support humans to socialise outdoors: how ambient technology enhances interactions in the non-human world

Katharina Brunkhorst

Interaction Design
One Year Master Program
15 ECTs, 2023
Supervisor: Henrik Svarrer Larsen
“We depend on nature not only for our physical survival. We also need nature to show us the way home.”

Eckhart Tolle
ABSTRACT

This thesis project aims to explore social interactions in outdoor scenarios and understand how interaction design can benefit group experiences in a non-human world. By taking a human-centred approach to this project, relevant theory and design examples have been researched and synthesised. In addition, extensive fieldwork was conducted through a series of interviews and a questionnaire addressed to outdoor enthusiasts. The project implemented ambient technology to foster human relationships through conversation and shared non-human knowledge acquisition. The designed outcome benefits people’s sense of community, physical health and mental well-being. Furthermore, interaction in a non-human environment contributes to a harmonious relationship between humans and the non-human world.

KEYWORDS

Ambient Technology, Communication, Disconnection, Human-Centred Design, Interaction Design, Non-Human, Social Interaction, Outdoor
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>3</td>
</tr>
<tr>
<td>Keywords</td>
<td>3</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>4</td>
</tr>
<tr>
<td>Introduction: Aim and Research Direction</td>
<td>6</td>
</tr>
<tr>
<td>State Of Field</td>
<td>6</td>
</tr>
<tr>
<td>Problem Definition</td>
<td>6</td>
</tr>
<tr>
<td>Study Motivation</td>
<td>7</td>
</tr>
<tr>
<td>Research Focus</td>
<td>7</td>
</tr>
<tr>
<td>Background Theory</td>
<td>8</td>
</tr>
<tr>
<td>Effect Of Nature On Humans’ Health</td>
<td>8</td>
</tr>
<tr>
<td>Technology In Nature</td>
<td>10</td>
</tr>
<tr>
<td>Voluntary Disconnection Of Mobile Devices</td>
<td>13</td>
</tr>
<tr>
<td>Disconnected, And Now?</td>
<td>15</td>
</tr>
<tr>
<td>Design Collection</td>
<td>16</td>
</tr>
<tr>
<td>Design Examples A: Technology Fades Into Life’s Background</td>
<td>16</td>
</tr>
<tr>
<td>Design Examples B: Engaging (Children) With Nature Through Smart Toys</td>
<td>17</td>
</tr>
<tr>
<td>Reflection On Design Collection</td>
<td>22</td>
</tr>
<tr>
<td>Design Process Model &amp; Methodologies</td>
<td>23</td>
</tr>
<tr>
<td>Design Process Model</td>
<td>23</td>
</tr>
<tr>
<td>Methods In First Diamond</td>
<td>24</td>
</tr>
<tr>
<td>Methods In Second Diamond</td>
<td>26</td>
</tr>
<tr>
<td>GDPR Statement</td>
<td>28</td>
</tr>
<tr>
<td>Design Process</td>
<td>29</td>
</tr>
<tr>
<td>Research And Synthesis</td>
<td>29</td>
</tr>
<tr>
<td>Ideation And Development</td>
<td>39</td>
</tr>
<tr>
<td>Final Design</td>
<td>53</td>
</tr>
<tr>
<td>Concept</td>
<td>53</td>
</tr>
<tr>
<td>Use Case Scenario And Storyboard</td>
<td>54</td>
</tr>
<tr>
<td>Interactions In Design</td>
<td>57</td>
</tr>
</tbody>
</table>
INTRODUCTION: AIM AND RESEARCH DIRECTION

STATE OF FIELD

Interaction design and human-computer interaction (HCI) are fields that focus on the design and use of computer technology, with an emphasis on user experience and and the interaction between humans and computers.

Being digitally connected is ubiquitous as technology continues to advance. Mobile devices have become an indispensable part of people's lives, acting as intermediaries for communication, access to information, social media, entertainment, productivity tools and more. As a result of connectivity becoming a natural part of people's daily lives, the counter research of digital disconnection is gaining interest and growing at the same time (Schwarzenegger & Lohmeier, 2021).

Solutions to disconnection have so far been provided by apps, phone features or offline travel retreats (Nassen et al., 2023). Schwarzenegger and Lohmeier (2021) unfold the contradiction of using mobile phones to disconnect: "The obvious paradox of promoting digital devices or applications as enablers of digital disconnection makes visible that digital disconnection as a commodity is not meant to propose a real or lasting alternative to digital lives, but rather provide a temporary retreat, which ultimately reinforces that connection is the norm" (Schwarzenegger & Lohmeier, 2021, p. 4). Furthermore, Allcott et al. (2020) argue that the absence of social media allows for more meaningful time to be spent on other activities, such as social relationships with friends and family or being outdoors.

In line with Helms et al. (2019), interest in HCI and outdoor activity support is growing, while "relatively little research has explored how outdoors experiences and activities are crafted in terms of managing disconnection" (Helms et al., 2019, p. 3). HCI research that has already explored outdoor scenarios "have focused on how technology can be integrated into outdoor activities in novel ways, particularly to support positive and mutually beneficial connections among people" (Helms et al., 2019, p. 3).

PROBLEM DEFINITION

According to Schwarzenegger and Lohmeier (2021), spending time in front of a screen can have a negative impact on social bonding. And even if people are aware of this, the authors say, there is a lack of concrete alternative ideas about what to do without media, especially outdoors. While the authors argue that disconnection is a luxury, not only do users of digital
media and devices seem to have little experience with it, but research has yet to answer the 'what then' or 'what else' of digital disconnection (Schwarzenegger & Lohmeier, 2021).

In addition to social interactions that may be negatively affected by technology use, the interaction between humans and nature also poses challenges. Gennari et al. (2019) report on the current tension between the use of technology by humans and the lack of interaction with the natural world.

**STUDY MOTIVATION**

The motivation to investigate the relationship between social interactions and natural environments stems from a curiosity for a broader understanding of human behaviour and well-being, and how interaction design can contribute to discovering the potential benefits of green interaction spaces.

Furthermore, HCI research is mostly focused on indoor technology use, often even sedentary designs (Helms et al., 2019). The authors argue that the focus on mainly indoor computer usage could lead to overlooking design opportunities for the outdoors. This suggests that interaction design has hidden and probably untapped potential to explore the gap between technology and the outdoors, which is addressed in this work.

Designing technology with an understanding of humans' innate connection to peers and nature should result in more user-friendly, engaging and socially beneficial experiences.

**RESEARCH FOCUS**

By taking a human-centred approach to the project, the research focuses on how interaction design principles can be applied to promote social interactions in natural environments. The research and design should consider human perception, health and overall satisfaction with the social experience provided by the absence of digital distractions and conscious perception of the non-human world.
BACKGROUND THEORY

EFFECT OF NATURE ON HUMANS’ HEALTH

This chapter presents the benefits of people spending time in nature. It outlines various theories about the effects of natural environments on our mental and physical health. It also analyses the environmental qualities of nature and provides arguments for the decision to locate this project in nature.

Design educator Shane Coen is known worldwide for implementing social and environmental aspects within a design process. Coen (2017) reports on the importance of an awakened perception of our surroundings and environment in our daily lives. "Who taught you to see? Do you take the time to see? And to understand what is around you and how that is making you feel?" (Coen, 2017, 2:00). Bringing a sense of calm and inspiration to others is Coen's mission - achieved through awakened awareness and paid attention (Coen, 2017).

When the term attention is used in the context of the natural environment, it can be woven into the popular theories of the Kaplans. In 1989, Kaplan and Kaplan published their theories on Kaplan's Restoration Theory (ART), in which the authors unpack the influence of a natural environment on mood, state of mind and physical health (Kaplan & Kaplan, 1989).

Kaplan's Restoration Theory (ART) originally proposed four types of attention. States of attention that someone can be in, based on Kaplan and Kaplan (1989):

1. Directed attention: Someone invests effort by avoiding possible distractions in order to focus on a specific task. Fatigue may occur while other emotions are inhibited.

2. Effortless attention: Someone is interested in a task and does not need to block out distractions in order to concentrate. There is no fatigue or boredom.

3. Directed attention fatigue: Someone is concentrating on a specific task for a long time. When fatigue occurs, irritability and distraction follow.

4. Restored attention: Someone who recovers from fatigue by engaging with nature. After recovering through a calming environment, it feels easier to focus on the original tasks.

Courtney and Ackerman (2018) summarise, based on Han (2003), that the final stage, restored attention, is the most restorative of the four stages. According to Han (2003), through engagement with nature, the individual is now able to relax and regain attention, as well as reflect on actions and goals in life.
Stephen Kaplan (1995) argues that it is not only the directed attention that is important to analyse, but also the nature and its characteristics in which the interaction takes place. "Natural environments turn out to be particularly rich in the characteristics necessary for restorative experiences" (Kaplan, 1995, p. 169).

Key components of a natural environment that have restorative effects on individuals, based on Stephen Kaplan (1995):

1. **Being away**: A mental (which may include physical) distance from activities and thoughts that cause fatigue.
2. **Soft fascination**: Attention is fully given to the natural environment without any effort to be distracted.
3. **Extend**: The nature visitor feels immersed by a sense of familiar and trusting the natural world.
4. **Compatibility**: It is necessary to engage with the situation and the environment and to ensure immersion in nature.

As Courtney and Ackerman (2018) note, the evaluation of Attention Restoration Theory (ART) should also take into account the time and earlier circumstances in which the theory was first explored. "This theory was developed and popularized by Stephen and Rachel Kaplan in the late 1980s and early 1990s, a time period characterized by rapid technological advancement and ever-increasing indoor entertainment. As people - and especially children - spent more and more time inside, concerns about the lack of time in nature grew" (Courtney & Ackerman, 2018, Chapter 2).

Another theory about humans and the natural environment was presented by Roger S. Ulrich in 1981. The Stress Reduction Theory (SRT) argues that spending time surrounded by natural elements, such as water or vegetation, has a positive effect on human well-being through stress reduction, while even viewing nature from a distance, through a window or in a picture, allows for a reduction in heart rate and blood pressure (Ulrich, 1981 & Ulrich et al., 1991). According to Ulrich (1981) and Ulrich et al. (1991), a lower level of stress also ensures the avoidance of negative thoughts and emotions. Furthermore, Ulrich (1991) states that urban environments, in contrast to nature, are characterised by artificial complexity in visuals, movement and high levels of noise and therefore have a negative impact on people by causing stress and fatigue.

Modern studies of the relationship between humans and nature still draw on Ulrich's work, such as Lega et al. (2021), who investigate the relationships between humans, their stress
levels and green environments. In their chain of argument, Ulrich’s theory plays an important role by referring to an increase in mood and emotions through nature (Lega et al., 2021).

TECHNOLOGY IN NATURE

The following part of the research provides an understanding of how technology is already being used in natural environments, how it can be used in the future, and the opportunities and potential for interaction design. This chapter highlights both the positive and negative impacts of technology use in nature, to provide a multifaceted insight into the combination of nature and computers.

According to Bakker (2023), interspecies communication between the human and non-human worlds can be enriched by listening to the hidden sounds of nature. Decoding non-human communication, especially that which is far beyond the range of human sensory perception, can lead humans to reflect on their surroundings and discover the world in a new way. "When we first learned about these secret sounds of the world, we are often surprised because humans tempt to believe that what we can not perceive does not exist. And so we miss a lot" (Bakker, 2023, 2:48).

Following these thoughts, it can be assumed that by considering other human senses, further sensory impressions can be expanded through the use of technology in order to perceive nature in a wider spectrum. A brief overview of the human senses will be presented in order to grasp the possibilities of technology in the natural environment in the context of perceptual enhancement.

Aristotle (384-322 BC) wrote about the five human senses in his treatise De Anima: vision, hearing, smell, taste and touch (Francis, 2020). To this day, theories abound as to whether there are more human senses than the five that Aristotle once envisaged. Senses are no longer exclusively associated with an external organ, as Aristotle suggested. "It doesn’t take much reflection to figure out that humans possess more than the five “classical” senses of sight, hearing, taste, smell, and touch,” criticises author and researcher Professor Henshaw (2012, para. 4). Henshaw (2012) and Francis (2020) agree that the number of senses a person appears to have depends greatly on the definition of "sense", which is not clearly defined. However, Rudolf Steiner gave several lectures between 1916 and 1921 in which he taught about the natural senses of humans, which he summarised as shown in Figure 1.
“In nature sound is everywhere and silence is an illusion” (Bakker, 2023, 5:30). Building on this, technology can be used to detect activity in nature beyond our sensory capabilities. With this in mind, Figure 2 shows the range of sound waves that are naturally audible to humans and the range of waves that are not.

Pye and Langbauer Jr (1998) report on the need for special instruments to detect infrasonic and ultrasonic signals. The authors are enthusiastic about the possibilities of using technology to observe non-human phenomena that were previously unknown to us.

Applying this to other human senses, Figure 3 shows the range of light waves that can be perceived by the human eye and, in turn, the optical impressions that cannot be seen, related to Steiner's sense number 6, the sense of sight.
These two examples, the range of human perception of the auditory and visual senses, show how little our range of perception is related to the whole of nature and animal activity. By perceiving only part of our natural environment, humans may be limited not only in their perception, but also in their response and interaction with the non-human world.

Bakker (2023) presents design possibilities on how transformative technology can be used to enrich human/non-human communication: What would happen if AI was used as a tool to make non-humans talk to us? Karen Bakker expresses possible future interactions by imagining a conversation from an orca to humans, a non-human to human communication: “Stories about desperately seeking the last remaining salmons. Stories about trying to survive on this beautiful planet in this crazy moment in our era of untethered human creativity and unprecedented environmental emergency” (Bakker, 2023, 13:13). By imagining such an anthropogenic “cry for help” from the ocean to the human surface, Karen Bakker underlines the influence that humans can have with their awareness of non-humans. In particular, futuristic technology can contribute to the conservation of nature.

Following the idea of future technology, Mossberg (2017) predicts that computers, including smart devices, will not only get smaller in the coming years, but will also fade into the background of life and may even disappear. According to Walt Mossberg (2017), computing functions will remain available, while interaction surfaces, such as physical screens, will be integrated into our environment and become hidden. In this way, technology would be used to provide a present awareness of how people see the world, while technology becomes ambient and invisible.

Imran Chaudhri, former user interface and interaction designer at Apple, in his May 2023 TED Talk agrees with Walt Mossberg's argument that technology will become increasingly invisible in the near future. Chaudhri (2023) explains that he shares Mossberg's goal of future human-computer interactions with invisible devices that are so natural that users forget the technology exists.
“Technology needs to blend in with our natural behaviors for it to be truly intuitive [...] On the other hand, becoming invisible is anything but simple. Achieving the perfect harmony between functionality with simplicity, along with maintaining privacy & trustworthiness in both the digital & physical worlds, can be challenging but must be done” (Rezende, 2023).

**VOLUNTARY DISCONNECTION OF MOBILE DEVICES**

*This chapter unfolds what digital disconnection means and contains as well as different types of disconnectivity and which role technology plays.*

Whether temporary or permanent disconnection, according to Nassen et al. (2023), current academic research focuses on people’s interactions with digital devices, platforms and tools, while the rapidly growing field also explores digital disconnection practices. Nassen et al. (2023) published a review of the literature on voluntary digital disconnection in which the authors defined what digital disconnection entails. This definition will also be used in this paper to provide a common ground of understanding. "Digital disconnection is a deliberate (i.e., chosen by the individual) form of non-use of devices, platforms, features, interactions, and/or messages that occurs with higher or lower frequencies, and for shorter or longer periods of time, after the initial adoption of these technologies, and with the aim of restoring or improving one’s perceived overuse, social interactions, psychological well-being, productivity, privacy and/or perceived usefulness" (Nassen et al., 2023, p. 10).

The use of mobile devices is pervasive. According to Howarth (2023), there are approximately 6.84 billion smartphones in use worldwide, representing 85% of the world’s population. Howarth (2023) uses the word "ubiquity" to describe the presence and use of mobile devices today. One of the reasons for the widespread ownership and use of digital phones is likely to be the wide range of functions, which can range from leisure entertainment, to turning the device into a communication interface for work-related spaces, or for checking other commitments and obligations. As a result, it can be assumed that the integration of the mobile phone into our everyday lives can lead to a risk of dependency when it comes to everyday situations, such as orientation in a physical space or even the mental state of feeling connected to other people.

As Helms et al. (2019) note, technology is becoming increasingly present in everyday life. Several design concepts aim to reduce screen time through screen tracking provided by the phone’s software or developed apps, aiming to meet users’ needs to reduce their screen time and mobile phone use. First, the condition of phone use for screen tracking can be interpreted as contradictory to the user’s intention to reduce phone use itself. Furthermore,
Helms et al. (2019), referring to Rooksby et al. (2016), argue that informing phone users about their data may shock them when they realise the actual amount, but may not effectively change their phone behaviour.

According to Vanden Abeele (2021), mobile media have the ability to make people feel autonomous, as a connection to people, content or services is possible regardless of the usual time and place. At the same time, the author mentions a conflict in autonomy: “We face new struggles, decisions, and pressure in relation to whether, when and where we connect and disconnect. Digital wellbeing is a new concept that refers to the (lack) of balance that we may experience in relation to mobile connectivity” (Vanden Abeele, 2021, p. 1).

One reason for regaining balance between digital use and non-use can be seen in the motivation to experience the moment of disconnection freely and authentically, as Rosenberg (2019) sees the potential for backpacking without mobile phone use. Experiencing the outdoors disconnected may offer independence and escapism from everyday habits of digital connectivity (Rosenberg, 2019). Similarly, Conti and Farsari (2022) talk about JOMO, the joy of missing out, when being in a natural environment with the intention of taking a break from internet-based demands. The authors explain JOMO as a common response to the feeling of FOMO, the fear of missing out. Furthermore, Conti and Farsari (2022) refer to mobile ICT (mobile information and communication technology) when talking about a “disembodied experiences, loss of sense of place, and lack of engagement with communities and places” (Conti & Farsari, 2022, p. 3), which can be seen as potential enhancements and motivations for people to disconnect.

Helms et al. (2019), as well as Conti and Farsari (2022), discuss that connection and disconnection do not necessarily need to be seen as opposites or a binary system. By interpreting the phrase being (dis)connected or being away in a more flexible and non-binary way, Helms at al. (2019) point to the possibility of creating and designing technology interactions in new and alternative ways. The authors describe pointed disconnection as one aspect within the spectrum between connection and disconnection, defining it as: “pointed disconnection; (dis)connection that involved the careful management of unavailability and remained porous enough to permit selected engagements” (Helms et al., 2019, p. 16). In summary, digital connection can occur during mental disconnection from digital devices, as long as the use is deliberate and conscious, while the overall experience of pointed disconnection should create a sense of being away.
DISCONNECTED, AND NOW?

What can someone who is disconnected expect from being away? And how might people’s relationship with autonomy and digital devices change?

Helms et al (2019) present a study that explores how the use and non-use of technology can influence being away from the everyday, with a focus on enabling purposeful engagement with digital technology. Through research in this area, the authors were able to describe two different contexts for someone to be (dis)connected. According to Helms et al. (2019), the term away can be distinguished into everyday away and artificial away: The term everyday away is described by a certain period of actions that provide an escape from everyday life, such as sabbaticals, holidays or being on an aeroplane. These situations share the context that there is no need to worry about being offline, the digital connection does not need to be repaired due to connection restrictions caused by the outside world. On the other hand, being artificially away is described by Helms et al. (2019) with situations of commuting on a train, pausing tasks at home or simply taking a break during work. The main characteristic of artificial aways is the mental state of feeling distant from daily routines, while deliberately not taking the opportunity to be digitally online.

These states lead to the goal of a design that supports the reduction of screen time on mobile devices, while at the same time providing an alternative in moments of voluntary disconnection from the mobile phone. By using the term alternative, it is important to add that the aim should not be to replace mobile devices, but rather to create a space “for what they desire to be away from, rather than restricting what they might like to do” (Helms et al., 2019, p. 17).
DESIGN COLLECTION

This chapter presents related design work that has played a significant role in the research on interactive technology and outdoor exploration. The design examples were found by searching for answers to the following questions:

A. How do modern interactive technologies create new possibilities for human-computer interaction? How might this influence human perception of the environment?

B. What tools are used to allow humans to explore the natural world and which senses are primarily involved?

DESIGN EXAMPLES A: TECHNOLOGY FADES INTO LIFE’S BACKGROUND

HUMANE AI PIN: TAKING ARTIFICIAL INTELLIGENCE EVERYWHERE (CHAUDHRI, 2023)

“The Humane Ai Pin is a new type of standalone device with a software platform that harnesses the power of AI to enable innovative personal computing experiences” (Humane, 2023, para. 1). The small wearable is designed to be worn on the user's clothing. In this way, the device collects contextual environmental data and enables screenless interaction via voice commands at any time.


Figure 4: Humane's Ai Pin, Source: https://www.techradar.com/news/the-new-humane-ai-powered-wearable-could-change-everything-or-nothing-at-all
According to Humane (2023), an example of an environment in which the device can be used is navigation in a foreign city, where the user no longer has to look at the screen of a mobile phone, but can concentrate on the traffic for safety reasons. Another example is the replacement of telephoning with a mobile phone, as shown in Figure 6.

Although the Human Ai Pin is not initially designed to explore the natural world, there are parallels with the thesis project in terms of human-environment interaction facilitated by technology. Both designs aim to explore new ways in which the user can perceive and interact with the world around them, and to enhance social communication through ambient technology. This allows the user to be present in the moment and experience the world around them without having to consciously interact with the technology.

**DESIGN EXAMPLES B: ENGAGING (CHILDREN) WITH NATURE THROUGH SMART TOYS**

**EKÔ: A SMART TOY FOR FUN AND ACTIVE LEARNING DURING OUTDOOR EXPERIENCES BY CAIOLA ET AL. (2023) AND CUSUMANO ET AL. (2021).**

With the increase of digital activities indoors and the attraction of screens, Ekô aims to motivate children to engage more with nature and spend more time outdoors using physical-digital systems. The design tries to support children in being playful and creative in the green, while the use of technology should not distract from exploring nature.

The auditory based design consists of four main functions: "natural sounds recording, sounds reproducing, visual feedback and transmission of data to the tablet app" (Cusumano et al., 2021, p. 3). Using portable recorders (see Figure 7), children can record and store...
audio in natural environments before connecting these sounds to an app to play with their audio findings in a digital environment. Depending on the slots selected on the control base (Figure 8), the recorded sounds are presented in the app in different visual scenarios (see Figure 9). In addition, the user can influence the audiovisual composition by manipulating parameters, as shown in Figure 10. Finally, the user can save all audio and visuals within the app.

This example was chosen because of a common area of inquiry in technology use and human-nature interaction, described by Caiola et al. (2023) as: “Investigating the relationship between children and the natural world and the influence that the use of electronic devices exerts on this relationship” (Caiola et al., 2023, p. 6). In addition, the concept of Ekō reflects on media consumption and screen time, which represents an overlap with the research areas of the thesis. Based on studies, Cusumano (2021) explains that children spend more and more time indoors, which has a negative impact on their health. These findings form a common design goal, summarised by the researcher and designer of Ekō: “transforming screen-time into an active, educational, and fun outdoor experience” (Cusumano, 2021, p. 1).
In addition, the concept demonstrates how human-nature interaction design can enhance social interactions among users, as multiple artifacts allow for co-participation and co-engagement while exploring nature together.

However, it is also important to reflect on the pain points. A criticism of the presented concept is that the overall design does not only motivate children to spend time outdoors (which is positively encouraged by the concept), but also invites them to go to a smart device afterwards to digitally interact with their outdoor findings via an app. It would be important to consider whether the users (in this case children) might not feel rewarded and develop behaviours where spending time outdoors automatically means media consumption, perhaps even indoors. This could potentially counteract the user’s genuine interaction with nature and make the perception of outdoor environments more of a means to an end of spending more time in front of a screen indoors.


The ABBOT concept explores how children’s tactile and visual experiences in nature can be supported by technology. ABBOT consists of two parts: capturing nature and interacting with a database of natural materials.

Children are given the opportunity to explore the materials and structures of their natural environment with the help of a tangible artifact, including a hidden microcontroller with an accelerometer that allows them to activate a camera that takes pictures by shaking the tangible object. To confirm this action, the young naturalist receives feedback in the form of a colour that appears on the top of the artifact. This light takes on the colour of the material found and photographed.

![Figure 11: ABBOT Artifact Prototype (Gennari et al., 2019A)](image-url)
This process can be repeated, capturing multiple natural finds. In addition to the outdoor discovery itself, the concept consists of a second step where the natural findings can be viewed in an app, along with explanations of the main characteristics of the digitised material findings. This data creates a virtual space where naturalists can play with their collections and learn about the natural world.

What is striking about the ABBOT concept, and why it belongs in the list of related design examples, is that it aims for a direct interaction between the user and nature, while the technology built into the artifact is meant to play a background role in the experience of nature. The technology is intended to act as a tool to stimulate the user's curiosity about the environment and to engage with various 'green' elements of the natural world. The design of ABBOT is intended to motivate children to be physically active and to make physical use of natural spaces. It also makes it easy for young people to record their findings visually through the use of technology.

What is striking about the ABBOT concept, and why it belongs in the list of related design examples, is that it aims for a direct interaction between the user and nature, while the technology built into the artifact is meant to play a background role in the experience of nature. The technology is intended to act as a tool to stimulate the user's curiosity about the environment and to engage with various 'green' elements of the natural world. The design of ABBOT is intended to motivate children to be physically active and to make physical use of natural spaces. It also makes it easy for young people to record their findings visually through the use of technology.

Similar to the concept Ekō presented earlier, there are concerns about the actual engagement with nature and children's real interest in, for example, flowers (as shown in Figure 11). The study does not indicate whether the children analyse and/or observe the natural space and its materials, or whether they are unconsciously driven by the lights of the artifact simply to find different colours that give feedback at the moment of using the artifact. If this were the case, it could be argued that the children are not focused on exploring the natural environment, but are more interested in its colours. Exploring the shades of nature is part of exploring nature, but it would require a different content of the app, focusing more on knowledge of colour rather than materials and structures. The ABBOT concept shows the importance of getting the right user feedback on the artifact to guide the nature explorer in a way that is appropriate to the research and design.
GAIA: GET OUT AND INTERACT (GENNARI ET AL., 2019A)

GAIA's portable design allows it to be used in a variety of outdoor locations, for example by being attached to trees or around poles in green parks. A group of children will listen to quests, such as finding a particular plant, as buttons are touched. Guided by the voice, nature can be explored with a focus on specific features of nature. In this way, the authors emphasise the relationship between children's movement and mental processes, which could be enhanced.

According to the authors Gennari et al. (2019a), after the young design participants listened to the first instructions from GAIA's speaker, some children shifted their attention completely to nature instead of following the game quest. "If on one side this aspect can be ascribed to a lack of clarity of the story told by the device, at the same time it can be interpreted as a positive evidence for the children's engagement in the exploration of the environment with GAIA" (Gennari et al. 2019a, p. 2).

Furthermore, the children's willingness to continue exploring nature after their engagement with GAIA shows that an interactive artifact that sharpens the user's senses can achieve long-term awareness and may be just the beginning of nature awareness, until the user no longer needs the support of a guide, but has developed their own ability and creativity to explore natural worlds. Evaluating other qualities of GAIA's design, it can be highlighted that exploring the natural environment in groups has the potential to strengthen social interactions between users and foster their sense of belonging and unity.
REFLECTION ON DESIGN COLLECTION

Analysing the research intentions of each design concept and learning from their user testing provided an understanding of current interaction designs in the field of human-nature interaction, including challenges and opportunities. The key findings, which provide an understanding and foundation for the thesis project, are summarised in the following statements.

1. Modern design avoids screens.
2. Technology is hidden in the tangible.
3. Interactive artifacts have the potential to encourage participation and social interaction.
4. Outdoor exploration findings are often stored in a digital database.
5. Playful approaches appeal to the user group.
DESIGN PROCESS MODEL & METHODOLOGIES

DESIGN PROCESS MODEL

The Double Diamond is an illustrated representation of a design process principle used worldwide to target innovative projects. As shown in Figure 14, the Double Diamond consists of two main areas, research and design, each of which can be divided into two sub-phases. Jonathan Ball (2022), the developer of the Double Diamond model, describes the four different phases as follows:

“Discover: The process starts by questioning the challenge and quickly leads to research to identify user needs. Define: The second phase is to make sense of the findings, understand how user needs and the problem align. The result is to create a design brief which clearly defines the challenge based on these insights. Develop: The third phase concentrates on developing, testing and refining multiple potential solutions. Deliver: The final phase involves selecting a single solution that works and preparing it for launch” (Ball, 2022, chapter 2).

This design process is appropriate for the project, as it allows for a broad exploration of the problem first, in order to narrow down the area to focus on later. Problem definition follows by making sense of the research and focusing on “how might we’s” generated by involving users in a participatory ideation workshop. The design phase in the second diamond opens up and explores the possibilities of different implementations through idea evaluation against design criteria and prototype testing.
METHODS IN FIRST DIAMOND

LITERATURE REVIEW
With a particular focus on the early stages of the project process, numerous books, articles, conference proceedings and additional types of written material are reviewed. According to the Digital Society School (n.d.), based on Hart (2018) and Fink (2019), a literature review aims at a detailed understanding of the most important problem area of the research question and the resulting connections of subtopics. In this way, a specific research direction can be further explored and initial assumptions can be verified by reviewing the scientific work of others. In agreement with Hanington & Martin (2019), this method is well suited to summarise a large amount of knowledge.

DESIGN COLLECTION
Reviewing different design examples to understand the state of the field and approaches to design solutions in the outdoor environment. By evaluating other designers' projects, strengths and weaknesses could be analysed and influence one's own design process.

STAKEHOLDERS MAP
“Stakeholder maps help to visually consolidate and communicate the key constituents of a design project, setting the stage for user-centered research and design development” (Hanington & Martin, 2012, p. 371). For this project, key stakeholders are visualised and grouped in terms of project influence and importance to provide “visual reference point for the design team in planning for user research activities” (Hanington & Martin, 2012, p. 371). The visualisation provides an overview of the interrelationships for ideation workshops involving stakeholders.

INTERVIEWS
Hanington and Martin (2019) describe the importance of involving stakeholders in the design process, where stakeholders are described as people who may be interested in the research and design. Whenever personal information from users or experts is needed, face-to-face interviews with stakeholders provide the researcher with a direct source of insight into potential user groups. “These consultations [...] can be useful for understanding consumer perceptions, opinions, motivation and behaviour concerning products or services, or to
gather information from experts in the field” (van Boeijen et al., 2014, p. 80). In this project in particular, semi-structured interviews allow for guidance on key questions, but also allow for spontaneous flexibility within the topics considered important by the interviewee.

**QUESTIONNAIRE & SURVEY**

A series of questions and other prompts find their place in the research tool of questionnaires to collect information from respondents (van Boeijen et al., 2020). These responses are used in the research process to analyse and interpret the information collected. According to the Digital Society School, based on Alreck (1995), a survey is used “when there is a need to validate information in a quantitative way […], to get an aggregation of answers regarding a specific topic” (Digital Society School, n.d., column 2). Findings, such as potential user insights, can be used to test assumptions and thus make important design decisions.

**DESIGN CRITERIA**

The definition of design principles summarised the results of the first diamond and was a fundamental part of the synthesis. As the design process continues, the design criteria can be used to filter and evaluate ideas.

**AFFINITY DIAGRAM**

Hanington and Martin (2012) explain the use of affinity mapping in collecting research findings, such as insights or observations, on sticky notes in order to group and cluster the findings into themes. This method was used to collate all the research findings in order to identify the frequency of each of the subtopics mentioned.

**HOW MIGHT WE**

According to Rosala (2021), a How Might We (HMW) question helps to analyse which problems should be solved by a creative solution. In order to generate an HMW statement for this project, the results of the participatory ideation were evaluated and individual qualities were combined.
METHODS IN SECOND DIAMOND

INDIVIDUAL AND PARTICIPATORY IDEATION

Concept sketching aims to sketch several ideas in a short period of time in order to iterate initial concepts and clarify their usefulness and potential, as described by the Digital Society School (n.d.) based on Rodgers et al. (2000). Buxton (2010) emphasises that sketching, especially in experience and interaction design, does not necessarily mean only pen and paper scribbles, but also the use of digital tools as well as physical modelling to create an ambiguous sketch that opens space for different interpretations. The value of sketching lies in the action and play of sketching and exploring, rather than in the specific artifact that emerges (Buxton, 2010).

HARRIS PROFILE

According to van Boeijen et al. (2014), a Harris Profile describes an evaluation of a design concept in relation to predefined requirements in order to reveal strengths and weaknesses. The graphical representation compares several concepts with each other and helps to facilitate decision making (van Boeijen et al., 2014). The method was used to filter the results of participatory ideation in relation to design criteria, in order to provide a targeted basis for individual direction.

PROTOTYPE

Houde and Hill (1997) define the term artifact as a designed interactive system, which includes commercial products as well as concept systems aimed at design activity within the purpose of research development. The authors further define a prototype as "as any representation of a design idea, regardless of medium. This includes a pre-existing object when used to answer a design question" (Houde & Hill, 1997, p. 369). Houde and Hill (1997) also present a model of a prototype (Figure 15) which shows the interrelationship between the role, the implementation and the look and feel of an interactive artifact, although it should be noted that each of these three dimensions is equally important in any prototype.

According to Boeijen et al. (2014), this method of prototyping is used in the development phase to iterate concepts and gather user feedback as quickly as possible. "Interaction prototypes can even be used to enhance discussion with clients about users’ future interactions with the product" (van Boeijen et al., 2014, p. 261).
WIZARD OF OZ PROTOTYPING AND TESTING

The Wizard of Oz system simulation technique involves the hidden human execution of a behavioural component within the prototyping process. Boeijen et al. (2020) emphasise the efficiency of the speed at which different design options can be tested, made possible by rapid test setup and execution with few complicated technical components. Multiple rounds of testing allow for iterative processes. In this way, as Bernsen et al. (1993) claim, the Wizard of Oz practice can lead to a detailed analysis and evaluation of the user-system interaction and reveal design possibilities.

STORYBOARD

According to Hanington and Martin (2012), storyboards are useful when visuals are intended to generate empathy and convey the meaning of the technology being implemented, social aspects or environmental factors. It visualises why, how and where potential users engage with the design (Hanington & Martin, 2012). In this project, a storyboard helped to show a use case scenario of the final design in sketched frames to help the reader understand the intended interactions and use of the artifact.
GDPR STATEMENT

The General Data Protection Regulation, or GDPR for short, is the privacy and security law in Europe. The European Union (EU) has established various obligations regarding the collection of personal data of individuals in the EU (GDPR, n.d.). These obligations consider "any information that relates to an individual who can be directly or indirectly identified. Names and email addresses [...] location information, ethnicity, gender, biometric data, religious beliefs, web cookies, and political opinions can also be personal data" (GDPR, n.d., para. 3). This study is compliant with the GDPR rules, and therefore no identifiable information can be used to identify participants in this project.
LITERATURE REVIEW

The literature review presented in the background theory provided interrelated insights that can be grouped into three main categories: technology, the non-human world and sociality.

Figure 16: Fields of Literature Review

STAKEHOLDERS MAP

The main stakeholders have been identified through the literature review. The map visualises four different groupings: human stakeholders (blue), non-human stakeholders (green), technology stakeholders (yellow) and regulatory stakeholders (red).
INTERVIEW: MEANINGFUL

What does “meaningful” mean?

According to the online dictionary (Dictionary, n.d.), the word “meaningful” can be described with synonyms such as “significance”, “purpose” and “value”. On the other hand, it is important to be aware that the definition and emotional connection to the word “meaningful” can vary from person to person and is highly personal.

In order to explore people's personal definitions, experiences and emotional reflections, the fieldwork included stakeholder interviews. The requirements for a stakeholder to be interviewed are the ability to communicate feelings and impressions in words and to have excellent language skills in English, German or Swedish. Furthermore, the interviewees were not familiar with the project topic, so that their answers would not be influenced by assumed design intentions or conceptual directions. A total of eight people are interviewed independently.

The answers are recorded on audio tape and transcribed into texts, which are included in Appendix B. The structured interviews are conducted by asking three questions in a specific...
order, with the intention that answers are not mixed or influenced by knowing which question will follow.

The three questions to gather insights are:

1. What is your personal definition of the word “meaningful”?  
2. How would you describe a “meaningful time” with your loved ones?  
3. Which emotions do you feel when thinking of a “meaningful time” with peers?

When asked for their definition of “meaningful”, five out of eight participants emphasised that an explanation of the word 'meaningful' is very personal. Person G summarised: “Something that can be meaningful is highly subjective to each person”. Nevertheless, a pattern of responses could be identified which showed that the most frequently mentioned synonym for “meaningful” was “importance”.

Emotional states were also included in order to find an individual definition for all kinds of personal meaningful moments. Person C identified: "I see it as a chain of feelings". In particular, the emotion of happiness was mentioned by six out of eight people. In addition, general positivity and the feeling of love were mentioned, followed by adjectives such as worthwhile and purposeful, as well as the nouns care and value.

Reflection on emotional impressions was most often in the context of being surrounded by peers, as Person F put it: “Something is meaningful if it's special for us internally. Even though it could also be [...] something mundane as [...] having like a laughter with friends.”

According to the participants, meaningful time can be created by strengthening relationships accompanied by positive emotions. Furthermore, all eight interviewees included family, friends or similar relationships in their thoughts about meaningful moments. Respondents reflected more on their feelings when spending meaningful time with loved ones. "I would say proud, present, relaxed and happy," said Person H. Other positive emotions mentioned in relation to shared experiences were joy, connection and ease.

According to person D, a meaningful time is created simply by being surrounded by loved ones and just being together. Person A mentioned a similar scenario where the condition to have a meaningful time with peers is described as being there "physically and mentally" without any distraction: "I'm maybe not thinking about things. I'm very focused in the present. That's also meaningful," completes Person A. A similar approach can be found with Person C, who also reflects on presence while thinking about contextual emotions: “feeling challenged, being open to do something you haven't done before. I would say trusted. I would say surprised. I would say, amused as well, mesmerised. I would say also insignificant".
As Person E summarises, being surrounded by loved ones is the basic condition, but the interviewee adds that activities such as sports or games can enhance relationships, emphasising the quality of anything that is offline. In line with this idea, Person A mentions a link between emotions and shared activities: "The activity becomes a mediator in order to connect, to feel closer, [...] fun, enjoyment, being close together, happy". A similar link was identified by Person G: "So it has to be something that my opinion, if my closest ones are in that moment really engaged, engaged with me, either with communication or by doing something specific, it can remain, it can be meaningful".

Group activities to facilitate meaningful experiences can be linked to talking and listening to each other, according to five out of eight respondents. Furthermore, activities such as cooking and eating as well as playing (offline) games and/or gaining knowledge were identified as meaningful. Person A: "say in the context of being in the woods, if someone teaches me something, I'm having a meaningful time".

Another aspect that was mentioned several times by several interviewees was retrospection. According to the emotions expressed by the participants, as well as the situations they illustrated, meaningfulness can be linked to melancholy, missing and the realisation of the past in the form of memories. Person H shared the personal meaning of being part of a group of friends while doing something to remember. Person C also reflected on the link between meaningful moments and memories: "It's a memory that whether you make it, [...] conscious or subconscious, it's a memory that ignites a lot of associations that have a positive connotation [...]. And why do I say a memory? Because I believe when something is happening to you, you’re going through an experience with other people, or alone. Or not alone, but with yourself. I believe that it's impossible in the moment that it's happening to be aware of how meaningful something is. So it's always in hindsight. It's always in a reflection mood."

The most important findings from the "meaningful" interview:

1. What is perceived as meaningful or meaningless is very personal and internal. There is no specific activity or environment that guarantees meaningful experiences.
2. The idea of a meaningful moment develops after the experience itself, in retrospect. Meaningful experiences are linked to memories.
3. Personal meaningfulness is associated with positively evoked emotions.
4. People expect meaningful time to be created when they engage in shared activities such as discussions, knowledge sharing, cooking, games or sports.
5. Being present not only physically but also mentally is desired, e.g. through a shared offline experience.

**QUESTIONNAIRE**

The questionnaire was designed to gain more in-depth information about outdoor behaviour and user needs. According to previous research through various interviews, meaningful moments in nature are often created as a group of friends or family. Based on this insight, the questionnaire presented peer scenarios that asked the participant to reflect on group behaviour, emotions and sensory impressions.

To create the questionnaire, a list of assumptions was made and considered for the questions within the survey. The responses are intended to test the assumptions in order to distinguish between true and false and to make further process decisions. All assumptions and the level of agreement are shown in Appendix C.

A total of 41 people completed the questionnaire. The prerequisite for completing the questionnaire was the experience of spending time in nature with the Fellows. All results are detailed in Appendix C, Table 4-7.

**Section 1: Who is answering the questionnaire?**

The first part is intended to group the participants between the extremes of a "nature person" who is used to exploring the natural environment and a "city person" who spends most of his time in cities but is interested in nature. This helps to understand the point of view behind each person's answers to the questionnaire.

**Take-aways of Section 1:**

1. Physical activity and spending time outdoors is very important to daily happiness for 75% of respondents.

2. Natural spaces are more often visited in a group than alone.

3. More than 92% would like to spend more time outdoors.

4. Lack of time, no available green spaces to visit and no enjoyable outdoor places nearby are the most common reasons given for not spending more time in nature.

5. When participants spend time in nature with friends or family, the most common activities are walking or hiking, picnics and/or barbecues, and outdoor sports.
6. What they like most about spending time outdoors: sounds, views, air quality, physical activity, no electronics, clearing the mind, appreciating the world, feeling part of a whole and deep conversations with people.

Section 2: Setting the participant mentally into an outdoor scenario.

In the second part of the survey, participants are asked to reflect on their intentions and motivations for certain green actions. The questions are formulated on the basis of assumptions that will be tested by the questionnaire.

Take-aways of Section 2:

1. Participants enjoy exploring nature and noticing details around them through conscious sensory impressions.

2. Favourite activities to do outdoors with friends are exploring and observing nature (greenery, sunsets, animals), making a fire, talking, making/playing music, arts (painting, crafts), games including physical activity, sports and using natural materials.

3. Reducing your own and your friends' screen time on mobile phones is appreciated. Furthermore, uncharged batteries limit prolonged use anyway. Phones should not be an essential part of outdoor exploration.

4. Most of the participants have several ideas about how to entertain themselves in nature, although their answers were very general and not detailed about how to make these ideas come true. This could be explained by the fact that the question did not specifically ask for detailed answers, but could also open up design possibilities, e.g. to guide people on off-road walks and to create sensory awareness by amplifying nature sounds.

Section 3: What do people desire to do in nature but does require too many resources?

The third part of the questionnaire asks participants to reflect on their previous experiences in nature and aims to gain insights into materials and tools that people might want to take with them into the outdoors, but which are not carried out due to circumstances.

Take-aways from Section 3:

1. People go into nature with the expectation of increasing their emotional state as well as mentally disconnecting from daily routines, including work or mobile phone habits. The dissertation project should consider the avoidance of mobile phones as well as aiming for joy and fun when interacting with the concept.
2. Many participants would like to entertain themselves playfully in nature, but feel restricted by carrying bulky and heavy things that may not be waterproof.

Section 4: Do nature explorer care about capturing their experience by a memory media?

This section explores users’ interests in using technology outdoors to capture the environment.

Take-aways of Section 4:

1. Explorers like to create memory media in different ways, both digital and physical artifacts. Technology can be involved in memory media, but does not necessarily have to be, as non-technical methods, such as collecting materials, are also practised.

2. Captured media are stored in different locations, but do not cause problems for the user when searching for a specific medium.

3. 37 out of 41 participants would be open to trying a new way of capturing if it existed.

4. There is no interest in sharing the outdoor experience with others who were not involved.

Section 5: Evaluating activities for nature exploration

The last section explores the participants’ interest in physical interaction surfaces for outdoor exploration, as well as a likely use of augmented reality applications. Two moodboards are presented in the questionnaire to test preferences for technology or non-technology use in different scenarios.

Figure 18: Concept A, Physical Interaction Surfaces

Figure 19: Concept B, Augmented Reality App
Take-aways of Section 5:

1. Physical interaction surfaces provide more curiosity to be used by a group of users, whereas a single user prefers to use an app when outdoors alone.

2. According to the average expectations of the participants, physical interaction surfaces provide a detailed long-term memory of the experience.

3. Participants feel engaged by physical interaction surfaces that stimulate their curiosity about the natural environment.

DESIGN CRITERIA

The following design criteria are defined by the results of the literature review and fieldwork.

<table>
<thead>
<tr>
<th>#</th>
<th>Project need</th>
<th>Design requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Target Group</td>
<td>The design is aimed at two or more people who meet with the intention of spending time together in a natural environment. The target group includes nature lovers who are used to being outdoors as well as people who are curious about nature but have not yet experienced being surrounded by greenery.</td>
</tr>
<tr>
<td>2</td>
<td>Social Aspects</td>
<td>People need to feel involved in order to have a meaningful time together. Verbal communication through group activities should enhance social interactions.</td>
</tr>
<tr>
<td>3</td>
<td>Technology</td>
<td>Technical components, including artifacts, should be ambient and blend into the environment or be hidden on the human body. Mobile phones are avoided. Outdoor qualities such as water resistance must be guaranteed.</td>
</tr>
<tr>
<td>4</td>
<td>Non-Human Awareness</td>
<td>The design should enhance human awareness of the non-human world. Details of plants and animals should be actively perceived through human sensors.</td>
</tr>
<tr>
<td>5</td>
<td>Knowledge Development</td>
<td>Users must be able to acquire new knowledge about non-humans. Social interactions should be considered and benefit from teaching and learning aspects.</td>
</tr>
<tr>
<td>6</td>
<td>Health Improvement</td>
<td>Improving health is one of the motivations for using the design. Involvement in the concept should reduce stress and give a feeling of being away from daily obligations.</td>
</tr>
<tr>
<td>7</td>
<td>Accessibility</td>
<td>The target design should be accessible to a group of users. A fixed outdoor installation needs to consider location and accessibility for people, while a personal sensor kit needs to allow the user to be transported and carried outdoors, taking into account size and weight.</td>
</tr>
</tbody>
</table>
AFFINITY DIAGRAM

For the purpose of grouping the whole research, an overview of the findings related to each methodology conducted within the first diamond summarises the insights and fieldwork in keywords (Figure 20). This diagram also takes into account interviews that are only presented in Appendix B, as the insights gained from these interviews were targeted but only conducted with individuals. The design process was influenced by these Appendix B interviews, but they were given less weight in the affinity diagram evaluation.

Table 1: Design Criteria

<table>
<thead>
<tr>
<th>#</th>
<th>Project need</th>
<th>Design requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Environmental Conditions</td>
<td>The natural environment should offer clear differences to urban characteristics, most likely provided by a physical distance between nature and urban space. Parks or green spaces within a city are only a suitable design setting if users do not perceive urban chaos, such as hearing urban noise or seeing urban buildings. Non-human activity must be provided.</td>
</tr>
</tbody>
</table>
Based on this overview, an affinity diagram (Figure 21) shows the synthesis keywords grouped together. The thematic overview provides an insight into the overlap between synthesis results and allows the relevance and importance of a topic area to be attributed through frequent mention.

**HOW MIGHT WE**

Themes identified as important in the affinity diagram were used to formulate “how might we” questions, while the eight design criteria were also considered.

1. How might we use sensors in natural environments to explore the environment with friends?
2. How might we use tangible artifacts to engage physically and playfully with friends in nature?
3. How might we create a digital memory medium in natural environments as a result of human-nature interaction?
IDEATION AND DEVELOPMENT

PARTICIPATORY IDEATION

The participatory workshop is designed to encourage creativity in response to the "How could we...?" questions presented earlier. To this end, four different categories of cards (see Figure 23) are used to stimulate creativity and inspire ideas for the implementation of sensors in outdoor environments. In addition, the workshop aimed to obtain feedback in terms of interest and creativity in relation to the three "how might we" questions in order to discuss design directions and user group acceptance.

In order to involve stakeholders in the ideation process, a group of four nature-loving friends will participate. The workshop is held outdoors in the middle of a Swedish forest to give the participants a sense of the contextual environment relevant to the project. As shown in Figure 22, the participatory ideation consists of four phases: introduction, sketching, ranking and discussion.

![Figure 22: Phases of Participatory Ideation]

Each participant is given a random combination of cards, while everyone is given one of the "How might we", "Environment", "Input" and "Output" cards. Using an example presented in Appendix D, participants are asked to create a story that includes all the conditions shown on the four cards, as well as a graphic representation.
Figure 23: Participatory Ideation Workshop Cards

Figure 24: Workshop Location

Figure 25: Workshop Location
Overall, the workshop was conducted successfully, with participants understanding the topic and feeling engaged by thinking about the tasks. All 12 sketches are numbered with letters to group the participants’ ideas, as shown in Figure 30.

Based on each participant’s personal concept ranking and open discussion, one sketch from each round was identified as the most appealing to the participants. The original sketches are shown in Appendix D, while the discussions on the merits of each favourite sketch per round are summarised in Table 2 below.

<table>
<thead>
<tr>
<th>How might we..?</th>
<th>How might we use sensors in natural environments to explore the surrounding with fellows?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment, Input, Output</td>
<td>Water, Orientation, Vibration</td>
</tr>
<tr>
<td>Interactive Scenario</td>
<td>In case one gets lost I have come up with this vibrating device that you can fit in your pocket, or wherever you like, as close as possible to your body. This device will be filled with GPS so it can tell which direction you’re walking and vibrate when you’re walking towards a body of water.</td>
</tr>
<tr>
<td>Participants’ Feedback and Conclusion of Discussion</td>
<td>Vibration is perceived as particularly appealing as user feedback, which the participants imagine to be very subtle and pleasant. The advantage of being able to wear the sensor anywhere covered by clothes on the body was also mentioned several times. Workshop participants feel engaged with a fun and playful approach that can be used in any natural environment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How might we..?</th>
<th>How might we engage physically active and playful with friends in nature with the help of tangible artifacts?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment, Input, Output</td>
<td>Birdhouse, Distance, Light Up</td>
</tr>
</tbody>
</table>
All three "how could we" questions are understood by the participants and seen as engaging. Finally, the total number of scenario sketches revealed an interest in fun social interactions provided by hidden technology giving invisible user feedback while gaining knowledge about the non-human world. The creation of a memory medium receded into the background of participants' importance and interest. The participatory ideation led to combining the three how might we's into one:

How might we socialise outdoors and gain knowledge about the non-human world with the help of ambient technology?

<table>
<thead>
<tr>
<th>Table 2: Participatory Ideation: Scenario Sketches and Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interactive Scenario</strong></td>
</tr>
<tr>
<td><strong>Participants' Feedback and Conclusion of Discussion</strong></td>
</tr>
<tr>
<td><strong>How might we..?</strong></td>
</tr>
<tr>
<td><strong>Environment, Input, Output</strong></td>
</tr>
<tr>
<td><strong>Interactive Scenario</strong></td>
</tr>
<tr>
<td><strong>Participants' Feedback and Conclusion of Discussion</strong></td>
</tr>
</tbody>
</table>
INDIVIDUAL IDEATION

The approaches identified in the participatory brainstorming (see Table 2) are taken into account in the brainstorming by creating a concept sketch that fits each approach and the eight design criteria.

Approach 1 "Knowledge-driven" material searches: Several sensor-based quest stations are installed hidden in a natural environment. A group of users will encounter interaction surfaces that communicate different challenges. The tasks require the knowledge of the community by finding different natural materials and placing them on the surfaces. For example, the tasks include finding certain types of trees and the corresponding bark or leaves of edible plants and mushrooms. The group activity encourages conversation, relationship building and knowledge sharing.

Approach 2 "Reading the landscape" through intuition and subtle guidance: Orientation through an unfamiliar landscape using ambient technology is made possible by a technical device containing a GPS sensor and a compass that is worn close to the body. The user receives a vibrating feedback from the device when the walking direction leads to the desired location. In this way, the natural environment can be explored without the need to follow specific paths; instead, the user can concentrate on reading the environment and paying attention to the non-human world, guided only by the direction of the compass.

Approach 3 "Entertaining exploration" through a card activity game: The natural environment is equipped with sensors that detect non-humans in the vicinity, e.g. types of plants, animals and weather conditions. Various environmental data are sent to a device placed on a table.
The aim is to find all the icons shown on the cards in the non-human world by physically exploring the environment together as a group of friends. Additional information about the hidden non-humans can be seen as help and clues to find them, provided by the device when a card is scanned. The aim is to be the first to find all the elements shown on the cards.

In order to analyse which of these concepts have the highest potential and which pain points may arise, the concept sketches are evaluated against the eight design criteria.

<table>
<thead>
<tr>
<th>Design Criteria</th>
<th>Approach 1: Knowledge Driven</th>
<th>Approach 2: Reading the Landscape</th>
<th>Approach 3: Entertaining Exploration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Group</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Social Aspects</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Technology</td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Non-Human Awareness</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Knowledge Development</td>
<td>++</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Health Improvement</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Accessibility</td>
<td>-</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>Environmental Conditions</td>
<td>-</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Average</td>
<td>+</td>
<td>++</td>
<td>+</td>
</tr>
</tbody>
</table>

Table 3: Evaluation of Individual Ideation
According to the evaluation of the design criteria, Approach 2 best fulfils the criteria and thus answers the "how might we" question the best. Nevertheless, the social aspect as well as the knowledge development need to be improved by considering elements of approaches 1 and 3. As shown below, sketch 4 (Figure 34) visualises the outcome of individual ideation.

The idea is to guide a peer group through nature using different tag devices attached to the body, while each person receives a unique sensor-based feedback. The tags are interconnected and provide individual information to the person looking after the device, such as gps location, direction of travel or environmental non-human information, encouraging teamwork and social communication between people. Together as a group, knowledge-based quests are to be solved, while a guided tour through unknown outdoor locations is provided by the tags.

**PROTOTYPING**

The prototype takes into account the previously presented concept, which was derived from participatory and individual ideation. Two tag devices were coded using Micro:Bits software and sensor components, while housings were modelled in Rhinoceros to 3D print housings for the two tag devices. For the prototype, it was important to test the function and communication of the device and the consequences for human-to-human interaction. The prototype can be categorised in the Houde and Hill model, with the emphasis on the role.
The first tag guides the user to the next checkpoint by emitting an audible signal when the user is off course, complemented by LEDs showing an arrow pointing in the right direction. The more the integrated compass deviates from the planned route, the more intense the correction tone is repeated. The Wizard of Oz method was used to give the user the feeling of being guided by the GPS position, while the system was coded in relation to the celestial direction between two pre-selected locations. The degrees between two locations were analysed on the map (as shown in Figure 40) and used to code the corresponding routes to be taken, taking into account the compass. The arrow shown does not indicate north, as with a conventional compass, but the direction in which to walk. The two routes can be accessed by pressing the left button to go from point A to B and the right button to go from point B to C.
The second tag assists in finding the control point by communicating the landmark. This is indicated by a short vibration when a landmark is reached and the corresponding change to the new symbol shown by the LEDs. Landmarks B and C are accessed by pressing the left or right button.

Figure 37: Tag 2 Components and Functionality

Figure 38: 3D print of Cases

Figure 39: Prototype Tags
TESTING

Testing the prototype with participants focuses on three evaluation points:

1. To what extent do participants accept the idea of the overall concept, i.e. carrying a tag device per person with different functions and user feedback? How do the participants wear the tags?

2. How do the participants interact with each other and communicate the tag feedback and their knowledge to the group?

3. What role does the non-human world play for the prototype users while walking?

The test takes place in the rural village of Höör in southern Sweden, which guarantees peace and nature. Based on the availability of the participants, the six users are divided into three groups and test the devices in pairs at different times during the day. The groups met at Location A (see map in Figure 40) and were introduced to the concept idea and the importance of perceiving feedback from the tag devices. After the tags were given to the participants, the pairs started their walk towards Location B, while their behaviour and interactions could be observed. In addition, a knowledge tag was mimicked by providing historical information about the location when passing the statue of Skånes Mitt at Location B (see Figure 40), as well as an explanation of the river along the walk.

Figure 40: Map of Prototype Testing
All participants felt engaged by wearing a tag and being responsible for the information transmitted by the device. While the prototypes were either carried in the hands or in the pockets of the participants, five users mentioned that they would like to have their hands free while walking. "A clip would be cool, so I could put the device under my jacket and fix it on my sweater. Or even hook it onto my backpack if we were out for long," said one participant, while his test partner in this round agreed.

Several participants found the vibration, sound and visual feedback very pleasant, but would prefer the output to be sent to the user even less frequently. One participant summarised: "It would feel better if the direction in which you are walking was only corrected after some time, as sometimes you deliberately stray from the actual path and vibration or sound can then be distracting or confusing for the whole group".

All participants stayed close to each other and asked each other for new information on their respective devices. There was a particularly high level of social interaction when it was necessary to synchronise the different devices, for example when finding a bridge or bank, but participants had to compare the feedback from the prototypes to understand whether it was the landmark they were looking for or whether they should continue walking. "It feels like I would be able to find my way back to where we started, even without the device. I see my surrounding much more intensively as if I would look on my smartphone to
lead the group to a certain place," summarised one participant upon arrival at the final destination. The paired participant added: "you also feel less responsibility to bring other people to the right unknown spot, because everybody is a part of the guidance".

Non-humans such as plants and animals were noticed and appreciated by the participants. The overall peer feedback on the additional information about the river was positive. Some participants expressed a desire to receive non-human information that could be useful or helpful for the upcoming trip and time in nature, such as knowing which wood is easy to use for making a fire.
**FINAL DESIGN**

The human-centred project involves relationships between social aspects, knowledge development and ambient technology. The focus of the design is the interaction between a group of people who share the intention of disconnecting from everyday life. A natural, non-human environment defines the restorative conditions that describe the interaction space. The user needs of people, such as exploring the natural environment, gaining knowledge or disusing mobile devices to name a few, were analysed and developed through interviews, questionnaires and participatory ideation. Hidden technology emerged as a suitable mediator between users, but also between humans and the non-human world, which was implemented with the help of tangible artifacts.

![Figure 47: Artifacts Render](image)

**CONCEPT**

Several wearable devices, called "tags", are equipped with a variety of sensors and e-paper displays to support the user's non-human exploration. Each tag has unique functions related to environmental information, which is communicated to the person wearing the device through sound, vibration and visuals. By sharing and combining the information received by the tags within the peers, the group of people can be guided through unknown natural environments and collectively gain knowledge about the non-human world.

The small size, ruggedness and water resistance of the artifacts allow them to be carried in the wild or attached to clothing or outdoor equipment. This leaves the user's hands free for
tactile exploration and conscious sensory experience of nature, while the technology fades seamlessly into the background.

The tags are calibrated and assigned functions by an app that only needs to be used before exploration begins. Based on GPS location, number of people in the group and personalised difficulty level, a route is automatically created and the tags are activated.

USE CASE SCENARIO AND STORYBOARD

The use case scenario presented expresses how the tag devices are intended to be used and how communication between devices and people is encouraged. The scenario sketch tells a story about a group of friends spending a weekend together in nature to get away from it all and enjoy time together while camping. Figure 49 shows which devices are active in the scenario, while the scenario map (Figure 50) explains where the frames of the scenario sketch (Figure 51) are intended to take place.
Figure 49: Tags Used in Scenario

- **Direction Tag**: Shows guiding arrow to next checkpoint and vibrates at lower intensities as well as acoustic signals according to direction of walking by gpr signal and compass.
- **Terrain Tag**: Synchronised to topographic map and informs about terrain information, ground or plant species related to gas location and complex.
- **Landmark Tag**: Vibrates when checkpoint is reached and next one is registered related to gas location of all tags, landmark is visualized by icon.
- **Identification Tag**: If specific non-human is found nearby by certain tag, detection is lighting and plants can be scanned by cameras to identify non-human correctly and receive details.
- **Section Tag**: Connected to the gas locations of all tags, the section clarified and informs the distance of checkpoints already reached as well as the number of upcoming sections.
- **Creative Tag**: Once the identification tag detected a non-human, the system is triggered by image and sounds how to be creative with found plants, e.g. crafting, cooking or playing.

Figure 50: Map of Use Case Scenario
After the tents have been pitched, the friends relax and think about what they could do in nature.

One of the friends brought small devices to the weekend trip in order to create a shared activity involving everyone.

The tags are activated via an app and get connected to a gps-located map. Personalized settings are made e.g. time and limitation.

The tags can be attached to clothing. Signals such as vibration or sounds can be received by the user at any time. Displayed symbols can also be viewed optionally.

The combination of all orientation tags are guiding the group through nature to take the right direction.

Arriving at a bridge, the friends are discussing if this is the first check point shown on the landmark tag, but since the direction tag guides them further, they continue walking.

Discovering another bridge on their way, all of the friends perceive synchronised vibrational patterns of their tags. The first check point is reached. The tags communicate new information for the next direction.

While reaching check point number two, the terrain tag detects by map and gps information that many birch trees are around. The integrated speaker explains characteristics of the tree, which the wearer of the device passes on to the other friends.

In order to understand which of the trees is meant, leaves are scanned with the help of the identification tag. Vibration and a sound signal communicate in addition to a check mark icon that the leaf is from a birch tree.

As soon as the identification tag detected the leaf, the creative tag communicates by a vibrational signal, speaker and visual that birch bark can be well used to start a fire. This sparks a conversation within the group.

After the information has spread out in the group, some peers decided to make use of the new gained knowledge and collect some birch bark to bring it back into the camp.

Together as a group, the friends are guided to their last check point on the round trip, way back to where they started.

Back at the camp, the adventurers not only know more about their surroundings, but also apply their new knowledge immediately and start a fire. The friends share their experiences.

Figure 51: Storyboard
INTERACTIONS IN DESIGN

The design involves four interaction layers: social interaction, human-non-human interaction, artifact-to-human interaction and the overall system logic of artifact-to-artifact interaction.

CONTRIBUTION

This project contributes to the field of human-centred design, while different interaction design methodologies have been applied to provide thematic insights to the academic design pool. Furthermore, physical artifacts that support social interactions as well as engagements with the non-human world could provide an answer to the research field and how we might we question.

AMBIENT TECHNOLOGY

One of the contributions of this work is to propose a concept that provides a solution to both mental and digital disconnection. Schwarzenegger and Lohmeier (2021) summarise the need for alternative disconnection solutions to apps, especially for outdoor experiences. Furthermore, the project explores how disconnection management benefits from outdoor experiences, which Helms et al. (2019) present as a research gap. The project concept
presents a solution in which the modern use of technology is applied as a mediator between the human, the sense of safety and disconnection.

SOCIAL INTERACTIONS

Social interaction in nature offers a range of holistic benefits, including physical health, mental wellbeing and community building. Designed for outdoor scenarios, it contributes to the overall quality of life for individuals and communities. It also promotes educational opportunities through the exchange of non-human knowledge.

APPRECIATION OF NON-HUMAN WORLD

Respect for nature and animals is essential to fostering a harmonious relationship between people and the environment. It helps to inspire conservation efforts and plays a crucial role in creating a sustainable and balanced coexistence with the natural world. In addition, the system’s tagging functions allow it to be extended in a number of ways: non-human activity could be detected by implementing artificial intelligence in a device that transmits information about animals and plants. This provides a possible contribution to animal communication models that create innovative solutions to enable humans to perceive, understand and interact with the natural world in ways that go beyond our inherent sensory capabilities.
DISCUSSION

CONCEPT AND INTERACTION EVALUATION

The overall acceptance of the concept idea could be tested with the participants using the prototypes. According to the test results and the evaluation of the user-centred design, the final result can be discussed in relation to the four interaction levels presented in the chapter "Interactions in design".

Social interactions were demonstrated in the test by the user behaviour of the test participants. Information provided by the tags was shared within the test teams as soon as the devices provided feedback. The idea of combining all the information from the tags encouraged the participants to work together. The interconnectedness of the different devices allows users to stay together and gives a sense of being part of the whole. Due to time constraints and the expected scope of the thesis project, it was not a priority to program an even more detailed and truly functional prototype. It can be assumed that even more social interactions would occur, especially with devices that convey knowledge about nature, as envisaged in the concept. However, this would have to be tested in a further test run.

Human-non-human interactions are made possible through the conscious perception of nature. Ambient technology should ensure that the user can interact directly with the non-human world. It is debatable whether the test demonstrated real human-non-human interaction or just human awareness of nature. For an interaction that requires both interaction partners to exchange information with each other, other tags would need to be tested, for example giving the non-human world a voice and responding to human actions. As the concept allows for the addition of other tags with different functions, it would be possible to include tags that sense non-human activity beyond the range of human senses, allowing non-humans to communicate with artificial intelligence.

Human-artifact interactions are defined by various feedback in the form of vibration, sound and visual graphics as artifact outputs. The information from the devices should be passively perceived by the user and mixed with intuition about the terrain and reading nature. The user can interact with the device to control the intensities of the output, as well as to confirm information received from the device when necessary. In the implementation of the prototype, this was possible by pressing buttons. In the real design, voice or gesture control could be considered to ensure as little physical interaction with the device as possible.
Further testing would need to evaluate user behaviour to ensure intuitive and fearless interaction.

Artifact-to-artifact interaction describes the communication between the tag devices. The output signals from the tags to the user depend on the GPS information of all the devices, as well as the inputs provided by the user to the tags, e.g. the scanning of non-human material.

**DESIGN PROCESS**

During the design process, the project evolved into many complex sub-themes and crucial decisions had to be made regarding the focus areas. These decisions turned out to be very difficult and complex, as the whole logic of the designed system was very much influenced by following or excluding a certain subfield, for example the creation of a storage medium or a database. The curiosity for possible directions led to a very broad research of literature review, but also fieldwork by conducting various interviews and a detailed questionnaire.

By gathering a large amount of information on the project topic, the priority was to understand the field of study and to check assumptions at an early stage in order to provide a stable basis for argumentation as well as an authentic and realistic outcome, involving stakeholders and the user group from the beginning. In the middle of the research it was easy to underestimate the synthesis phase and the challenge of keeping track of all the different information. Both the affinity diagram and allowing the participants in the participatory ideation to be creative with “how might we statements” enabled the project to be narrowed down and the directions for further development to be prioritised.

**FUTURE PERSPECTIVES**

To bring this concept to life, more people from interrelated disciplines would need to be considered: engineers to contribute with knowledge of product components, programmers to develop prototypes and final tag devices that are close to the vision of the concept, and biologists to focus the exploration of the non-human world on exciting interactions while taking into account sustainable aspects.

The concept could also be used to store the routes taken and the nature explored in the app. Not only the gps signals and the route could be recorded, but also the interactions with nature and animals, as well as the newly acquired knowledge. Photos of the identification tag can be stored. It is anticipated that a digital community could be created if routes and non-human findings can be viewed by other users in the app. People will be encouraged to spend more time outdoors, improving their mental and physical health.
Moreover, new impressions of the non-human world may lead to long-term changes in people's behaviour, which would have a positive impact on the World Wildlife Fund's (WWF) call for an improvement in human-wildlife conflict. To develop this hypothesis: Wood & Rünger (2016) argue that impressions form the basis, which are fleeting but could attract attention, after which awareness would follow. Awareness would have the potential to turn into feelings, which could lead to engagement, and engagement can lead to intentions. If these intentions are strong enough, this could lead to action which could turn into habit (Wood & Rünger, 2016). At the same time, WWF argues that “in order to reduce human-wildlife conflict, we must reassess the relationship—and especially the direct interactions—between people and wildlife to improve our coexistence in the future” (What Is Human-Wildlife Conflict and Why Is It More Than Just a Conservation Concern?, n.d.). As a result, direct experiences in and with nature could lead people to develop a new awareness and appreciation of non-humans and to make long-term behavioural changes, such as travelling sustainably, conserving biodiversity or becoming active in environmental protection.
CONCLUSION

This project aimed to propose an outdoor design solution that motivates people to spend more time in green environments. The aim was to engage a group of people to improve their social interactions with each other by gaining shared knowledge of the non-human world around them using ambient technology. Following the Double Diamond design process, the research question found its answer in connected wearables that require collaborative teamwork and communication when exploring natural places together, while subtle feedback from the devices aims to enable conscious and active perception of nature and animals.

The project began with a review of literature on the impact of nature on human health, the implementation of technology in natural environments, and motivations for voluntary disconnection from mobile devices. In addition to this research, design examples of interactive technology for outdoor exploration provided insights into current design solutions and their (dis)advantages. Detailed fieldwork was also carried out through a series of interviews and a survey to test assumptions.

In the development phase, potential users and stakeholders were involved in the ideation process at an early stage. Participatory ideation and prototype testing evaluated possible outcomes and defined the final delivery. In conclusion, the design addresses four levels of interaction: social interaction, human-non-human interaction, artifact-human interaction and artifact-artifact interaction.

The research and the concept make several contributions. By acknowledging nature and animals, individuals and societies can reap the benefits of improved physical and mental health, stronger community ties, enhanced education and a heightened commitment to environmental conservation, ultimately contributing to a more sustainable and harmonious relationship with fellow humans and the planet.
ACKNOWLEDGEMENTS

For this project I would like to thank Henrik Svarrer Larsen for his supervision at the beginning of my project, which has influenced my approach to literature and topic definition throughout the project. I would also like to thank Tina, Maida, Fabio and Sander for their willingness to listen and for their profound feedback on my drafts of the thesis. I would also like to thank all the participants in the questionnaires, interviews, participatory ideation and prototype testing for allowing me to gather insights and define the concept. Probably the biggest thanks goes to my parents, who believed in me at all times and supported my entire 6.5 years of study with love and care. I am deeply grateful to you both for allowing me to feel free and find my own way in life. Finally, I would like to thank Alve for his unconditional love and belief in me.
REFERENCES


Buxton, B. (2010). *Sketching user experiences: getting the design right and the right design*. Morgan kaufmann.


Chaudhri, I. [TED]. (2023, May 9). *The Disappearing Computer: An Exclusive Preview of Humane's Screenless Tech* [Video]. YouTube. [https://www.youtube.com/watch?v=gMsQ0S5u7-NQ&t=291s](https://www.youtube.com/watch?v=gMsQ0S5u7-NQ&t=291s)

Coen, S. [TED]. (2017, October 5) *Contextual Design; Creating Connection and Calm* [Video]. YouTube. [https://www.youtube.com/watch?v=vvL0I5dpJSU&t=134s](https://www.youtube.com/watch?v=vvL0I5dpJSU&t=134s)


GDPR. (n.d.). What is GDPR, the EU’s new data protection law? Retrieved September 09, 2023, from https://gdpr.eu/what-is-gdpr/


Humane. (2023, June 20). *Humane reveals the name of first device, the Humane Ai Pin.* https://hu.ma.ne/media/humane-names-first-device-humane-ai-pin


APPENDIX A: DICTIONARY OF WORD DEFINITIONS

INTERACTION DESIGN
Interaction design is a broad field that encompasses the design and creation of interactive products, systems, services or experiences. It focuses on the design of user interactions, ensuring that the user experience is intuitive, engaging and meets the user's needs. Several disciplines have been involved in this project, including user experience design, human-computer interaction, product design and communication design.

HUMAN-COMPUTER-INTERACTION (HCI)
Human-computer interaction is a more specific subfield within the broader context of interaction design. HCI is specifically concerned with the design and use of computer technology, with an emphasis on human-computer interaction. It involves the study of how people interact with computers and the design of interfaces that facilitate effective and enjoyable interactions.

HUMAN-CENTERED DESIGN
A human-centred approach to a project means considering four elements: focusing on people's needs, analysing the root of a problem, understanding the interconnectedness of the system and allowing iteration within the process (What is Human-Centered Design?, 2023).

NON-HUMAN WORLD
In the context of this project, the non-human world describes the whole of the natural environment, including animals, plants, micro-organisms and ecological systems on Earth that are not human. The terminology is based on Bakker (2023).

MEMORY MEDIA
In the context of this project, a memory medium is any form of digital media (such as photographs, videos, audio recordings, ...) that serves as a means of preserving memories.
APPENDIX B: INTERVIEWS

INTERVIEWS, WORD DEFINITION OF “MEANINGFUL”

All interviewees are anonymised by numbered pseudonyms, while each person is referred to by an assigned letter in alphabetical order. The responses of the eight interviewees are presented below, grouped by question and content, with the number of responses indicated by the letter assigned to each person.

What is your personal definition of the word “meaningful”?

- **synonyms**: importance, value, worthwhile, care, purposeful
- **peers**: family, friends, interpersonal relationship
- **reaching goals**: accomplishment, success, performance
- **situation**: contextual, personal
- **emotions**: happiness, feelings, internally, melancholy
- **time**: past
- **mental state**: memory, positive associations, reflection
How would you describe a "meaningful time" with your loved ones?

Which emotions do you feel when thinking of a "meaningful time" with peers?

- **Positive**
  - fun
  - joy
  - happiness
  - empowerment
  - trusted
  - mesmerised
  - connectedness
  - ease
  - recovery
  - freedom
  - fulfilment
  - proud
  - presence
  - relaxation

- **Negative**
  - sadness
  - anxiety
  - vulnerability
  - confused
  - missing

- **Neutral**
  - challenged
  - surprised
  - melancholy
  - realisation
INTERVIEW: GENERATION NO NETWORK CONNECTION

An observation about the increased use of technical devices over decades

In recent decades, technological devices have become more and more our daily companions. We are used to taking them with us wherever we go, and especially when we have new experiences in a previously unfamiliar place, mobile phones can help us to record sensory impressions such as things we see or hear. The use of mobile phones in natural environments can be seen as a habit. This interview aims to look behind the scenes of our habits and dive into a world where the omnipresence of the mobile phone did not exist. The aim is to gain an understanding of scenarios where smart devices are absent from the outdoors and what opportunities might arise for an alternative implementation of digital technology.

The participant who was interviewed was born in 1942 and grew up in a very craft-oriented environment. An awareness of natural materials and natural environments was established at an early age and has been reinforced throughout his life in both private and professional contexts. At the same time, the participant has an awareness and knowledge of technological devices by using mobile phones and computers on a daily basis.

The interview was conducted in the participant's foreign language, German, and took place in a green garden setting. The interview was documented by handwritten notes. The following questions were prepared for the semi-structured interview:

1. Do you perceive an overuse of network devices in natural surrounding nowadays?
2. What are you using your mobile phone for when out in nature?
3. How do you remember an outdoor experience? Can this be enhanced by implementing technology?
4. Have you ever been surrounded by peers who payed mainly attention on their mobile phones instead of engaging socially? How often did that happen and how did this make you feel?
5. To what extents does nature have recharging effects on you?
6. Which associations do you get by thinking about natural environments?
7. Which importance do nostalgic memories have to you?

The results of the interview are sorted by content and arranged by section. There is no hierarchy of importance or chronological order.
The participant reported that he did not always have his mobile phone with him. Text messages and emails were often only read in the evening during what the participant described as “unimportant events” such as shopping or spending time in the garden. The interviewee described ‘important events’ as going for a walk or meeting friends and family for an extended period of between two and six hours. The mobile phone is then taken to navigate, but also to take pictures.

Typical pictures on the participant's mobile phone would be images of rare plants, aesthetic colour combinations of nature such as flowers, leaves and structures, but also small animals passing by. In addition, photos are taken that are not aesthetically pleasing, but rather informative and emotional, such as annual family reunions.

The participant also talked about the positive effect of sharing digital media, such as pictures on public social media and direct messenger applications. This would make it easier not to focus on taking pictures during an outdoor exploration, but rather to later access photographic material that others have taken of shared experiences. Another advantage of accessing digital information (e.g. photos) on public platforms such as social media is highlighted by the participant, who emphasises the storage capacity as well as the organisation on one's own device. According to the interviewee, it can feel overwhelming to have all media in one visual space, so spreading it across multiple storage locations (e.g. phone gallery, social media publications, direct messengers) gives it structure and makes it easier for the participant to find specific media.

Reflecting on ways of sharing media that were more common in the past, the participant talked about physical photo albums and how the value of sharing can be seen as higher in these than in digital photo sharing on social media, as photo books are actively opened and meant to be shared with someone who is emotionally close enough to enter your home. Furthermore, the participant argued that showing the physical pictures with someone creates a more intimate atmosphere and the sharing becomes more unique, as storytelling allows for individual emphasis on certain memories, depending on the person you are sharing with. The focus of showing physical images compared to digital publications was explained by the interviewee in terms of quality rather than quantity. Only the most important media are shown to carefully selected people, such as family and close friends.

The interviewee summarised that the use of technology can make many processes easier and that technological progress cannot and should not be stopped. At the same time, the interviewee felt that the security of the systems should address personal concerns about privacy and cyber security.
Finally, the interviewee stated that in the future technology should be able to restore social skills and real face-to-face interactions between people should increase again. It is important to be able to spend time outdoors with friends without a device, but smart use of technology can create long-term awareness and could lead to device independence in the future. The participant felt that a guide to documenting impressions would be great for oneself, as it is sometimes difficult to use the latest technology or to find the right words in written documentation of experiences. In addition, future technology could guide people through nature and teach details.

Key findings from the “Mobile devices and nature perception” survey:

1. Mobile phones are used outdoors for navigation and photography.
2. Technology features that allow sorting and separating photos (e.g. nature findings) are perceived as pleasant and facilitating by the user.
3. People with knowledge of nature pay attention to details of specific plants, colours and animals.
4. The natural environment and/or sensory impressions are captured in the form of photos. At the same time, "less is more". Too many media can be overwhelming and confusing.
5. Nature explorers want technology that enables personal communication and social interaction without the distraction of human-technology interaction.

INTERVIEW: OUTDOOR EXPERIENCES ALL OVER THE WORLD

How do long-term world traveler perceive the outdoors on different places as unique and which details do they remember?

Previous interviews have shown that meaningful moments are often associated with memories of the past. The following two interviews were designed to find out what impressions of the outdoors remain in people's minds for a long time, and where people pay attention in nature. The interviews also tried to find out what elements make a natural place unique and different from others.

The interviews were conducted with the parents of a travelling family. Together with their three children, they have been continuously exploring the planet since 2016. Over the past seven years, the family has explored more than 43 countries on different continents. The interviewees have gathered many impressions of outdoor environments with different characteristics.
Due to the distance, the interviews were conducted remotely based on prepared questions sent to the interviewees. The answers were sent via recorded audio files in the original German language. The following questions were relevant for the preparation:

1. What sensations come to mind when you think about the uniqueness of outdoor places?
2. Do objects or physical materials have qualities that make you feel connected to a place, both in the moment of being in nature and as a souvenir for later?
3. What do you do in the moment of exploring nature to remember the special experience in the future?

In terms of conscious sensory impressions of outdoor environments, interviewee A mentioned a clear perception of smell. Arab countries in particular, from the perspective of someone born and raised in Europe, would have a recognisable uniqueness in terms of smell, not only in cities but also in natural environments. Another sensation mentioned by Person A was the sense of temperature. The participant described it as something you cannot escape. In particular, the effects of extreme temperatures, e.g. very hot climates, can have consequences on other aspects, such as wet skin or seeking shade as a privilege, which makes a sensory impression, the heat, but also the change in temperature, into a chain of discernible effects that make the environment perceived in many layers. In line with these thoughts, Participant A also mentions acoustic perceptions, and similar to temperature sensations, the changes from loud to quiet environments would make a specific place something unique to pay attention to in moments of awareness. According to Participant B, the sensory impressions discussed by Participant A were relatable, yet the visual attention would be personally very present and contribute to an awareness of the surroundings. The way light reflects on different surfaces and materials creates clear visuals that are mentally accessible even after a very long time, allowing Person B to see the uniqueness of the environment and to mentally travel back in time to that moment.

According to Participant A and B, feeling connected to a past experience is not related to a physical object, such as filling a bottle with sand from a particular outdoor location. According to Participant A, taking objects from an environment to remember a beautiful moment has never been a practice or a need, neither for Person A nor for Person B. Participant A emphasises possessions that would lead to possessing oneself at some point, because they would require not only physical but also mental space. Life feels easier and less anxious, as person A illustrated, when one does not have much to carry or worry about. Participant A describes physical materials as very static and not able to evoke emotions.
In comparison, digital materials, according to person A, have the chance to be more alive and to evoke memories because of the possibility of movement through video media. Participant B agrees and mentions not only the positive aspect of digital material that does not need to be physically carried from the outdoor space to somewhere else by you, but also the advantage of creating an interactive form of memory through videos that you can choose between and look at different outdoor places that you have visited. According to Person B, this way of creating an archive of your outdoor experiences allows for a catalogue of highlights.

The following points have been the most relevant insights:

1. Participants become aware of nature by perceiving smells, temperatures, noises and material reflections.

2. Noticing differences between different conditions (e.g. temperature or volume changes) in an outdoor place leads to a perception of environmental uniqueness.

3. Explorers who discover many places do not practice taking or collecting (natural) objects from the places they visit.

4. Static vs. dynamic: natural materials can be interpreted as a static moment, whereas dynamic playable recordings in the form of videos or audios offer the possibility to perceive the environment more intensively and also influence the memory process dynamically.

INTERVIEW: ENVIRONMENTAL EXPLORATION BY MOBILE PHONE USAGE

How conscious does someone who uses the mobile phone outdoors perceive the natural environment and which role does technology play?

This interview aims to gain insights into the role of a mobile phone (as an example of technology) when exploring a new outdoor place. The interviewee was suitable for the interview because her mobile phone is taken everywhere. Taking pictures during the day, whether of food, friends or nature, is commonplace, so the assumption for this interview was that the person would also have the phone with them when exploring new outdoor places.

The interview was conducted face to face. Questions were prepared and asked in a semi-structured interview, while the interviewee had enough freedom to change the direction of the conversation to topics related to his own flow. The questions were:

1. What sensory impressions do you remember from your previous nature trips?
2. Have you used any technical support to explore your surroundings? For example, let yourself be guided by your mobile phone's camera and try to find an appreciated outdoor space to photograph.

3. Could you think of any other technical guide that could increase your awareness of the natural environment other than your mobile phone?

4. Have you ever felt motivated to explore nature because of other people? Whether positive group dynamics or negative peer pressure. How did that make you feel?

The sensory impressions that participants consciously perceived during their most recent trip were, in particular, tropical tastes and aromas that were familiar to the region and different from their home country. Other traditional features were mentioned, such as tropical weather conditions, the sense of place and space, wide views from high vantage points, and sounds of nature such as the sea. What was very noticeable, according to the interviewee, was the sound of people and inhabitants performing traditional songs and dances in the streets. Even though this experience did not take place in a natural environment, it shows the interviewee's attention to different traditions and conspicuousness compared to already known places.

The mobile phone was carried and used by the interviewee when exploring outdoor places. Photos and videos were taken to help the interviewee remember special discoveries such as extraordinary landscapes. When the interviewee was asked to reflect on this habit of using the mobile phone in a natural environment, the participant argued: "A picture is what we have nowadays to capture moments. It's the closest thing we have to capture moments". In relation to the use of technology and 'catching moments', the participant continued with his own observations: "Some people are just filming to post. It's not because you want to appreciate and see. It's because you want to show people". The participant judged this behaviour as something negative that distracts from appreciating the real surroundings and reflected on his own phone use: "Even me, I was in Copenhagen, I took pictures and videos every time. It's true, to show people that I was in Copenhagen. But am I really enjoying the moment of being in Copenhagen? Am I really seeing details of what is around me? Instead of looking at the monument as it is, the castle as it is, the mermaid or the parks. I'm more worried about the picture I'm taking. Nowadays we worry too much about having pictures in the memory of the phone, rather than the actual memory of our brains."

When asked what it would be like if people didn't have mobile phones with them when they were outdoors, the interviewee spoke of the opportunity to "just go and you don't care, you just go and have this trip. And not record every time". According to the interviewee, there is a
noticeable desire for moments when one is not thinking about interactions with the mobile phone, including natural contexts: "We also want to have those moments where [...] we don't have to touch it every time. You want to enjoy your journey and maybe relax. I want to look and see what is around me and just appreciate it without my mobile phone. It's so annoying.

1. The insights that emerged from the interview are as follows
2. In undiscovered environments, attention is paid especially to the unknown, to what is unusual and different from what we are used to in familiar surroundings.
3. The senses of taste, smell, hearing, warmth and sight are often actively perceived when discovering an outdoor space.
4. Spending time outdoors with technical devices can prevent awareness of the actual details of the environment.
5. There is a desire to spend time in nature without the mental pressure of interacting with a mobile phone, with an emphasis on noticing greenery, enjoyment and relaxation.
APPENDIX C: QUESTIONNAIRE RESPONDS

SECTION 1: WHO IS ANSWERING THE QUESTIONNAIRE?

In what time period were you born?
41 Antworten

- 68.3% earlier than 1946
- 17.1% 1946 - 1964
- 9.8% 1965 - 1979
- 1.7% 1980 - 1994
- 1.7% 1995 - 2010
- 0.0% later than 2010

How important is it to you, in terms of your daily happiness, to get physical movement and spending time outside?
41 Antworten

- 58.5% not important
- 26.8% moderately important
- 17.1% very important
- 0.0% essential

How many times on average do you visit a park, wood, beach, garden or other natural spaces alone per month?
41 Antworten

- 39% 0
- 22% 1 - 3
- 22% 4 - 6
- 17.1% 7 - 9
- 1.7% 10 or more
How many times on average do you visit a park, wood, beach, garden or other natural spaces with others per month?

41 Antworten

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>26,8%</td>
</tr>
<tr>
<td>1 - 3</td>
<td>14,6%</td>
</tr>
<tr>
<td>4 - 6</td>
<td>7,3%</td>
</tr>
<tr>
<td>7 - 9</td>
<td>31,7%</td>
</tr>
<tr>
<td>10 or more</td>
<td>19,5%</td>
</tr>
</tbody>
</table>

Would you like to spend more time outdoors?

41 Antworten

<table>
<thead>
<tr>
<th>Option</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>92,7%</td>
</tr>
<tr>
<td>No</td>
<td>7,3%</td>
</tr>
</tbody>
</table>

What prevents you spending more time in natural spaces?

41 Antworten

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of time / busy schedule</td>
<td>36 (87,8%)</td>
</tr>
<tr>
<td>Lack of available spaces to visit</td>
<td>11 (26,8%)</td>
</tr>
<tr>
<td>Lack of transport to green spaces</td>
<td>5 (12,2%)</td>
</tr>
<tr>
<td>No enjoyable outdoor spots</td>
<td>7 (17,1%)</td>
</tr>
<tr>
<td>I am spending enough time in n...</td>
<td>3 (7,3%)</td>
</tr>
<tr>
<td>Sometimes mind gets cluttered...</td>
<td>1 (2,4%)</td>
</tr>
<tr>
<td>Lack of outdoor activities other than n...</td>
<td>1 (2,4%)</td>
</tr>
<tr>
<td>Sensitivity to sunlight</td>
<td>1 (2,4%)</td>
</tr>
<tr>
<td>I don't prioritise it, I could blame...</td>
<td>1 (2,4%)</td>
</tr>
<tr>
<td>I'm too lazy to leave my sofa</td>
<td>1 (2,4%)</td>
</tr>
<tr>
<td>Bad weather</td>
<td>1 (2,4%)</td>
</tr>
<tr>
<td>I'm lazy</td>
<td>1 (2,4%)</td>
</tr>
</tbody>
</table>
SECTION 2: SETTING THE PARTICIPANT MENTALLY INTO AN OUTDOOR SCENARIO.

Statements are presented in the questionnaire in order to be rated on a linear scale from 1 (not true at all) to 6 (absolutely true).

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Statement/Question</th>
<th>Average answer</th>
<th>Assumption status</th>
</tr>
</thead>
<tbody>
<tr>
<td>People who are surrounded by nature feel curious about the environment.</td>
<td>I feel curious about my natural environment.</td>
<td>4.5</td>
<td>True</td>
</tr>
<tr>
<td>Nature explorer enjoy the active perception on various sensory impressions in greenness.</td>
<td>It is meaningful to me to perceive certain sensory impressions actively (e.g. listen to the wind in the trees or take in a deep breath and try to detect any scents in the air)</td>
<td>4.6</td>
<td>True</td>
</tr>
<tr>
<td>There is a demand for nature exploration guidance in a playful way.</td>
<td>Playing a nature exploration game as a group is an enjoyable activity</td>
<td>4.5</td>
<td>True</td>
</tr>
<tr>
<td>People appreciate reducing their own or fellow’s screen-time.</td>
<td>It makes me feel uncomfortable when my dialog partner pays attention on their screen for a significant time while I try to socialise with them</td>
<td>5.1</td>
<td>True</td>
</tr>
<tr>
<td>People who are spending time outdoors with friends do not have many ideas about what to do/entertain with in nature which are not including cell-phones.</td>
<td>Brainstorming: What would you like to do as a group of friends in order to create a meaningful time and memory outdoors? List as many ideas as possible</td>
<td>On average 4 ideas per person</td>
<td>Not fully true</td>
</tr>
<tr>
<td>Assumption</td>
<td>Statement/Question</td>
<td>Average answer</td>
<td>Assumption status</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Phones are present but power is saved for navigation and informational phone calls or messages.</td>
<td>While being a day in greenness, I am using my mobile phone mainly for navigation and informational messages.</td>
<td>4.5</td>
<td>True</td>
</tr>
<tr>
<td>Phones can not be used much (unlimited) outdoors</td>
<td>I am having an eye on my phones battery level and trying to save up power.</td>
<td>4.2</td>
<td>True</td>
</tr>
<tr>
<td>Phones can not be used much (unlimited) outdoors.</td>
<td>When the gathering takes an entire day, I make sure to be able to charge my phone outdoors (e.g. with PowerBank).</td>
<td>3.1</td>
<td>Not fully true</td>
</tr>
<tr>
<td>Nature explorer like to share their experience with the help of memory media on social media.</td>
<td>I share my outdoor day on social media (e.g. story, feed post, status).</td>
<td>2.7</td>
<td>Not true</td>
</tr>
<tr>
<td>Fellows want to exchange and share their medias with each others during and after their common trip</td>
<td>I would like to have access to pictures or videos my fellows took from our shared experience.</td>
<td>4.4</td>
<td>TRUE</td>
</tr>
</tbody>
</table>

Table 4: Section 2 outcomes

I feel curious about my natural environment.

41 Antworten

![Bar chart showing responses to I feel curious about my natural environment.](image)
It is meaningful to me to perceive certain sensory impressions actively (e.g. listen to the wind in the trees or take in a deep breath and try to detect any scents in the air).

41 Antworten

Playing a nature exploration game as a group is an enjoyable activity.

41 Antworten

It makes me feel uncomfortable when my dialog partner pays attention on their screen for a significant time while I try to socialise with them.

41 Antworten
While being a day in greenness, I am using my mobile phone mainly for navigation and informational messages.

I am having an eye on my phones battery level and trying to save up power.

When the gathering takes an entire day, I make sure to be able to charge my phone outdoors (e.g. with PowerBank).
SECTION 3: WHAT ARE PEOPLE ENTERTAINED WITH WHEN BEING OUTDOORS?

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Statement/Question</th>
<th>Most frequent answer</th>
<th>Assumption status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green explorer do want to feel connected to nature. Being in nature without digital connection is wanted and feels desirable. Satisfying curiosity about the natural environment has a positive effect on mood</td>
<td>Socialise outdoors mainly is a chance for me to ...</td>
<td>feel better emotionally, relax from daily routines, slow down/ no information overload, disconnect from work, reduce screen-time and explore nature.</td>
<td>TRUE</td>
</tr>
</tbody>
</table>
Carrying materials for outdoor activities often is limited due to size or water resistance.

Did you ever want to bring something for outdoor entertainment, but you couldn’t? If yes, what stopped you?

People like playful and interactive entertainment when outdoors with friends, but some games can be not optimal for carrying.

Table 5: Section 3 outcomes

Socialise outdoors mainly is a chance for me to (choose max. 3)

<table>
<thead>
<tr>
<th>Relax from daily routines</th>
<th>24 (58.5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disconnect from work</td>
<td>21 (51.2%)</td>
</tr>
<tr>
<td>Explore nature</td>
<td>13 (31.7%)</td>
</tr>
<tr>
<td>Feel better emotionally</td>
<td>33 (80.5%)</td>
</tr>
<tr>
<td>Increase health</td>
<td>-10 (24.4%)</td>
</tr>
<tr>
<td>Practice mindfulness</td>
<td>8 (19.5%)</td>
</tr>
<tr>
<td>Reduce screen-time</td>
<td>-15 (36.6%)</td>
</tr>
<tr>
<td>Slow down, no information over...</td>
<td>-23 (56.1%)</td>
</tr>
<tr>
<td>Appreciate my surroundings and...</td>
<td>-1 (2.4%)</td>
</tr>
<tr>
<td>Also to enjoy the weather and s...</td>
<td>-1 (2.4%)</td>
</tr>
</tbody>
</table>

Did you ever want to bring something for outdoor entertainment, but you couldn’t? If yes, what stopped you?

<table>
<thead>
<tr>
<th>Weight</th>
<th>13 (52%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>16 (64%)</td>
</tr>
<tr>
<td>Value / worth</td>
<td>5 (20%)</td>
</tr>
<tr>
<td>Water resistance</td>
<td>8 (32%)</td>
</tr>
<tr>
<td>Battery</td>
<td>-2 (8%)</td>
</tr>
<tr>
<td>No</td>
<td>-1 (4%)</td>
</tr>
<tr>
<td>Does not apply</td>
<td>-1 (4%)</td>
</tr>
<tr>
<td>It may not be allowed in specific...</td>
<td>-1 (4%)</td>
</tr>
<tr>
<td>If I go out in nature I try make s...</td>
<td>-1 (4%)</td>
</tr>
<tr>
<td>Nothing</td>
<td>-1 (4%)</td>
</tr>
<tr>
<td>If it included many small pieces...</td>
<td>-1 (4%)</td>
</tr>
<tr>
<td>Nothing</td>
<td>-1 (4%)</td>
</tr>
</tbody>
</table>
### SECTION 4: PRACTICES OF NATURE EXPLORERS RELATED TO MEMORY MEDIA

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Statement/Question</th>
<th>Average answer</th>
<th>Assumption status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature explorer like to create a memory media by using technology.</td>
<td>I like to create a memory media of my time in nature by ...</td>
<td>pictures, videos, objects (e.g. found feather, shell) and painting.</td>
<td>Partly true</td>
</tr>
<tr>
<td>Creating a memory media can fulfil user’s need to pay more attention on nature surrounding and guide to explore greenness.</td>
<td>What are your intensions while creating or collecting a memory media outdoors?</td>
<td>interaction with memory media afterwards, symbolising that the moment is meaningful to me, enjoying the artsy process and feeling of being more connected with the situation</td>
<td>Party true</td>
</tr>
<tr>
<td>The potential user group likes to interact with memory media afterwards.</td>
<td>How are you interacting with memory media you have been created or collected? (e.g. photo, video, audio, drawing, souvenir)</td>
<td>looking intentionally for a specific media, stumble over randomly by scrolling, share it digitally on social media</td>
<td>TRUE</td>
</tr>
<tr>
<td>Captured media of one event can be found in multiple storage places, such as phone gallery, clouds, social media history or even on multiple devices</td>
<td>Where are you storing digital memory media? (e.g. photos, videos)</td>
<td>device storage, chat messenger, social media publications, cloud and hard drive</td>
<td>TRUE</td>
</tr>
<tr>
<td>It is difficult to find a specific memory media due to the amount of media.</td>
<td>It is difficult for me to find a specific picture or video due to the amount of media.</td>
<td>4.1</td>
<td>TRUE</td>
</tr>
<tr>
<td>It is difficult to find a specific memory media due to different storage places.</td>
<td>It is difficult for me to find a specific picture or video due to different storage places.</td>
<td>3.4</td>
<td>Not true</td>
</tr>
<tr>
<td>It is difficult to find a specific memory media due to the lack of filter options.</td>
<td>It is difficult for me to find a specific memory media due to the lack of filter options.</td>
<td>3.9</td>
<td>Not true</td>
</tr>
</tbody>
</table>
A smart filter function is appreciated and can ease managing memory media.

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Statement/Question</th>
<th>Average answer</th>
<th>Assumption status</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would enjoy to have a smart filter function that shows my data from</td>
<td>I would enjoy to have a smart filter function that shows my data from different</td>
<td>4.5</td>
<td>TRUE</td>
</tr>
<tr>
<td>different storage places and enables a non-public personal overview from all</td>
<td>storage places and enables a non-public personal overview from all media at the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>media at the same time (e.g. filter by location, people and weather in</td>
<td>same time (e.g. filter by location, people and weather in Phone, Cloud and Instagram</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone, Cloud and Instagram archive)</td>
<td>archive)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>People are curious about a new way of capturing and would try if existing.</td>
<td>I would be open to try a new way of creating meaningful memory media, if I get</td>
<td>5.1</td>
<td>TRUE</td>
</tr>
<tr>
<td>I would be open to try a new way of creating meaningful memory media, if I</td>
<td>taught or guided.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>get taught or guided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nature explorer like to share their experience afterwards. Their memories</td>
<td>Talking about my experience influences my recall and memory positively.</td>
<td>3.8</td>
<td>Not true</td>
</tr>
<tr>
<td>get more alive by talking about experience.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6: Section 4 outcomes
I like to create a memory media of my time in nature by

41 Antworten

- pictures: 39 (95.1%)
- videos: 27 (65.9%)
- audio files: 3 (7.3%)
- notes (artsy or descriptive): 9 (22%)
- drawing or painting: 12 (29.3%)
- objects (e.g. found feather, shell): 20 (48.8%)
- bought souvenir: 9 (22%)
- nothing: 2 (4.9%)

What are your intensions while creating or collecting a memory media outdoors?

41 Antworten

- enjoying the artsy process of cr: 19 (46.3%)
- feeling of being more connecte: 18 (43.9%)
- symbolising that the moment is: 22 (53.7%)
- matter of habit: 5 (12.2%)
- pay attention on details nearby: 13 (31.7%)
- moving and explore surrounding: 8 (19.5%)
- interaction with memory media: 28 (68.3%)
- I do not create a memory media: 2 (4.9%)
- My friends often want the pictur: 1 (2.4%)
- Being able to reflect on it later: 1 (2.4%)

How are you interacting with memory media you have been created or collected? (e.g. photo, video, audio, drawing, souvenir)

41 Antworten

- let myself reminding by an app: 14 (34.1%)
- stumble over randomly (e.g. sc: 28 (68.3%)
- looking intentionally for a specif: 29 (70.7%)
- share it digitally (e.g. social me: 22 (53.7%)
- support my storytelling while tal: 18 (43.9%)
- I do not interact with them at all: 4 (9.8%)
- ehm tuein mein Büslein oder e... 1 (2.4%)
- I try to rework them into a more: 1 (2.4%)
Where are you storing digital memory media? (e.g. photos, videos)

- Device storage (e.g. phone, tablet): 35 (85.4%)
- Cloud: 18 (43.9%)
- External hard drive: 15 (36.6%)
- Social media publications (e.g. Instagram): 18 (43.9%)
- Chat messenger (e.g. Snapchat): 21 (51.2%)
- Prints (e.g. photo album, polaroid): 12 (29.3%)
- Beyond my personal storage (e.g. family, friend): 4 (9.8%)

It is difficult for me to find a specific picture or video due to the amount of media.

- 1 (2.4%)
- 2: 7 (17.1%)
- 3: 3 (7.3%)
- 4: 12 (29.3%)
- 5: 10 (24.4%)
- 6: 8 (19.5%)

It is difficult for me to find a specific picture or video due to different storage places.

- 1: 5 (12.2%)
- 2: 8 (19.5%)
- 3: 8 (19.5%)
- 4: 10 (24.4%)
- 5: 7 (17.1%)
- 6: 3 (7.3%)
It is difficult for me to find a specific memory media due to the lack of filter options.
41 Antworten

I would enjoy to have a smart filter function that shows my data from different storage places and enables a non-public personal overview from all my...e weather in Phone, Cloud and Instagram archive)
41 Antworten

I would be open to try a new way of creating meaningful memory media, if I get taught or guided.
41 Antworten
SECTION 5: EVALUATING ACTIVITIES FOR NATURE EXPLORATION

Tendency to the left (1-4) shows participant’s preference of Concept A “Physical Interaction Surfaces” while a tendency to the right (5-8) refers to Concept B “Augmented Reality App.”

<table>
<thead>
<tr>
<th>Question</th>
<th>Average answer</th>
<th>Interaction preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which concept would you like to try out alone?</td>
<td>3.6</td>
<td>Both appeal</td>
</tr>
<tr>
<td>Which concept would you like to try out in a group?</td>
<td>3.0</td>
<td>Physical interaction surfaces</td>
</tr>
<tr>
<td>Which design sparks your interest to use multiple times on different places?</td>
<td>4.0</td>
<td>Both appeal</td>
</tr>
<tr>
<td>Where do you expect to keep the experience detailed and long-term in memory?</td>
<td>2.8</td>
<td>Physical interaction surfaces</td>
</tr>
<tr>
<td>Which interaction engages you?</td>
<td>2.8</td>
<td>Physical interaction surfaces</td>
</tr>
<tr>
<td>Which concept sparks your curiosity about the natural surrounding?</td>
<td>2.9</td>
<td>Physical interaction surfaces</td>
</tr>
</tbody>
</table>

Table 7: Section 5 outcomes
Which concept would you like to try out alone?

1. 12 (29, 3 %)
2. 3 (7,3 %)
3. 6 (14, 6 %)
4. 6 (14, 6 %)
5. 2 (4,9 %)
6. 8 (19, 5 %)
7. 3 (7,3 %)
8. 1 (2,4 %)

Which concept would you like to try out in a group?

1. 11 (26, 8 %)
2. 12 (29, 3 %)
3. 5 (12, 2 %)
4. 5 (12, 2 %)
5. 2 (4,9 %)
6. 0 (0 %)
7. 4 (9,8 %)
8. 2 (4,9 %)
Which design sparks your interest to use multiple times on different places?
41 Antworten

Where do you expect to keep the experience detailed and long-term in memory?
41 Antworten

Which interaction engages you?
41 Antworten
Which concept sparks your curiosity about the natural surrounding?

41 Antworten

0 1 2 3 4 5 6 7 8

10 (24, 4 %)
11 (26, 8 %)
5 (12, 2 %)
7 (17, 1 %)
6 (14, 6 %)
0 (0 %)
0 (0 %)
2 (4,9 %)
APPENDIX D: PARTICIPATORY IDEATION

Ideation Participants were presented with an example (Figure 53) to introduce them to the task. The best ideas are presented below.

![Interactive Scenario](image1)

*In order to explore the surrounding, I would equip trees with motion sensors that make the space light up when I am close. Furthermore, the lights could guide me to new natural places by enlightening the unknown or hidden spots. I did not walk into yet.*

![Visual Space](image2)

**Figure 53: Example of Participatory Ideation Sketch**

![Sketch A](image3)

*Explore / Reveal Surroundings with friends*  
*How might we*  
*environment*  
*input*  
*output*

- **explore the surrounding with fellows**  
- **tree**  
- **motion sensor**  
- **light up**  

**Figure 54: Participatory Ideation: Sketch A**

**Figure 55: Participatory Ideation: Sketch B**