further adds to the trouble.

User Preferences and Suggestions

- Live camera feedback (e.g. via envision glasses) for real-time understanding and corrections.

- Use of environmental sounds/tactile landmarks like flooring changes or ambient sounds (e.g., server hum).

- Simpler, sequential instructions like "walk 10 steps," then pause, then "turn right." [Or possibility to go to next step of navigation based on user's feedback. One pointed out they he does not use the swipe when he is outside as that needs removing hands from gloves and that is difficult when it is cold outside. Voice interaction might be more suitable]

- The AI should sense about the orientation on its own to avoid redundant instructions (e.g., "turn" when already facing correct direction).

- Preference for meter-based over step-based distances – or combination with known tactile landmarks.

> *"I don't use the touch interface on the Envision Glasses. When I am out, it's just too cold to take my hands out of the gloves. I would prefer if it could work directly with the voice.*
>
> (Quote from Test Participant)

B. Using Touch Screen

Key Findings:

1. Touchscreen interactions were far more successful than navigation tasks.

2. The best-performing setup combined:

   - AI voice guidance

   - Clear layout information

   - Tactile markers to mark rows and columns

3. Participants were able to learn the grid layout and repeat actions independently. But the results were not same - one could follow, while other couldn't follow at the pace being guided. This point of guiding pace and the correction in the approach could be similar to as indicated for navigation - which is going for the next step

after user says so verbally.

4. Voice-only AI (without markers) was till helpful but required more effort and trial-error.

Main Challenges

- Hand/finger-based measurement instructions (e.g., “3 hand widths down”) were confusing.

- Users were unsure how to measure – which hand, finger, or angle to use.

- Lack of pacing in audio instructions made it hard to keep up – users missed second-hand instructions while still processing the first.

- Inconsistent language (e.g., “top of box” vs. “top of screen”) created uncertainty especially if someone couldn’t follow along at the same pace.

User Preferences and Suggestions

- Tactile markers was appreciated for quick orientation and repeatability.
- Users preferred standard layout they could memorize and reuse. For example where the tactile markers were placed.
- Ideal approach: voice-initiated commands + tactile layout with minimal steps.

> *“My dog can help with navigation but can’t read names or signages. I think AI can help with that.”*
> (Quote from Test Participant)

- Participants want the system to allow user-controlled pacing, e.g., tapping or saying “next” after each instruction.
- Ultimate/Ideal wish: voice-only interaction that bypasses touchscreens entirely – “I just want to ask for coffee.”

3.10 Overall Summary:

1. Navigation was rated low in effectiveness but offered higher value if improved – especially for indoor environments like offices or universities where users often seek non-fixed locations (e.g., meeting rooms).

2. Touchscreen interaction performed better in tests (especially with tactile markers) but was considered less frequent in daily life and more dependent on specific hardware setups.

3. Navigation had higher potential impact on user independence, even though it was harder to implement - users still preferred improvements in real-time, hands-free, vision-based systems (e.g., via Envision Glasses).

4. AI-guided touchscreen support was useful, but some users expressed a desire to bypass screens entirely with voice-only requests (e.g., “I just want to ask for coffee”), indicating its usefulness may be transitional rather than essential.

5. Frequency in a day noted dyring User Journey favored navigation as a longer-term, more widely applicable solution, with concrete directions to improve (like pace control, use of orientation cues, and hybrid visual-audio input via wearables).

3.11 Selecting Focus Area

Based on user feedback, frequency of task relevance, and implementation feasibility, the project will focus on indoor navigation to non-fixed locations (such as meeting rooms or classrooms).

Touchscreen interaction, while valuable, was deemed less frequent in daily use and technically more hardware-dependent. Navigation, though more complex, presents higher value and a clearer opportunity to enhance independence in s\ tructured environments like offices and universities.

3.12 Design Variables

This step aimed to systematically identify all the underlying factors—both user-driven and context-specific—that influence the nature of the design problem.
As Watkins and Dunne (2015) emphasize, clarifying key variables such as user needs, environmental context, and task demands is essential in developing functional design solutions that are both effective and user-centered.

DESIGN VARIABLES	SUB VARIABLE	RELEVANCE TO THE PROJECT
Interaction Modality	Voice input/output, tactile feedback, physical touch	Users rely on non-visual modes. Good to support audio-based interaction (preferably without the need for touch)
Cognitive Load	Instruction pacing, information stacking	Users prefer step-by-step instructions over stacked messages. High information density leads to confusion or delay.
User Control	Instruction speed, decision checkpoints	Users want to control the pace of the interaction (e.g., when to proceed to the next step), not be passively guided.
Hands-Free Use	Wearable input/output, microphone access	Users often have hands occupied with a cane or guide dog. The solution must minimize reliance on handheld devices or touch gestures.
Environmental Orientation	Physical cues, layout references	Changes in flooring or spatial elements help users orient. Design should leverage these environmental anchors for navigation and encourage users that they can always ask if their orientation is right.
Proactive Guidance	Anticipatory help vs. reactive replies	Current AI needs prompting. A system that proactively offers context-sensitive guidance would reduce dependence and cognitive effort. **But this is not feasible with current models.**
Visual Processing Support	Static image interpretation, layout mapping	AI works better with clear, structured visual inputs (e.g., screen photos, floor plan images) and can support layout-based guidance as pre-fed document
Feedback Responsiveness	Processing delays, user confirmation	Users need clear confirmation that the system is listening or thinking—especially during slow internet or backend processing (like audio feedback)
Trust and Predictability	Error handling, hallucination prevention	Users lose trust if AI offers incorrect options. Ensuring factual consistency and fallback responses is essential for adoption
Direction Clarity (Left/Right)	Left/right accuracy, layered directionality	Audio instructions must be unambiguous and not mirror-flipped. Terms (e.g., "turn left") must match actual layout.

3.13 Design Constraints

This step focused on identifying design variables that fall outside the designer's scope of influence and must be treated as fixed constraints (Watkins & Dunne, 2015). These constraints define the boundaries within which the solution must operate, and are shaped by user context, environmental limitations, and technical realities observed during testing.

DESIGN CONSTRAINTS	DESCRIPTION
Non-Visual Interaction Requirement	Users cannot rely on visual cues. All interaction must be accessible through audio, tactile, or other non-visual means - smell, floor textures, sounds, walls, etc.
Hands Not Always Free	Users often hold a cane or guide dog. Interaction should not require using both hands or maintaining continuous physical input.
Environmental Noise/Voices	Public or semi-public environments (e.g., offices, universities) may have background noise, or people talking while passingby that interferes with voice interaction.
Device and Platform Limitations	AI runs on existing devices like smartphones or Envision glasses. These have limitations in processing power, battery life, internet connectivity and interface options.
Real-Time Video Interpretation Gaps	Current AI models process static images and not live videos. This limits continuous situational awareness and hinders real-time spatial orientation.
Inconsistent Internet Connectivity	In some locations, slow or unstable internevt affects AI responsiveness. Users need feedback even when systems are delayed or offline. But further instructions still may need internet.
Accessibility Regulations and Privacy Standards	Any deployed solution must comply with accessibility (e.g., WCAG) and privacy laws (e.g., GDPR), which may limit data handling or third-party integrations. User data and privacy policy should be explicitly informed to the users with option to change their preferences in the future.
User Technology Comfort Level	Users may differ in digital literacy or prior exposure to AI tools. The system must be usable without complex onboarding or assumptions about prior knowledge.
AI Fallibility	AI systems may hallucinate or provide incorrect output, especially when asked about unavailable options. This cannot be fully prevented and must be managed carefully in design. Although users can be advised to be situationally aware as they are still using their existing approaches like cane or dogs.

3.14 Design Requirements

This section outlines the essential requirements that emerged from user research, constraints, and testing, and identifies the strategic priorities that will guide the direction of this project. While all requirements remain relevant, the selected priorities reflect decisions made based on feasibility, impact, and alignment with Envision's context.

The design was guided by practical and strategic parameters that evolved based on the insights from the testing of user tests for the initial ideas:

Feasibility: The solution should be feasible ideally within a 6–12 month timeline after the end of this project.

Scalability: It should be adaptable to multiple locations and contexts.

Hands-Free Operation: The user should be able to interact with the system without needing to use their hands.

Error Prevention: The AI should not mislead the user if the requested spot or target does not exist.

Clear Feedback: The system must provide clear, timely feedback—even during waiting states like poor connectivity or processing delays.

Personalised Guidance Pace: The assistant should allow users to control the pacing of information—no stacked or overwhelming bursts of data.

Complementary to Guide Dogs: The assistant should not replace guide dogs but work in harmony with them if present.

Physical/Practical Anchoring: Guidance should include reference to physical or practical cues in the environment.

Arrival Awareness: The assistant should confirm when the destination has been reached to support closure and orientation.

3.15 Testable Targets

A. INDEPENDENCE (USERS)
1.Do users feel independent in doing the task using the AI assistant?
2.Do users avoid needing to ask others for help during the task?
3.Is the experience hands-free?
4.Are users able to orient themselves and start in the right direction?

B. PRODUCTIVITY (USERS)
5.Do users reach their destination more quickly than without Ally?
6.Do users understand when to change directions without backtracking?
7.Does the pace of Ally's instructions match the user's walking speed and decision pace?

C. USABILITY AND RELEVANCE (USERS)

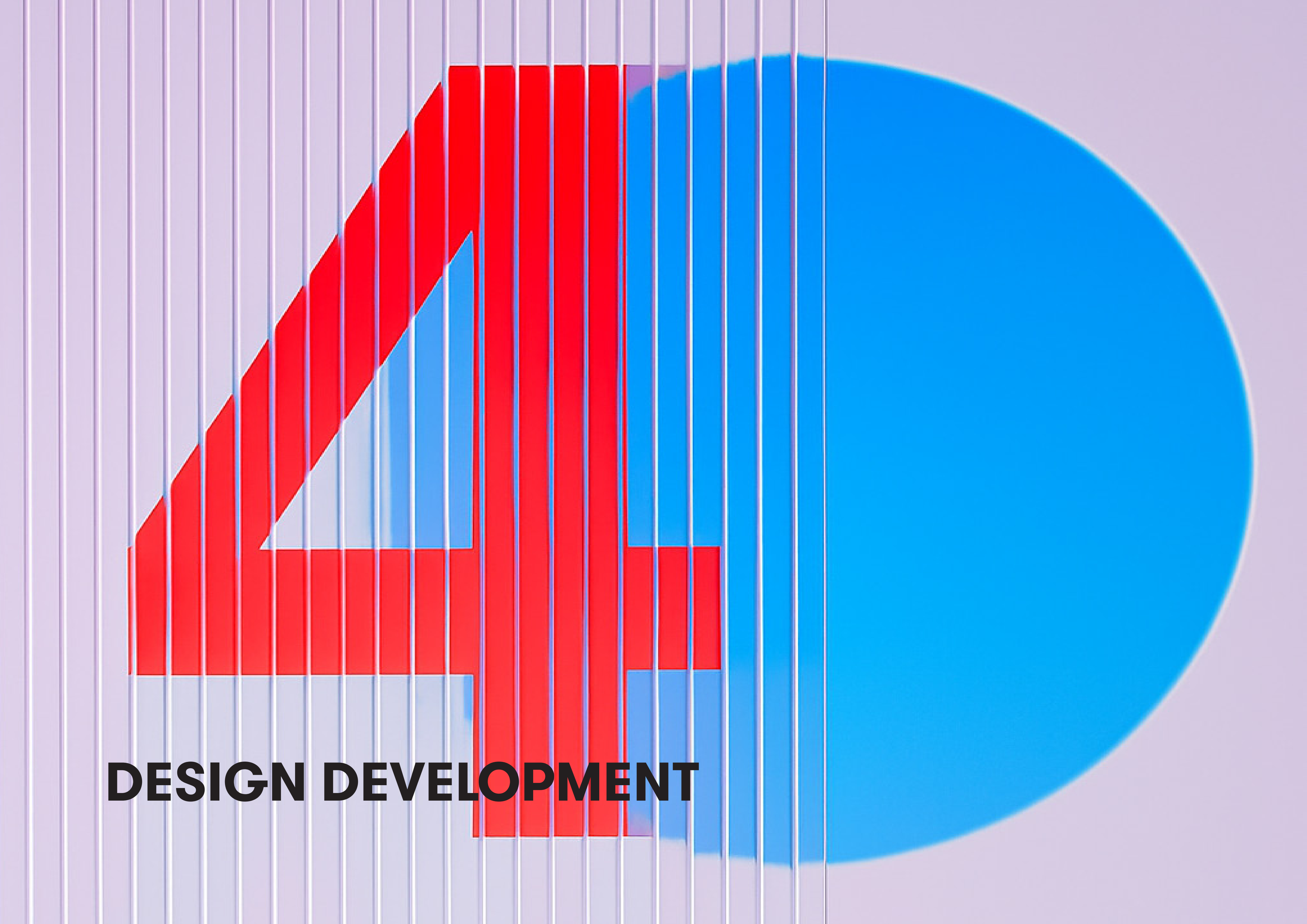
8.Are the instructions clear and useful for completing the task?
9.Do users want to use Ally again in future tasks?

D. SCALIBILITY (CLIENT)

10.Can the design solution be easily replicated in other buildings?
11.Does Ally require minimal training/setup from users or staff?

3.16 CHAPTER CONCLUSIONS

Chapter 3 documents the early prototyping and co-creation phase, where two shortlisted directions—indoor navigation to non-fixed locations and touchscreen interaction—were tested with real users. The goal was to evaluate which direction offered greater value and feasibility, using structured sessions during Envisioners Day with participants who are blind or have low vision. Each prototype was tested through Wizard-of-Oz methods (prepared, tested GPT which worked on 1 route and 1 screen), focusing on how clearly and effectively the AI assistant could guide users via voice and photo-based instructions. For touchscreen interaction, participants tested a simulated coffee machine interface guided by audio, with and without tactile markers. For navigation, both photo-based and audio-only turn-by-turn guidance were tested. Participants consistently rated touchscreen tasks higher in usability but indicated that navigation was more essential and frequent in real life. Key preferences included: clock-based directions, step-counting over distance (with mixed opinions), environmental cues, and voice-pacing controlled by the user. Based on feedback, navigation was selected as the final design focus—despite its complexity—because it offered greater potential to improve daily independence. This chapter transitions into Chapter 4 by finalizing the decision to develop Ally SenseScape, an audio-first, hands-free navigation assistant using Envision Glasses.



DESIGN DEVELOPMENT

4.1 DESIGN DEVELOPMENT

4.1.1 Overview

This chapter documents the development of the design solution through three exploratory directions—Approach A, B, and C—each shaped by different insights from the envisioners' day (user test and co-creation session). These design approaches were not fully visualised concepts, but interesting directions to pursue while ideating suitable design solution.

Narrowing down to define the approapriate direction was guided by Harris Profile, which helped assess the relative strengths and limitations of each approach. Through prototyping and testing, Approach B—an audio-first, voice-activated navigation assistant—was identified as the most promising direction and further developed into a refined solution.

4.1.2 Design Approaches Considered

As part of design development, three possible approaches were explored to address the challenge of indoor navigation for people who are blind or have low vision. Each option was evaluated against the design requirements using a Harris Profile to determine feasibility, user suitability, and alignment with project priorities.

Approach A: AI as a Guide Dog Companion

This approach imagined AI as an assistive companion that enhances the capabilities of a guide dog. It focused on tasks guide dogs cannot do—such as reading signage or recognizing landmarks. The user insight that "my dog can help with navigation but can't read signs—AI can help with that" inspired this idea. While the concept aligns with user habits and builds on existing tools, its broad scope and need for tight AI-animal integration made it less feasible in the short term.

Approach B: Voice-Based Guidance Using Floor Plans (Selected Approach)

This approach was based on voice interaction with a personal AI assistant ("Hey Ally"), which guides users based on floor plans, environmental cues (e.g., sounds, textures), and photos of key locations. It requires only occasional image input (e.g., to establish orientation), allowing for mostly hands-free interaction.

Approach C: Real-Time Video Interpretation

This concept explored using continuous video input (e.g., via Envision Glasses) to analyze surroundings in real time. It offered high adaptability but required continuous visual processing, introducing challenges with processing speed, reliability, and the practicality of device use while walking. It was rated lowest in feasibility due to current limitations of available AI vision models.

4.2 Harris Profile

		CONCEPT A				CONCEPT B				CONCEPT C			
Requirements		-2	-1	1	2	-2	-1	1	2	-2	-1	1	2
1	Likely to be feasible in 6-12 months				2				2	-2			
2	Scalability to more locations	-2							2			1	
3	Possibility to use without needing hands				2				2				2
4	AI should not misguide in case of absence of requested location		-1	1			-1	1			-1	1	
5	User should have clear feedback (even during lack of internet, processing)		-1					1		-2			
6	Guiding pace should be personalisable				2				2			1	
7	Physical/Practical References in guiding the route				2				2			1	
8	Awareness if destination is reached			1				1				1	
9	Right orientation at starting point		-1					1					

4.1 Introduction to Design Development

Following the focus selection in the previous chapter, this section details the development of Concept B, a voice-based navigation assistant designed for people who are blind or have low vision. The design supports independent navigation to non-fixed indoor locations using Envision Glasses and voice interaction with a custom AI assistant called Ally.

The concept was selected based on its strong alignment with user needs, feasibility within a 6–12 month timeline, and it mixes the reliability of using images while better pace by relying mainly on voice first guidance. The system builds on a layered approach, combining pre-fed floor plans, photos, and sensory cues (e.g., sounds, textures), and allows hands-free interaction which gets triggered by saying 'Hey Ally' to suit the physical realities of users managing guide dogs, canes, or bags which makes their hands busy.

Based on the discussion with client, along the design requirements noted in previous chapters, concept B was noted as more promising than the other two.

4.2 Approach B Overview: Ally SenseScape

The approach envisions Ally as a personal AI assistant built into the Envision ecosystem. Users activate Ally via voice ("Hey Ally") and receive step-by-step guidance to a destination within a building.

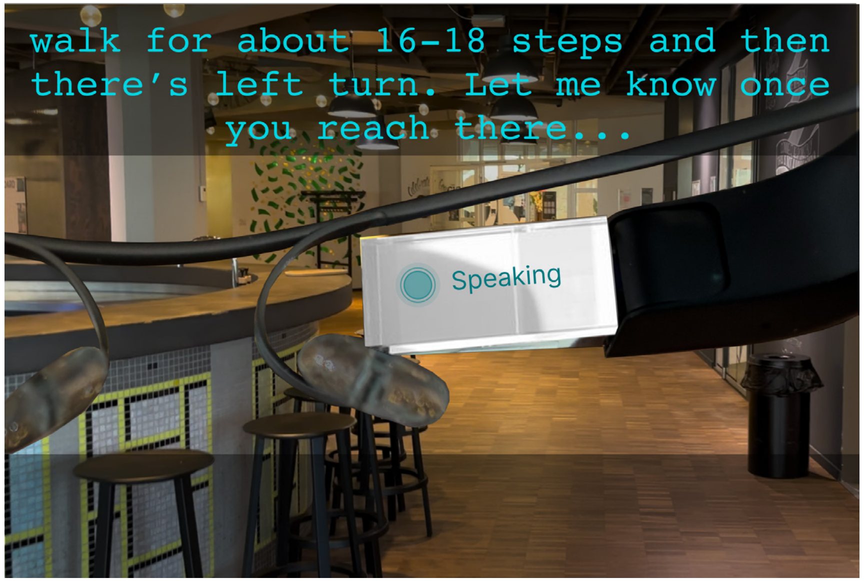
Core idea of the approach include:
• Audio-first interaction, activated by voice and delivered through Envision Glasses.
• Hands-free use, no need to hold or operate a phone (images are captured through theEnvision glasses).
• Guidance paced by the user, using a call-and-response model ("Ally, I have turned the corner"). Also images are captured, when user needs support in orientation or checking the current location on the floor.
• Physical/environmental anchoring, using known cues like floor transitions or sounds.
• Orientation support, using photos sparingly only at start or on request (e.g., "Can you check where I am?").

4.3 User Interaction Flow

Click here to play the interaction flow audio (Acrobat Reader)

Ally SenseScape has access to Map, Location Photo and Compass info. "Hey Ally" initiated the conversation.

(Hereafter, conversation can be followed in "Z" flow on each page)


walk for about 16-18 steps and then there's left turn. Let me know once you reach there...
Speaking

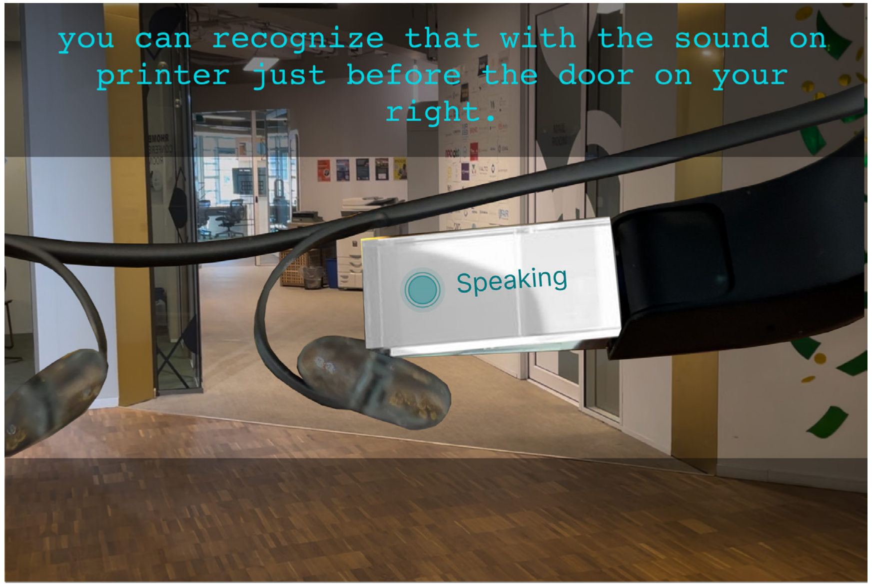

watch out for space around you as the corridors on this floor don't turn at perfect right angles
Speaking
Ok, I walking now...


Listening
And taken a left turn. Can you check if I am still on the right path

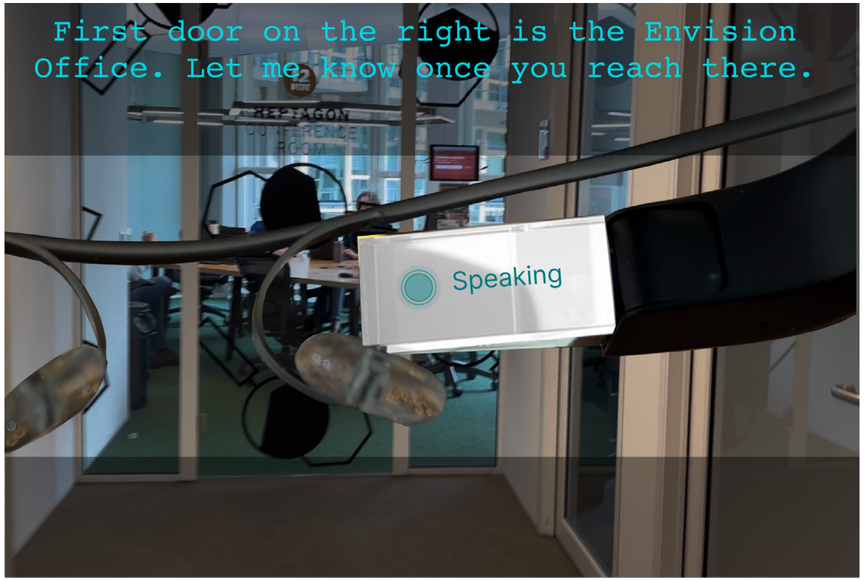

Sure, let me take a look...
Capturing Image

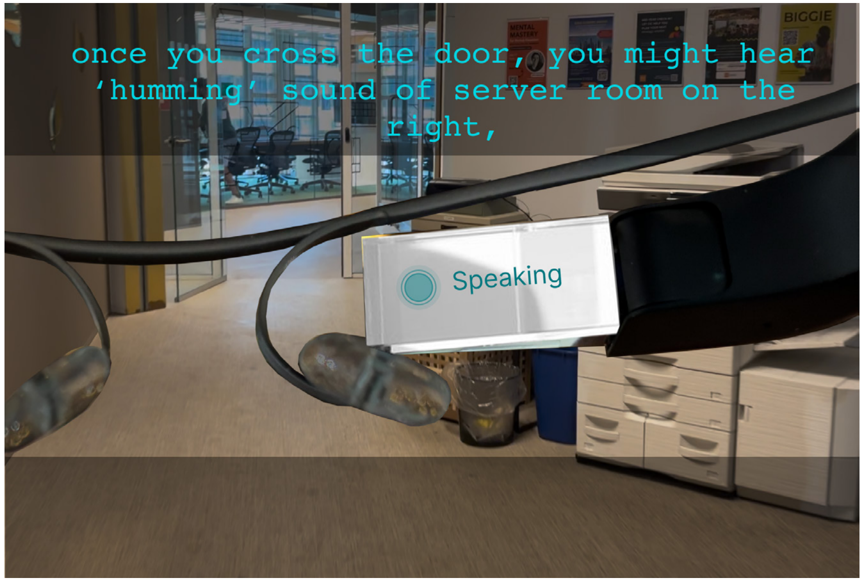

envision
Listening
Can you check if I have reached?


Yes, this looks like a right path...
In about 15 steps, you will cross a door
Speaking


you can recognize that with the sound on printer just before the door on your right.
Speaking

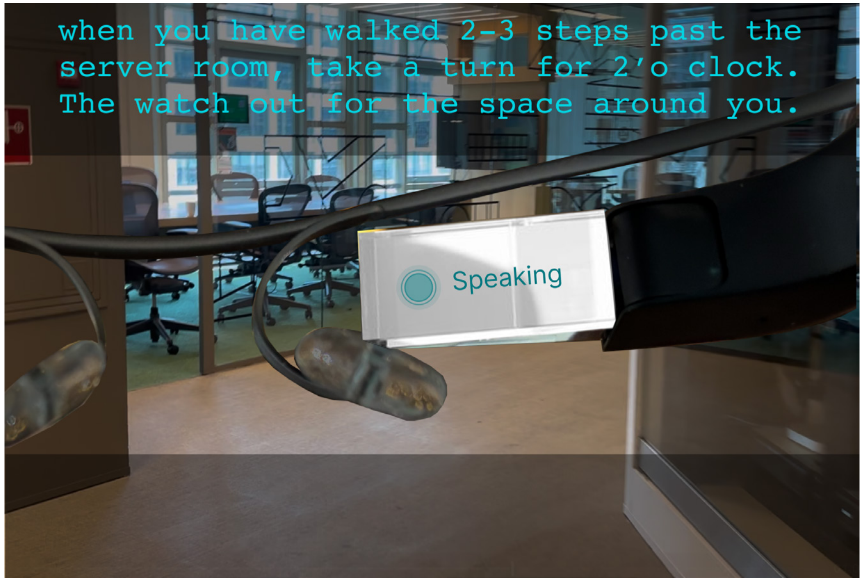

BIGGIE
Listening
I am passing by printers on my right...

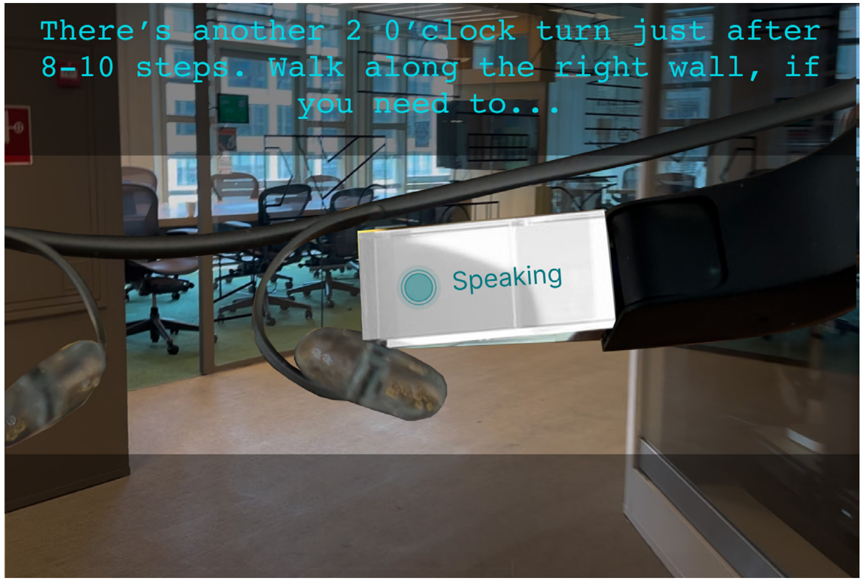

First door on the right is the Envision Office. Let me know once you reach there.
Speaking


once you cross the door, you might hear 'humming' sound of server room on the right,
Speaking


the hallway slowly turns right there. Please be aware of your surroundings.
Speaking


Listening
And I have now passed the server room


when you have walked 2-3 steps past the
server room, take a turn for 2'o clock.
The watch out for the space around you.
Speaking

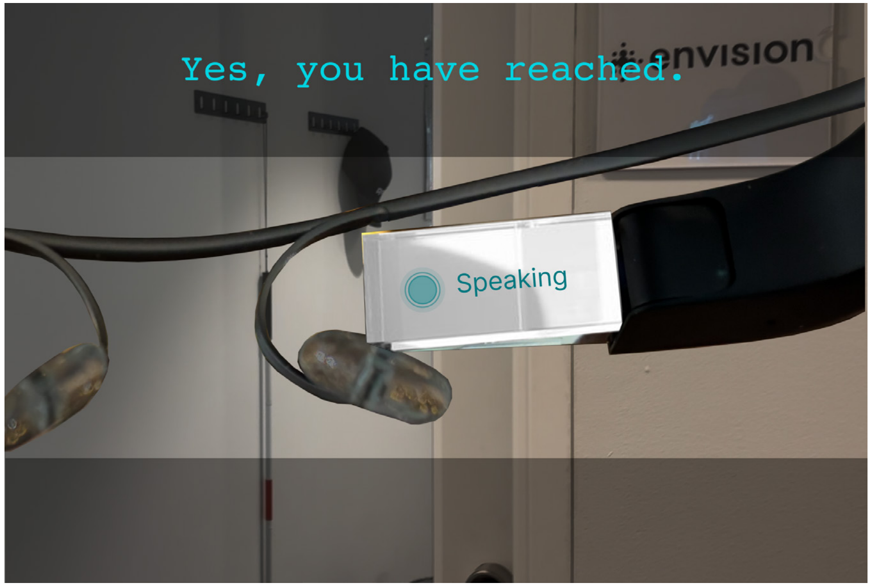

There's another 2 0'clock turn just after
8-10 steps. Walk along the right wall, if
you need to...
Speaking

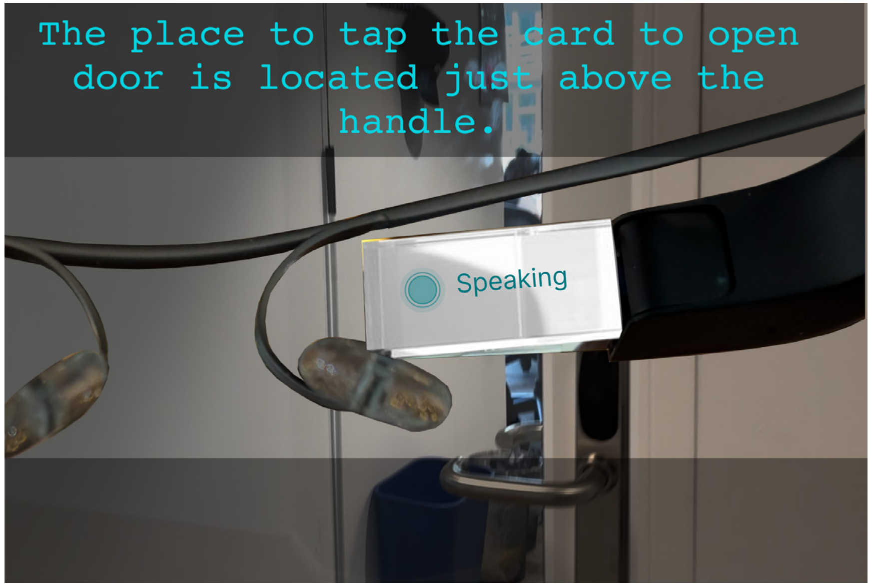

Speaking
Now, I am taking the 2 o'clock turn.


We are almost there now, just continue
further for 14-15 steps.
Speaking


We are almost there now, just continue further for 14-15 steps.
Speaking


Sure...Let me take a look!
envision
Capturing & Analysing Image

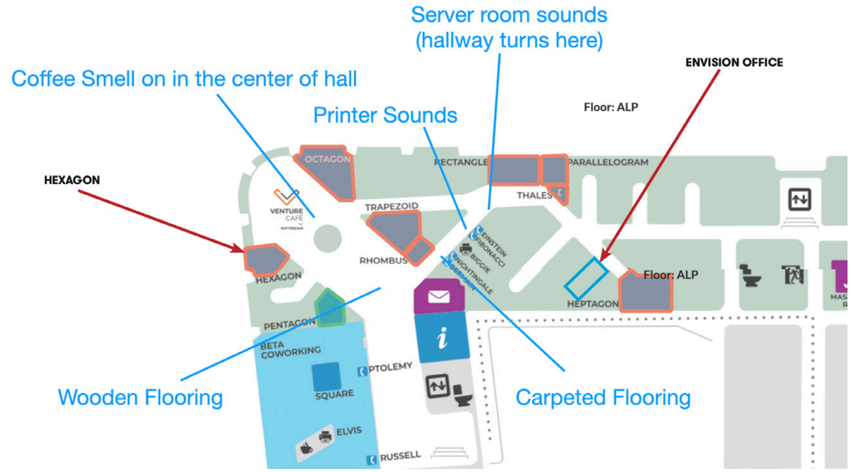

Yes, you have reached.
envision
Speaking

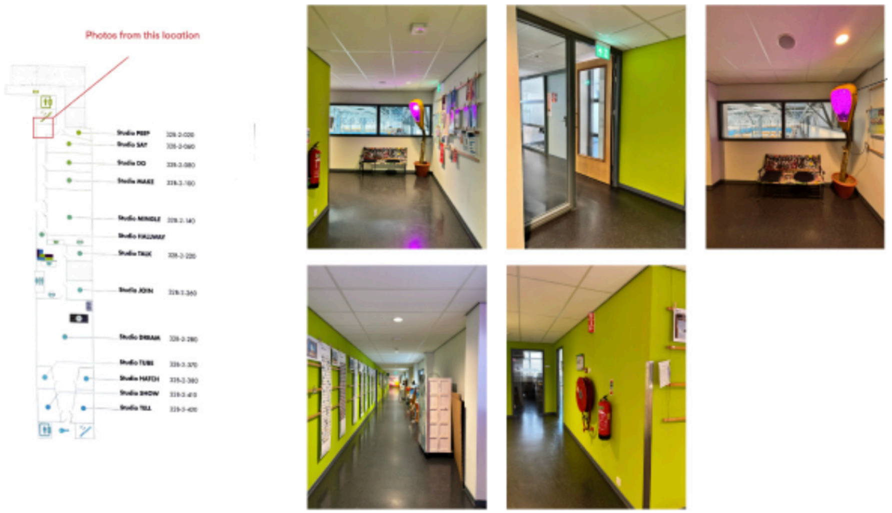

The place to tap the card to open door is located just above the handle.
Speaking

4.4 Knowledge Files and Data Access

The functionality of Ally Sensescape relies on a set of structured knowledge files that inform its navigation guidance. These include the floor plan of the building, which defines the spatial layout and connections between rooms, and reference images of key locations, which the assistant can use to verify orientation or confirm arrival when prompted by the user. Additionally, the system incorporates environmental anchors–such as flooring (carpeted/wooden) or the sound of a nearby printer, the smell of a coffee machine, or the ambient noise of a server room–as supplemental cues to enhance spatial awareness during wayfinding. These details are gathered during while adding the floor on the Ally SenseScape library. These addition of places can be done by sighter people in the company or university to ensure that the images are clear etc.

The assistant also accesses data from the built-in compass module of the user's device to estimate orientation, such as helping determine if a user is turen "2 o'clock" or "north." While compass data supports directional accuracy, it is treated as a supplementary aid and never used as the sole basis for navigation decisions, due to the known limitations of indoor compass precision. If the user requests it, the assistant can triangulate this compass input with either a verbal confirmation (e.g., "I've turned right") or a photo-based orientation check. This layered, on-demand approach reflects the system's commitment to robustness without assuming real-time environmental awareness. It must be noted that while the feasibility of compass has been checked with Envision team, real use could not be checked in the user test as implementation in app needs more time than this project timeline could allow.





4.5 Development Decisions

The following decisions guided the development of Concept B:
• No continuous image processing: Live video processing is not yet feasible with current AI tools. The assistant uses single-image inputs only when prompted.
• Clock-based directions: Phrases like "turn to 2 o'clock" were clearer than "turn slightly right," unless turns on the floor are right angled.
• Step counts over meters: Users preferred counting steps rather than estimating meters, as steps are easier to track mentally.
• Landmarks for confidence: Sounds (e.g., server rooms, printers), floor texture (e.g., carpet vs. tile), and smells (e.g., coffee) increase spatial awareness and clarity.
• No need to hold the phone: System works entirely through voice and Envision Glasses to keep hands free for cane, dog, or bag.
• Pacing is user-led: Rather than flooding users with instructions, Ally waits for the user to request the next step or share the turn that they have already taken.

4.6 Error Handling and Troubleshooting

Given the dynamic nature of indoor navigation and the current limitations of AI systems, error handling in Ally Sensescape is a critical component of the design. Rather than attempting to eliminate all errors, the system is designed to acknowledge uncertainty, maintain transparency, and invite collaboration from the user. These fallback strategies are not fixed solutions, but evolving interaction patterns—refined continuously through real-world testing and user feedback.

Below are seven key scenarios observed or anticipated during prototyping and early testing, where Ally Sensescape actively manages uncertainty or errors through structured fallback responses. These do not cover all possible edge cases—further testing in real-world contexts is needed to surface additional breakdowns and adaptations that were beyond the scope of this project timeline.

4.6.1. Unrecognized or Incorrect Location Requests

When a user requests a location that doesn't exist in the current Ally Sensescape profile (e.g., "Room 4.15" while on Floor 3), the assistant cross-checks the known room list and responds:

"I couldn't find that room on this floor. It might be on another floor. Would you like me to check if it's available in another Ally Sensescape location?"

This fallback is triggered only when the user asks for a room name that does not match any in the pre-fed list.

4.6.2. Loss of Internet or Connectivity

If the system cannot process a user's request—especially when a photo needs to be uploaded—Ally does not go silent. Instead, a prompt is included in the fallback logic:
"I'm having trouble connecting right now, so I can't check the photo. But I can still guide you using saved directions and known floor information."

This keeps the interaction responsive, even when cloud-based image processing is unavailable.

4.6.3. Missed Orientation Input (e.g., user forgets to mention a turn)

When the flow expects confirmation (e.g., "I've turned right") and the user continues without it, the system does not guess. Instead, it prompts clarification:

"Just checking—did you make a left or right turn just now? I can update your position or wait for a photo if you'd like me to confirm your current location."

This is a designed check-in prompt that is triggered if expected user feedback is missing in a known decision point or if the conversation goes confusing.

4.6.4. User Changes Destination Midway

If the user says something like, "Actually, take me to Room 3.17 instead," Ally acknowledges the change and responds through fallback prompting:

"Okay, I've updated your destination to Room 3.17. Should I continue from your current location or wait for a photo to re-check where you are?"

Again, this is not automatic rerouting but a branching logic defined in response to user intent.

4.6.5. Unexpected Physical Obstruction

If the user encounters an obstacle and reports it (e.g., "The corridor is blocked"), Ally cannot detect the obstruction itself but is designed to respond supportively:

"Thanks for letting me know. You can take a photo or describe what's ahead, and I'll try to help you reroute."

The fallback here assumes user-initiated reporting of the breakdown. Ally advises users to be aware of the surrounding using their personal approaches (cane or guide dogs). This Ally SenseScape system is an add-on designed to enhance the what already works individually.

4.6.6. Ambiguous or Vague Commands

When the user makes a vague request such as "Take me to the meeting room," and multiple matching results exist, Ally uses a clarification prompt:

"I found more than one possible match for 'meeting room.' Do you mean Room 3.09, Room 3.13, or the large hall?"
This logic helps avoid misdirection while letting the user disambiguate the intent.

4.6.7. Voice Confusion in Shared Spaces

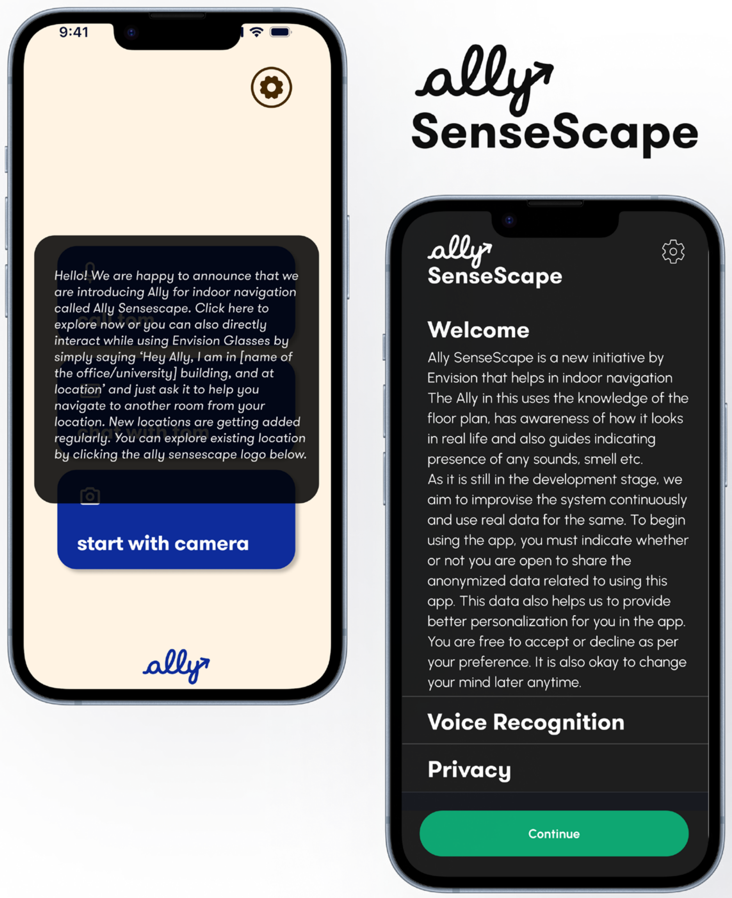
In environments like offices or classrooms, if another person nearby speaks a command (intentionally or unintentionally), Ally may interpret it as coming from the user—leading to incorrect actions or confusion.

To prevent unintended commands being accepted from others, Ally Sensescape incorporates voice recognition to verify whether the command is coming from the registered user. If the voice does not match, Ally responds with:

"That doesn't sound like the person I'm assisting. If this is still you, please say your name or ask me to continue."

This mechanism helps ensure that instructions are only accepted from the intended user, reducing the risk of misdirection, confusion, or breaches of autonomy in shared settings. Voice verification is treated as a lightweight security layer—not for authentication, but for interaction consistency. But Ally doesn't ignore such situations like cough etc when the sound might be a bit different.

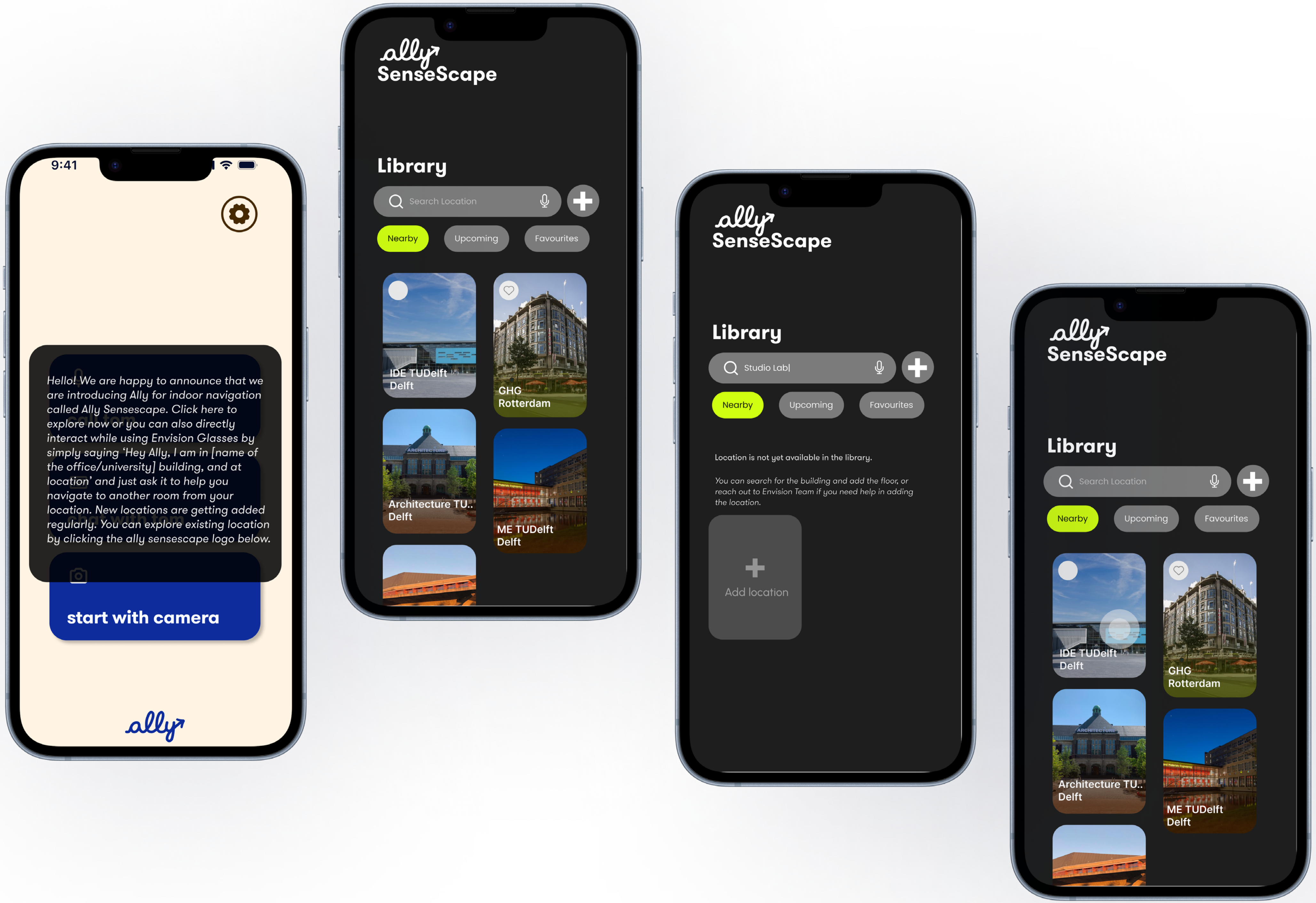
Each of these strategies is based on explicit, pre-structured interaction patterns, not AI initiative. These fallback prompts were embedded into Ally's interaction design to maintain fluidity and user trust without overpromising intelligence or real-world awareness. As Ally evolves, more fallback scenarios will be developed in response to real-world variability and diverse user preferences.



4.7 Onboarding and Scalability for New Locations

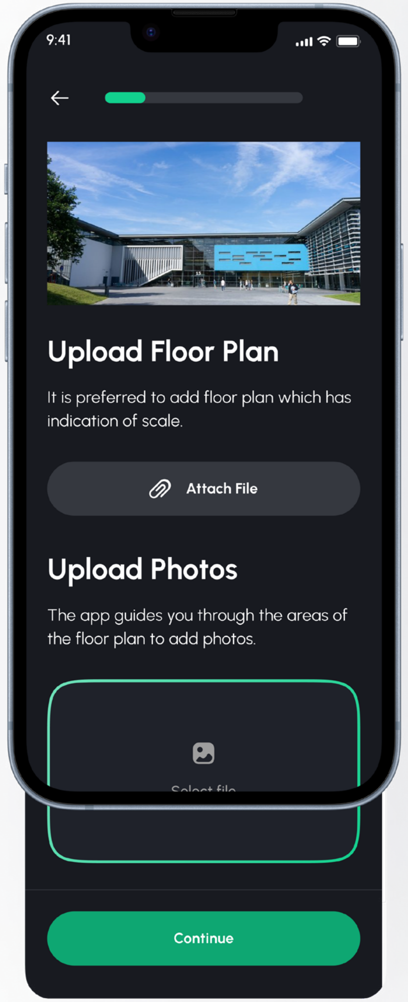
To ensure implementation feasibility, Concept B is designed as a modular, building-specific assistant:

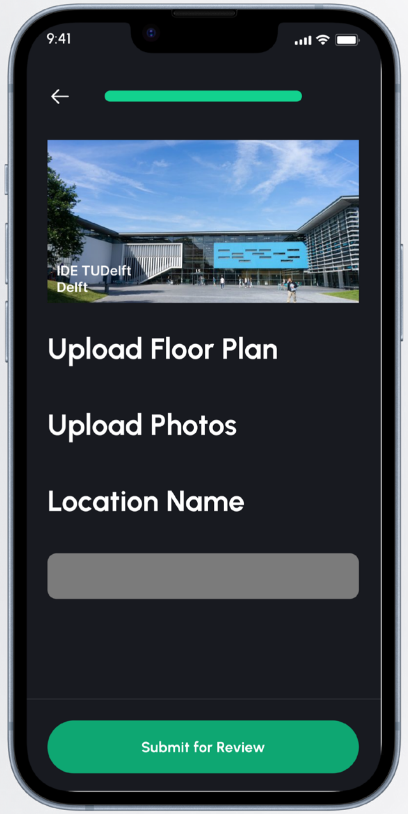
• Ally profiles are created per floor in a building (e.g., CIC Office, IDE TU Delft).
• Users can select the correct Ally instance for their location within the Envision app or website.
• Once user submits a new location/floor, it is reviewed by Envision team for ensuring that the details are reliable (for example the images are clearly recognization etc) before publishing.

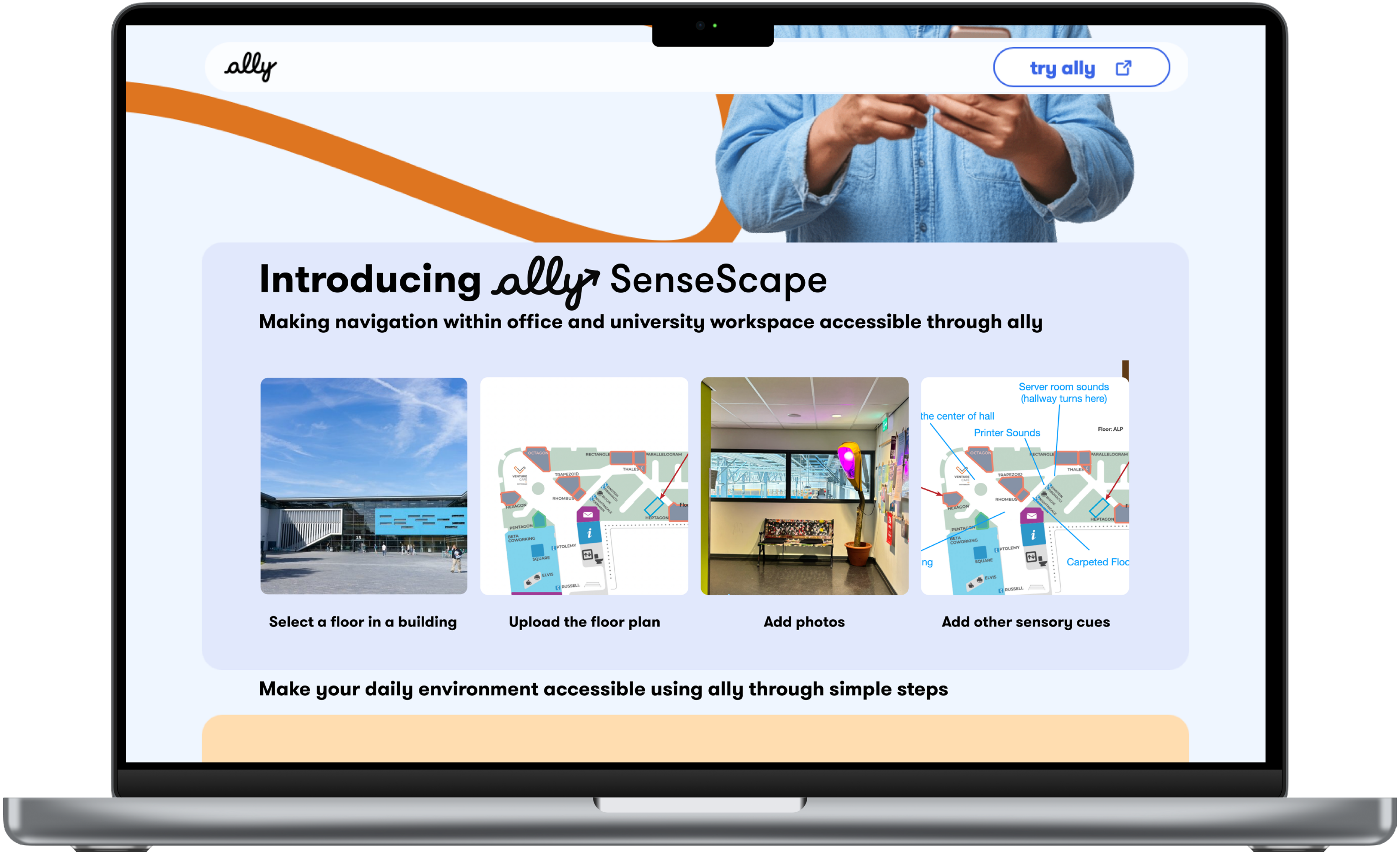

9:41
Hello! We are happy to announce that we are introducing Ally for indoor navigation called Ally Sensescape. Click here to explore now or you can also directly interact while using Envision Glasses by simply saying 'Hey Ally, I am in [name of the office/university] building, and at location' and just ask it to help you navigate to another room from your location. New locations are getting added regularly. You can explore existing location by clicking the ally sensescape logo below.
start with camera
ally
ally SenseScape
Library
Search Location
Nearby
Upcoming
Favourites
IDE TUDelft Delft
GHG Rotterdam
Architecture TU.. Delft
ME TUDelft Delft
ally SenseScape
Library
Studio Lab|
Nearby
Upcoming
Favourites
Location is not yet available in the library.
You can search for the building and add the floor, or reach out to Envision Team if you need help in adding the location.
Add location
ally SenseScape
Library
Search Location
Nearby
Upcoming
Favourites
IDE TUDelft Delft
GHG Rotterdam
Architecture TU.. Delft
ME TUDelft Delft

Onboarding process includes:

- Floor plan
- Photos of key locations (6-8 per area, facing different directions)
- Notes on landmarks: smells, sounds, textures
- These profiles are processed once by envision to evaluate that the information is reliable to use by the AI, and then can be used by any Ally user.
- This can be added by sighter users (like staff in the company or university) who can make sure the clarity of images etc.
- New Place can also be added using ally website. (www.ally.me/sensescape)



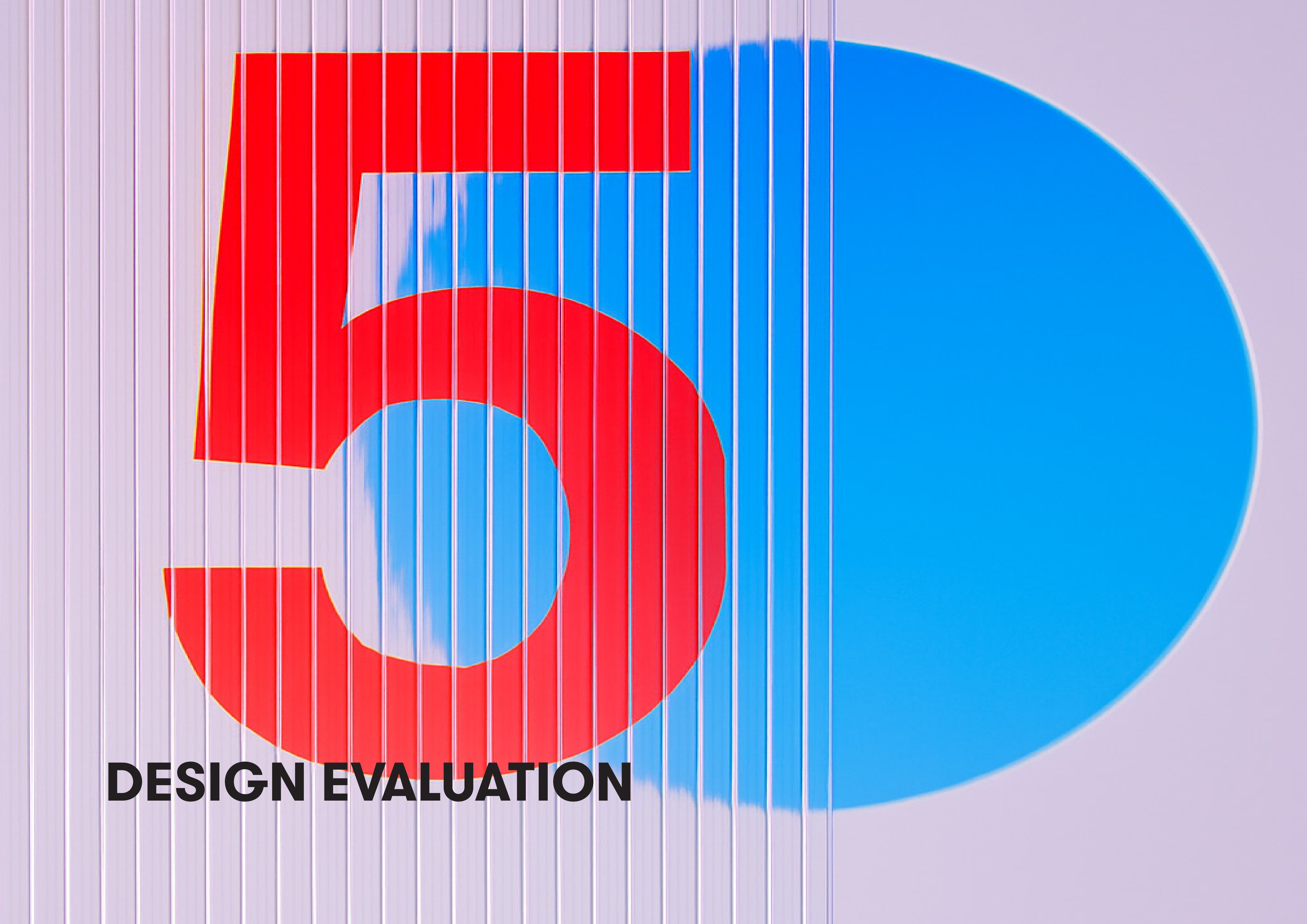




New Place can also be added using ally website. (www.ally.me/sensescape)

4.8 CHAPTER CONCLUSIONS

Chapter 4 presents the design development of Ally SenseScape, an audio-first indoor navigation assistant integrated with Envision Glasses. Building on findings from earlier testing, three directions were explored - AI as a guide dog companion, real-time video navigation, and audio-first voice-based guidance. Using the Harris Profile to evaluate feasibility, scalability, and user fit, the voice-guided approach (Concept B) emerged as the most promising. Ally SenseScape enables users to initiate navigation via voice ("Hey Ally") and receive step-based, clock-oriented instructions using floor plans, sensory references, and compass input. The system is designed to work hands-free and adapt to users' preferred pace, with fallback mechanisms for errors like missed turns, unclear commands, or connectivity issues. Development choices prioritized clarity, trust, and usability—avoiding live video streaming in favor of single image checks (for faster processing as well as limitation of current vision models) and emphasizing environmental cues like sound, floor texture, and smell. A modular onboarding flow was designed for scaling Ally SenseScape to new buildings, allowing sighted staff to upload floor plans, photos, and cues through the Ally website or mobile app. This chapter sets the stage for Chapter 5 by translating inclusive insights and technical constraints into a testable concept ready for structured user evaluation.



5

DESIGN EVALUATION

5. DESIGN EVALUATION

5.1 Introduction

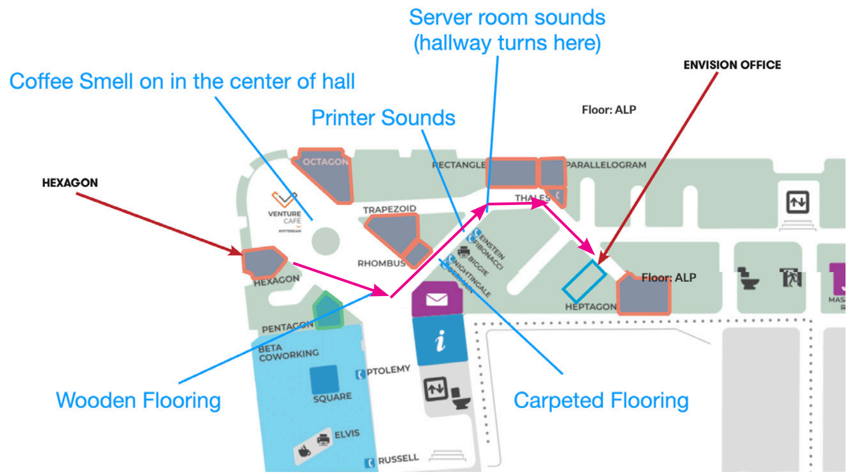
This chapter evaluates the performance of Ally Sensescape through three structured user tests. The objective was to assess if the final design proposal covers all aspects of the design requirements outlined as well as the testable target, both in chapter 2.

Two participants were IDE students and for them, the test was conducted in Studio Lab of IDE where they navigated (blindfolded) from Studio Say (Meeting Room A) to Studio Join (Meeting Room B). Third user test was with a real user (a blind participant) and the test was conducted at Envision Office. The navigation was from Hexagon Meeting room to Envision Office.

5.2 Test Setup and Methodology

The evaluation was conducted through three individual user sessions, using a structured plan. The goal was to assess how users experienced Ally Sensescape in realistic indoor navigation tasks where they were informed about the features, how it works and that I would be assisting as their personal AI Assistant (Wizard of Oz). They were also informed that they need to tell if they made a turn (as it is the case of the design, where AI doesn't actively acceses the camera). These situations also created scenarios where they needed to reorient or ask where they were during the navigation.

All participants were asked to navigate a pre-defined route as described earlier (Studio Lab for students and Envision Office for real user). As a preparation to be AI Assistant, I made notes of the sessory cues that I can share with the participants, like flooring, or sounds that they can hear. Student participants were voluntarily blind folded (prior to test, they were shown the route to make them familiar with the exercise as they were not used to walking blindfolded).



Planned route is shown in Pink

Each session followed the same structure:

- A formal informed consent process was conducted, followed by a verbal briefing outlining the purpose of the test, safety considerations, and how to interact with the assistant.
- Student participants (sighted) were showed around the route, to make them familiar as they were not used to walking blind folded. This was not done in case of the real user.
- During the navigation task, participants were encouraged to ask questions,

request confirmation, or indicate if they made any turns.
• They were observed during the task for any questions later on (e.g., orientation errors, walking hesitation) and noted responses and timing.
• After completing the task, participants participated in a semi-structured interview in which they shared their experiences and filled in a Likert-scale feedback form. A System Usability Scale (SUS) was also completed in selected cases to assess the perceived usability of the assistant.

5.3 Participants

The test involved a total of three participants:
• Two design students from TU Delft participated under blindfolded conditions. They were already made familiar with the route to follow, but completed the test with their eyes covered. They were provided which a wooden stick (acting as a cane)
• One blind participant tested the solution at the Envision office. The test environment was unfamiliar to them, providing a closer match to real-world scenarios.

5.4 User Feedback: Blindfolded Student Participants (P1 & P2)

• Both students struggled to stay straight without vision—they often drifted or stepped sideways while walking.
• Found the AI guidance helpful overall, but emphasized that timing and reaction time adaptation needed improvement.
• Preferred step-based instructions over distance-based ones, as they were easier to process.
• Highlighted the need for simpler, user-adjustable language and more personalized pacing.
• One student suggested the system should confirm user preferences (e.g., whether to switch to step-based guidance).
• Observation (not mentioned by participants): While they didn't explicitly say it, their inconsistent straight-line walking and hesitation showed a need for stronger orientation support and continuous correction during straight-path segments.

5.5 User Feedback: PBLV Participant (P3 – Envision Office)

• Gave high Likert ratings and a SUS score of 92.5/100, indicating excellent usability.
• Felt confident and independent using the system, especially appreciated clock-based directions and contextual markers (e.g., printer on the right). Suggested use of right of left when it was right angle turns.

• Said he would like to use the system frequently in daily life, especially in shopping centers and offices with many meeting rooms.
• Mentioned that pacing felt appropriate and instructions were clear in most places.
• Shared that he trusted the AI more if it were part of Envision Glasses in real-world use.
• Observation: During the test, he seemed unsure when a turn had to be taken in the middle of a hallway, especially in areas lacking clear markers.
• Overall, unlike sudents this participant was did not disorient on a usually straight path (unless it was a clock turn) without much physical reference in a a hall.

5.6 Summary

What worked
• Clock-based instructions were intuitive and well-understood by both real and student participants.
• Environmental references (e.g., "printer on the right") helped users feel confident that they were on the right path.
• Step-based guidance was consistently preferred over meters; participants could count steps more easily. But possibility to switch the system was desired.
• Real user felt independent and confident, especially "imagining the AI working


SLIDE
Houd de lijn vrij!

through Envision Glasses."
• Tactile support tools (like the cane) helped complement the AI guidance.
• All three participants said they would want to use the system again in different real-life contexts.

What didn't work

• Both student participants struggled to walk straight without vision – frequently drifting or stepping sideways.
• Turns in mid-hallway without tactile markers caused uncertainty, especially in the real user case – though this wasn't mentioned verbally, it was clearly observed.
• If the participant forgot to mention that they took a turn, the AI wouldn't be aware of the location and this created situation there re-orientation or checking location was needed.
• Timing of instructions was sometimes off – AI didn't always account for user reaction time, leading to confusion or near-collisions. Real User was better equippied with better handling of cane.
• Distance in meters was unclear – participants had trouble estimating what "10 meters" meant and preferred step-based alternatives. This was individual preference.
• Environmental references were sometimes ambiguous – participants couldn't always identify landmarks the AI mentioned, for example coloured sofas in studio hallway due to lack of other sensory cues there. [Indicates not all turns have sensory cues].
• Lack of live feedback – users didn't always know if they were still on the right path after making a turn or missing a step or drifting sideways.
• Students mentioned lack of personalisation – one suggested that the system should confirm changes like switching from meters to steps.
• Participants didn't always know how much control they had – unclear interaction model made it harder to know what commands or prompts were possible.

5.7 System Usability and Ratings

Participants provided feedback using Likert-scale items adapted to the context of assistive navigation. Below is a summary of qualitative and quantitative ratings across three key areas.

Perceived independence (1–5 scale):

• P1: 3 – Felt partially independent but still required orientation support.
• P2: 3 – Same as above.
• P3: 5 – Felt fully independent throughout the task.

Clarity of instructions (1–5 scale):
• P1: 4 – Clear but sometimes late.
• P2: 4 – Same as above.
• P3: 5 – Found all instructions helpful and easy to follow.

Willingness to use in real life (1–5 scale):
• P1: 3 – Would use in unfamiliar settings.
• P2: 3 – Similar response.
• P3: 5 – Would actively use it in daily life if available. But eventually learn the route and then might not need it.

SUS Score (P3 only):
• 85 – Suggests excellent usability and high potential for real-world deployment.

5.8 Reflections and Design Implications

The evaluation demonstrated that Ally Sensescape holds promise as an audio-first navigation assistant for people who are blind or have low vision. Across both simulated and real user sessions, participants reported increased orientation confidence and a stronger sense of autonomy compared to unaided movement through unfamiliar spaces. The assistant's step-based instructions, clock-face orientation, and environment-anchored cues were positively received, particularlywhen delivered with user-controlled pacing and the option to ask for clarification.

The findings reaffirm several design principles established in earlier stages: the importance of keeping interactions simple and spatially descriptive, allowing for user-led confirmation, and supporting fallback strategies when uncertainty arises. However, several improvement areas were also identified:

• Instruction timing: Participants noted that some instructions—particularly at corners or transitions—arrived too late to act on comfortably. Future versions should aim to deliver key guidance slightly earlier in the path sequence, within the limits of user-prompted flow.
• Orientation feedback: Participants expressed a desire for occasional reassurance (e.g., "you are still on track") during long stretches. While Ally is not currently proactive, this insight suggests the value of introducing simple, user-initiated check-in prompts such as "Am I on the right track?" in future iterations.
• Consistency in instruction formats: Shifting from meters to steps or from one phrasing style to another without notice caused confusion. Ally should ask for preference at the beginning.

While Ally Sensescape is not intended to replace primary mobility aids such as canes or guide dogs, it demonstrated value as a complementary tool—particularly in enhancing spatial awareness and interpreting environmental structure (e.g., room layouts, signage, or turn sequences). The evaluation supports the feasibility of deploying such a system in structured indoor environments, provided that limitations are acknowledged and fallback mechanisms remain robust.

These insights will inform refinements in the final design, including improvements to phrasing, clarification handling, and fallback interaction logic, to ensure the system is both practical and adaptable for real-world use.

5.9 CONCLUSIONS OF THE CHAPTER

Chapter 5 evaluates the Ally SenseScape concept through structured user testing to assess usability, clarity, independence, and real-world applicability. Three participants—two sighted students (blindfolded) and one real blind user—navigated indoor routes using the Wizard-of-Oz version of the system. Participants interacted with Ally through voice commands, receiving clock-based, step-count instructions enriched by environmental cues like floor textures and ambient sounds. The real user rated the system highly (SUS score of 92.5/100), noting increased confidence, intuitive interaction, and usefulness in daily settings like offices or shopping centers. While blindfolded users struggled with orientation and straight-line walking, they appreciated step-based pacing and hands-free guidance. Across tests, preferences emerged for user-controlled pacing, confirmation feedback ("am I still on track?"), and the option to switch between steps and distance units. Some challenges—like unclear turns in larger hallways or late instruction timing-surfaced, highlighting the need for improved fallback cues and personalization settings. Overall, the evaluation confirmed that Ally SenseScape meaningfully supports navigation for PBLV in structured indoor spaces, especially when layered with physical tools like canes or guide dogs. These insights validate the concept's potential for real-world deployment and offer clear refinement paths for future iterations. It utilises what already works and enhances the experience in aspects where AI can support.

LEARNINGS

Throughout this project, I experienced a deep shift in how I approach complexity, make design decisions, and structure the flow of work. One of the most important learnings was decision-making through clarity in terms of practicality as well as impact through asking the right questions and framing problems in ways that invite both feasibility and empathy.

Initially, with multiple user needs and technology directions in front of me, it felt tempting to keep all options open. But through testing, feedback, and mapping value vs. complexity, I learned to converge with confidence, even when it meant letting go of directions that seemed exciting but less impactful. Choosing navigation over touchscreen interaction was one such moment—guided not by assumptions but by evidence, user feedback, and a clear view of implementation context.

Another key learning listening and observing the users to understand what already works, and imagining solutions through their perspective. It opened up unique perspectives. This was even more helpful because these are topics where I don't have lived experiences, thus the approach was much different than most of the other projects that I had done earlier.

I also became more intentional about structuring the project flow. By repeatedly returning to a few core criteria—user independence, hands-free interaction, and real-world feasibility—I could filter noise from insight and avoid over-designing. The iterative loops with Envision and users helped me maintain a steady rhythm between exploration and validation. Presentation moments like mid-term and greenlight were also such moments what helped to filter out and identify/share the key thread that holds the story of this project well.

Finally, this project reinforced how much emotional nuance and systemic barriers exist in tasks that are often seen as "simple." Designing for PBLV is not about reducing effort but restoring agency—and that responsibility shaped how I defined success at every step. I walk away from this project with not just a concept I believe in, but with a more grounded, systems-aware, and user-led design approach that I'll carry forward into future work.

Regular meetings also were good occasions to hear from experience and re-think about next steps better.

RECOMMENDATIONS

Pilot Ally SenseScape in one university and one office to test real-world usability and adaptability. More tests are needed to make it more practical.

Test further using built-in device features like the compass to improve orientation and step-level accuracy.

Explore the newly launched ChatGPT Agent to evaluate its potential for proactive, multi-step navigation guidance. As on 22 July, the video model still isn't proactive but there is better potential now.

Add more troubleshooting mechanisms, that evolve during more tests.

Ally that can still remain personal Ally but with access to new location, so the guidance could be more personalised.

Ally that learns and grows? If there are changes in the existing environment, it adapts for next use on it's own.

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APPENDICES

APPENDIX A

Design Brief

DESIGN FOR our future

TU Delft

IDE Master Graduation Project

Project team, procedural checks and Personal Project Brief

In this document the agreements made between student and supervisory team about the student's IDE Master Graduation Project are set out. This document may also include involvement of an external client, however does not cover any legal matters student and client (might) agree upon. Next to that, this document facilitates the required procedural checks:

- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project

STUDENT DATA & MASTER PROGRAMME

Complete all fields and indicate which master(s) you are in

Family name	Prasun 7603	IDE master(s)	IPD ☐ Dfl ✔ SPD ☐
Initials	P	2nd non-IDE master	
Given name	Pranav	Individual programme *(date of approval)*	
Student number	5954282	Medisign	✔
		HPM	☐

SUPERVISORY TEAM

Fill in he required information of supervisory team members. If applicable, company mentor is added as 2nd mentor

Chair	Dr. Dipl. Des. Stella Boess	dept./section	HCD/HTR
mentor	Dr.ir. A.I. (Ianus) Keller	dept./section	HCD/SCC
2nd mentor	Ferkan Metin		
client:	Envision Technologies BV		
city:	Rotterdam	country:	Netherlands
optional comments			

! Ensure a heterogeneous team. In case you wish to include team members from the same section, explain why.

! Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.

! 2nd mentor only applies when a client is involved.

APPROVAL OF CHAIR on PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in **by the Chair** of the supervisory team

Sign for approval (Chair)

Name Stella Boess Date 13 March 2025 Signature [signature]

CHECK ON STUDY PROGRESS

To be filled in **by SSC E&SA** (Shared Service Centre, Education & Student Affairs), after approval of the project brief by the chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total ____ EC

Of which, taking conditional requirements into account, can be part of the exam programme ____ EC

★	YES	all 1st year master courses passed
	NO	missing 1st year courses

Comments:

Sign for approval (SSC E&SA)

L. Boot — Digitaal ondertekend door L. Boot Datum: 2025.03.18 11:10:46 +01'00'

Name Lisette Boot Date 18-03-2025 Signature

APPROVAL OF BOARD OF EXAMINERS IDE on SUPERVISORY TEAM -> to be checked and filled in by IDE's Board of Examiners

Does the composition of the Supervisory Team comply with regulations?

YES	★	Supervisory Team approved
NO		Supervisory Team not approved

Comments:

Based on study progress, students is ...

★	**ALLOWED** to start the graduation project
	NOT allowed to start the graduation project

Comments:

Sign for approval (BoEx)

Monique von Morgen — Digitally signed by Monique von Morgen Date: 2025.03.19 11:12:53 +01'00'

Name Monique von Morgen Date 19/3/2025 Signature

DESIGN FOR our future

TU Delft

Personal Project Brief – IDE Master Graduation Project

Name student Pranav Prasun

Student number 5954282

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT
Complete all fields, keep information clear, specific and concise

Project title Enhancing Educational/Workplace Accessibility for People who are Blind or have Low Vision (PBLV)

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

Context of the Project:
The project is in the context of Educational environment like universities and workplace. For feasibility of the project, I'll be considering TUDelft as educational environment, and Envision (client's) office located in CIC Rotterdam as workplace environment.

The main stakeholders are:
1. PBLV: While they are already well accustomed to relying on other sources of information than sight and navigate around quite naturally. But the world is evolving much faster now because of technology there are new kinds of products or systems in place. The question is are there still something that PBLV find difficult in terms of accessibility? Out of the tasks which lacks accessibility, which ones seem more critical. Touch screens are one such example where there's lack of texture. Since educational and workplace are something that's important in terms of daily lives which people regularly go to - but is not as personalised and familiar as their own homes for example, it might be a good context to explore further.

2. Envision (client): It is a technology startup and client for this project. They currently have their app and Envision Glasses that uses Google Glass 2. Recently, they have been working on making a Virtual Personal Assistant called Ally. While Ally already does a lot of tasks like reading/scanning pages, describing scene, finding an object etc, it has a scope of further enhancing the independence and productivity of PBLV.

Opportunity and Limitations:
This situation offers an opportunity to research about the issues and concerns that PBLV face in context described above and explore ways in which a personal assistant/AI from envision can be trained to address those issues. Limitation is making feasibile solution in terms of technology, limitation in terms of time and a solution that

space available for images / figures on next page

introduction (continued): space for images

image / figure 1 Scenario: Identifying tasks that might still make PBLV feel less independence

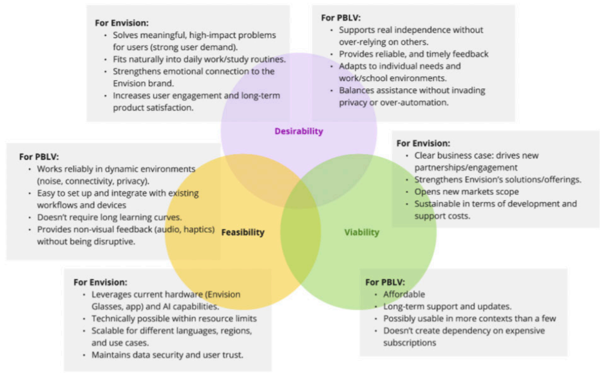


image / figure 2 Context: Human, Technology and Business Perspectives

DESIGN FOR our future

TU Delft

Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

Based on initial research, tasks like using a touch screen in a coffee machine, or finding an empty spot in classroom/lecturehall to sit, or working on collaborative digital tools etc lacks accessibility and thus requires some more time or assistance for PBLV. But as of now, it requires further validation to finalise the task to work on. Solutions that addresses such accessibility from user's perspective can potentially enhance their independence and productivity. An in-depth user research can help to identify more of such tasks and select tasks to work on.

In terms of opportunities that can create added value for the described stakeholders are:
Clear identification of tasks to address, and working on design solution that are possible to integrate in user's daily life - both in terms of technical feasibility as well as usability perspective of the users (learning curve, possible usability beyond one or two specific tasks, convenience to carry or potentially no need of one additional device etc.). Besides, based on research papers referred and importantly considering the client's requirement - solutions that are feasible to implement or that can be integrated in their existing ecosystem or physical products and app, ally personal assistant can be an added value to the client being one of the stakeholders.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence)
As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Design a products/service or approach to enhance independence and productivity for people who are blind or have low vision in the context of educational and work environments.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

This project will follow a user-centered, iterative approach to design a solution that enhances independence and productivity for people who are blind or have low vision (PBLV). In the first phase (Day 1-40), I will conduct mixed method research through interviews, generative sessions (Course: CnC), and surveys to identify tasks/issues and their severity - validating there a design solution can provide a meaningful value from user's point of view. Insights will inform initial low-fidelity prototypes (building on iterative prototyping and testing like EI and ITD courses), which will be evaluated through simulated testing with sighted participants - to check further direction and prototyping approach.

In the second phase (days 41-80), I will develop and refine concepts, and make a concept decision, through iterative prototyping (ITD) and usability testing (UXAD) with PBLV while keeping in regular contact with the client to be aligned with feasibility from their perspective as well - both from technology and business perspective. Towards day 80, my focus will be on finaling the design based on the insights so far.

In the last phase (day 81-100), focus will be on user evaluation of the final design, final report and graduation

Project planning and key moments

To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a ***kick-off meeting, mid-term evaluation meeting, green light meeting*** *and* ***graduation ceremony****. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	26 Feb 2025
Mid-term evaluation	6 May 2025
Green light meeting	3 Jul 2025
Graduation ceremony	24 Jul 2025

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	20
Number of project days per week	5

Comments:

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

While working on my internship project, I realised I got an opportunity to look at things from a very different perspective than I had before - there were many new things to realise and learn. Later, while looking for a graduation project, I had a few areas in mind that I wished to dive deeper into and learn while working on it in the project. These were Inclusive Design, AI and technology. I am keen on being solution oriented designer that leads to the final design outcome - form, approach etc (from a single product focus before TUDelft, which is indeed a valuable skill). Inclusive design helps to hold that idea well. I also liked Interactive Technology Design course and wish to explore further in that.

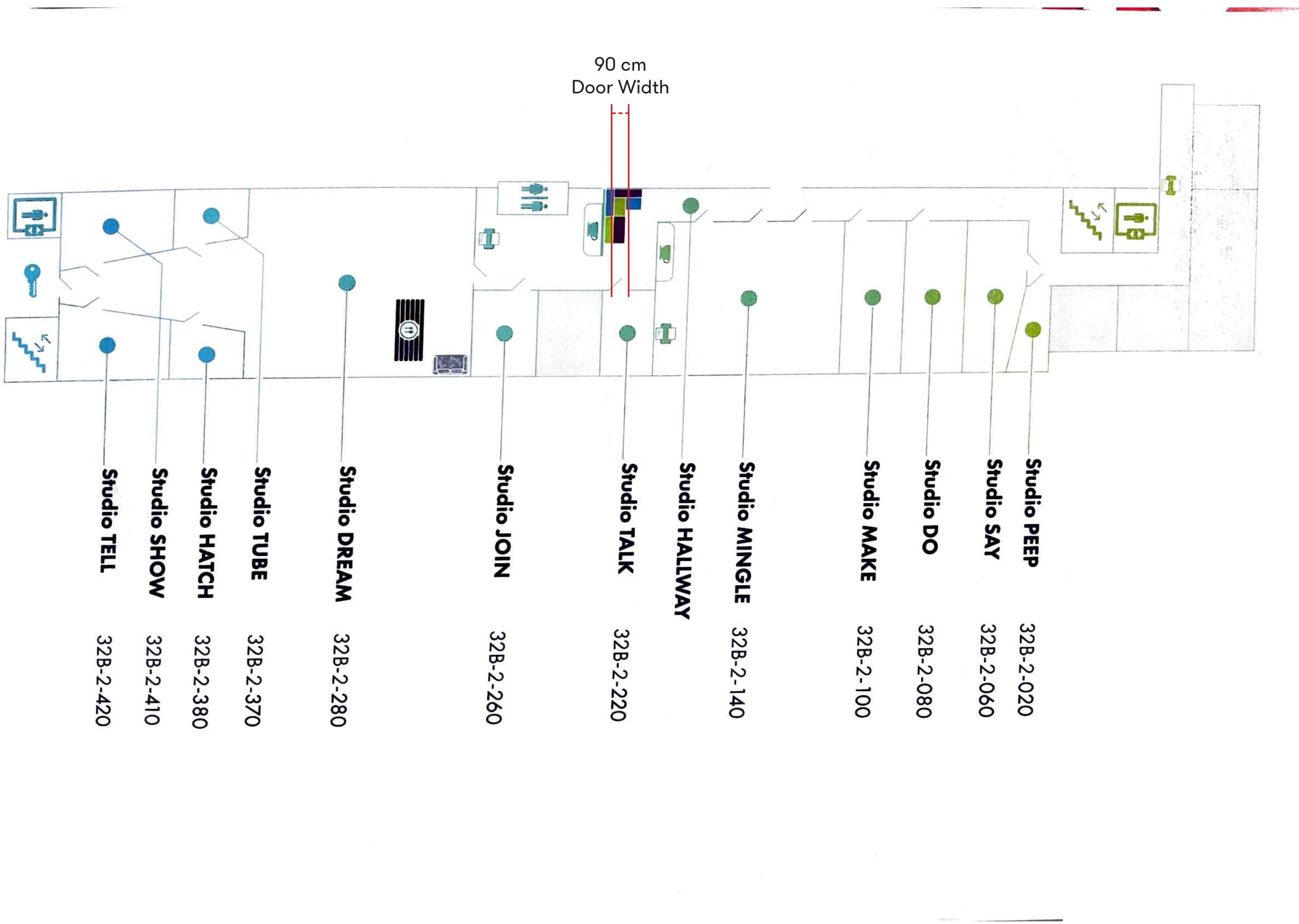
This project covers my area of interest well. This project is very real world oriented with a focus on feasibility within a short term. Because of this there would be a lot of attention to a design solution that is feasible and can integrate seamlessly into user's lives - involving research driven strategic decisions on what to or not to do. And finally, it would be a positive feeling if the solution is able to create positive value in people's lives.

Overall, this project can deepen my understanding in including and accessible design, enhance user experience research skills, explore prototyping with AI for personal assistant and integrate with usable interaction approach.

APPENDIX B

CustomGPT Knowledge File Example for Studio Lab

Studio Lab Floor Plan



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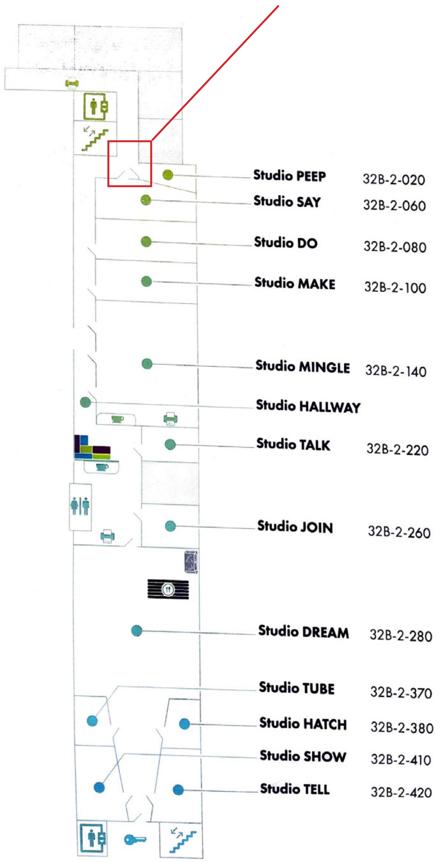

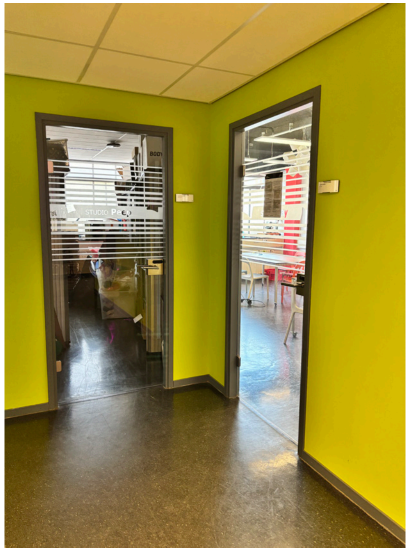

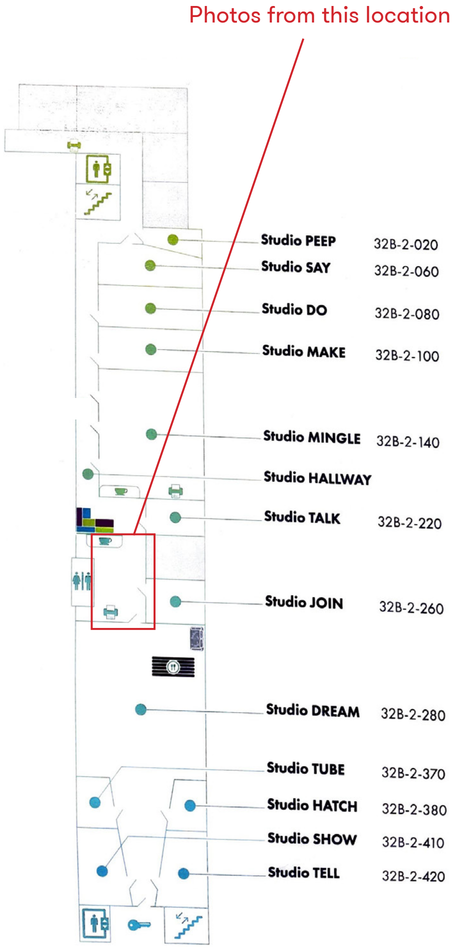
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Studio HALLWAY
Studio TALK 32B-2-220
Studio JOIN 32B-2-260
Studio DREAM 32B-2-280
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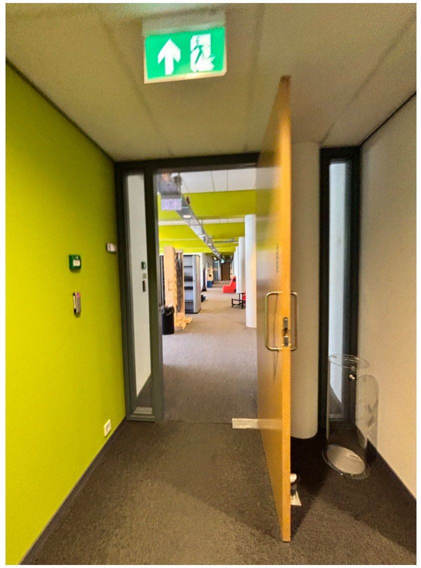
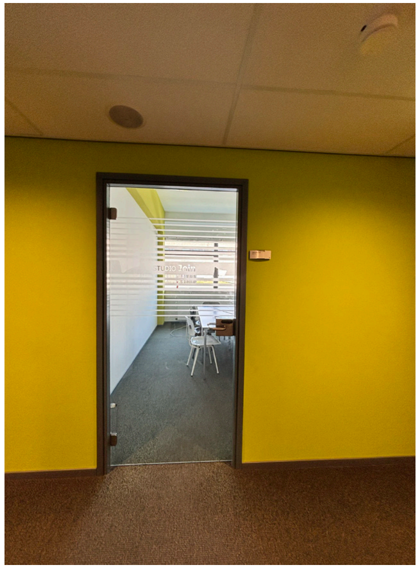
Studio SHOW 32B-2-410
Studio TELL 32B-2-420


STUDIO Talk





APPENDIX C

Test Plan

TEST PLAN SCRIPT

*(This **document will be in print during the session** to avoid engaging with laptop in between unless needed)*

User Test Plan

Why

The goal of this test is to evaluate whether the design proposal meets the defined testable targets and reliably supports user independence, productivity, and usability.

How

The test will use a **Wizard of Oz** approach, where the AI assistant (Ally) is simulated through pre-recorded or live voice instructions (including camera sounds and processing cues). This allows realistic feedback without fully implemented technology.

3.9 Testable Targets

A. INDEPENDENCE (USERS)

1.Do users feel independent in doing the task using the AI assistant?
2.Do users avoid needing to ask others for help during the task?
3.Is the experience hands-free?
4.Are users able to orient themselves and start in the right direction?

B. PRODUCTIVITY (USERS)

5.Do users reach their destination more quickly than without Ally?
6.Do users understand when to change directions without backtracking?
7.Does the pace of Ally's instructions match the user's walking speed and decision pace?

C. USABILITY AND RELEVANCE (USERS)

8.Are the instructions clear and useful for completing the task?
9.Do users want to use Ally again in future tasks?

D. SCALIBILITY (CLIENT)

10.Can the design solution be easily replicated in other buildings?
11.Does Ally require minimal training/setup from users or staff?

Preparation

- **Script**: Includes an introduction, task instructions, observation notes, user questions, Likert scale ratings, and a closing thank-you.
- **Voice assistant simulation**: Pre-recorded or researcher-delivered voice prompts to mimic Ally's behavior.
- **Rating sheet**: 1–5 scale for user feedback on clarity, usefulness, confidence, and likelihood of future use.
- **Consent forms**: To inform participants and record agreement to participate and be observed.

User Test Plan

1. Introduction

Thank you for participating in this test session. Today, we will evaluate an early version of "Ally," a personal AI assistant concept designed to support navigation and orientation. The aim is to understand if Ally can help you feel more independent and confident while moving between spaces.

The assistant will be simulated using a Wizard of Oz method, meaning I will provide live voice guidance as if it were coming from Ally.

2. Consent

Before we start, I would like to ask for your permission to record audio, video, and take photos during the session. This is purely for research and analysis purposes, and all data will be kept confidential and used only within this project.

Permission script:

"Do I have your permission to record audio, video, and photos during this session for research documentation purposes? You can stop or withdraw your consent at any point."

3. Test Plan

- Scenario: Navigate from the meeting room "Hexagon" to the Envision office.
- Guidance method: Voice directions provided live by me, simulating Ally's behavior (including environmental or processing sounds if relevant).
- Focus: Evaluate if participants can orient themselves, move independently, and understand instructions without needing external help.

4. Observation During the Test

During the navigation task, I will observe and note:

- Whether the participant asks for additional help or clarification

- How often they pause or seem disoriented
- Their walking speed and whether it matches the guidance pace
- Their body language and confidence during the task
- Points where they might backtrack or hesitate

5. Questions to Ask After the Experience

(Ask openly, allow them to elaborate)

- How did you feel about your independence while using Ally?
- Did you feel confident in the directions given?
- Did you need to rely on other people for support at any point?
- How did the pace of the instructions feel to you? Too fast, too slow, or just right?
- Was there any moment you felt confused or unsure what to do next?
- Would you want to use Ally for similar navigation tasks in the future? Why or why not?
- What improvements or changes would make Ally more helpful for you?

6. Likert Scale Questions

(Ask before and after, so you can compare with their current experience)

On a scale of 1 (strongly disagree) to 5 (strongly agree):

- I felt independent during the navigation.
- I did not need to ask anyone else for help.
- I was able to understand when to change directions clearly.
- The pace of instructions matched my walking speed and decision-making.
- I felt confident that I was going in the right direction.
- I would like to use Ally again in the future.
- I think Ally can help me save time compared to my usual way.

7. System Usability Scale (SUS)

You can also include the standard SUS questionnaire at the end to capture overall perceived usability. Participants respond on a scale from 1 (strongly disagree) to 5 (strongly agree).

Statements:

1. I think I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think I would need support from a technical person to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

---

6. CLOSING

Script:

"Thank you so much for your time and input today. Your feedback will directly shape the next steps of our project. Do you have any final thoughts or ideas you'd like to share?"

[Pause.]

"Thanks again. Have a great day!"

Let me know if you'd like this in a printable format (PDF or Word). I can also help you generate a Likert scale sheet or a feedback form to go with this.