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ESTONIAN ACADEMY OF ARTS
FACULTY OF DESIGN

MSc. Design and Technology Futures

Enchanted Object Facilitating Exploratory Walks

Võlutud Ese, Mis Abistab Avastamist Jalutuskäigul

MASTER THESIS

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THESIS TASK

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Thesis main objectives:

1. Research the main issues surrounding exploratory walking, and neighbourhood perception
2. Explore the best options for facilitating exploratory walking
3. Develop intervention to assist exploratory walking

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Preface

This thesis delves into the practice of exploratory walking as a leisure activity that centres around the discovery of new experiences and knowledge. It emphasises the diverse array of benefits associated with exploratory walking, such as mental restoration, cultural immersion, and neighbourhood familiarisation. Collaborative efforts between hobby groups, city administrations, and organisations aim to improve the accessibility of exploratory walking by developing pedestrian-friendly environments and enhancing infrastructure.

However, the predominant approach focuses on place-making solutions, which prioritize enhancing the walkability of places with the assumption that it will lead to desired behavioral changes. While this perspective is partially valid, it overlooks other potential barriers that deter individuals from engaging in exploratory walks, such as limited mobility resulting from commuting and navigation methods and spatial anxiety stemming from the fear of getting lost. These barriers restrict exploration by impeding movement and reliance on navigational aids.

However, this approach is biased towards place-making solutions, which primarily address the walkability of spaces. While this approach is not without merit, it overlooks other potential barriers that hinder individuals' inclination to engage in exploratory walks. Such as limited mobility resulting from commuting and navigation methods leading to decreased neighbourhood exposure. Or spatial anxiety stemming from the fear of getting lost. These barriers restrict exploration by impeding movement through the over-reliance on mobile navigational applications. Which utilises route-based guidance.

To overcome these challenges, this research adopts a novel navigation approach known as orientation-based guidance. This approach, though underutilized due to perceived time inefficiency, is well-suited for exploration as it promotes flexible movement, enables adaptable path selection, and fosters active engagement between pedestrians and their surroundings.

The design of a meaningful navigational tool incorporating orientation-based guidance is approached through the concept of enchanting objects. Drawing upon design principles and the framework devised by David Rose in his book "Enchanted Objects," the research presents Aleth, an enchanted object functioning as a navigational spell that can be attached to the user or their belongings. Aleth takes the form of a handheld device easily bound to the user and utilizes compass-like symbols and characteristics for clear and instant communication, conforming to the familiar archetype of navigation.

Through extensive user testing and iterative revisions, the proposed device ensures that its working principle, interface, and construction effectively achieve the desired impact of the intervention. This entails a navigational aid that assists with exploratory walks, by not limiting route selection, encouraging user-made navigational decisions and only guiding when asked to, allowing the user to remain immersed in exploring.

Keywords: exploratory walking, orientation-based guidance, spatial anxiety, enchanting objects.

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1 Introduction

Movement patterns within urban environments are becoming increasingly limited [1, 2, 3], leading to reduced familiarity with neighbourhoods, weakened community bonds, and underutilization of public spaces. This constriction hinders the formation of emotional connections and attachments to places, which are essential for fostering a sense of belonging, identity, psychological well-being, and environmental stewardship (one's willingness to take care of their environment) [4, 5, 6].

This phenomenon can be attributed to the way we navigate our urban surroundings [7]. Prioritising destination-based journeys over exploratory ones. Resulting in limited exposure to the surroundings and their offerings. To illustrate this, we can employ an ant metaphor to elucidate the purpose behind our journeys and the impact of solely engaging in destination-based travel.

Ants possess a highly stratified society, comprising various classes with distinct roles and responsibilities. For instance, certain ant colonies have specialised forager-ants whose task is to locate food, while designated gatherer-ants retrieve the discovered food and transport it back to the colony. Forager-ants create scent trails as direct routes from the discovered food to the nest, which gatherer-ants faithfully follow to reach their destinations. [8].

The coordination between different ant classes is highly efficient, as they only acquire specific skills and knowledge needed for their roles within a complex system. Scientists observed this skill difference by displacing forager and gatherer-ants from their nests and studying their attempts to return home. Forager-ants quickly determined their bearings and found a direct route back to the nest, while gatherer-ants became lost, wandering aimlessly and eventually succumbing to exhaustion, cold, or hunger. This outcome demonstrates the consequences of relying solely on scent trails, which gatherer-ants blindly follow to efficiently reach their destinations (food or nest).

In contrast, forager-ants do not depend on predetermined routes. They explore their surroundings by travelling in spiral paths away from their nest, actively seeking new discoveries. They continuously gather environmental information, building a backlog of knowledge to rely on. In contrast, gatherer-ants remain unaware of their surroundings, solely focusing on following the scent trail.

However, in nature, the lack of navigational skills is not problematic for the gatherer-ants since they are confined to their role. Whose journey has one purpose, to make use of discovered offerings within the environment. While navigational skills are essential for forager-ants whose purpose is to discover potential offerings within the environment and create a path for the gatherer-ants to follow. Taking on the responsibility of navigational decision-making by determining the most direct route [9].

In practice, we mostly behave like gatherer-ants whose journeys mirror destination-based journeys. Where the main concern is utilising the offerings available at the destination. Blindly following the trail laid out for us, while mostly remaining indifferent to our surroundings since it is not the priority. Additionally, our mobile phones take on the role of

a forager-ant, generating the most efficient route and relieving us of making any navigational decisions.

However, individuals who consistently adopt a gatherer-ant approach in their behaviour tend to be less inclined to form connections with their neighbourhoods due to indifference. Their limited exposure results in a lack of knowledge about the offerings within their neighbourhood, as their focus and movement are confined to predetermined routes provided by their smartphones [10, 11, 12]. This lack of engagement is problematic for environmental stewardship and the utilisation of public spaces. Consequently, there is a growing movement to promote exploratory walking among urban residents, aiming to enhance community bonds and neighbourhood perception. Exploratory walking serves as a means of mental restoration, leisurely socialising, and immersing oneself in the surroundings. It involves freely moving without following pre-established paths, instead focusing on making conscious navigational decisions to discover new aspects of the environment [13, 14, 15, 16].

Unfortunately, similar to gatherer-ants, those who are too reliant on pre-made routes struggle to perform exploratory journeys and tend to avoid them, due to limited trust in their own navigational abilities [10]. Abilities that go unused due to being replaced by navigational aids. Which are designed to take on all of the navigational decision-making responsibility and plot the most efficient route. Ideal for destination-based journeys, but not for exploratory ones. Which are journeys aimed at environmental familiarisation and seeking discoveries, instead of reaching the destination efficiently.

The predominant focus on navigational aids geared towards destination-based journeys hinders people's ability to engage in meaningful exploratory walking and discourages them from exploring their surroundings. Therefore, there is a need for a suitable solution that assists in exploratory journeys, allowing individuals to immerse themselves in their environment, seek out discoveries, and avoid getting lost. To address this, the design process employed in this project provides a flexible framework for effective problem discovery, ideation, and testing, aligning with the novel objective of supporting exploratory journeys.

Orientation-based navigation emerged as a suitable approach for assisting navigation without constraining users' movement or their interaction with the surrounding environment. Through the use of technology probes, the experiences of individuals utilizing orientation-based guidance, specifically in the form of a compass, were tested. The results demonstrated its effectiveness in encouraging exploration and enhancing user confidence in making navigational decisions.

To ensure the designed object holds significance and meaning, the project adopted the design approach pioneered by David Rose. This approach incorporates design principles aimed at "enchanting" an object, thereby fostering more meaningful interactions with users. By combining this approach with orientation-based guidance, a navigational aid tailored for exploratory walks was created. The final concept minimises user interaction to keep their focus on the surroundings, while still allowing them to regain their bearings when needed, thus maintaining their confidence during exploration.

2 Design Process

2.1 Double Diamond

Without a process, it can be difficult to know how to move forward. How to transition from an abstract problem statement into a refined solution. A process provides structure to an otherwise ambiguous undertaking.

The Double Diamond is a problem-solving process used in design thinking. The diamond shape eludes to when the process should be diverging or converging. Hence why the process is split into four phases: Discover, Define, Develop, and Deliver. It encourages designers to explore a wide range of options before settling on a final solution, resulting in better outcomes that are more effective and sustainable. While the methodology also helps designers to understand and empathise with their users and remain focused on solving the correct problem [11].

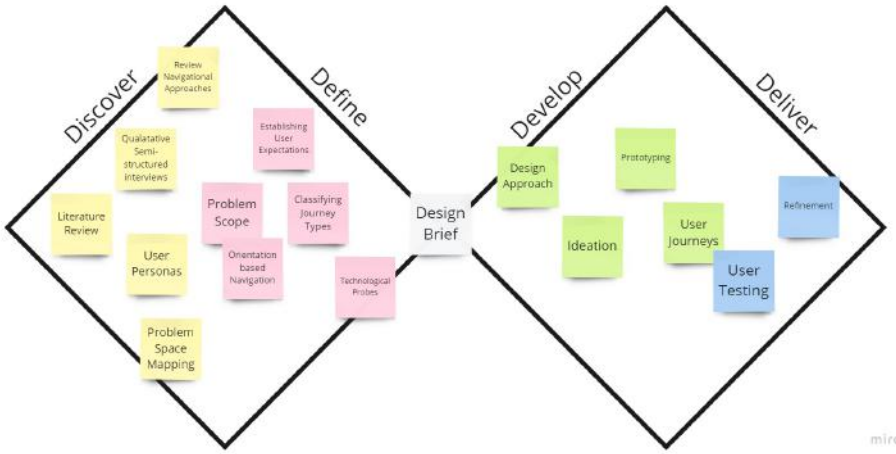

Figure 1: Double Diamond Process

The first diamond, Discover and Define, is where designers explore and identify the problem, the stakeholders involved, and the objectives of the project. The second diamond, Develop and Deliver, is where designers create solutions to the problem and implement them.

2.2 Discover

In the discovery phase the main problem and problem owner needs to be established. This phase is characterised by uncertainty and is commonly referred to as the 'fuzzy' front end. Exploration and familiarising are the main actions during this phase, as the designer tries to holistically grasp the situation. Common tactics during this phase include reviewing past research/ case studies, interviews with stakeholders, journey mapping and problem space mapping. Employing a wide array of tools to ensure multiple perspectives and an accurate representation of the issues is grasped.

2.3 Define

In the define phase the needs, problems, and ideas are focused toward end goals. The knowledge gathered from the previous stage is analysed and synthesised to make sense of the problem and understand its causalities. Emphasis is placed on the context in which the problem resides. Designers use different techniques to determine which ideas, solutions, or approaches would be most suitable for addressing the defined problem or opportunity. Some of these techniques include paper prototyping, storyboarding, brainstorming, sketching, and creating quick and rough physical prototypes as well as technology probes. All in an effort to gain insights which may determine the most suitable approach for a solution which will be outlined in a design brief.

2.4 Develop

In the third phase, ideation, testing and iteration takes place in order to develop a solution. This stage requires creativity and experimentation as the designer implements techniques involving brainstorming, prototyping and user testing to challenge possible solutions. Continuously evolving and refining the concept until its ready for the delivery phase.

2.5 Deliver

The Delivery phase is the final stage in the Double Diamond Design Process, where the focus shifts from design to implementation. During this phase, the finalised design solution from the Develop stage is presented to the intended audience and end-users.

2.6 Design Process Reflection

It is important to remember that the double diamond is not a fixed set of instructions. The design process is not linear but messy. The double diamond is used to give structure and direction, but it remains flexible and adaptable depending on the needs of the project.

Design is an iterative process, filled with multiple cycles and revisions. This was reflected in my design process, refer to Figure 2. Although my journey was rather uncertain, with revisions on the problem definition as well as the proposed solution approach, the double diamond offered a secure base to tie the research to. By making it clear what the next step should be in the process. Such as during the testing of high-fidelity prototypes during previous concept refinements, it was discovered that the solution approach was flawed. However there is no waste in design research, only the acquirement of new insights. These late-stage user testings weren't failures. Instead, they're interpreted as technological probes that offered valuable insights into revising the design brief. Giving direction for the next round of ideation. Overall, the double diamond was helpful in offsetting failures, and providing guidance in moving forward within the design process.

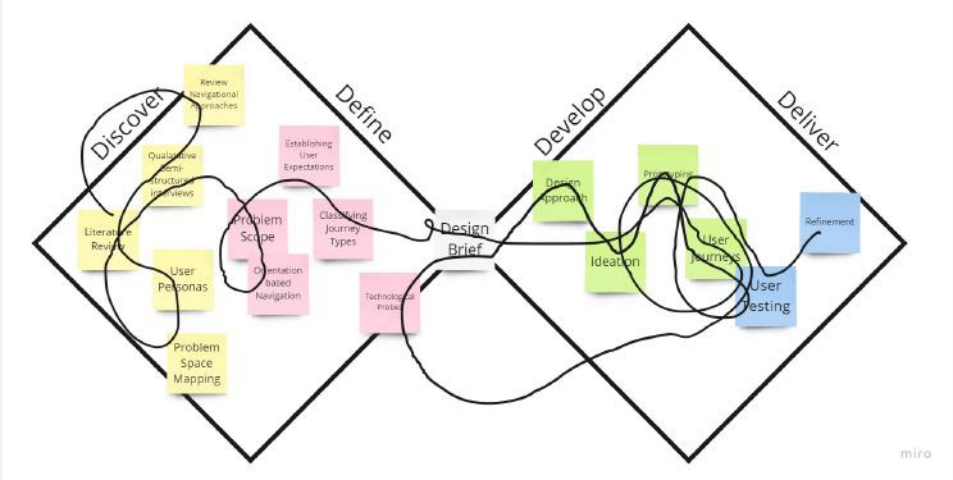

Figure 2: Double Diamond Process Experienced

3 Literature Review

3.1 Urban Exploratory Walking

Taking our first steps in infanthood marks the moment when we attain our primary method of mobility in life [12]. It's an action which gives us the freedom to move, play and explore. However, as we get older, its auxiliary roles expand, becoming more aligned with utilitarian purposes. Shifting the primary intention from enjoyment and wonder towards efficiency and a means to an end. In saying that, walking as a means of experiencing joy and curiosity still remains a desirable activity. Providing a reprieve from the daily stressors and strains encountered in life, such as walking with the intention of exploring, or exploratory walking.

Exploring is the act of seeking discoveries. Where discoveries refer to attaining new knowledge and experiences. Although the definition of discoveries makes the application of exploratory walking broad, its defining attribute is that the main intention of the practitioner is to explore through immersion. That the act of immersive exploring itself enacts feelings of joy and curiosity.

Exploratory walks are typically associated with nature walks and hiking. Where the hiker's intent is to explore the outdoors [13, 14, 15]. In hopes of experiencing feelings of joy and wonder, as a result of discovering new phenomena in nature. Although this is a good application, exploratory walks can also be applied within the urban environment. Where navigating within the urban environment can also spout feelings of joy and curiosity [16]. Urban exploratory walks may include acts of flâneur, neighbourhood familiarisation and wayfinding. Where each action shares the root intent of exploration while having different secondary intents.

Flâneur for example, is understood as a leisure activity in which the practitioner aimlessly wanders around an urban space as an observer, in order to view and experience it in its natural state. Akin to 'losing yourself' as a tourist in a new city in order to soak up the local atmosphere of ordinary life. In this case, the practitioner's exploration is intended to discover the local culture [17].

Alternatively, neighbourhood familiarisation is the act of acquainting oneself with the usefulness of the urban space. Understanding what it has to offer, and where those offerings are. With this action, the practitioner's exploration is intended to discover the potential uses and benefits of the urban space. Fully grasping the place's potential value. While extracting moments of joy and curiosity through the spontaneous discoveries of the offerings.

Additionally, wayfinding is an extension of neighbourhood familiarisation. It's the act of navigating by formulating a route to a particular offering within the urban environment. In essence, wayfinding is exploring with the intention of discovering the route to a destination. Utilising the knowledge of past discoveries.

Although all three cases have different secondary intentions, there is no reason that they cannot be performed on the same exploratory walk. Since the primary action remains the

same, exploring. From personal experience, I can reflect on my time in Kyiv. Where for one month I stayed in the city while waiting for my Schengen visa to be approved. As many tourists do, I began exploring the streets around my apartment, hoping to immerse myself in the atmosphere of the city. On the streets, I was exposed to and bombarded with the many happenings of my surroundings. From the smell of the pizzeria down the road to the loud festival music being projected from even further down. I discovered the inconspicuous grocery stores hidden behind plain, label-less storefronts, noting the bags carried out by their goers. I was awestruck by the discovery of the maze below the streets. An underground network of pedestrian walkways leading to subterranean shopping districts. Or the miniature forests, dotted around to break up the concrete facade of the city. Connected via seemingly identical grid-like roads. Over time, and through further exploration I mastered them all. Building a cumulative base of knowledge that allowed me to move and navigate as the locals did. I no longer simply mirrored the locals' actions, but established my own habits based on my personal preference for what the urban environment had to offer me. Establishing a sense of ownership over the city.

Although exploratory walking is often looked at as an unconscious action naturally undertaken in daily life, many practitioners purposely perform it in order to reap its benefits, and consciously enact exploratory journeys in their urban environments. UK-based initiatives such as Living Streets, Ramblers and Walk Ride GM encourage and mobilise actors to explore their local neighbourhoods, building stronger community ties as well as improving the overall health of the participants [18, 19, 20]. Similar organisations have also begun to pop up in other areas in Europe, such as COWIfonden and UrbEX, who promote walking as a means of adventure and economic revitalisation of urban spaces [21]. While other organisations such as ARUP, WHO and local city councils work on improving the walkability of European cities [22, 23, 24]. In an effort to implement greener modes of transport and decongest urban areas of automobile traffic. Overall, there is an upwards trend towards encouraging people to walk more in their cities due to the wide array of benefits it offers.

Such as being a distressing activity and mood elevator. Multiple studies have demonstrated the positive effects that exploratory walking has on its practitioners' mental health [25]. By providing an escape from everyday problems and negative emotions, enabling self-restoration and revitalisation. It achieves this by diverting the practitioner's attention to the task at hand, which is to explore. An activity filled with bouts of spontaneous discoveries and triggered moments of curiosity.

These new discoveries also lead to the increased awareness that practitioners have of their surroundings. Expanding their knowledge of the area and the potential offerings it holds. Which they can make use of at a later date. The increase in familiarity with the use and spatial information of an area evolves into a more instinctive movement and navigation style by the practitioner, as they become more comfortable and settled in their environment.

This correlates with studies that found pedestrians develop unique preferences and interpretations of their walking environment. Acquiring personalised meanings and habits as they emotionally bond to an area. This emotional bond, also known as place attachment positively influences their attitude and travel satisfaction in the area [26, 4].

3.2 Traditional Bias Towards Place-Making Solutions

It is often cited that the primary barrier which prevents exploratory walking, and leisure urban walks in general is the walkability of the urban environment. Where walkability is dependent on the pedestrian infrastructure, scenery appeal and potential public offerings available to the community. All of which can be linked to how the neighbourhood is perceived.

Due to this, many civilian groups, organisations and city councils work collectively in trying to improve their neighbourhood's characteristics in order to improve the neighbourhood perception. These methods often encompass place-making, possessing a bias towards urbanist solutions. Often adopting the thinking that providing a place is enough to foster community participation in walking activities. Utilising the assumption that the availability of such places will result in community use, improvement of neighbourhood perception, formation of place attachment and the improvement of community members' well-being [27, 28, 29, 30].

However, this assumption neglects the consequences of the navigation methods employed by residents. Multiple studies have found that the use and reliance on navigation applications such as Google Maps, results in limited neighbourhood awareness, movement area and awareness of surroundings. This is due to the applications fixing the user's movement to a set path while simultaneously holding their attention in order to effectively guide them. Resulting in diminished awareness of their surroundings [31, 32, 33, 34]. This results in limited exposure to the neighbourhood itself, and increasingly isolates urbanites from their surroundings [35]. Hence, place-making and infrastructure interventions may remain unknown or underutilised by those who are reliant on navigation applications which limit their exposure to the neighbourhood.

3.3 Effect of Spatial Anxiety on Exploration Tendency

Our navigational ability allows us to maintain our sense of orientation and location as we travel. We rely on it to learn the layout of new environments and plan routes (make navigational decisions) in familiar ones. Colloquially known as our sense of direction, it is well understood that proficiency varies substantially between people [31]. However, research has demonstrated that one's ability to navigate is also affected by one's motivation and emotional state [36].

Self-doubt in navigational ability results in anxiety when required to make navigational decisions and formulate routes [10]. This phenomenon is known as spatial anxiety and has an effect on the navigational tendencies of an individual. For people with high spatial anxiety, there is a preference towards route-based strategies in contrast to orientation-based strategies. A route-based strategy refers to relying on a set path comprised of turns, intersections and landmarks from a first-person perspective (egocentric). While an orientation-based strategy makes use of the allocentric representation of a place in a person's mind (spatial cognitive map) to keep them oriented while they use novel routes to reach their destination [37].

The bias towards a route-based strategy is due to the distrust in their own navigational instincts, which is linked to their belief of having a defective sense of direction and limited allocentric knowledge. This results in them using predefined routes, limiting the navigational decisions they have to make, as well as any potential alternative routes. Simultaneously denying instances of exploration as they become restricted to a fixed allocated path. Meaning people with high spatial anxiety tend to avoid exploration since it's an action centred around intuition and confidence in navigational decision-making. Resulting in them avoiding navigational exploratory activities [36].

3.4 Loop of Regression of Spatial Anxiety

It has been shown that navigational ability correlates with the Pygmalion effect. In that, a negative belief of one's ability results in poor performance and outcome [38]. This is often the case with those who possess high spatial anxiety. Where the belief of having poor navigational abilities results in it becoming true [36].

This is observed through their tendency to avoid exploration and growing dependency on navigational aids, due to poor confidence in their navigational decision-making ability. Typical navigational aids are cellular-based route guidance applications (apps), which predetermine the route and make all of the navigational decisions. Limiting the possibility of exploration, which is reliant on spontaneous/intuitive navigational decisions instead of predetermined ones.

Additionally, it has been established that reliance on such tools also reduces one's navigational abilities further [31, 32, 39]. Fulfilling the self-made prophecy of being poor at navigation. This is due to the diversion of attention away from the surroundings and onto the application's guidance. Users become blinded from their environment, preventing them from taking in allocentric knowledge and building effective spatial cognitive maps of the area. Reducing their abilities to independently make beneficial navigational decisions due to their inability to orient themselves. Becoming further reliant on navigational aids and less inclined to explore [36]. This process results in the cycle illustrated in Figure 3.

Therefore, it can be concluded that current navigational aids do not fix a person's 'defective' sense of direction. Instead diverting the issue by taking on the responsibility of making all of the navigational decisions and releasing the person of the burden. However, in doing so, the current navigational aids make the person's inability to navigate worse [34]. In turn, making them even more reliant on technology and prevents them from benefiting from independent navigation and exploring.

For example, by taxing the user's attention and limiting the need to pay attention to the details of their surroundings, an awareness bubble is created. Where the user is masked from the potential offerings of their surroundings. Remaining ignorant and never fully utilising the potential of the area. Reducing the likelihood of an emotional bond and place attachment forming to the area [7]. Another benefit lost is the feeling of joy and curiosity created through moments of discovery encountered when exploring. Reducing the opportunity for the walking journey to act as an immersive mood elevator and distressing activity.

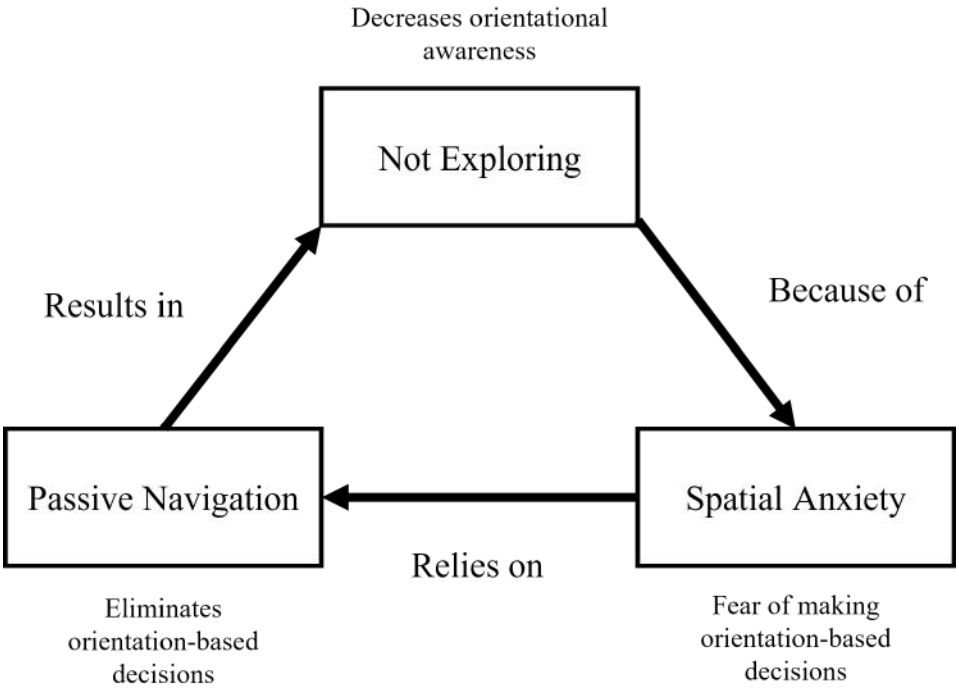

Figure 3: Loop of Regression of Spatial Anxiety

Unfortunately, this means that people with high spatial anxiety often choose between the benefits of a route-guided app-based journey or an exploratory-based journey. With majority choosing to rely on route guidance apps due to their expectations of bad experiences with exploratory journeys, where they are in charge of making their own navigational decisions [36].

4 Qualitative Study Determining the Effects of Spatial Anxiety on Walking Attitudes, Neighbourhood Perception and Exploratory Walking Experiences

4.1 Overview

People with higher levels of spatial anxiety tend to not explore due to their fear of getting lost. It can be construed that this results in a limited allocentric knowledge of the neighbourhood and its offerings, as pedestrians with high spatial anxiety restrict their movement to the guided path laid out by the navigation apps. It can also be construed that those who rely on navigation apps may have a different attitude towards walking since the benefits gained from the activity differ from those who aren't reliant on navigation apps, and view urban navigation more favourably. Lastly, the experience of exploring for those with spatial anxiety is largely unknown, since they are known to typically avoid the experience. However, one can construe that the lack of confidence in navigational ability and general anxiety encountered in unfamiliar areas may result in adverse experiences when said people do engage in exploratory walking.

Hence the following study is conducted to investigate the experiences of people with spatial anxiety undertaking exploratory walks, as well as the effects these experiences have on the participants' perception of and approach towards exploratory walks and their usefulness.

4.2 Preliminary Survey

In order to determine the level of spatial anxiety each participant experiences, they were asked to complete a survey designed to measure their spatial anxiety according to the spacial anxiety scale (SAS) [40]. This scale is an adaptation of the survey created by Lawton, with the only difference being the substitution of the word 'driving' for 'walking'. The survey consisted of 8 items, and responses to these items are rated on a 5-point scale from not at all anxious to very anxious. Scores totalling more than 30 are considered high on the SAS. The items were as follows, what anxiety level do you experience when:

1. Finding your way to an appointment in an area of a city or town with which you are not familiar?
2. Finding your way back to your hotel after becoming lost in a new city?
3. Asked to follow directions to a location across town without the use of a map?
4. Finding your way back to a familiar area after realising you have made a wrong turn and become lost while walking?
5. Trying to get somewhere you have never been to before in the middle of an unfamiliar city?
6. Trying a new route that you think will be a shortcut without the benefit of a map?
7. Asked to do the navigational planning for a long journey?
8. Memorising routes and landmarks on a map for an upcoming exam?

4.3 Qualitative Methodology

In-depth qualitative interviews were conducted with university students within Tallinn. Individuals' ages ranged between 21 and 35 years old, with all participants being Tallinn residents for at least 1 year.

The interview focused on topics surrounding attitude towards walking, neighbourhood perception and past experiences of exploring and leisure walking. Since the concept of what a neighbourhood is can be interpreted subjectively, the following definition was made clear to the participants.

A neighbourhood is the immediate geographical area surrounding a place of residence, bounded by physical features of the environment such as streets, rivers, train tracks, and political divisions [41]

The leading questions used for the semi-structured interviews were as follows:

Walking Attitude

1. Do you like walking as a means of travel?
2. Why do you use walking to travel?
3. Do you like to walk and stroll?
4. When deciding if you should walk, how important is the walking time?
5. When deciding if you should walk, how important is the walking area?
6. Do you prefer walking in an area with good scenery?
7. Are you willing to take a detour in order to take a route with good scenery?
8. Do you prefer a street with people, even if you have to take a detour?
9. Do you prefer taking the shortest route, if the scenery is boring?
10. Do you believe that you walk faster than others?

Neighbourhood Perception

1. Do you enjoy walking in your neighbourhood?
2. Are there many trees along your streets?
3. Are the buildings in your area interesting to look at?
4. Are there unpleasant qualities of your neighbourhood?
5. Is your neighbourhood well maintained?
6. Are there interesting things to do in your neighbourhood?

7. Are there many useful destinations within walking distance of your residence?
8. Are their walking trails or parks close to where you live?
9. How would you describe the pedestrian infrastructure in your neighbourhood?
10. Do you see many people walking or exercising in your neighbourhood?
11. Are the people in your neighbourhood friendly?
12. Is your neighbourhood safe?

Exploratory Walking Experience

1. How do you feel about exploring your neighbourhood?
2. Have you ever attempted to 'lose yourself' in a city, and if so how was your experience?
3. What has your experience been navigating in an unfamiliar area without your phone?
4. Can you describe your last experience getting lost?
5. Are you motivated to explore when you walk?

4.4 Participants

Twelve participants were interviewed, with seven ranking high (SAS score above 30), two ranking moderate and three ranking low (SAS score below 20) on the spatial anxiety scale.

Neighbourhood and residence duration was also noted to provide context to some answers given by the interviewees.

Table 1: Participant Demographic

No.	Gender (f/m)	Age (years)	Neighbourhood	Residence Duration	SAS Score
1	f	23	Kristiine	2 years	32
2	f	26	Kristiine	2 years	36
3	m	24	Mustamäe	2 years	33
4	f	24	Torupilli	1 year	25
5	m	29	Pelgulinn	4.5 years	18
6	m	33	Nõmme	1 year	35
7	f	25	Mustamäe	2 years	16
8	f	21	Kristiine	2 years	21
9	m	32	Nõmme	3 years	26
10	m	19	Mustamäe	2 years	36
11	f	27	Nõmme	4 years	34
12	f	30	Torupilli	8 years	32

4.5 Recurring Themes

Four themes were identified through the compilation and interpretation of the interviews. These were engagement and perceived value of walking, neighbourhood perception and leisure activities, fear of getting lost and its consequences, and a fixed mindset versus a growth mindset.

Engagement and perceived value of walking

It was noted that all participants viewed walking as their primary method of commuting, pairing it with the free local public transportation within Tallinn. Favouring it for its cost-saving benefits. However, those with higher ratings of spatial anxiety mostly referred to walking as a means to an end, appreciating it only for its utilitarian aspects. This was reflected in the motivations of their walking trips.

"I walk to the bus, the Maxima close by ... and back home. I don't know, I walk when I need to go somewhere"(01, female, 23 years old, Kristiine)

"I don't really think of walking, unless I'm too tired to walk. I prefer to take a taxi, but when I'm broke I have to walk."(03, male, 24 years old, Mustamäe)

Comparatively, those with relatively low ratings of spatial anxiety viewed their walking trips more openly. Besides transportation, walking was viewed as relaxing, social, a method of seeing the city and a means of entertainment.

"It's expensive now, so walking can be a potential date...talking while sightseeing. Even after the date, It normally turns into a walk around the area and we talk some more. Let the food digest and wander around" (05, male, 29 years old, Pelgulinn)

"Walking the area is the first thing I do when I'm in a new place. It's how I get a sense of where I am."(08, female, 21 years old, Kristiine)

"If I have to choose between waiting and walking, then I'd rather walk so that I don't get bored. Like in airports, I sometimes walk 10km just circling around it." (11, female, 27 years old, Nõmme)

Participant 11 was particularly interesting since she wouldn't consider exploring without following a set route decided by Google maps in a city, while being able to trust her intuition in the airport. She explained her willingness to 'let go' in the airport was due to her knowing she wouldn't get lost, due to all of the signs and information desks. Compared to exploring in the city, where she would be too nervous to ask someone for directions if she felt lost. Hence, according to her, being in a situation that made getting lost impossible led her to freely decide where to go.

A correlation emerged insinuating those who felt less spatial anxiety found more value in their walking journeys. And formed more positive attitudes towards walking and their experiences gained through it. This can be linked to their willingness to be more exposed and immersed in their surroundings, becoming more engaged with the experience.

Neighbourhood perception and leisure activities

After the interviews, an affinity between neighbourhood perception and performed leisure activities in neighbourhoods appeared. It was found that those who found more uses and value in offerings within their neighbourhood viewed it more favourably.

"I love where I live now. I have everything I need by me, buses to take me anywhere I need to go... Tallinn is a beautiful city and small enough to have everything close by"(08, female, 21 years old, Kristiine)

"I walk in the evenings to take pictures. I like to take pictures in sunset light. Everything looks more interesting and beautiful. It's easy to just walk around and find things that make a good picture. Things people would normally miss."(05, male, 29 years old, Pelgulinn)

While those who engaged less with the surroundings of their neighbourhood tended to have a more negative perception of it.

"Kristiine is boring, there are only houses and roads. Nothing pretty to look at."(01, female, 23 years old, Kristiine)

This correlation may be attributed to the mere exposure effect. A theory which postulates that people have positive feelings towards things they are more familiar with. Leisure activities act as a good mechanism for neighbourhood familiarisation. However, those who aren't knowledgeable about the full extent of offerings in a neighbourhood may remain ignorant and likely not partake in them. Remaining partially unexposed to the neighbourhood, resulting in a poorer perspective.

Getting lost is a catalyst for more bad things to happen

Unsurprisingly, many participants referenced getting lost as the main deterrent for not exploring. It became apparent that people's past experiences of getting lost and fear of making navigational errors were influential in their own perception of their navigational abilities. Acting as a deterrent for relying on themselves.

"Getting lost in a city can be dangerous, not knowing where you are or if you are safe." (12, female, 30 years old, Torupilli)

"If I get lost then I might miss the bus. If I miss the bus then I can't get home and I'll be stuck. The thought of being stuck is scary since no one will help you and you're on your own." (01, female, 23 years old, Kristiine)

"After getting lost in Rome, I couldn't find my way back for over 2hrs. I was so tired from walking the whole time, and my phone was dead. I felt hopeless...I never went out by myself again that holiday." (10, male, 19 years old, Mustamäe)

Those with high levels of spatial anxiety also imagined more severe consequences. Where getting lost acts as a catalyst for more bad things to happen. Compounding issues into

an irreversibly bad experience. Hence, the fear of getting lost is a powerful deterrent to explore.

Difference in navigation strategies using the same technology

It is documented that those who possess high levels of spatial anxiety are less motivated to explore. And that their dependence on navigational apps reinforces their habit of not exploring by further diminishing their spatial navigational abilities. Making them more dependent on technology. For the most part, this was echoed by the participants who scored relatively high on the SAS. Describing journeys centred around the instructions given by the navigational apps.

However, when speaking to those who scored low on the SAS, an interesting insight emerged. It wasn't that these participants never utilised external assistance like navigational apps, subjecting themselves to only relying on passive navigational aids such as maps and compasses. In fact, they admitted to using the same navigational apps as often as the others did. However, their strategies for using the apps differed substantially.

"I explore a lot when using Google Maps. I put in the destination where I want to go and then just walk. If I see something interesting then I walk towards it. I never get lost because I can just look at Google Maps and see the direction I need to walk in again. I never head straight to the destination, because I prefer to have an interesting walk along the way." (07, female, 25 years old, Mustamäe)

"I memorise the route on the map before I go. I don't normally need to look at the app again... I just use it like a normal map and see the area I need to go to." (05, male, 29 years old, Pelgulinn)

They utilised the app as an ordinary map, something to regain their bearing with. And never fully paid attention to the route itself. Meaning that they only referred back to the app once they needed to regain their whereabouts, and then proceeded to head in the direction they felt was right. Which is substantially different compared to those who cling to the route provided by the navigational apps. They admitted that using the app in this manner was more enjoyable since it allowed them to move around more naturally.

5 Review of Navigational Approaches

5.1 Problematic Interaction

It can be stated that the GPS technology itself is not responsible for the over-dependence issue people have with it. Rather the fault can be found in the interactions required by the route-guidance systems which employ GPS technology. Specifically, mobile applications such as Google Maps, Waze and Apple Maps to name a few [31, 32, 33, 42, 43].

In order to guide the user, their movement is restricted to a set path through continuous instruction and monitoring. This results in intrusive interactions and notifications, which distract them during their journey.

Smartphone screens are sometimes described as micro-worlds composed of digital spaces. Since these digital spaces ensnare our psyche similarly to physical spaces in the real world [7]. Thus, the interaction induced by the route guidance system masks the user's attention from their surroundings, by drawing the psyche away from the real world. By continuously demanding the user to listen and follow the application's instructions. Therefore, it is the continuous communication required by route guidance as well as the resulting screen time which prevents the users from staying engaged with their surroundings.

5.2 Alternative Modern Navigational Aids

The documented consequences of using mobile applications for navigation have led to multiple alternative navigational aids aimed at freeing up the user's attention from their phone screens. This in turn enables the user to take in their surroundings and what their surroundings have to offer. As well as begin the formation of spatial cognitive maps (allo-centric knowledge).

Figure 4: Route Guidance vs. Beacon Guidance

Many of the alternatives reference the route, landmark and survey theory (RLS) as the method of how spatial cognitive maps are formed and used [32, 44, 45, 46]. It proposes that there are three knowledge levels required for wayfinding; landmark, route and survey [47]. According to the theory, landmarks are recorded to be used as reference points. When wayfinding takes place, these landmarks are ordered in the sequence they'd appear in during the journey. A path is then formed between the landmarks to form a route. In time, other landmarks and routes are surveyed and overlaid onto the known knowledge, giving spatial and orientational context to the landmarks and routes in the cognitive map.

The alternative aids employ a variety of different sensorial methods to communicate directional instructions, in order to free up the commuter's attention to take in potential landmarks. These alternatives typically use tactile, visual or audible cues, to instruct the user. However, although these feedbacks differ from the traditional means of communication implemented by mobile applications (i.e. a visual map with worded instructions), they still tend to follow a similar format of directional instructions. This is because there is a bias towards 'turn-by-turn' methods of directional instruction [42]. This bias neglects the qualities of the feedback, forcing them to be used in unfavourable ways. Instead of allowing the characteristics of the feedback to dictate instructional format [48].

This has led to a high proportion of the aids implementing a route guidance technique, as opposed to a beacon or orientation guidance technique. The difference between the two methods is depicted in Figure 4. Where route guidance formulates the route for the user, and actively leads the commuter along it. While beacon guidance dictates the general direction that the user has to travel, the user is left to formulate their route using their own navigational decisions. Which may seem daunting to those who have spatial anxiety. The preference disparity between the techniques is supported by performance-based research. That determined the users were able to navigate faster with route guidance. And that they preferred the continuous guidance employed by route-guidance, as a result of it reducing their mental load [43].

However, this technique favours travel time over the formation of spatial cognitive maps and neighbourhood familiarisation. Although, users of non-mobile navigational tools are able to soak in their surroundings. When a route guidance technique is utilised, the traveller is robbed of making decisions. Preventing them from actively navigating and hindering associations (landmarks) with the route to be recalled later. Meaning the person remains a passenger being guided along. They may see the city, but do they necessarily know the city? By being confined to the allocated routes, the users lack the opportunity to further explore their environment.

On the other hand, beacon guidance pushes the users to take in their surroundings and actively make navigational decisions. Encouraging more route choices and exploratory behaviour, as shown in Figure 5. Hence why orientation-based guidance is preferred for exploratory activities [43].

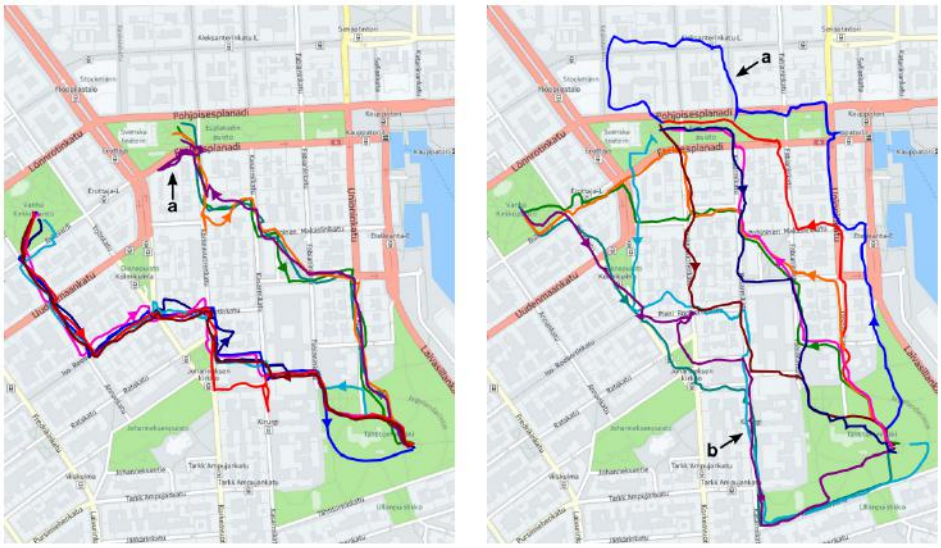

Figure 5: Route Guidance (left) vs. Beacon Guidance (right) Route Choice [43]

5.3 Growth Mindset and Reducing Spatial Anxiety

Research has found a link between a growth mindset, spatial anxiety and navigational ability [36]. The research found that people with a growth mindset towards navigational abilities exhibited low rates of spatial anxiety. Where a growth mindset in navigational ability was defined as believing one's ability can be improved. Alternatively, the research showed people with spatial anxiety often possessed a fixed mindset about their navigational abilities, resigning to their fate of having a poor sense of direction. And accepting their fate of having to rely on route-planning apps to make up for their deficiency.

However, studies agree that one's navigational skills can be improved. And it is incorrect to have a fixed mindset about it. A case study was done on a group of orienteering participants [49]. Orienteering is a sport which requires the use of a compass and map to navigate to multiple checkpoints in the shortest amount of time. It's a sport which relies on a person's ability to sort allocentric knowledge and utilise their sense of direction to make navigational decisions. It found that those who partook in the sport showed greater confidence in their navigational abilities and therefore a lower level of spatial anxiety.

Another study found that London taxi drivers possessed a greater navigational ability than the average person [50]. Demonstrating their commands of London's roads without the use of navigational aids. Relying only on their memory which they refer to as "The Knowledge" to construct routes to their destinations. The drivers spend years building up 'The Knowledge" until they can effectively blend allocentric and egocentric knowledge to plan a route anywhere within London and its surrounding suburbs.

While both studies revealed that individuals who participate in activities that demand navigation skills exhibit greater confidence in their own navigation capabilities. It is difficult to disprove the correlation between people with good navigational abilities being naturally

attracted to activities that require such abilities. However, research performed in psychogeography also alludes to the regularity of navigational activities improving navigational abilities [51]. Pointing towards practice makes perfect.

So if the navigational ability can be improved through practice (i.e. making navigational decisions), then confidence in one's navigational activity can also be improved. Reducing the spatial anxiety experienced. Therefore, a method of reducing spatial anxiety is to encourage a person to make navigational decisions. Which in turn will make them more willing to engage and take part in exploratory activities.

6 Refining Project Scope

6.1 Overview

Urban exploratory walks elicit feelings of joy and curiosity. With the primary aim of discovering new phenomena and offerings within the urban environment through immersion. The benefits of such activities range from distressing and self-restoration to improved perception and well-being in one's neighbourhood. However, people with spatial anxiety struggle to fully partake in these types of activities effectively, due to their perceived poor sense of direction. This makes them reliant on route-guidance apps that confine their movements to set paths which they follow religiously. Hampering chances of exploration. Making them less likely to explore.

6.2 Problem

Spatial anxiety pushes people to become over-reliant on route-guidance tools. These tools inhibit their ability to gather allocentric knowledge and further depreciate their navigational abilities. Making the spatial anxiety worse. While simultaneously preventing them from reaping most of the benefits associated with exploratory walking.

However, the fear of getting lost prevents those with spatial anxiety from trying to rely on their own navigational decisions, which would improve their navigational ability, and encourage exploratory experiences. Since getting lost is seen as a catalyst for more bad things, which ruin positive experiences. Hence, willing participants of exploratory walking with spatial anxiety struggle to effectively perform the activity.

6.3 Barriers

The following barriers exist:

- An expectation of a negative experience when exploring due to the fear of getting lost.
- Exploring unknown areas can be interpreted as dangerous.
- Current navigational methods preferred by people with spatial anxiety inhibit exploration.
- Although exploratory walks do not prioritise time, public transport is time sensitive.

6.4 Research Question

How can orientation-based navigation facilitate exploratory journeys for pedestrians with spatial anxiety?

6.5 Research Hypothesis

Minimising interaction time between the user and their digital devices will enable them to be more immersed in their surroundings.

7 Technical Probing

7.1 Exploratory Interviews

Eight exploratory interviews were conducted to probe further into potential users' opinions and thoughts based on orientation-based guided exploratory journeys. The purpose of these interviews was to explore the needs and expectations of the proposed guiding method. In order to contextualise the exploratory journeys and use case of the orientation-based guidance, participants were asked to envision scenarios when ruminating about the characteristics and values desired from their journeys and navigational aid. These scenarios are tabulated in Table 2.

Table 2: Participant's Imagined Scenarios

No.	Gender (f/m)	Age (years)	Imagined Scenarios
1	f	25	Exploring the old town and walking along the beach
2	m	30	Finding a hidden building in a forest that only locals can find
3	f	32	Going to a friend's house and taking a bus to a village to explore
4	f	28	Walking along the coast until Kadriog Park, then going back home
5	m	28	Being a tourist in Rome
6	f	33	Finding a restaurant in the city and then going to an art gallery
7	f	25	Being a tourist in Paris, and exploring in a forest
8	m	29	Finding friends on the beach, and going to a furniture store

7.1.1 Establishing User Expectations

Since an orientation-based navigational aid is comparatively novel in the modern age. User expectations of such a tool are important to establish, in order to create something which is intuitive and readable. Understanding the typical archetypes one associate with this type of working principle is important. As well as grasping the expectations of the type of experience this type of guidance would provide.

Participants were given a piece of paper with a human silhouette as a prompt, to assist them in visually sketching their thoughts. By having the participants visually sketch their thoughts, the hope was to aid them in imagining possible futures and scenarios of them using such a tool. In some cases, the participant didn't feel comfortable drawing due to perceiving their own drawing ability as poor. In these cases, I assisted in drawing their thoughts with confirmations from the interviewee. Sketching their thoughts enabled faster communication allowing me to gather more information during the interview.

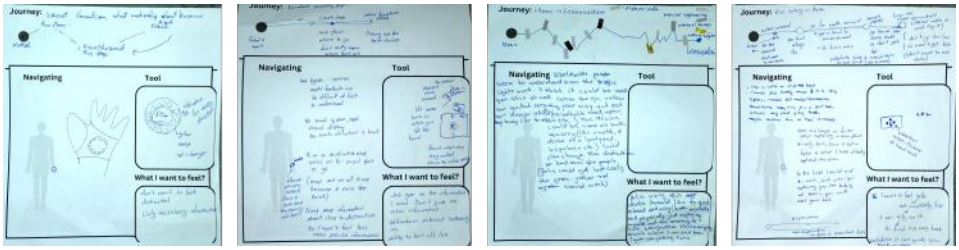

Figure 6: Interview Prompt

All of the interviews seemed to align on characteristics they believed the solution should have. This can be attributed to the common mental image (compass) used by the interviewees when thinking of orientation-based guidance. As well as the imagined scenarios formulated by the interviewees converging on a similar desired experience. The desired characteristics which emerged are as follows:

Bias towards hand

The envisioned forms of the solutions centred around the hand. Where participants viewed the imagined device as easily reachable and controllable. This is likely due to participants being reliant on the common navigational aid archetype, the navigational app on a phone. Which is hand-held. As well as prior exposure to typical wearable archetypes that fit around the wrist such as smart watches and Fitbits.

Visual communication

There was a noteworthy bias towards visual instruction as appose to audible or tactile. Besides the fact that participants are most familiar with visual cues as instructions for navigation. Notable drawbacks of the other sensory forms were considered. Such as vibration being an unfamiliar medium, which could induce anxiety if activated too often. Or the commonly held thought that audible notifications were viewed as intrusive and annoying, based on previous experiences using it with Google Maps route guidance.

Visual communication was also likely favoured due to the common mental image of a compass, which is the visual all of the participants associated with orientation-based guidance. Where orientation was based on a 360° circle with a visual signifier used to indicate the direction in which to walk in. Viewing the arrow as the ultimate signifier of direction.

Non intrusive

The participants viewed their exploratory journeys as moments of disconnection from their normal worlds. Being able to fully commit to being in the moment and taking in everything the surrounding environment had to offer. Hence, the desire for the guidance communication to not be intrusive and infringe on the interviewees' ability to stay fully engaged with their surroundings.

This is an expected desired characteristic, since one of the main issues with commonly employed navigational apps, is their attention-absorbing nature. Since the interaction is

often initiated by the navigational decision-maker. Route guidance requires continuous communication in order to pilot the person along the journey. While orientation based guidance is traditionally passive, requiring the user to initiate the interaction, since they are the decision maker for the route taken.

Intuitive nudging

Most participants expressed a want to not be instructed, instead opting to be nudged. Describing an experience where they're fully immersed in exploring, while intuitively knowing where to go next.

When I'm in the forest, nature guides me. I feel a breeze to the right, so I go right, I feel a breeze to the left, so I go left. I follow the wind until the forest leads me to what I was looking for. (2, male, 30 years old, finding a hidden building in a forest that only the locals can find)

In essence, they expressed a want to not have to think and just know. For example, we can look at interviewee 2 describing being led by a breeze. The touch of the breeze initiates the guidance and the path is simultaneously discerned from the breeze's direction. Hence there is a desire for a quick transition from guidance to understanding.

Depict progress

The interviewees eluded to a need to show progression. In order to let a person verify that they are making the right navigational decisions. Dispelling notions or concerns that they might be getting lost.

It was also pointed out by interviewees 1,3 and 8 that not knowing where the person is within their journey could be anxiety-inducing in itself since the person wouldn't have an idea of how much further they still need to go. Which they considered a vital piece of information when commuting.

7.1.2 Journey Types

During the interview process, various scenarios and use cases were envisioned to give the guiding method context when determining what features and abilities it should have. After analysis, it was determined that the proposed use case journeys could be classified into three subgroups, loop journeys, pedestrian journeys and hybrid journeys.

Loop journey

The most pure form of an exploratory journey is when there is no destination in mind. Where the full focus of the person is on exploring, discovering, and experiencing their surroundings. In this case, the only destination is the starting point.

Pedestrian journey

A pedestrian journey is when there is an established start and end point, with the only unknown being the in-between in the case of an exploratory journey. In this scenario, the person has a place in mind they want to head towards (a destination), and that place is reachable by pedestrian means. Such as heading to the park, grocery store or other offerings within the local neighbourhood.

Hybrid journey

In hybrid journeys, the interviewees expressed the importance of cases which included public transport. Pedestrian journeys often include some form of public transport in order optimally commute to a city. Hence, hybrid journeys are a blend of exploratory journeys and public transport segments.

7.2 Synthesising Expectations into Technological Probes

The following technology probes were initially late-stage user testings of past concepts, influenced by the exploratory interviews in Section 7.1. However, these tests revealed gaps in user needs when put into the situation of an actual navigational journey within a city. The failure of these concepts isn't interpreted negatively, as the revealed insights shed light on value drivers potential users are looking for.

The purpose of the high-fidelity prototypes was to:

- Validate the working principle of the guidance mechanism.
- Evaluate the navigational experience.
- Evaluate the interaction experience.
- Evaluate the engagement of the user with their surroundings.

Six participants volunteered to take part in testing for the mobile app prototype, while four were willing to take part in the wearable prototype. Participants were given coordinates to an unknown destination to input into the app and try to reach said location while using high-fidelity prototypes. The testing took place in an urban setting (Tallinn). The trip allocations for the participants are Tabulated in Tables 3 and 4.

Table 3: Trip Allocation for Technology Probe - Mobile Application

No.	Gender (f/m)	Age (years)	Trip
1	m	28	Walk from Estonian Art Academy to Reval Waterpark (900 m)
2	m	30	Walk from Estonian Art Academy to Reval Waterpark (900 m)
3	f	32	Walk from Estonian Art Academy to Reval Waterpark (900 m)
4	f	25	Walk from Taltech Siidisaba dorm to Kullo School (2.1 km)
5	f	31	Walk from Taltech Siidisaba dorm to Kullo School (2.1 km)
6	f	19	Walk from Taltech Siidisaba dorm to Kullo School (2.1 km)

Table 4: Trip Allocation for Technology Probe - Wearable

No.	Gender (f/m)	Age (years)	Trip
1	m	28	Walk from Vabaduse Valjak to Patkuli Viewing Platform (700 m) to Estonian Arts Academy (700 m)
2	f	26	Walk from Vabaduse Valjak to Patkuli Viewing Platform (700 m) to Estonian Arts Academy (700m)
3	f	31	Walk from Vabaduse Valjak to Patkuli Viewing Platform (700 m) to Estonian Arts Academy (700 m) *Exploring Tartu City
4	f	19	Walk from Vabaduse Valjak to Patkuli Viewing Platform (700 m) to Estonian Arts Academy (700 m) *Exploring Tartu City

7.2.1 Mobile Application

An app was initially considered due to it fitting the traditional archetype of a modern navigational aid. Therefore, users would be familiar with the concept of being guided by an app. While there would also be a relatively low barrier to implementation since users would already possess the navigation device (smartphone).

An app was developed, which utilised the built-in GPS sensor and electronic compass found in smartphones. With this data, the app is able to calculate a vector between the user and the destination, i.e. distance and orientational angle. The app used in probing is available for download in Appendix A.

It utilised a compass symbol which pointed in the direction of the chosen destination, as well as a readout of the distance between the user and the destination. The app did not initiate the interaction with the user or give continuous guidance. Instead, it was used as

a mechanism for the user to regain their bearings during the journey. This was done by the user pressing the 'reorientate' button within the app. The user was able to manually input the GPS coordinates of the destination into a text box in the app.

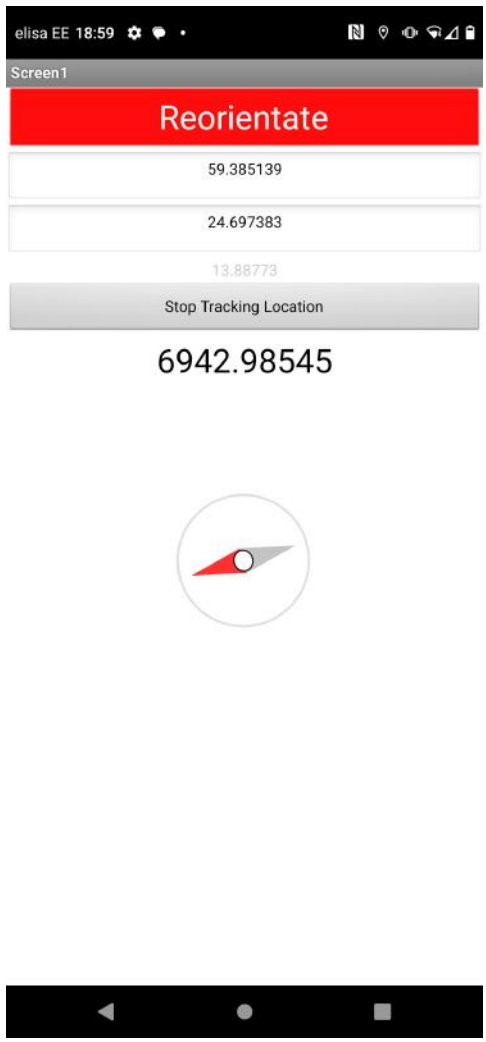

Figure 7: High-fidelity Prototype - Mobile App

Working principle

All participants were able to get to their desired locations. Most found the arrow and distance readout sufficient, while participant 4 became frustrated due to encountering dead ends on her journey. Since an allocentric representation (map) was not presented, she was unable to discern where each road led to, which became frustrating after a couple of 'wrong turns'. However, although she was making self-perceived navigational errors, she mentioned that she never felt lost since she was able to judge if she was getting closer or further to the destination using the distance readout.

Navigational experience

Besides participant 4, who experienced frustration during the test, all others mentioned having a pleasant time using the application, while trying to discover the destination's location. Highlighting that it was simple to understand and worked as expected. Participants 2 and 5 mentioned that they felt like pirates on an adventure trying to find hidden treasure. Emphasising elements of solo roleplay to make the experience more enjoyable for themselves. All felt an accomplishment when they found the destination, which made them happy.

Interaction experience

All participants found the operation of the app intuitive, pressing the reorientate button when they wanted confirmation of their bearings, and utilising their own decision making to find a route. However, the participants did not use the app as expected. Although they did press the button whenever they needed to self-orientate, they still looked at the screen continuously for guidance. Although the interaction between the app and the participant was minuscule (less than 1 s) for checking bearings, the participant continuously repeated the interaction, prolonging the overall screen time. This resulted in the participant clinging to their phone and looking down for significant periods of the journey. In many ways mirroring the problems associated with the route-based navigational apps.

Engagement with surroundings

In some cases (1,2,4 and 7), the screen interactions resulted in the participants becoming distracted from notifications of other apps. Resulting in further screen time usage during the journey. Although all users perpetuated that they felt more aware of their surrounding, it was observed that app-based navigation may result in excess screen time due to phone usage habits and external notifications. Hence a mobile app solution, using visual cues, is not optimal for reducing screen time during navigation.

7.2.2 Hand Wearable

Although the app was not deemed suitable, the working principle behind the guidance mechanism worked well and was received favourably by most participants. Hence, it was decided to try the same guidance mechanism on a hand wearable instead of a phone. In order to try and reduce the screen time users spent while navigating. A hand wearable still aligned with the mental image interviewees formed of a potential device, and complied with being reachable and easy to control via hands.

Two types of hand wearbles were tested, a wristband and a ring. This is so the participants could compare the two options with one another. Making it easier for them to form opinions about the devices. The wristband motif mirrors wearables such as smartwatches, which a popular and widely accepted wearable in society [reference]. Alternatively, the ring is less explored and untested as a potential form for a wearable. Although, examples do exist such as the mood ring. A mystified object which is able to judge a person's emotional state. But in reality, uses a thermochromic crystal whose colour changes as the

surface temperature changes [52]. Ultimately, it is a tool which is able to provide feedback to the user about the ring's surface temperature. Acting as a sensor, transducer and display, performing the actions of many wearables. Albeit, unable to make use of IoT.

The prototypes made use of the mobile app as the input for the desired destination. While a Bluetooth connection was used to mirror the guidance cues of the app onto an Oled display fixed to the wearable. This was then attached to the ring or wrist wearable as needed, a schematic of the components is displayed in Figure 4.

A wrist reflector was used as the wristband which the Oled display screen was fixed to since the reflector provided a simple one size fits all design. Making changing between participants easy. Electrical conductive tape was used as the method for securing the display to the participants' fingers since it provided a convenient method of accommodating the various sizes of fingers. A black pouch is also used to house the electrical components and strap them around the participant's arm.

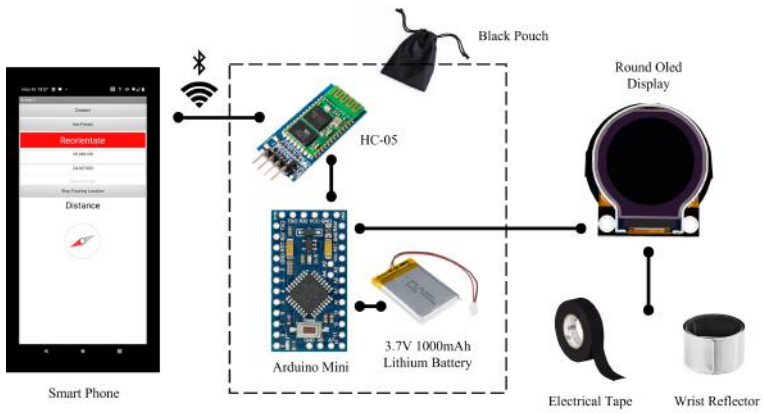

Figure 8: High-fidelity Prototype - Wearable

Figure 9: Photo of Wearable Prototype

In order to initiate the device to orientate the participant, they had to press a 'reorientate button', which was a pink sticker placed on the prototypes. The sticker was placed on the outside of the index finger, reachable by the thumb for the ring prototype. While a sticker was placed at the bottom of the Oled display for the wrist prototype. When a participant made a gesture to press the sticker, I would manually press the reorientate button in the app, which mirrored what the Oled screen displayed.

After the initial testing, two of the participants offered to try using the prototypes while on their trip to Tartu. In Tartu they would use the device to navigate the city centre and surrounding areas. This was a good opportunity to test the device outside of experimental conditions, with people who are on a real exploratory walk. Another benefit is that the participants could use the prototypes without me observing them, eliminating the influence my presence could potentially have on the feedback.

Working principle

The ring wearable was able to successfully guide all participants to their respective destinations. Similar to the app prototype, the navigational cues were well understood resulting in the participants easily orienting themselves, making navigational decisions confidently.

However, the band wearable performed less consistently. The manner in which the GPS technology worked clashed with the gesture the participants used to view the wearable's display. GPS systems are able to determine the direction the user is facing by assuming they are facing the same direction they are moving in [53]. This meant that in order for the guidance of the prototype to work, the screen needs to be facing forward as well. Unfortunately, participants viewed the display by bending their arms towards their chest, similar to a person checking the time on their watch. This gesture resulted in the display not facing forward and leading to participants misreading their bearings. Causing issues in reaching their destination. However, after a slight learning curve, participants were able to reach their destination while keeping in mind their arm orientation.

Navigational experience

As stated before, there was an initial struggle as participants learnt how to orient their arm when reading the display for the wrist prototype. This resulted in early confusion which dissipated once the participants got used to using the device. Resulting in an overall pleasant navigational experience. Similarly, the participants were pleased with their navigational experience with the ring prototype as well. With all participants once again celebrating when they discovered their destinations, akin to the reaction of the earlier participants who used the app prototype.

Interaction experience

The use of the ring prototype looked more fluid. This is due to the prototype feature of being single-hand operated. The participants were able to lift their arm while simultaneously pressing the reorientate button with their thumb, allowing for a quick and efficient interaction. And after regaining their bearings the participant just dropped their arm and continued walking, never having to slow down throughout the interaction.

The wrist prototype produced a less fluid interaction since it require two arms. One to lift the display upwards and the other to press the button. This however was minor and caused the user to slow down or stop walking briefly, before continuing the walk. Unlike when the mobile app was the centre of the interaction during navigation, both prototypes didn't hold onto the participants' attention for long. Only keeping it for brief moments when the users initiated the interaction.

Engagement with surroundings

It was observed that the participants seemed engaged with their surroundings as they navigated. Continuously looking around and deciding their next route, with minimal interaction with the prototypes.

In one case, Participant 1 mentioned that he instinctively pointed when using the ring wearable. Causing him to point in the direction of the destination. Which resulted in him paying extra attention to where he ended up pointing. Though he also mentioned that he worried that by pointing all the time, he might offend a stranger who happens to be in the same direction. Since he felt that pointing directly at someone is rude.

Tartu trip feedback

Two of the participants (3 and 4) offered to try using the prototypes while on their trip to Tartu. It was discussed that they would use the devices to navigate the city centre and the immediate surrounding areas. Both participants were familiar with the operation of the devices after the initial testing and would be in charge of operating the device without me. This type of testing was seen as useful as it presented an opportunity for the device to be used in a non-experimental context by a potential user.

After returning from the trip, the two participants listed issues which they encountered when trying to use the prototypes. The first one was that they forgot to charge the battery of the devices before use, resulting in them being unable to use them. They mentioned that it was problematic that they had to have their phones and devices charged in order to explore since it's another thing to remember.

Another issue was regarding the ring prototype. Outside of an experimental environment, both participants felt 'silly' using the prototype and worried about how they were perceived by others. Alluding to the appearance of the device and tape around their fingers looking strange. They suggested that the wearables cannot look cheap, otherwise they would be 'tacky' to wear. Since the wrist and ring wearables would also act as fashion items. However, this also led to a complaint that requiring two luxury items in order to explore was too expensive. Hence, although they felt the prototypes were easy to use, they didn't see the economic practicality of it.

7.2.3 Summary of Findings

The participants found that being guided by an arrow depicting direction and a numerical readout for distance was sufficient. The numerical readout dispelled any feeling of being lost, as well as acted as a reliable indicator of progress. The compass arrow symbol was immediately understood, resulting in a usable interface.

The utilisation of a mobile app as the primary interface of guidance during exploring proved problematic due to garnering excess screen time. The decision to pivot the mobile app to a secondary interface with the primary interface being on a wearable proved successful in eliminating the excess screen time issue. Resulting in users being able to fully immerse themselves in their surroundings without distractions.

The interaction of the ring prototype proved to be more fluid due to its one-handed nature. Compared to the wrist prototype which required both hands and the user to slow down. However, the ring prototype was not well received outside of the experimental environment, due to its appearance. The cost was then brought up as a concern. Both wearables were perceived as luxury items since both archetypes (wrist wearable and smart jewellery) are known for being status symbols for wealth, technology and fashion. And cheaper versions of said archetypes are viewed as inferior and tacky. Hence participants felt that the current solution would present an economic barrier since requiring two luxury items (smartphone + wearable) to explore is considered impractical.

8 Design Brief

The design brief serves as a summary of the research conducted during the discovery and defining phases. It outlines the goals and anticipated outcomes for the development phase, providing a framework for the concept development process. The brief sets boundaries for what the solution should accomplish and what it shouldn't.

8.1 Overview

Current navigational aids (mobile applications) impede exploration, through movement restriction and cognitive absorption/distraction. This makes exploring difficult for those who are reliant on said navigational aids because of their low confidence in their own navigational decision-making ability.

Additionally, their dependence on route-forming technology progressively worsens their wayfinding ability. Since navigational skills improve through practising navigational decision-making and allocentric familiarity. Thus, current navigational aids trap their over-reliant users in a cycle which worsens their navigational abilities and further reduces their tendency to explore. Preventing them from fully reaping the benefits of exploratory walking.

However, over-reliant users of navigation applications lack alternatives which are simple and efficient to use. Hence, it is decided that the intervention will be a navigational aid that facilitates its user to make their own navigational decisions, in order to make them more engaged with their surroundings and confident to freely explore. While also being intuitive and simple to use.

8.2 What it must be

Based on insights from potential users, known requirements to perform the activity and barriers which prevent exploratory walking, the following qualities are outlined which need to be within the proposed device.

- **Accommodate multiple journey types**. From the user research it was discovered that exploratory walking journeys can be divided into three classes: pedestrian (walking to a specific destination), hybrid (walking to a specific destination with the incorporation of public transport) and loop (pure exploration journey with no preconceived destination). The proposed device will need to be able to facilitate all journey types, in order to be considered useful to the intended users.
- **Be reliable**. In order to be used as an alternative navigation device to the phone, the user needs to be able to depend on it when needed. Hence, the device needs to be conservative on power consumption and sustain reasonable periods of usage before running out of power. The device also needs to adequately guide the user to their intended destinations in order to maintain trust and continual usage.

- **Depict progress**. People who tend to not explore often feel anxiety when required to do so without the aid of navigation applications. However, this inhibits exploration. User research also noted this requirement to instill confidence that the user's navigational decisions would lead them to their destination. Thus depicting progress is necessary to convey a sense of confidence to the user and dispel feelings of being lost.
- **Be non-obtrusive**. One of the biggest criticisms of employed navigational aids is their infringement on their user's attention when in use. It is also highlighted in the user research that for exploratory journeys, notifications and interactions should be kept to a minimum (i.e. minimise interaction time) in order to allow the user to stay engaged with their surroundings while exploring.
- **Intuitive experience**. Potential users expressed an expectation of intuitiveness. A feeling of just knowing where to go instead of being told where to go. As if being guided by instinct rather than instruction. Although this can be difficult to achieve, the desire was interpreted as instantaneous or immediate understanding. Where the user didn't have to think in order to interpret the information.

8.3 What it is not

It is important to keep in mind what the intervention should not be, in order to stay aligned with the user's needs and the task at hand. Hence the proposed device is not:

- **a replacement for current mobile navigation applications**. These applications serve a specific purpose which is to guide their users efficiently to their destinations in a timely fashion. The applications also serve as a method of allowing their users to familiarise themselves with an area digitally. However, these qualities do not carry over to exploratory walking, which requires a different set of qualities. The proposed device is meant to act as an alternative specifically geared towards exploring. Thus, the purpose of the two navigation methods is different.
- **a symbol of wealth and technology**. Novel technological devices are often pivoted as pushing the technological boundaries, which is appealing to those who want a status item demonstrating their wealth or interest in technology. However, this would restrict the usability of the proposed device, by creating a monetary barrier for those who wish to explore, as well as compromise safety by making their user show off valuables in unfamiliar areas.

9 Design Approach

9.1 Enchanted Objects

The concept of enchantment and enchanted objects was first coined by David Rose in his book 'Enchanted Objects: Human Desire and the Internet of Things' [54]. Within the book, he lays out the framework and design principles applied to create an enchanted object. Which to him is the way forward for interaction between technology and us. He defines an enchanted object as an ordinary object with extraordinary capabilities. A famous example used to explain the concept is the umbrella that radiates light when it detects that it will rain. Basically, an object that can anticipate its own use and notify its owner. Vitally given the necessary information at the right moment, when the user is deciding to leave with or without their umbrella. The idea of technology giving you information at the point you need it most can be thought of as enchanting. This interaction is vastly different from an app that notifies its user at random moments during the day about weather conditions. Where the information is considered more distracting due to it not readily being required.

Similarly in this project, the interactions between the user and solution, and when those interactions take place is a focal point. Geared towards creating a relationship between technology and the user where their attention is respected. Additionally, in an effort to not create a meaningless object, the road map laid out by David Rose provides guidelines aimed at basing object smartness on meaning creation. By only adhering to functionalities needed by the user while attending to their cognitive and behavioural needs and desires. Therefore, the approach laid out by David Rose is suitable for designing a navigational tool which facilitates exploring while preventing getting lost.

9.2 The Framework: Ladder of Enchantment

The framework offers up the process of enchanting an object. Highlighting five key steps and the degrees of enchantment an object can have. With objects on the higher steps considered more enchanting. In summary, climbing the ladder of enchantment bestows more personality, differentiation and monetary value onto an object. In saying that, it does not mean all objects need to reach the top, only that each step provides more value. And that depending on the user's needs, less enchanted and sophisticated objects may provide more meaning. The steps are referred to as the following:

1. Connection
2. Personalisation
3. Socialisation
4. Gamification
5. Story-ification

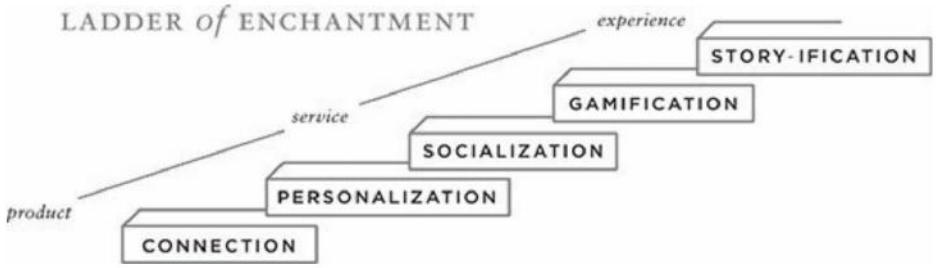

Figure 10: Ladder of Enchantment [54]

Connection

The first step centres around connectivity and the possibilities the Internet of Things (IoT) can provide. Emphasising the power of pairing sensors with the cloud. IoT has the ability to add another dimension to an object, with sensors acting as a link between the object and the digital realm. Surpassing the established limitations of the object in its physical form by compensating with its digital functionality.

Personalisation

The next step is utilising the data gathered to tailor unique services and functions to meet individual needs. Becoming an enchanted object that is able to accommodate and adapt to its user's preferences in order to be more useful.

Socialisation

The third step is socialisation or the connection of data with people. Facilitating connection with others through technology. Whereas others can also refer to technology and objects as well. Meaning connection refers to facilitating a link between a person and thing, or thing and thing or even a person as a go-between things.

Gamification

After achieving the first three steps, the next step is getting the user engaged. Changing them from a spectator into players. Actors who can initiate the change of the outcome. In this step, aspects from video games are taken to make people more engaged with mundane objects. Tapping into peoples' natural appetite for competition and progression. And wants to revel in newly acquired levels of mastery.

Story-ification

The final step of the ladder is story-ification, attaching a story to the object that will enchant the user. Stories are drivers of empathy and curiosity. The previous steps pull at our cognitive nature, but stories can be used to capture our hearts. Rose states that "that stories have an innate ability to engage, and that if they engage enough then they enchant".

As the object climbs higher up the ladder, the value and meaning the user derives from it changes. Starting with finding meaning in the object itself, shifting to the service it provides and finally the experience it offers. Hence, a meaningful experience is the highest form of enchantment.

9.3 Design Principles: Seven Abilities of Enchanted Objects

In order to climb the steps of enchantment, certain design principles should be kept in mind. There are seven abilities that enchanted objects make use of which differentiate them from smartphones and their apps. Specifically, how an enchanted object is able to garner our trust and act as a respectful agent of our time and attention. These abilities influence the manner in which we learn the objects and the objects learn us. The seven key abilities of enchanted objects are outlined as follows:

Glanceability

Enchanted objects can assist us in making decisions, often without us even realising it, and can provide us with information precisely when and where we need it most. When crafted effectively, these objects can reduce our mental burden by presenting us with only the necessary information to make optimal choices, without overwhelming us with extraneous details.

Gestureability

Another intrinsic characteristic of magical objects is that we intuitively and effortlessly understand how to engage with them. They are familiar objects, only augmented. Now with the ability to sense and respond to our natural movements.

Affordability

We are living in an age where the cost of computing is decreasing rapidly. Enabling us to explore novel methods of integrating computing into everyday objects. In comparison to high-valued technological items such as smartphones, the cost of enchanted objects can seem relatively small. In many cases, enchanted objects don't require the newest technological advancements, making use of essential computing and nothing extra. Meaning, they're purpose is not to act as status items demonstrating the latest technological discoveries. Instead, an enchanted object relies on the value it generates instead of possessing the latest technological features to enchant its user.

Wearability

Wearability enables us to break away from the limiting archetype set by smartphones, 'the black slab'. Instead incorporating technology into the objects that surround us, and on us. Distributed technologies are simpler and more forgiving of user errors. In comparison to terminal-centric technologies, where overusing GPS may result in the phone dying and loss of all other functionalities.

Indestructibility

Enchanted objects can be surprisingly durable given their affordability. In any case more durable than any 'iThing', as stated by David Rose. Like any well-used tool, it should be made almost impervious to wear, and last for decades. Garnering a certain mysticism during the journey of its lifetime.

Usability

It seems obvious, but enchanted objects are primarily useful. And achieve this by working on their user's behalf with limited interface or instruction. Usability aims to take advantage of the intuitive ways we interact with objects.

Loveability

Lastly, enchanted objects should connect with us emotionally. Attaining emotional engagement in a variety of ways, such as anthropomorphism or baby schema. David Rose suggests that "loveability results primarily by bestowing human attributes on inanimate devices, especially those with cute or infantile features". But simply bestowing any human quality will not do. Qualities such as loud, intrusive and inconsiderate will result in rejection. Rather enchanted devices need to adhere to being gentle, considerate and patient. This is necessary if we are to be surrounded by enchanted objects.

In summary, these seven principles can be used to climb up the ladder of enchantment. However, these are not set rules, but merely guides to follow and assist in making design decisions.

10 Ideation

10.1 Value Proposition Canvas

The Value Proposition Canvas, developed by Alexender Osterwalder, assists in creating value for the user. The canvas consists of two sections. The first part called the Customer Profile, helps the designer better understand their customers. While the second part called the Value Map, describes how the designer plans to provide value to those customers. When these two parts align, it creates a Fit where the designer's product or service meets the needs of the customer [55].

10.2 Customer Profile

The Customer Profile provides a detailed description of a particular group of users who will use the product or service. It includes a breakdown of the user's needs, problems, and desired outcomes. This information helps to better understand the customer segment and create a solution that addresses their specific needs. For the purpose of this Value Proposition Canvas the selected customer profile is: *Leisure Going Pedestrians in Urban Environments (with spatial anxiety)*.

10.2.1 Customer Jobs

Jobs refer to the objectives that the users aim to achieve in their personal or professional lives. These could include tasks they need to complete, issues they want to resolve, or desires they wish to fulfil. The jobs are described in Figure 11.

Figure 11: Jobs to be Done

10.2.2 Customer Gains

Gains refer to the advantages and benefits that the users desire. While some gains are essential or anticipated, others may come as a surprise. These benefits can range from practical usefulness to social status, positive feelings, or financial savings. The gains are illustrated in Figure 12.

Figure 12: Gains

10.2.3 Customer Pains

Pains are any factors that cause frustration or inconvenience for the users when attempting to complete a task, either before, during, or after the process. They can also refer to potential negative consequences or risks associated with performing the task poorly or not at all. The pains are shown in Figure 13.

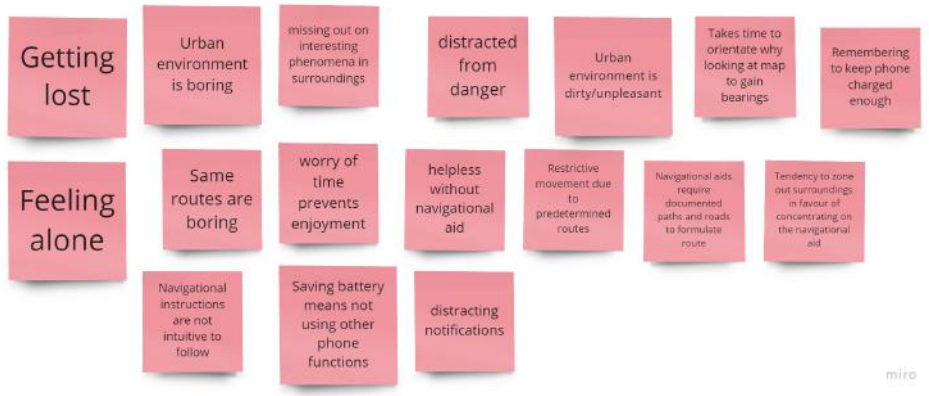

Figure 13: Pains

10.3 Value Map

The Value Map describes the features of a specific value proposition the solution offers in a more structured and detailed way. It breaks the value proposition down into products and services, pain relievers, and gain creators. Which are used to address the pains and gains in the Customer Profile.

10.3.1 Products and Services

These are offerings intended to fulfil the functional, social, or emotional needs of the target users, and satisfy their basic requirements. It's important to note that products and services alone don't create value; rather, they are valuable only when they are tailored to a specific user segment, addressing the needs, problems, and desired outcomes. The proposed products and services are displayed in Figure 14.

Figure 14: Products and Services

10.3.2 Gain Creators

Gain creators refer to the ways in which the proposed products and services generate benefits for the users. They provide a clear description of how the solution can deliver desired outcomes and advantages, such as practical usefulness, social status, positive feelings, or financial savings. This encompasses any gains that the customer may expect or want, as well as any unexpected benefits they may experience. Gain creators are depicted below in Figure 15.

Figure 15: Gain Creators

10.3.3 Pain Relievers

Pain relievers detail how the products and services address and alleviate particular customer discomforts. They provide a clear explanation of the proposed solution will eliminate or minimise factors that cause frustration or inconvenience for the users, whether during, before, or after completing a task. In summary, it outlines how the idea addresses the pains of the user. The pain relievers are shown in Figure 16.

Figure 16: Pain Relievers

10.4 Fit - Ideas

Fit is achieved by linking the Customer Profile with the Value Map. It should be noted that an idea does not have to address all of the users' jobs, pains and gains. But it should be clear how the idea does address some of them to ensure that it will add value to the user. Products, services and features as well as their respective gain creators and pain relievers can be used in various configurations within ideas. This ensures that the ideas are addressing the needs of the specified user. The filled-in value proposition map is shown in Figure 17.

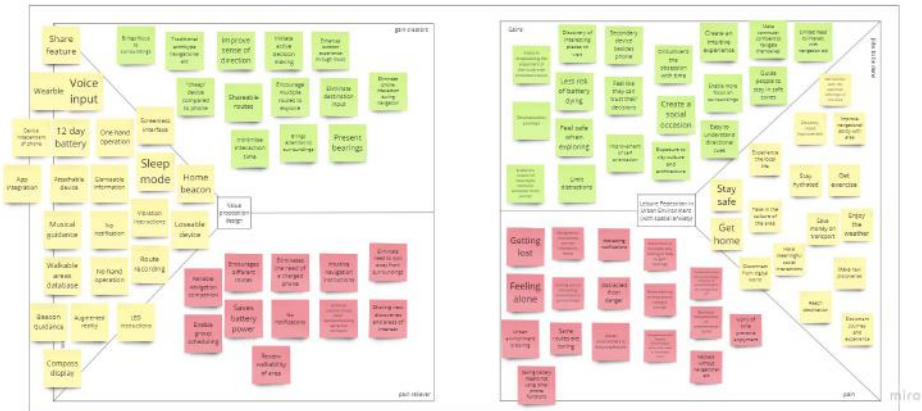

Figure 17: Value Proposition Map

10.4.1 Enchanted Glasses

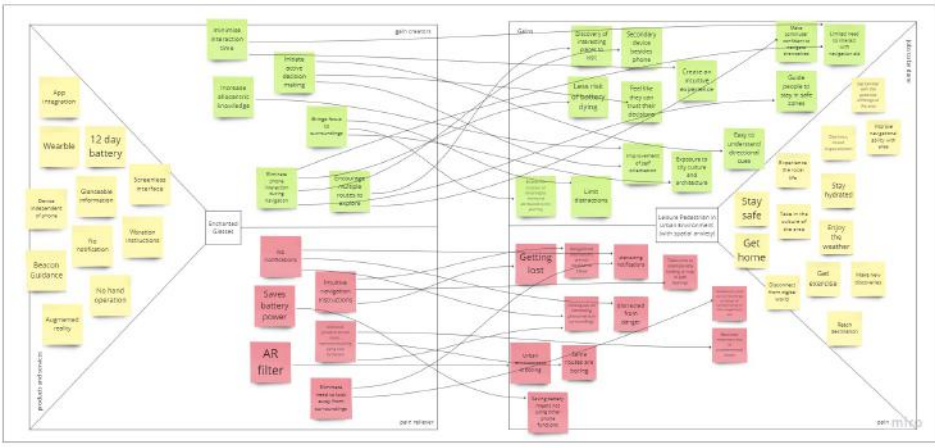

Figure 18: Value Proposition Map - Enchanted Glasses

Enchanted glasses utilise augmented reality (AR) to provide a beacon for the user to walk towards. Similar to people using large landmarks to gauge their bearings such as stars or a mountain, this idea creates a virtual beacon. This beacon is overlaid over the user's vision, giving the user continuous feedback of their bearings relative to their destination.

This also eliminates the need for the user to ever look away from their surroundings since all of the guidance information is provided within the surroundings via AR. Meaning, after entering the destination in the user's phone, the phone can be kept away for the remainder of the journey. The beacon may change in colour and scale to indicate if the user is getting closer or not.

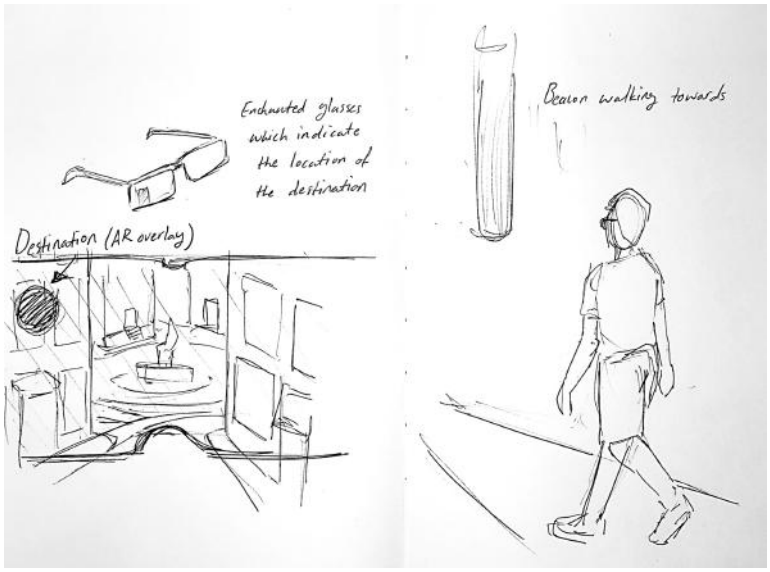

Figure 19: Enchanted Glasses Idea

10.4.2 Enchanted Keys

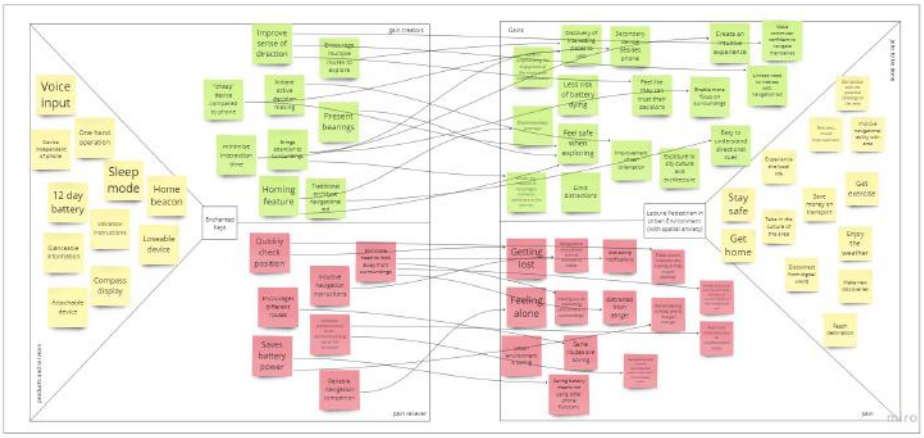

Figure 20: Value Proposition Map - Enchanted Keys

People seldom leave their homes without their keys. Hence, keys are an ideal object to enchant with a navigation spell. The idea is to 'enchant' the keys with a device which can provide orientation-based guidance to the owner. This device can then be used to gather one's bearings while travelling.

The idea also makes use of voice input, making the interaction faster for entering a destination, while at the same time reducing the effort necessary required. The device is also able to break up complex journeys into smaller ones with checkpoints along the way. This enables it to integrate public transport into their trip or prevents the user from missing essential crossings such as bridges. Ideal for addressing hybrid exploratory journeys.

The mundane appearance also allows the user to freely use it in public without worrying about it being stolen, while their phone remains in a safe place. This makes exploring unfamiliar areas safer while at the same time eliminating excess contact with the user's phone.

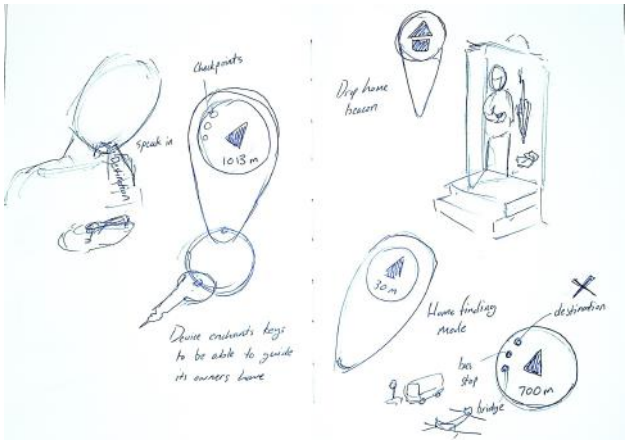

Figure 21: Enchanted Keys Idea

10.4.3 Enchanted Shoes

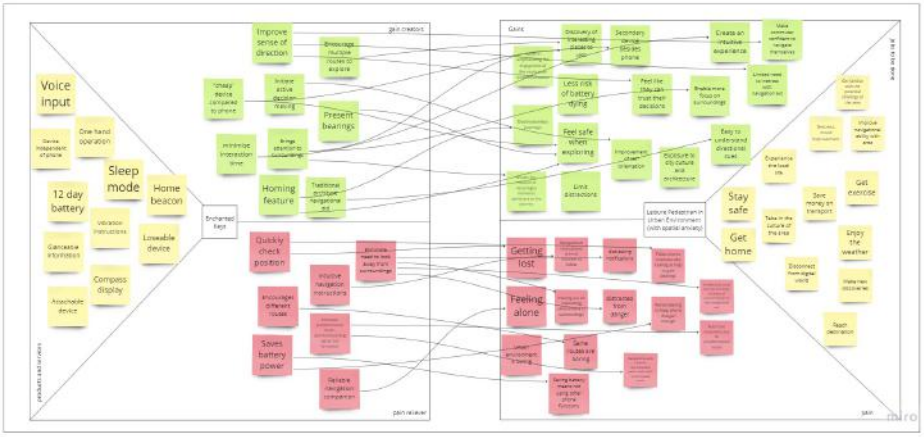

Figure 22: Value Proposition Map - Enchanted Shoes

Enchanted shoes leading their owners back home is not a novel concept in fiction. Ruby's slippers from The Wizard of Oz are a famous enchanted object which instantly transports their owner back home when they are tapped together three times. However, this idea is slightly different, than Dorothy's pair of shoes. Although teleportation currently remains out of reach, shoes which can guide their owners back home can still be considered enchanting. And convenient considering people rarely leave their homes without their shoes. The idea is to integrate shoes with an app, where the app can keep track of where the shoes walk, and then point to the direction of the home when the owner wishes it. The tracked routes can be captured within the app and shared with friends, indicating interesting discoveries made along the way. These friends can later try your shared route using their own pair of enchanted shoes. Guided along the route through visual cues given off by the shoes themselves, meaning the phone is not required to be actively used during the journey.

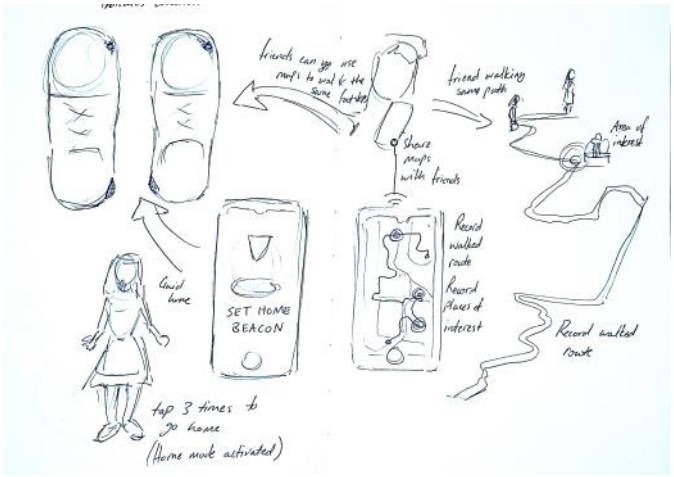

Figure 23: Enchanted Shoes Idea

10.5 Selection Justification

Although all ideas respond to the needs of the customers/users. The idea chosen is the one that best complies with the design brief outlined in Section 9. For this reason, enchanted keys was chosen to move forward with because of the following:

- The enchanted keys are more suited to incorporating all journey types, especially hybrid journeys. Comparatively, the enchanted shoes may lack clarity when trying to convey more detailed information which is required for public transport. Due to the tactile mode of communication. Making it difficult to integrate hybrid journeys.
- The interface is also thought to be the least distracting compared to an AR overlay, which is used for the enchanted glasses. Since the overlay would continuously be issuing feedback and drawing user attention. While the enchanted shoes require the person to continuously look downwards which can also be problematic.
- Enchanted keys is not a luxury item and is purposely designed to not be perceived as one. It will not be interpreted as a status piece which wearables are typically seen as. Although not all shoes and glasses are perceived as luxury items, incorporating smart technology into them may heighten their status. Considering that these items are also considered fashion items, this would also add another dimension which would need to be addressed that is unrelated to the original purpose of the enchanted object.
- Enchanted keys are also a very personal item. Which means thieves would be discouraged from stealing them. Hence the keys can be used as a primary navigating device openly without the worry of attracting unwanted attention, while the phone is kept safely concealed. Which is beneficial in unknown urban areas when exploring.
- The enchanted keys utilise a tested method of guidance. During user research, it was expressed that egocentric guidance is preferred over allocentric (many envision being led by a compass instead of environmental factors such as stars or landmarks). Egocentric orientation guidance was tested using technological probes and proved to be a very effective means of guidance while initiating users to make their own navigational decisions and remain engaged with their surroundings. Comparatively, the other ideas utilise untested modes of conveying guidance, which would require further research. Considering that the compass egocentric mode of communication has proven to work effectively, it is deemed suitable to move forward with.

11 Concept: Enchanted Keys

11.1 Mental Construct

Figure 24: Aleth

Following the approach of enchanting ordinary objects to accomplish extraordinary tasks. The device is an enchantment which enables your home keys to guide you back home. Considering one rarely leaves their home without their keys, it presents an ideal object to attach a 'navigation spell' to guide the user on their journeys away from home.

The device makes use of an audio interface to allow the user to input their destination and queries. This is similar to the interface visually impaired people utilise for current navigational aids. The destination is then processed and the user's relative position (bearings) with respect to the destination is effectively communicated.

This is accomplished by providing glanceable information. Utilising only an arrow and number to convey to the user their bearings. The glanceable nature of the device respects the user's attention and minimises the interaction time. Encouraging the user to remain engaged with their surroundings instead of the device.

Hence the device doesn't offer continuous guidance. Only providing navigational information when prompted by the user. And going into sleep mode when not in use. Empowering the user to make their own navigational decisions and only offering guidance when asked to. This lowers the device's power consumption, ideal for prolonging spans of use without needing to be recharged.

In cases where the journey is more complex, requiring a low level of nudging. Checkpoints are used to steer the user. These are specific locations that the user has to pass along the way in order to reach their destination. Such as if the user is required to use a form of public transport, then a bus station is considered a checkpoint that has to be reached. Similarly, bridges and railway crossings may be checkpoints to assist the user in avoiding obstacles and hazards.

The user is also able to change modes, set home pins, or access more detailed guidance information through the use of a 2-axis joystick. Which acts as the primary point of interaction with the user. While destination queries can be made through listening mode which is activated when the user holds the device towards their mouth.

11.2 Destination Input

11.2.1 Listening Mode

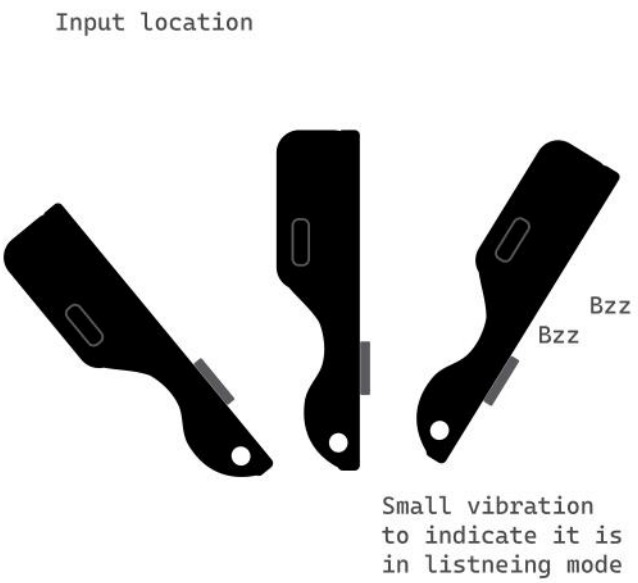

Figure 25: Listening Mode Activated

A listening mode is proposed to record the user's destination and destination queries. It is envisioned to operate similarly to the audible inputs utilised in current navigation apps such as Google Maps. Which converts the user's speech into a search query.

This interface turns the destination input into a brief conversation between the user and the device. Shortening the interaction time by minimising the necessary actions performed. For example, in most cases, saying a word requires less time and actions compared to typing the word out.

In order to make sure that the device is able to listen effectively, the user is encouraged to hold the device towards their mouth like a microphone. This is achieved by the manner in which the listening mode is activated. Once the user orientates the device towards their mouth, the device vibrates to notify them that it is in listening mode. This alerts the user that the device is ready to take in their query. The activation gesture mirrors the action of speaking into a microphone. Using an intuitive action associated with the operational mental maps of microphones.

11.2.2 Home Beacon: Loop Journey

A loop journey is described as a destination-less journey, where the user's only guidance requirement is to return back to the starting point. Setting a home beacon allows the user to record their 'home' or 'return to' location. The user is able to set a home pin by toggling the joystick down and holding it for at least 3 s. The device then records the GPS coordinates of the location. The user is then able to set the home pin as the desired destination by toggling the joystick down again and letting go, without holding it down (1-second action). The device then guides the user towards the home pin.

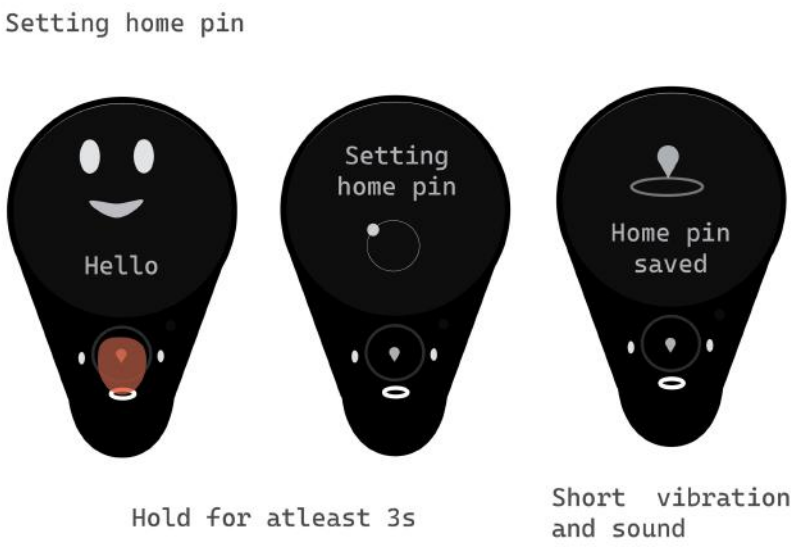

Figure 26: Setting Home Pin

11.3 Journey Modes

11.3.1 Basic Guidance Mode

A uni-destination journey enacts the basic guidance mode. Where the user is given their bearings relative to their selected destination. This is automatically determined by the device when it recognises that there is no need to set up checkpoints along the journey.

Figure 27: Basic Guidance Mode

11.3.2 Checkpoint Guidance Mode

A checkpoint journey enacts the checkpoint guidance mode. This mode is automatically activated once the device determines that it is necessary to guide the user to specific places in order to for them to reach their destination. This splits up the journey into multiple uni-destination journeys leading to the checkpoints. Hence, once the user reaches a checkpoint, a small vibration and sound notification goes off, and the device switches to guiding them to their destination or checkpoint. The user is also able to enquire about checkpoints by toggling the joystick right and receiving information such as "cross the bridge" or "at Ööbiku stop, take bus 23 to Rahumäe stop". This gives the user more context for what they have to do at the checkpoint.

Figure 28: Checkpoint Guidance Mode

11.3.3 Sleep Mode

In order to minimise the interaction time between the user and the device, it will only communicate guidance (shows bearings) when prompted to do so (pressing the joystick button down). Otherwise, it remains in sleep mode, only notifying the user if they have arrived at a checkpoint or destination.

There is an automatic and manual way to enter sleep mode. If the device is not interacted with for 2 minutes it will automatically switch to sleep mode. Alternatively, if the joystick button is pressed, it will manually switch to sleep mode. Similarly, the guidance mode can be turned on again by pressing the joystick button again.

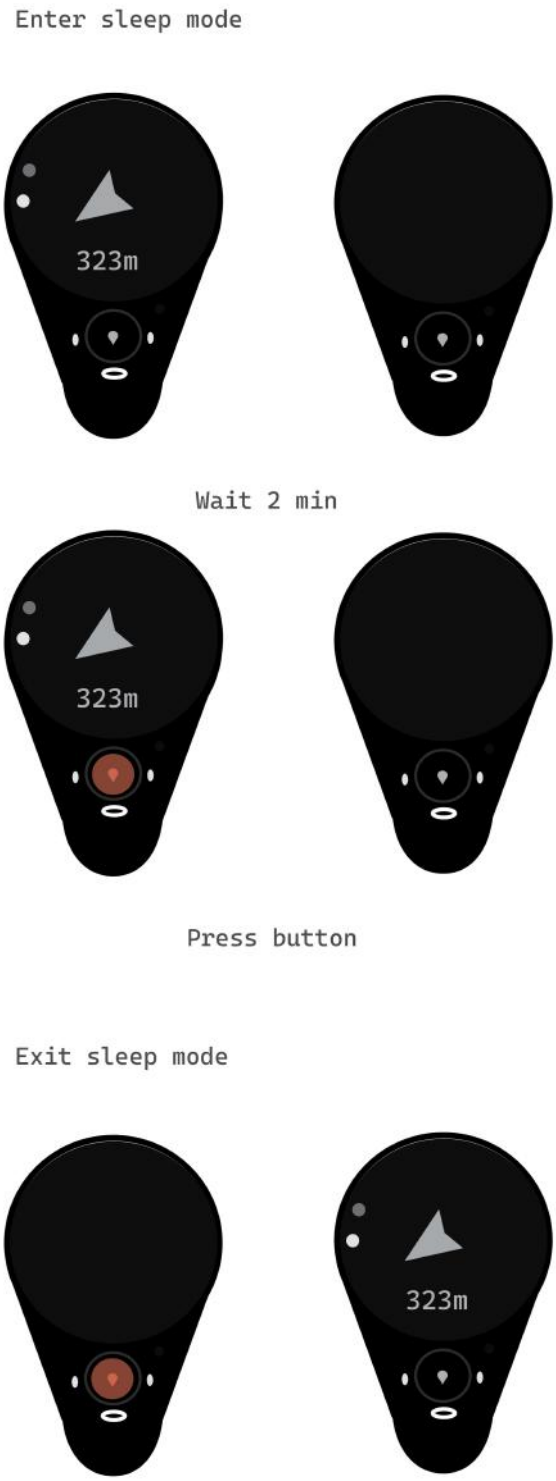

Figure 29: Sleep Mode

12 User Testing

12.1 Prototypes

12.1.1 Sketch Representation

The visuals of the idea were put through a filter to make them look like hand-drawn sketches. This is done to re-establish to the participants that it is only a proposed idea which is open to change. Allowing them to be more forthcoming with critical feedback. The 'sketched' visuals demonstrated the working principle of the idea, through a low-fidelity storyboard.

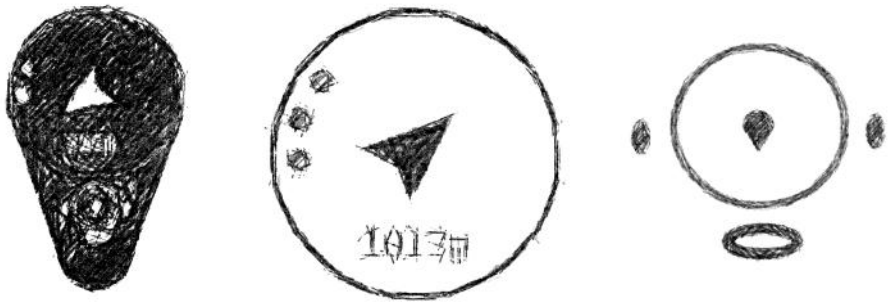

Figure 30: Sketch Examples

12.1.2 Physical Representation

An RFID tag on a key chain was used to act as the physical representation of the idea. The participant was expected to act out the interactions and gestures required to operate the proposed device. The physical representation gave the participants a more tangible experience, allowing them to physically feel how it would be to use the idea.

Figure 31: Key Chain Prototype

12.2 Overview

The idea was tested with potential users. Some participants were selected from past interviewees who scored relatively high on the SAS, refer to Section 4.2. While others who were not familiar with the project were selected as well, after registering a high SAS score. Interviews were held in person, with the participant interacting with the prototypes during the process. A brief presentation of the idea and its working principle was given beforehand. The sketch representations were used to give context during the presentation. While the key chain prototype was used as a prop to act out scenarios and gain insights into the usability of the proposed idea.

The main aims were as follows:

- Gauge the initial impression from potential users.
- Evaluate the readability of the interface.
- Evaluate the perceived usability of the device.

The leading questions for the interviews were as follows:

1. What is your initial impression of the concept?
2. How would you feel about making navigational decisions with the assistance of the concept?
3. Was the explanation in the presentation understandable?
4. What are the top two things you like about the concept?
5. What are the top two things you dislike about the concept?
6. What is your opinion of the usability of the concept?
7. What aspects of the concept can be improved?
8. Would you use the concept, if so, when and how?

12.3 Feedback

Interviewee 1, 31 year old, female, past interviewee

The initial impression was positive. The person thought that the guidance was intuitive and simple to follow. They associated it with using a compass to navigate in a forest. She likes the non-intrusive nature of the device, and that she is in control of when the interaction takes place. She thought it was logical to have a navigation device attached to her keys since she never leaves them behind when going out.

The usefulness was highlighted in a scenario of her getting back home after a night out in the city with her phone dead (something that happens commonly when she goes out). She liked the joystick interaction since it reminded her of using her Nintendo Switch controller. And how she can scroll through the checkpoint information so that she can build a road map of the journey in her mind beforehand. There was nothing specifically she didn't like about the device, only that she wouldn't pay more than 40 € for it.

Interviewee 2, 24 years old, male, past interviewee

The concept was viewed as something suitable to be attached to a key chain. As well as something that was comfortable to hold and handle. The user liked that it was convenient to use since they always keep their keys in their jacket pockets or jeans. They liked the 'simple' interactions required to operate the device, only mentioning doubts about mistakenly initiating a home beacon when taking the device out of their pockets since it's a single pull-down motion on the joystick.

Another doubt they had was about using voice input. They expressed their negative experience with using similar interfaces in the past and mentioned that they are suspicious of such interfaces. Pointing out that the technology struggles to understand their accent. He suggested that I find another way of inputting destination information.

Interviewee 3, 23 years old, female, past interviewee

It is beneficial that she doesn't have to download another app. Since she only uses Google Maps and doesn't see a need for another navigation app. She complained that she already has too many useless apps on her phone. The navigational guidance was deemed simple to follow and the interactions to operate the device were considered logical. She liked that there is extra information given for the checkpoints since it gives her an idea of what she is looking for, providing an indication she is heading in the right direction.

She pointed out that although it is easy to hold the device on the key chain, she still doesn't think it's a good idea. This is because she doesn't keep her keys in her pocket and sometimes she doesn't have pockets at all. She mostly keeps her keys in her handbag, so having to dig through her handbag each time she wants to use it seems troublesome.

Interviewee 4, 42 years old, male, new interviewee

His first impression was that it is a cool little gadget that he would buy for his wife who also has no sense of direction. He thinks it is something he would likely use on holiday when he wants to explore the city as a tourist. Where he could use the home pin to find his way back to the hotel when he needs to. The device also provides an alternative to 'waving a phone around', which is troublesome in unfamiliar or unsafe areas prone to pick-pocketing.

The arrow and distance indicator are easy to understand and the interactions to operate the device are intuitive to use. He is confident that with this device he and his wife wouldn't have to worry about getting lost while they navigate the city. However, when not on holiday he cannot imagine using the device because it cannot estimate times. So using public transport would be difficult. Overall positive feedback.

Interviewee 5, 36 years old, female, new interviewee

The initial emotion was happiness that she could have a device that could guide her when her phone dies. She has a lot of anxiety when she travels and her phone battery is low. The arrow and distance are perceived as safety net to prevent her from getting lost, and this makes her comfortable with exploring. She doesn't believe that the device should be used for longer trips or trips with public transport because Google Maps is already 'perfect' for that. But she thinks that the device is suited to be used in forests and exploring nearby areas. Especially the home pin, which would make it easy to return to the car after exploring the forest.

The device on a key chain was deemed problematic since she doesn't keep her keys in her pockets. Instead, she keeps them in her bag so that they don't fall out and to keep them safe. So she would probably not keep the device on a key chain, but she is not sure where else to put it. As long as it is not the pockets since her pockets are small.

The voice input was also considered problematic, since on holiday she might not be able to pronounce the names of the local streets. She also mentioned having issues with similar types of interfaces such as Hey Google. She suggests that voice input should not be used.

12.4 Analysis

From the user testing, it is confirmed that the arrow and distance readout is intuitive and quick to understand. Insinuating that the guidance information exhibits glanceable qualities. Another function which was positively received was the sleep mode. Which meant that the user had to initiate the interaction with the device. Meaning the device couldn't act as a distraction. All participants also found the home pin useful for routeless journeys and or trips back home. A fail-safe for getting home when the phone cannot be used.

There were mixed feelings about latching the device to a key chain. Noting some people do not carry their keys in immediately accessible areas such as their pockets, instead relying on handbags and backpacks. Others also pointed out that the pocketability of the device didn't matter because their clothes mostly don't have pockets or usable ones, to begin with.

There was also scepticism surrounding the voice input for destination queries. With some alluding to their past negative experience with similar interfaces, as well as the potential limitations of the usability. Such as a person being unable to pronounce the destination they want to go to, or their accent affecting the technologies ability to process their query correctly.

All users found the home pin to be the most novel feature. Pointing out its usefulness in a variety of cases. However, some did seem hesitant about longer journeys requiring multiple checkpoints, stating they would be more comfortable using Google Maps. This was partly due to the potential of longer journeys being too complex (requiring many correct navigational decisions) and the integration of public transport being time sensitive.

The device was also perceived to be a relatively low-cost item compared to a phone, with one participant pointing out she wouldn't pay more than 40 € for it. This is not however a problem, since it was also pointed out that it could increase the user's safety by providing a cheap alternative navigational aid in unsafe areas.

In summary, the guidance mechanism and designed interactions were mostly well received. The main exception being the voice input, due to perceived limitations and past bad experiences regarding its usability. The device fixed on a key ring was also called into question due to preferences of not keeping home keys in easily accessible places such as pockets. And finally, explorative journeys requiring multiple checkpoints don't seem feasible due to the number of navigational decisions it requires. However, the home pin feature was universally well received an seen as a novel useful tool for not getting lost when exploring.

13 Concept Development

13.1 Grip Selection

As a device which is frequently handled, a comfortable grip is paramount for its usability. Additionally, the grip must also serve as a subliminal cue as to how the device is operated, through suggestive geometry of it should be held. Where the thumb rests comfortably on the joystick, while the device is supported by the index or middle fingers. Or in a lateral pinch position, illustrated in Figure 32 [56].

Figure 32: Lateral Pinch [56]

In terms of experience, the device should feel not only comfortable but pleasant to handle. Similar to a river rock that is picked up on a hike. It is also an object to be rubbed, squeezed and held on the journey. Striving to provide a soothing quality, sense of calmness and serenity when being handled.

Figure 33: River Pebble - Grip Experience Inspiration

13.1.1 Clay Models

Clay was used to sculpt various proposed profiles in order to experience and test them. Clay was chosen as the method of prototyping because the malleable material allows for quick experimentation and changes within testing. Ideal for trying to determine a suitable grip. Since it allows for tactile sense, instead of only utilising visual representations, allowing for effective and quick alterations. Five models were created with each being used to test potential grips. With finger groove depth, length, width and shape being varied, in order to achieve a grip which is satisfying to handle.

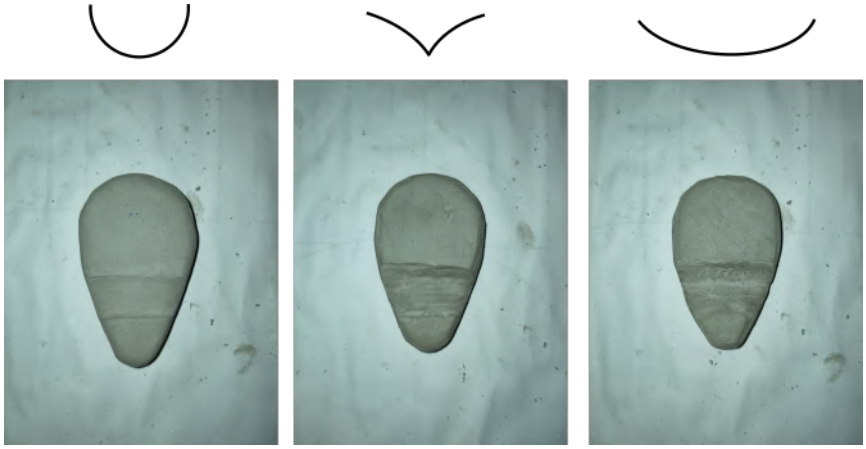

Figure 34: Clay Models

13.1.2 Analysis

Initially, a simple finger groove was proposed, where the user's index finger would snugly fit into the grove, providing a secure fixture point for the device. However, through testing, it was determined that this proved to be uncomfortable, and hindered the manoeuvrability of the device in the grip.

Two factors proved problematic when combined in the case of the initial grip, the concave shape and the narrow grip. It was found that utilising a narrow finger groove, with convex curves, resulted in a more pleasant and secure feeling. Partially due to the pressure points created by the finger being in contact with the convex curves.

Alternatively, widening the finger groove and reducing the depth, enabled the device to be more freely handled and fidgeted with, like a river stone. Enabling the index finger's position to be more flexible. This also eliminated the problem of fingers being too small or big for the finger groove, which was encountered in the initial proposal. However, due to the device being more free to handle, it resulted in a less secure grip.

Hence a narrower finger groove allowed for a more secure hold at the expense of being freer to handle and open to various finger/hand sizes. The choice came down to picking a side of the trade-off. In the end, a wider and less deep groove was selected, since it more closely echoed the qualities of handling a river pebble, while at the same time being more forgiving towards different hand types. It was also considered that the device is also secured via a cord used to bind the device to the person. This binding offers the surety that the device will not fall when being handled.

13.2 Testing Latching Ability

This testing evaluates the practicality of binding the object and explores potential bindings which would be convenient for an exploratory walk. In order for the object to act as an attachable navigation spell, it needs to be able to latch onto the user, their clothes or objects in reachable areas. This is achieved through a threaded cord which is used to wind/hang around or bind/tie the device to things. However, the device cannot look out of place as well as has to maintain its usability when latched to the person or their possession. Therefore, a physical prototype is required to simulate how the object would perform and be perceived when being latched onto things.

13.2.1 Prototype

A 3d printed model was decided to be used as the prototype. This is because a 3d printer is able to create an accurate geometric representation of the design as well as the plastic material it uses is similar to what the final product would be manufactured out of. Meaning the prototype will feel similar to the final product.

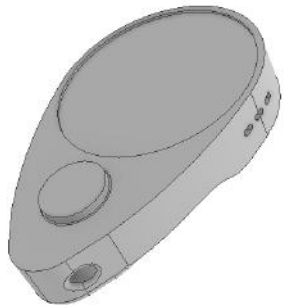

Figure 35: CAD Model

Figure 36: 3d Printed Prototype

13.3 Use Case Scenarios

The latch ability of the prototype was tested by trying out different binding opportunities. It was found that the cord offered a wide array of possibilities to attach the prototype to various locations of the body or within reach of the hands. The prototype was found to be very adaptable when it came to attachment point selection and didn't look out of place when bound to the various locations.

Another possibility which was uncovered as a result of the testing is to use the device in conjunction with micro-mobility such as bicycles and e-scooters. These are forms of transportation that also require glanceable guidance so as to not distract the commuter from their surroundings. And can, therefore, benefit from the proposed solution as well. Overall, the prototype proved the cord offered a high versatility to bind the device, which is important for the usability of the solution.

Figure 37: Latching Scenarios

14 Refined Concept: Aleth

Figure 38: Aleth

Aleth is a navigation spell that can be latched onto their owner or their belongings. The name is derived from the Greek word for truth, taking inspiration from the Alethiometer, an enchanted object from the book His Dark Materials, is used to seek out truths in order to guide its user [57]. However, unlike the Alethiometer, which was notoriously difficult to master and read, Aleth is intuitive, emitting quick and easily understood information. Pointing its user to the true location of their destination.

The device utilises symbols and characteristics of a compass, to ensure glanceable communication as well as being instantly readable to users, as it conforms to a typical archetype associated with navigation. This interface has proven successful in guiding users without infringing on their attention, refer to Section 7.2.

In terms of addressing the journey types, pedestrian, hybrid and loop. The device possesses two modes for inputting destinations. The first requires a phone in order to go on pedestrian and hybrid journeys. This is because Aleth integrates with the Google Maps application. Where the user inputs their destination as if they were using the application, but then switches over to Aleth when starting the journey. Aleth then takes the route generated by Google Maps and converts it into orientation-based guidance. This also means that the users can switch between Aleth and phone whenever the need arises, such as gaining confirmation of public transport times. However, the majority of the guidance is still given by Aleth, allowing the user to stay immersed in exploring.

The second mode of destination input is utilising the home beacon. Which can be used without a phone and is ideal for loop journeys. This mode allows the user to drop and save a location pin, which can later be set as the destination by the user. This mode is independent of the phone for two reasons. The first is that loop journeys are the purest form of exploratory journeys since the only objective is to explore. Hence, limited guidance and interference are necessary and a phone is not required. Secondly, the mode may act as a safety net, allowing the user to be led back to a familiar point in the case of their phone dying. Becoming a reliable homing tool for the user.

The device also requires the user to initiate the interaction and guidance. Only offering information when prompted to. Otherwise, the device remains in sleep mode, conserving battery life and allowing the user to not be distracted. This makes the hand-held device an

ideal travel companion, utilising low-energy systems to extend the period between charging times. Making it a suitable alternative navigational tool that can be relied on in place of a phone. The device is also not perceived as a status symbol for wealth and technology, but rather signifying a person's inclination to explore. This means that the device can be carried outwardly, without the fear of attracting unwanted attention. Making exploring unfamiliar urban areas safer.

14.1 Construction

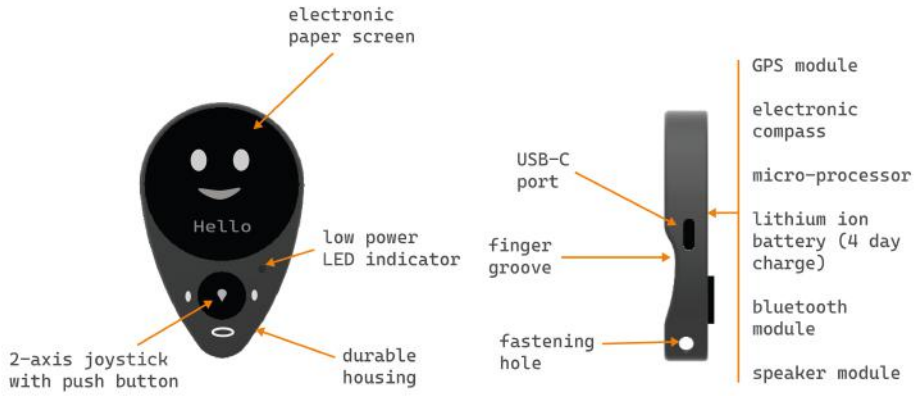

Figure 39: Aleth Design Components

Electronic paper screen

These screens are visible in direct sunlight, making them ideal for outdoor use, especially considering that exploratory walks often occur on sunny days. The screens also are known for their low power consumption which is important for preserving battery life.

2-axis joystick

This specific component is commonly associated with being manoeuvred with the thumb, important considering the device's natural grip facilitates a lateral pinch position. This component also enables five analogue inputs, saving space on an already small surface.

Durable housing

The housing mostly requires durability and not mechanical or tensile toughness. Hence, recycled industrial plastic such as Durat is a suitable choice. Durat plastic is composed of a mixture of polyester resin and recycled post-industrial plastics, such as acrylic and polyethylene. This combination results in a strong, resilient material that can withstand everyday wear and tear. It is also known for its non-porous nature, making it resistant

to stains, moisture, and bacteria growth. Ideal for an object which is to be handled a lot outside [58].

In addition to its functional and aesthetic qualities, Durat plastic is also recognised for its environmental sustainability. By incorporating recycled materials into its composition, Durat contributes to reducing waste and minimising environmental impact. An important consideration when designing new objects to be manufactured.

Finger groove

The groove offers a grip for the person to hold the device securely. The groove is also wide enough to accommodate multiple finger positioning. The slight slope also mimics the gentle curvature of river pebbles, making the device more pleasant to hold and rub. Promoting a repetitive interaction which presents a soothing quality.

Low power LED indicator

The LED communicates to the user when the device is low on power and needs to be recharged. The LED also indicates when the device is fully charged when plugged in by changing colour (from red to green).

USB-C port

The EU has approved a 'common charger' mandate in order to reduce electronic waste. Stating that by 2024, most electronics, including portable navigation devices, will be required to use a USB-C port [59].

Lithium ion battery

These types of batteries are known for their high energy density, meaning they can store a lot of power in a relatively small space. The battery can also be designed to conform to any shape needed, which is ideal for the proposed device which needs to be space efficient within its interior.

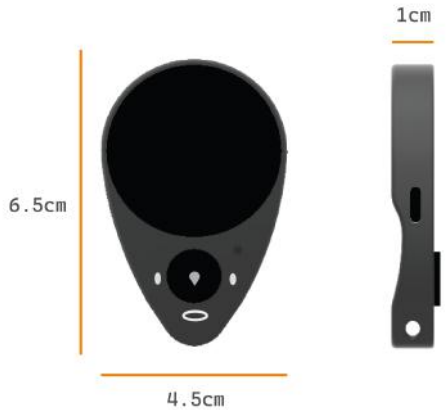

Figure 40: Aleth Dimensions

14.2 Symbolism

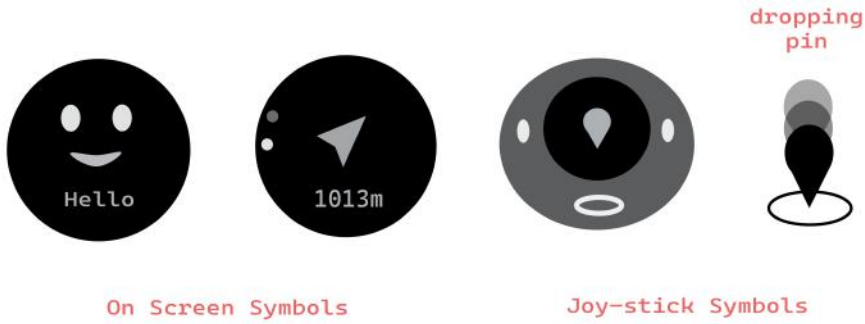

Figure 41: Interface Symbols

14.2.1 Smiley Face

A common tactic for anthropomorphism is adding a face. In this case, a smiley face. The face assists in ascribing human qualities to the device, enabling the user to bond with the object. A smiley face is chosen to reinforce that the interaction between the user and the device is positive and friendly, and solidifies the object as an ideal travel companion.

14.2.2 Arrow

The arrow mimics the symbols found on compasses. Therefore, it is used due to its instant recognition as a guidance symbol which most people are familiar with. The information communicated via the arrow is also glanceable, which is important for minimising the interaction time between the user and the device.

14.2.3 Numeral Distance Output

A numerical output was chosen to communicate the distance between the user and their destination. This is because a numerical value is easier for the user to interpret and accept, compared to more abstract indicators such as a slider or colour scale. A precise value for distance was required by the user to offset feelings of being lost and enable them to accurately measure their progress.

14.2.4 Checkpoint Dots

In order to incorporate hybrid journeys, checkpoints are used to mark important locations such as bus stops. The checkpoint dots on the left-hand side of the screen indicate the number of checkpoints the journey is broken up into, as well as how many checkpoints are left until the destination is reached.

14.2.5 Joystick Symbols

The symbol on the joystick itself mimics the geo pin icon. Which is a common symbol used to represent a specific location or point of interest on a map or in digital applications. It typically resembles a graphical representation of a pushpin with a circular head and a pointed end.

The symbol is suitable because of the functions associated with the joystick. Such as when the person wants to regain their bearings, they push the geo pin symbol down. And when they want to set a homing pin, they pull the geo pin downwards towards the loop symbol, which mirrors a geo pin being placed in the ground. This makes interacting with the device's functions more intuitive.

14.2.6 Material

One of the distinguishing features of Durat plastic is its vibrant and consistent colour options. It is available in a vast array of hues, ranging from bold and bright to more subtle and neutral tones. The colour permeates throughout the material, ensuring that any scratches or surface damage are less noticeable. The smooth finish of the material can also be regained through sanding. This means that the device can be rough-handled to a larger degree and is not perceived as delicate or fragile.

14.2.7 Finger Groove and Joystick

The grip and joystick placement signify how the device should be held, in a lateral pinch position. This position enables the user to fully interact with the device in the most effective way. By being able to intuitively know how to hold the device, the user is then able to infer how the device is used and operates. Thus, making the device more readable.

14.2.8 Size and Shape

The size of the object reinforces that it is a handheld device which is suitable to be latched onto the user's body and possessions. The object is palm-sized making it ideal to clutch and handle comfortably. The shape of Aleth also echoes the profile of a geo pin, a symbol synonym with navigation.

14.3 Google Maps Integration

In 2023, it was found that 80% of smartphone users rely on google maps as their primary navigation application [60]. Meaning that 80% of people would likely not trade Google Maps for an alternative navigation application. People are also typically against having to download extra apps to clog up their smartphones. And requiring a user to download an app to utilise a product simply adds another layer of complexity and steps needed to make use of the product. Therefore, it was decided to incorporate Google Maps into the working principle of the navigation aid as the destination input. This is beneficial because of the following:

- High chance that the user is already familiar with using Google Maps and is comfortable utilising it.
- The beginning of the user's journey remains the same (inputting their destination into Google Maps). This means that the user is more likely to adapt to using Aleth, since it still feels similar to a typical navigation journey for them. The user is also more likely to try Aleth since it involves using their preferred navigation application.
- Google Maps is effective at route creation and destination finding. Meaning Aleth doesn't have to perform this task and can simply use Google Maps for it.

Although integrating another application into Aleth may seem complicated; Google themselves promotes collaboration and has made it easier to combine projects with Google Maps. By releasing the API, developers are able to integrate the technology within their solutions effectively [60]. Meaning it is possible to scrape information directly from the application using 3rd party technology. Hence by connecting Aleth to the user's smartphone, it is able to gather data from Google Maps when it is used, so that it can sync and transform a Google Maps' journey into an exploratory journey.

14.4 Pedestrian Journey

As stated earlier, a pedestrian journey is when the user wants to walk to a specific destination on their exploratory journey. As shown in Figure 42, the first step is entering their desired destination into the Google Maps application.

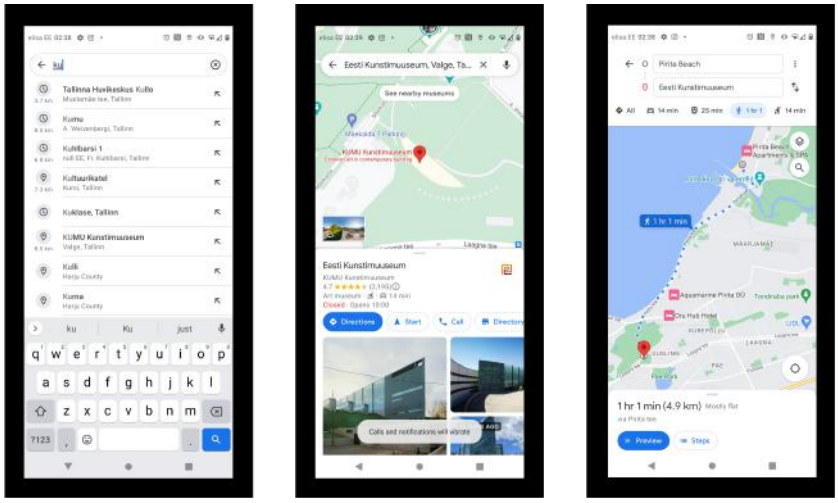

Figure 42: Inputting Destination for Pedestrian Journey

After the location is found and a route is set, the user can then move on to using Aleth, which has taken and transformed the Google Maps' journey into orientation-based guidance, as shown in Figure 43. While at the same time, put their phone away and begin their immersive urban exploring experience.

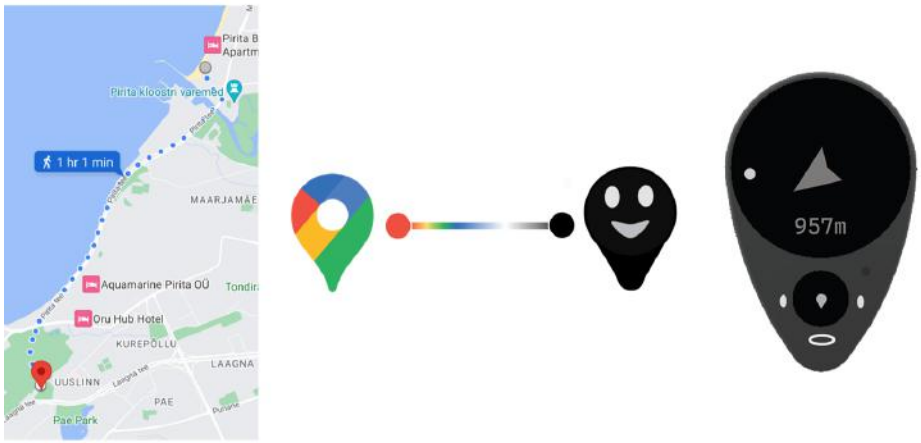

Figure 43: Translating Google Map Route into Orientation-based Guidance

14.5 Hybrid Journey

A hybrid journey is defined as a pedestrian journey which incorporates public transport. Thus, the initiation of the journey is the same, where the user inputs their destination into the Google Maps application, as depicted in Figure 44. However, the interaction differs when the user is allowed to choose their preferred route with regard to public transport.

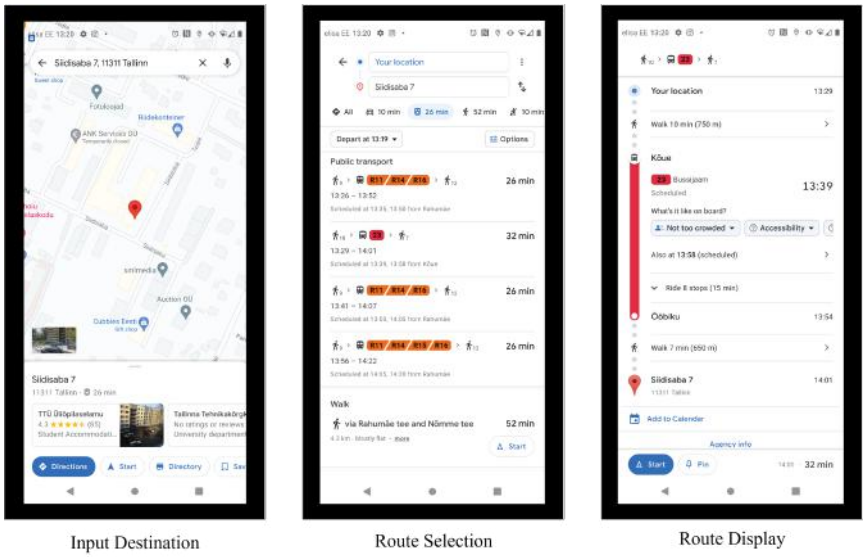

Figure 44: Inputting Destination for Hybrid Journey

After selecting their route, the Google Maps data is scraped via Bluetooth and the route is converted into orientation-based guidance. However, specific locations such as bus stops are logged as checkpoints within Aleth, as the journey is broken up into secondary destinations in order to incorporate public transport.

Figure 45: Translating Google Map Route into Aleth Guidance Checkpoints

The user is also able to view more detail about the checkpoints by toggling the joystick left and right to scroll through the checkpoint menu for additional information. The user can then return back to the guidance screen by pushing the joystick button down once. After each checkpoint is reached, Aleth moves on to guiding the user to their next checkpoint until they reach their destination.

Figure 46: Checkpoint Menu Interaction

14.6 Home Pin - Loop Journey

Aleth also offers the user to create a home pin which can serve the purpose of a homing beacon. This feature is independent of Google Maps and can therefore be used without a phone. When the user is setting a homing pin, Aleth stores the GPS coordinates of the current location. So that when the user wants to return back to the home location, they are able to set the home pin as their destination.

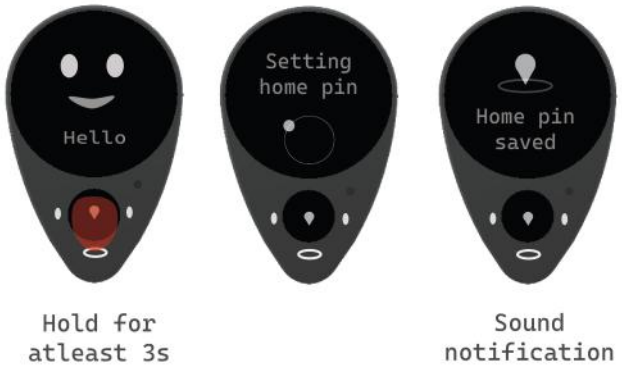

Figure 47: Saving Home Pin

Figure 48: Setting Home Pin as Destination

In order to set the home pin as the destination, the user has to toggle the joystick up and down. This interaction requires two movements to initiate to help prevent the home pin from being mistakenly set as the destination while the device is being handled. An additional layer of protection is added through the use of a verification step, confirming the user's intent to set the home pin as the destination.

Only one home pin can be stored at a time and can be used to set the return point of a loop journey. Thus, the user can set the home pin before the start of their exploratory walk, and then activate the home pin and set it as their destination when they wish to return. Such as setting their hotel as their home beacon when exploring a new city, or setting their car as their home beacon when out exploring nature.

14.7 Sleep Mode

To minimise user-device interaction, the device will only provide guidance (displaying bearings) upon user request, triggered by pressing the joystick button down. Otherwise, it remains in sleep mode and will only notify the user upon reaching a checkpoint or destination.

There are two ways to activate sleep mode: automatic and manual. If there is no interaction with the device for a period of 2 minutes, it will automatically switch to sleep mode. Alternatively, pressing the joystick button will manually activate sleep mode. Similarly, to re-enable guidance mode, the user can simply press the joystick button again.

Figure 49: Sleep Mode Interaction

14.8 Arrival Notification

Although Aleth minimises its presence during the user and relies on the user to initiate the interactions. The only exception is when Aleth has to notify the user that they have reached their destination or checkpoint. This interruption is required to notify the user that they've reached their destination and prevents the user from unknowingly passing it.

Thus, the notification sound has to be distinct enough to momentarily disrupt and alert the user, while not being perceived as annoying. Hence, a short (1 to 2s) soundbite should be used, with a piercing pleasant quality, utilising synthetic sounds to distinguish it from the surrounding environment. Similar to the pickup notification utilised by Bolt Taxi services. Which is a two-second sound clip made up of two distinct synthetic sounds at different pitches.

14.9 Battery Life Indicator

In order to be considered reliable, the device has to maintain usage throughout the walking trip. Therefore, it is important for the user to be able to know when they need to recharge the device to prevent it from running out of power during the journey.

A subtle indicator is used in the form of a small RGB LED. Which blinks red when the device is considered low on power during use. Alerting the user that when they return home, they should recharge the device before its next use. When charging, the LED stops blinking but remains red, indicating that the device is not fully charged. And once the device has been fully charged, the LED switches to green.

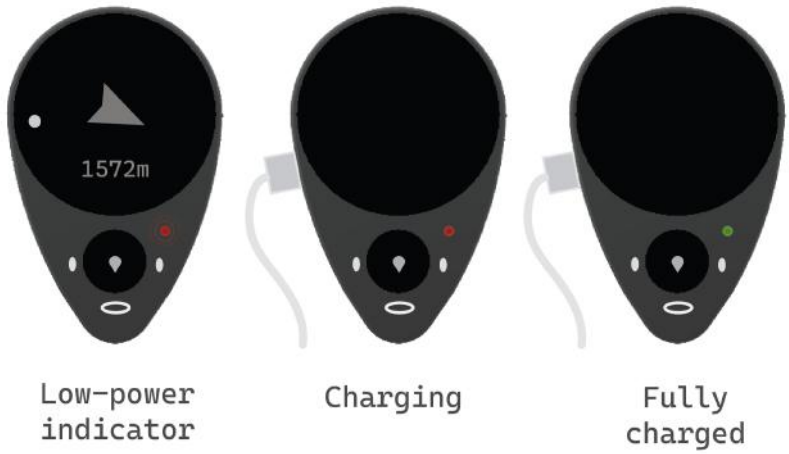

Figure 50: Charge Level Indicator

14.10 Value Creation

Aleth enables exploratory journeys for those who otherwise do not or cannot perform them. Thus, allowing them to experience the benefits associated with the activity. The device accomplishes this by achieving the following:

- **A reliable travel companion**

  Aleth aims to be a consistent companion for their user's outings. Being always available to enable the user to transition their journey into an exploratory one. Through repeated use, the device will gain the trust of the user in guiding them, staving off fears of getting lost which result in anxiety.

- **Instills confidence to explore**

  By repeatedly supporting the user to make their own navigational decisions, Aleth increases the user's own confidence in their navigational ability. Leading to the user being more open to going on exploratory journeys and trusting themselves.

- **Neighbourhood familiarisation**

  Exploring enables practitioners to familiarise themselves with their surroundings and available offerings. Through Aleth, the user is open to more path selections and is exposed to a wider area. The device also promotes a type of guidance which works towards keeping the user immersed and engaged with their surroundings.

- **Assist in decreasing spatial anxiety**

  Spatial anxiety is primarily caused by two things. Poor confidence in navigational ability and limited knowledge of the surroundings. Aleth works towards solving both issues and thereby can serve as a tool to decrease the spatial anxiety one experiences.

- **Safe secondary device**

  Smartphones are considered valuable items to most. Acting as the centrepiece of our technological use. However, utilising a device in charge of many responsibilities can be problematic. When utilising a smartphone, one application takes up the battery power meant for all of the applications. Meaning the overusing one application may result in all of the phone uses being unavailable due to the battery dying. Hence, splitting some of the smartphone tasks into secondary devices may assist in offsetting this problem.

  Another benefit is that since phones are considered valuable items, they are prone the theft. A secondary device allows for the phone to be kept safely away, while the user relies on Aleth. This is beneficial when exploring unfamiliar urban environments, where the user can feel more comfortable knowing that they are less likely to be perceived as a target for theft.

14.11 Fulfilment of Framework Analysis

In order to design an object which is enchanting, the framework laid out in Section 9.2 was followed. In this section, Aleth is evaluated with respect to the ladder of enchantment and its five steps to determine what level of enchantment it falls into.

Connection

Aleth utilises GPS technology and Bluetooth to issue guidance to its user. The device makes use of the connective foundation established by the Google Maps application, while also using a GPS sensor to triangulate the user's position relative to their destination.

Personalisation

Aleth allows the user to create home pins. Which are not limited to known addresses and can be saved and replaced easily. This means that the user can create their own homing beacon wherever and whenever they want. Aleth also does not restrict the use of Google Maps and allows the user to switch between navigational aids as they see fit. Allowing the user to control the degree of exploratory walking they wish to perform.

Socialisation

Although Aleth doesn't necessarily encourage its users to socialise with others. It does form a strong bond of trust with the user itself. Becoming an exploring partner that instils feelings of safety and reliability. Giving them the confidence to explore when equipped with it.

Gamification

Unlike route-based navigational aids. Orientation-based navigation requires the users' skill and therefore imparts more of a challenge. Although this can dissuade many from utilising it, Aleth packages orientation-based guidance in an easy-to-understand format, which still garners feelings of achievement when the user reaches their destination. Since the user is able to reach their destination based on their own navigational skills. And similar to a computer game, the user gets better at using their skills with practice. Transitioning from amateur to master over time.

Story-ification

In terms of story-ification, Aleth is presented as a navigation spell that can be attached to almost anything and guide its user to their destination. The convenience of such a spell is quite compelling to most and does have the potential to elicit feelings of enchantment. As a secondary consequence, the spell not only guides the user to their destinations but also improves the user's own navigational ability as well as acting as a reliable exploring partner which prevents the user from getting lost. Becoming an integral part of the user's outings away from home.

In summary, Aleth adheres to all five steps on the ladder of enchantment. Meaning it can be classified as the top level of enchantment. With a high probability of creating an enchanting experience for its user.

15 Conclusion

15.1 Research Answer

The double diamond design process served as the base framework for the research process. Research methods such as literature reviewing, semi-structured interviews and probes were used to establish the stakeholders and their needs, problems and expectations. While other techniques such as prototyping, and role-playing offered a foundation for ideation, user testing and concept refinement.

It was found that people's navigation habits often get overlooked when proposing methods for improving neighbourhood perception and participation. Where the overreliance on route-based navigation results in limited exposure to the potential offerings of the environment. As well as people who experience spatial anxiety cannot freely explore and are bound to their navigational aids as a result. Thus, it was proposed to examine the possibilities of utilising orientation-based guidance as a means of promoting neighbourhood familiarisation while also acting as an effective navigation aid.

The following research question was proposed:

How can orientation-based navigation facilitate exploratory journeys for pedestrians with spatial anxiety?

The answer was found by testing the proposed research hypothesis:

Minimising interaction time between the user and their digital devices will enable them to be more immersed in their surroundings.

Through technology probes, it was found that reducing screen time did result in more environmental awareness and immersion during exploratory journeys. However, the proposed concept Aleth expands on the research hypothesis and creates a more well-rounded solution. By addressing issues such as usability and user confidence as well.

Aleth minimises the interaction time through glanceable information. Respecting the users attention. Aleth takes this further by making the user responsible for initiating the interaction. Meaning Aleth will only engage when the users deem it needed, remaining non-intrusive during the exploratory experience.

Aleth also maintains readability by issuing guidance in a form akin to a compass. Utilising the same archetypal symbols associated with guidance. This makes the guidance intuitively understandable.

The proposed concept also encourages the user to make their own navigational decisions while dispelling feelings of being lost through a numerical output which displays the relative distance to the destination. This number enables the user to accurately gauge their progress, maintaining their confidence that their navigational decisions will not get them lost.

Aleth also acts as an appropriate secondary device that can be used in conjunction with the user's phone. Meaning the user can store their phone safely on their person while outwardly using Aleth in less familiar areas while exploring. Allowing them to explore comfortably, with their expensive items hidden.

15.2 Contribution

The feasibility of incorporating Aleth as an orientation-based navigational aid is explored in this study, highlighting its potential benefits that have often been disregarded due to concerns regarding time efficiency compared to conventional route-based guidance systems. However, Aleth capitalises on the inherent tendency of orientation-based guidance to encourage exploration, presenting a novel approach to facilitate exploration for individuals experiencing spatial anxiety—a group that typically exhibits avoidance behaviour towards exploration.

Additionally, this research contributes to the promotion of place attachment and the enhancement of neighbourhood perception through the utilisation of a navigational aid designed to facilitate exploratory walking. This intervention results in increased familiarity with the neighbourhood, strengthened community connections, and opportunities for mental restoration, thereby promoting overall well-being.

15.3 Future Work

The efficacy of Aleth as a navigational aid has been demonstrated through technology probes, affirming its working principle. Additionally, a physical prototype has been utilized to assess the device's usability as an easily attachable and ergonomically designed object. Moving forward, the subsequent phase entails developing a technology probe in the form of Aleth, building upon the existing wearable probes as outlined in Section 7.2.2.

Furthermore, Aleth addresses two primary factors contributing to spatial anxiety, namely deficient allocentric knowledge and low confidence in personal navigational skills. Consequently, Aleth has the potential to effectively alleviate spatial anxiety. However, further research is necessary to empirically evaluate this hypothesis.

An additional area of interest involves investigating the application of Aleth within the realm of micro-mobility. Initial assessments have shown the feasibility of attaching Aleth to bicycles and e-scooters, which serve as modes of transportation requiring minimal distraction to allow riders to maintain awareness of their surroundings. Aleth presents a potential solution for facilitating safe navigation in such contexts.

Furthermore, Aleth employs orientation-based guidance, eliminating the necessity for pre-existing roads or paths to provide directions to users, as typically required in route-based guidance systems. This characteristic opens up avenues for utilising Aleth in nature exploration scenarios, particularly in instances where documented paths are scarce. Consequently, Aleth may prove beneficial for activities such as camping, hiking, and forest exploration, which are popular outdoor pursuits where the risk of becoming lost can entail serious hazards.

16 Summary

Exploratory walking is a leisure activity that focuses on the act of exploration, which involves seeking novel discoveries, acquiring new knowledge, and gaining meaningful experiences. This immersive activity offers a multifaceted array of benefits, serving as a means for mental restoration, cultural immersion, and neighbourhood familiarisation. These advantages have garnered support from various hobby groups, city administrations, and organisations, who collaborate to enhance the accessibility of exploratory walking. Their efforts primarily revolve around creating pedestrian-friendly environments and improving the infrastructural provisions for walking. However, this approach exhibits a bias toward place-making solutions, primarily emphasising the enhancement of walkability in specific areas. It operates under the assumption that by optimising the physical aspects of a place, desired changes in behaviour will naturally follow. While this approach is not without merit, it tends to overlook other potential barriers that may impede individuals' inclination to engage in exploratory walks.

Two significant barriers include the constrained mobility experienced by urban residents due to their reliance on specific commuting and navigation methods, as well as spatial anxiety, which dissuades many from undertaking meaningful exploratory walks due to a fear of becoming lost. These barriers limit the exploration potential by restricting movement, which is facilitated by the utilisation of conventional navigational aids. To address these challenges, a novel approach to navigation, termed orientation-based guidance, is employed in the following project. This approach, although underused in modern times due to its perceived lack of time efficiency, is well-suited for exploration-focused activities. It facilitates a broad range of movement and path selection, while actively engaging pedestrians with their surroundings.

In order to develop a suitable form of orientation-based guidance that was readable to users. Probing was utilised to determine people's preconceived expectations of orientation-based guidance and what sort of experience it creates. These expectations were then developed into guidance concepts and tested through experience simulation with technology probes. Which discovered that people preferred egocentric guidance which resembled a compass archetype. Essentially, choosing visual communication (arrow) over audible and tactile alternatives. It was also found that a smartphone issuing guidance was too distracting, even if the information was considered non intrusive. While it was also determined that designing a wearable could prove problematic since such devices are often classed as luxury items. Which could enforce economic barriers who wish to explore, if that was the solution. Hence it was decided that an inconspicuous object that utilised the guidance mechanism should be considered to act as a navigational aid.

To design the inconspicuous object incorporating orientation-based guidance, the project employs the " enchanting objects design approach." This approach draws upon design principles and a framework devised by David Rose, author of the book "Enchanted Objects," which envisions a future where augmented objects perform extraordinary functions through cloud-based technology and intelligent design choices. The resulting enchanted object, named Aleth, takes the form of a handheld, bindable device that serves as a navigational aid. It employs symbols and characteristics reminiscent of a compass, ensuring glanceable communication and instant readability for users, as it conforms to a well-known archetypal representation associated with navigation.

The proposed device has undergone extensive iterations of user testing and refinements to ensure that its fundamental operation, interface, and physical construction effectively achieve the desired objectives of the intervention. These objectives entail serving as a navigational aid that assists exploratory walking by not limiting path selection, promoting user-driven navigational decisions, and providing guidance solely when asked to. As a result, users can fully immerse themselves in the exploration process, while feeling safe and confident that they won't get lost. Thereby enhancing their overall exploration experience.

Kokkuvõte

Exploratiivne jalutamine on vabaaja tegevus, mis keskendub avastamisele. See hõlmab uute avastuste otsimist, uue teadmise omandamist ning tähendusrikaste kogemuste saamist. See kaasahaarav tegevus pakub mitmekihilisi eeliseid, toimides vahendina vaimseks taastumiseks, kultuuriliseks süvenemiseks ning naabruskonna tundmaõppimiseks. Need eelised on saanud toetust mitmetelt hobigruppidelt, linnaametnikelt ja organisatsioonidelt, kes koostöös püüavad muuta exploratiivset jalutamist paremini kättesaadavaks. Nende jõupingutused keskenduvad eelkõige jalakäijasõbralike keskkondade loomisele ja jalakäijate infrastruktuuri parendamisele. Siiski on see lähenemine kalduv üksnes kohakujunduslike lahenduste poole, mis keskenduvad eelkõige konkreetsete piirkondade jalakäidavuse parandamisele. See lähenemine eeldab, et füüsilise keskkonna optimeerimine toob kaasa soovitud käitumuslikud muutused. Kuigi see lähenemine pole ilma väärtuseta, jääb see sageli tähelepanuta teistele võimalikele takistustele, mis võivad vähendada inimeste kalduvust tegeleda exploratiivse jalutamisega.

Kaks olulist takistust on linnakeskkonna elanike piiratud liikuvus, mis tuleneb nende sõltuvusest konkreetsetest transpordi- ja navigeerimismeetoditest, ning ruumiline ärevus, mis peletab paljusid eemale mõtestatud exploratiivse jalutamise katsetest hirmust eksida. Mõlemad takistused piiravad avastamisvõimalusi, kuna liikumist piiratakse tavapäraste navigeerimisvahendite kasutamisega. Nende väljakutsete lahendamiseks kasutatakse käesolevas projektis uudset navigeerimisviisi - orienteerumispõhist juhendamist. See lähenemine, kuigi kaasaegsetes aegades vähemkasutatud, sobib hästi exploratiivsetele tegevustele, kuna soodustab laia liikumisulatust ja raja valikuvabadust, samal ajal hoides jalakäijat aktiivselt seotuna ümbritseva keskkonnaga.

Sobiva orienteerumispõhise juhendamise vormi kujundamiseks kasutati "maagiliste esemete kujundamise" lähenemisviisi. Selle lähenemise aluseks on disainiprintsiibid ja raamistik, mille on välja töötanud David Rose, raamatu "Enchanted Objects" autor. Raamat visandab tulevikuvõimalusi, kus täiustatud esemed täidavad pilvepõhiste tehnoloogiate ja nutikate disainivalikute abil erakordseid ülesandeid. Selle tulemusena loodi Aleth-nimeline maagiline ese, mis võtab enda külge sidumiseks mõeldud kaasaskantava seadme kuju. Navigatsioonivahend kasutab kompassi sümbolid ja omadusi, tagades kasutajale kiiresti mõistetava visuaalse suhtluse ning kinnitudes tuntud navigatsiooniga seostatava arhetüübi kujule.

Esitatud seadet on põhjalikult testitud kasutajate kaasamise ja korduvate täiustuste käigus, et tagada selle tööpõhimõtte, liidese ja füüsilise konstruktsiooni tõhusus soovitud eesmärkide saavutamiseks. Nende eesmärkide hulka kuulub navigatsiooniline abivahend exploratiivsete jalutuskäikude jaoks, mis ei piira eelnevalt määratud raja valikut, soodustab kasutajapõhiseid navigeerimisotsuseid ning annab juhiseid ainult siis, kui seda selgelt palutakse. Selle tulemusena saavad kasutajad täielikult sukelduda oma avastusretkedesse, rikastades seeläbi oma üldist kogemust.

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A Technical Probe - App Download

The following QR code offers a person the ability to download the technical probe app used in the research. This offers them the opportunity to experience the orientation-based guidance utilised in the proposed concept.

In order to enter a destination, the known coordinates are required. After entering the two GPS values of the destination, the user can use the 'reorientate' button to regain their bearings throughout the journey while using the app.

The following App was created using MIT App Inventor and was last updated on 18/05/2023. The app is designed to work on Android only.

https://drive.google.com/file/d/1JT-K1$_dRHMQfuOnHd0kNNsffy1bBQsA_/view?usp=sharing$

Figure 51: QR Download Technical Probe App